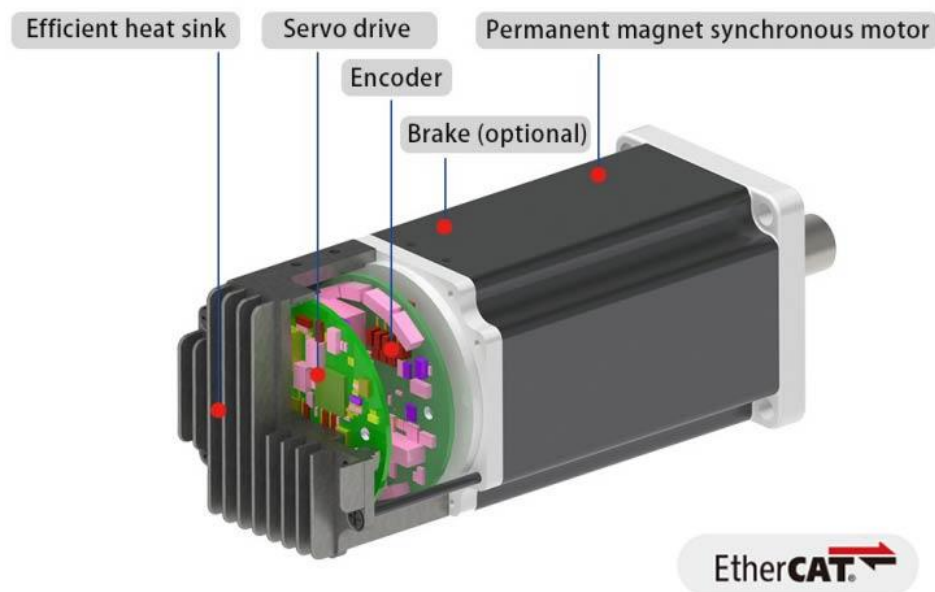




# Integrated Low-voltage Servo Motor EtherCAT User Manual

Version No.E02

## INTEGRATED SERVO MOTOR (MOTOR + DRIVE)



Beijing NiMotion Control Technology Co., Ltd.

# Catalog

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## 1 About this Manual

### 1.1 Brief Introduction

This manual explains how to program and operate the integrated low-voltage Servo motor manufactured by Beijing NiMotion Control Technology Co., Ltd.

### 1.2 The implication of the numerical values

In this manual, numerical values are usually in decimal notation. If they have to be in hexadecimal notation, the subscript "h" at the end of the number is used, for example: 03<sub>h</sub>.

Directory index and sub-index of object are represented as follows:

<index>:<sub-index>

For example, sub-index 02 of object 01<sub>h</sub> is represented as **01<sub>h</sub>:02<sub>h</sub>**.

### 1.3 Bit

Bits of an object always start from 0 at LSB.

|            | MSB |   |   |   | LSB |   |   |   |                                       |
|------------|-----|---|---|---|-----|---|---|---|---------------------------------------|
| Bit Number | 7   | 6 | 5 | 4 | 3   | 2 | 1 | 0 |                                       |
| Bits       | 0   | 1 | 0 | 1 | 0   | 1 | 0 | 1 | ≐55 <sub>hex</sub> ≐85 <sub>dec</sub> |

## 2 Terms and Abbreviations

|      |                                        |
|------|----------------------------------------|
| COE  | CAN application protocol over EtherCAT |
| D C  | Distributed Clocks                     |
| S M  | Sync Manager                           |
| CIA  | CAN in Automation                      |
| LSB  | Least significant bit                  |
| MSB  | Most significant bit                   |
| PDS  | Power drive system                     |
| FSA  | Finite state automaton                 |
| PDO  | Process data object                    |
| SDO  | Service data object                    |
| RPDO | Receive process data object            |
| TPDO | Transmit process data object           |

### 3 Communication Network

#### 3.1 Overview of EtherCAT Protocol

The integrated low-voltage servo motor of Beijing NiMotion Control Technology Co.,Ltd. is controlled by EtherCAT, which is a Ethernet technology with advantages such as high performance, low cost, user-friendly and flexible topological structure, used in super-high speed I/O industrial field bus network, by standard Ethernet physical layer and twisted-pair wiring (100Base~TX).

The EtherCAT of PMM integrated servo series is based on IEC61800~7 (CiA402) - CANopen motion control sub-protocol.

The EtherCAT communication based on CANopen application layer is showed in the following figure.

In this structure diagram, the object dictionary of the application layer contains communication parameters, application data and PDO mapping data. The PDO process data object contains real-time data in the process of servo motor operation, which is read and write periodically. In SDO mailbox communication, some communication parameter objects and PDO process data objects are accessed and modified periodically.

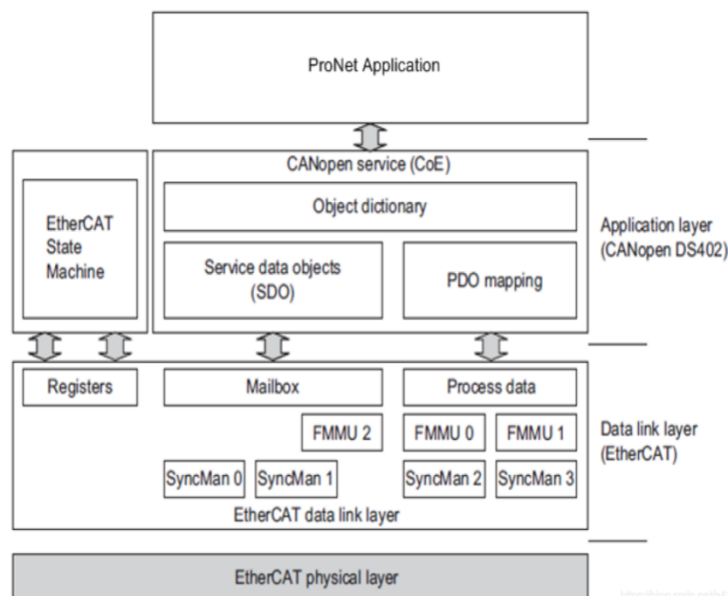


Figure 3-1

#### 3.2 Process Data Object PDO

PDO real-time process data transmission follows the producer-consumer model. PDO is divided into RPDO (Reception PDO) and TPDO (Transmission PDO). The slave station receives instructions from the master station through RPDO, feedback its own state through TPDO.

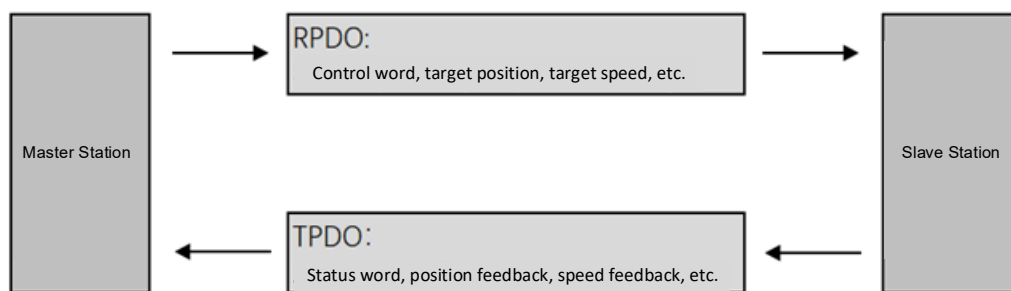


Figure 3-2

### 3.2.1 PDO Mapping Parameters

PDO mapping establishes the mapping relationship between object dictionary and PDO. 1600<sub>h</sub>~17FF<sub>h</sub> for RPDO, and 1A00<sub>h</sub>~1BFF<sub>h</sub> for TPDO. There are 4 variable RPDOs and 4 variable TPDOs available in PMM series integrated servo motor, as specified in the table below.

Table 3-1

| Name                      | Mapping objects                                                                                                                                                                                                           | Servo Mode Available             |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 1600 <sub>h</sub> (RPDO0) | 6040 <sub>h</sub> 6060 <sub>h</sub> 607A <sub>h</sub> 6042 <sub>h</sub> 6071 <sub>h</sub> 60C1 <sub>h</sub> 60FF <sub>h</sub><br>6072 <sub>h</sub> 607F <sub>h</sub> 6080 <sub>h</sub> 2031 <sub>h</sub> :02 <sub>h</sub> | CSP CSV CST PP PV VM<br>PT HM IP |
| 1A00 <sub>h</sub> (TPDO0) | 603F <sub>h</sub> 6041 <sub>h</sub> 6061 <sub>h</sub> 6064 <sub>h</sub> 6063 <sub>h</sub> 6069 <sub>h</sub> 606C <sub>h</sub><br>6077 <sub>h</sub> 6078 <sub>h</sub> 200B <sub>h</sub> :05 <sub>h</sub>                   | CSP CSV CST PP PV VM<br>PT HM IP |
| 1601 <sub>h</sub> (RPDO1) | 6040 <sub>h</sub> 6060 <sub>h</sub> 607A <sub>h</sub> 60FF <sub>h</sub> 6072 <sub>h</sub> 2031 <sub>h</sub> :02 <sub>h</sub>                                                                                              | CSP CSV PP PV HM                 |
| 1A01 <sub>h</sub> (TPDO1) | 603F <sub>h</sub> 6041 <sub>h</sub> 6061 <sub>h</sub> 6063 <sub>h</sub> 606C <sub>h</sub> 6077 <sub>h</sub><br>200B <sub>h</sub> :05 <sub>h</sub>                                                                         | CSP CSV PP PV HM                 |
| 1602 <sub>h</sub> (RPDO2) | 6040 <sub>h</sub> 6060 <sub>h</sub> 607A <sub>h</sub> 6071 <sub>h</sub> 60FF <sub>h</sub> 6072 <sub>h</sub><br>2031 <sub>h</sub> :02 <sub>h</sub>                                                                         | CSP CSV PP PV HM                 |
| 1A02 <sub>h</sub> (TPDO2) | 603F <sub>h</sub> 6041 <sub>h</sub> 6061 <sub>h</sub> 6069 <sub>h</sub> 606C <sub>h</sub>                                                                                                                                 | CSP CSV PP PV HM                 |
| 1603 <sub>h</sub> (RPDO3) | 6040 <sub>h</sub> 6060 <sub>h</sub> 60FF <sub>h</sub> 607F <sub>h</sub> 6080 <sub>h</sub>                                                                                                                                 | CSV PV HM                        |
| 1A03 <sub>h</sub> (TPDO3) | 603F <sub>h</sub> 6041 <sub>h</sub> 6061 <sub>h</sub> 6064 <sub>h</sub> 6063 <sub>h</sub> 6069 <sub>h</sub> 606C <sub>h</sub>                                                                                             | CSV PV HM                        |

### 3.2.2 PDO Allocation Settings

In the EtherCAT periodic communication, process data contains multiple PDO mapping data objects. The data objects 0x1C10~0x1C2F in CoE Protocol defines the PDO mapping objects list of corresponding SM (synchronous management channel). Multiple PDOs can be mapped into different sub-indexes. PMM series integrated low-voltage servo motor support 4 RPDOs and 4 TPDOs allocated, as shown in the following table:

Table 3-2

| Index             | Sub-index       | Content                                                                    |
|-------------------|-----------------|----------------------------------------------------------------------------|
| 1C12 <sub>h</sub> | 01 <sub>h</sub> | Use one object of 1600 <sub>h</sub> ~ 1603 <sub>h</sub> as the actual RPDO |
| 1C13 <sub>h</sub> | 01 <sub>h</sub> | Use one object of 1A00 <sub>h</sub> ~1A03 <sub>h</sub> as the actual TPDO  |

### 3.2.3 PDO Configuration

PDO mapping parameters include pointers to the process data corresponding to the sending PDO or receiving PDO, containing index, sub-index and mapping object length. Sub-index 0 records the number of objects specifically mapped by the PDO. Each PDO can be mapped to one or more objects at the same time, with maximum length up to 4\*N bytes, and Sub-index 1~N are map contents. The mapping parameters are specified as follows.

Table 3-3

| Bit         | 15    | ..... | 16 | 15        | ..... | 8 | 7             | ..... | 0 |
|-------------|-------|-------|----|-----------|-------|---|---------------|-------|---|
| Implication | Index |       |    | Sub-index |       |   | Object length |       |   |

Index and sub-index jointly determine the position of the object in the object dictionary. The object length indicates the specific bit length of the object, which is in hexadecimal notation, that is:

Table 3-4

| Length of Object | Length of Bits |
|------------------|----------------|
| 08 <sub>h</sub>  | 8bits          |
| 10 <sub>h</sub>  | 16 bits        |
| 20 <sub>h</sub>  | 32 bits        |

For example, 60400010<sub>h</sub> is the mapping parameter representing the 16-bits control word 6040<sub>h</sub> ~ 00.

### 3.3 Mailbox Data SDO

The EtherCAT Mailbox Data SDO is used to transmit non-weekly data, such as the configuration of communication parameters and the configuration of servo driver operation parameters, etc. The CoE services of EtherCAT include: 1) emergency information; 2) SDO request; 3) SDO response; 4) TPDO; 5) RPDO; 6) Request transmission by remote TPDO ; 7) Request transmission by remote RPDO; 8) SDO information.

### 3.4 Distributed Clock

The EtherCAT protocol provides distributed clock (DC) control, with low jitter and guarantee of synchronous clock error  $\leq 1\mu s$ .

### 3.5 EtherCAT Interface

#### 3.5.1 Interface Information

PMM integrated servo motor series have: EtherCAT-IN and EtherCAT-OUT interfaces independently, according to RJ45 interface standard, IEEE802.3 electrical characteristics standard and ISO8877.

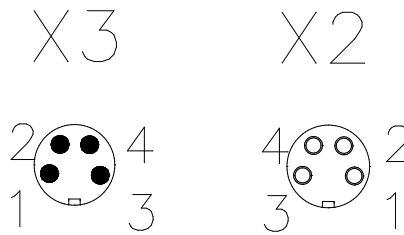


Figure 3-3

Table 3-5

| X2<br>EtherCAT IN |     | X3<br>EtherCAT OUT |     |
|-------------------|-----|--------------------|-----|
| 1                 | TX+ | 1                  | TX+ |
| 2                 | RX+ | 2                  | RX+ |
| 3                 | RX- | 3                  | RX- |
| 4                 | TX- | 4                  | TX- |

### 3.5.2 Topology Structure

The topology of EtherCAT communication is flexible, meeting the following linear topology connection:

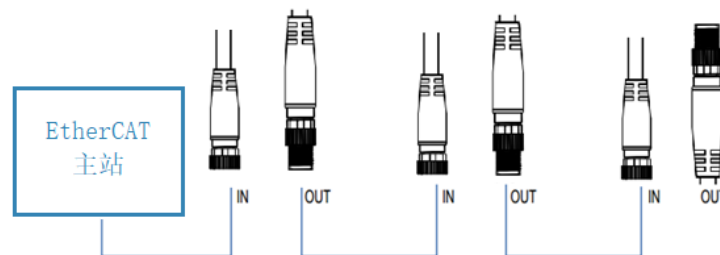


Figure 3-4

Redundant loop connection:

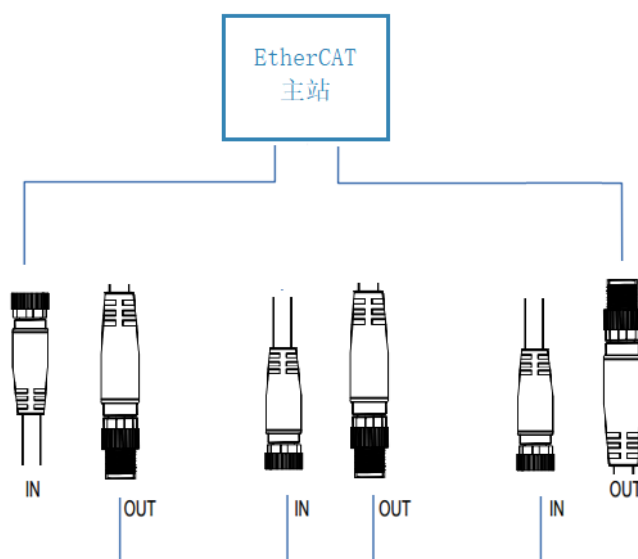


Figure 3-5

## 3.6 Commission of EtherCAT

### 3.6.1 Prepare

The following components are required for commission:

- Power source according to manual requirements
- Integrated low-voltage servo motor
- Description file 《PMM6040C01~\*\*.xml》 or 《PMM6020C01~\*\*.xml》
- Communication cable required
- EtherCAT interface required
- EtherCAT main station or master computer

### 3.6.2 Commission

1. The XML file must be installed first. The operation is as follows:

- Obtain description file(《PMM6040C01~\*\*.xml》 or 《PMM6020C01~\*\*.xml》) from sales of NiMotion Control Technology Co.,Ltd. or download it on the official website ( [www.nimotion.com](http://www.nimotion.com) ) .
- Secondly, copy this file to a sub-folder of TwinCAT:
 

If it's TwinCAT version 2, use the folder <TWINCAT INSTALL DIR>/Io/EtherCAT

If it's TwinCAT version 3, use the folder <TWINCAT INSTALL DIR>/3.1/Config/Io/EtherCAT

Example:

If the installation path of TwinCAT 3 on the user's PC is C: \TwinCAT\, copy the XML file to the path C: \TwinCAT\3.1\Config\Io\EtherCAT\.
- If the TwinCAT System Manager is open, close it and open it again. The directory will be read in after the TwinCAT System Manager boots up.

2.Connect

- Connect the power cord(marked X1) of the integrated low-voltage servo motor to the power voltage (DC12-48V) specified in manual. Note that the positive and negative poles of the power source can not be reversed.

- Connect the EtherCAT master station with the communication line of the integrated low-voltage servo motor EtherCAT~IN (marked X2). Note that EtherCAT~IN and EtherCAT~OUT can not be confused, otherwise the downstream EtherCAT equipment will not work.

## 4 Control of Equipment

### 4.1 The CiA402 State Machine

The operating state of integrated low-voltage servo motor is switched by a state machine, which is defined in the CiA402 standard. The motor drive is controlled by the control word  $6040_h$ , and the actual state of the device can be read back from the status word object  $6041_h$ .

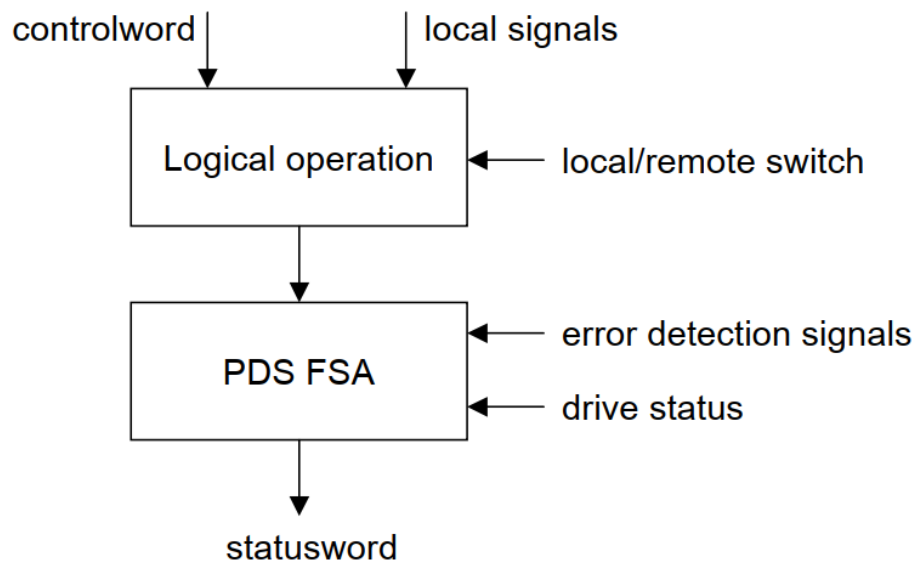


Figure 4-1

### 4.1.1 The State Transition Diagram

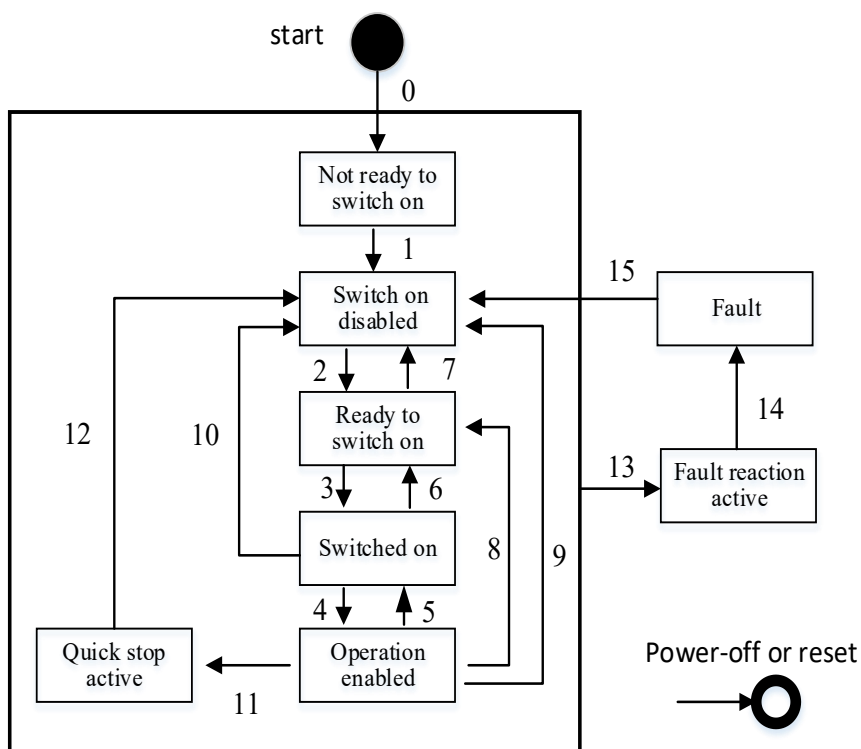


Figure 4-2

The motor states corresponding to each state are in this table below:

Table 4-1

| Function                  | FSA states             |                    |                    |             |                   |                   |                       |        |
|---------------------------|------------------------|--------------------|--------------------|-------------|-------------------|-------------------|-----------------------|--------|
|                           | Not ready to switch on | Switch on disabled | Ready to switch on | Switched on | Operation enabled | Quick stop active | Fault reaction active | Fault  |
| Brake applied, if present | Yes                    | Yes                | Yes                | Yes         | Yes/No            | Yes/No            | Yes/No                | Yes    |
| Low-level power applied   | Yes                    | Yes                | Yes                | Yes         | Yes               | Yes               | Yes                   | Yes    |
| High-level power applied  | Yes/No                 | Yes/No             | Yes/No             | Yes         | Yes               | Yes               | Yes                   | Yes/No |
| Drive function enabled    | No                     | No                 | No                 | No          | Yes               | Yes               | Yes                   | No     |
| Configuration allowed     | Yes                    | Yes                | Yes                | Yes         | Yes/No            | Yes/No            | Yes/No                | Yes    |

The control word and switching of state machine are in this table below:

Table 4-2

| Command                      | Bits of the control word                                                          |      |      |      |      | Transitions  |
|------------------------------|-----------------------------------------------------------------------------------|------|------|------|------|--------------|
|                              | Bit7                                                                              | Bit3 | Bit2 | Bit1 | Bit0 |              |
| Shutdown                     | 0                                                                                 | ×    | 1    | 1    | 0    | 2,6,8        |
| Switch on                    | 0                                                                                 | 0    | 1    | 1    | 1    | 3            |
| Switch on + enable operation | 0                                                                                 | 1    | 1    | 1    | 1    | 3+4 (NOTE)   |
| Disable voltage              | 0                                                                                 | ×    | ×    | 0    | ×    | 7, 9, 10, 12 |
| Quick stop                   | 0                                                                                 | ×    | 0    | 1    | ×    | 7, 10, 11    |
| Disable operation            | 0                                                                                 | 0    | 1    | 1    | 1    | 5            |
| Enable operation             | 0                                                                                 | 1    | 1    | 1    | 1    | 4, 16        |
| Fault reset                  |  | ×    | ×    | ×    | ×    | 15           |

NOTE: Automatic transition to Enable operation state after executing Switch on state functionality.

The status word in each state are as follows:

Table 4-3

| Status word          | PDS FSA state          |
|----------------------|------------------------|
| xxxx xxxx x0xx 0000b | Not ready to switch on |
| xxxx xxxx x1xx 0000b | Switch on disabled     |
| xxxx xxxx x01x 0001b | Ready to switch on     |
| xxxx xxxx x01x 0011b | Switched on            |
| xxxx xxxx x01x 0111b | Operation enabled      |
| xxxx xxxx x00x 0111b | Quick stop active      |
| xxxx xxxx x0xx 1111b | Fault reaction active  |
| xxxx xxxx x0xx 1000b | Fault                  |

Notes: x means that this bit does not been care, bit 8 ~ bit15 has different meaning in different modes.

Please check its specific status in each mode.

### 4.1.2 Control Word

The bits of the control word are defined as follows:

|    |    |     |   |    |     |    |    |    |    |   |   |
|----|----|-----|---|----|-----|----|----|----|----|---|---|
| 15 | 11 | 10  | 9 | 8  | 7   | 6  | 4  | 3  | 2  | 1 | 0 |
| ms | r  | oms | h | fr | oms | eo | qs | ev | so |   |   |

MSB

LSB

LEGEND: ms = manufacturer-specific; r = reserved; oms = operation mode specific; h = halt; fr = fault reset; eo = enable operation; qs = quick stop; ev = enable voltage; so = switch on

#### ● Notes

It is meaningless to assign each bit of the control word individually, It must be combined with other bits to form a control instruction. Bit 0 ~ bit 3 and bit 7 have the same meaning in each mode, Only by sending commands sequentially can the motor drive be guided into the predicted state according to the

switching process of the CiA402 state machine, and each command corresponds to 1 definitive state. Bit4 ~ bit6 are related to each operation mode ( please check the control instructions in different modes)

### 4.1.3 Status Word

The bits of the status word are defined as follows:

|     |    |     |    |     |    |    |    |   |     |    |    |   |    |    |      |
|-----|----|-----|----|-----|----|----|----|---|-----|----|----|---|----|----|------|
| 15  | 14 | 13  | 12 | 11  | 10 | 9  | 8  | 7 | 6   | 5  | 4  | 3 | 2  | 1  | 0    |
| ms  |    | oms |    | ila | tr | rm | ms | w | sod | qs | ve | f | oe | so | rtso |
| MSB |    |     |    |     |    |    |    |   |     |    |    |   |    |    |      |
| LSB |    |     |    |     |    |    |    |   |     |    |    |   |    |    |      |

Table 4-4

| Bit   | Description             |
|-------|-------------------------|
| 0     | ready to switch on      |
| 1     | switched on             |
| 2     | operation enabled       |
| 3     | fault                   |
| 4     | voltage enabled         |
| 5     | quick stop              |
| 6     | switch on disabled      |
| 7     | warning                 |
| 8     | manufacturer specific   |
| 9     | remote                  |
| 10    | target reached          |
| 11    | internal limit active   |
| 12-13 | operation mode specific |
| 14-15 | manufacturer specific   |

#### ● Notes

It is meaningless to assign each bit of the status word individually, It must be combined with other control bits to form the current state feedback of the motor. In each stepping mode, bit 0-bit9 has the same meaning, by which the motor feeds back a certain status after sending commands by the control word 6040<sub>h</sub> sequentially. Besides, bit10, bit11 and bit15 have the same meaning in each mode, by which the motor feeds back its status after a certain operation mode is executed.

### 4.1.4 The Stop Mode

The stop mode is the action of the state machine which leaving the "Operation enabled" state, corresponding settings are as follows:

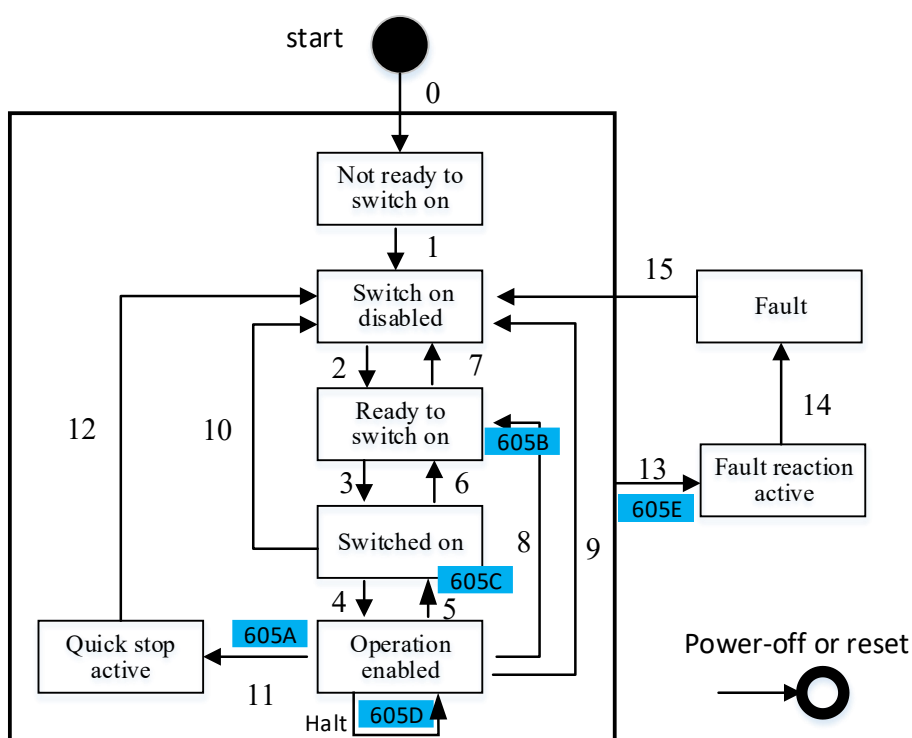


Figure 4-3

## ● Fault

When a error or a warning occurs, automatically the servo switches to the Fault state which is related to 605E<sub>h</sub>(Fault response option code). When 605E<sub>h</sub>= -1, the fault reaction is related to the reaction code in the fault code which is configurable. When 605E<sub>h</sub> > 0, the fault reaction is selected by the object dictionary 605E<sub>h</sub>. The relationship between the setting value in 605E<sub>h</sub> and the fault reaction is as follows:

Table 4-5

| Setting Value | Stop Mode                                                                                              |
|---------------|--------------------------------------------------------------------------------------------------------|
| -1            | The stop mode is related to fault reaction option code in alarm code. See "9.1 alarm code" for details |
| 0x00          | Slow down freely and keep operating freely.                                                            |
| 0x01          | Slow down on slow down ramp set in 6084 <sub>h</sub> .                                                 |
| 0x02          | Slow down on quick slow down ramp set in 6085 <sub>h</sub> .                                           |

## ● Quick Stop

In non-fault states, when the control word 6040<sub>h</sub> = 0x02, Quick stop is executed. The Quick stop mode is selected by the object dictionary 605A<sub>h</sub>. The meaning of the setting value in 605A<sub>h</sub> is shown in the table below:

Table 4-6

| Setting Value | Stop Mode                                                                        |
|---------------|----------------------------------------------------------------------------------|
| 0x00          | Slow down freely and keep operating freely.                                      |
| 0x01          | Slow down on slow down ramp set in 6084 <sub>h</sub> ,and keep operating freely. |
| 0x02          | Slow down on slow down ramp set in 6085 <sub>h</sub> ,and keep operating freely. |

### ● Halt

Bit8 of the control word 6040<sub>h</sub> is the functional bit of Halt. When the bit8 changes from 0 to 1, Halt stop is executed. The Halt stop mode is chose by the object dictionary 605D<sub>h</sub>.The meaning of the setting value of 605D<sub>h</sub> is shown in the table below:

Table 4-7

| Setting Value | Stop Mode                                                                        |
|---------------|----------------------------------------------------------------------------------|
| 0x00          | Reserved                                                                         |
| 0x01          | Slow down on slow down ramp set in 6084 <sub>h</sub> ,and stay in Clamped state. |
| 0x02          | Slow down on slow down ramp set in 6085 <sub>h</sub> ,and stay in Clamped state. |

### ● Disable Operation

The Unpower mode is chose by object dictionary 605C<sub>h</sub>.The meaning of the setting value of 605C<sub>h</sub> is shown in the table below:

Table 4-8

| Setting Value | Slow Down Mode                                                                   |
|---------------|----------------------------------------------------------------------------------|
| 0x00          | Slow down freely and keep operating freely..                                     |
| 0x01          | Slow down on slow down ramp set in 6084 <sub>h</sub> ,and keep operating freely. |

### ● Shutdown

The Power off mode is chose by object dictionary 605B<sub>h</sub>.The meaning of the setting value of 605B<sub>h</sub> is shown in the table below:

Table 4-9

| Setting Value | Slow Down Mode                                                                   |
|---------------|----------------------------------------------------------------------------------|
| 0x00          | Slow down freely and keep operating freely.                                      |
| 0x01          | Slow down on slow down ramp set in 6084 <sub>h</sub> ,and keep operating freely. |

## 5 Unit conversion

In order to meet application requirements of all industries, facilitate users to define their own instruction units, the units-conversion module in the device can convert any User Unit (UU) into internal unit(Encoder Increment:shorter form is Inc).

### 5.1 608F<sub>h</sub>:Resolution of position encoder

This object shall indicate increment and rotation number of the encoder installed. The formulas to calculate the resolution of position encoder are as follows:

$$\text{Resolution of position encoder} = \frac{\text{increment of encoder}(608F_h:01h)}{\text{motor turns}(608F_h:02h)}$$

The object description is specified in the table below:

Table 5-1

| Attribution    | Description                    |
|----------------|--------------------------------|
| Index          | 608F <sub>h</sub>              |
| Name           | Resolution of position encoder |
| Data structure | Array                          |
| Data type      | Unsigned32                     |

The sub-indexes description is specified in the table below:

Table 5-2

| Attribution   | Description          |                 |
|---------------|----------------------|-----------------|
| Sub-index     | 01 <sub>h</sub>      | 02 <sub>h</sub> |
| Description   | Increment of encoder | Motor turns     |
| Accessibility | rw                   | rw              |
| Mappability   | No                   | No              |
| Data type     | Unsigned32           | Unsigned32      |
| Default value | 10000                | 1               |

### 5.2 6091<sub>h</sub>:Transmission Ratio

This object shall indicate the numbers of motor revolutions and drive-shaft revolutions. The formula to calculate Gear ratio is as follows:

$$\text{Gear ratio} = \frac{\text{Motor shaft revolutions}(6091h:01h)}{\text{Drive shaft revolutions}(6091h:02h)}$$

The object description is specified in the table below:

Table 5-2

| Attribution    | Description       |
|----------------|-------------------|
| Index          | 6091 <sub>h</sub> |
| Name           | Gear ratio        |
| Data structure | Array             |
| Data type      | Unsigned32        |

The sub-indexes description is specified in the table below:

Table 5-3

| Attribution   | Description             |                         |
|---------------|-------------------------|-------------------------|
| Sub-index     | 01 <sub>h</sub>         | 02 <sub>h</sub>         |
| Description   | Motor shaft revolutions | Drive shaft revolutions |
| Accessibility | rw                      | rw                      |
| Mappability   | No                      | No                      |
| Data type     | Unsigned32              | Unsigned32              |
| Default value | 1                       | 1                       |

Gear ratio is used to specify the proportional relationship between the drive shaft displacement and the motor shaft displacement.

- Relationship between shaft position feedback (encoder unit) and drive shaft position feedback (instruction unit):

$$\text{shaft position feedback} = \text{drive shaft position feedback} \times \text{Gear ratio}$$

- Relationship between motor shaft speed (rpm) and drive shaft speed (unit /s):

$$\text{motor shaft speed (rpm)} = \frac{\text{drive shaft speed} \times \text{gear ratio (6091}_{\text{h}})}{\text{encoder resolutions}} \times 60$$

- Relationship between motor shaft acceleration (rpm / s) and drive shaft acceleration ( unit /s<sup>2</sup>):

$$\text{motor shaft acceleration} = \frac{\text{drive shaft acceleration} \times \text{gear ratio (6091}_{\text{h}})}{\text{encoder resolutions}} \times 60$$

### 5.3 607Eh: Polarity

This object dictionary is configured to determine whether the position command and velocity command are multiplied by 1 or -1. Position polarity is only used in Profile position mode and Cyclic sync position mode, and has no effect in Homing mode. Velocity polarity is only used in Profile velocity mode and Cyclic sync velocity mode. The specific definitions are as follows:

Table 5-4

| bit               |                   |              |
|-------------------|-------------------|--------------|
| 7                 | 6                 | 5~0          |
| Position polarity | Velocity polarity | reserved (0) |

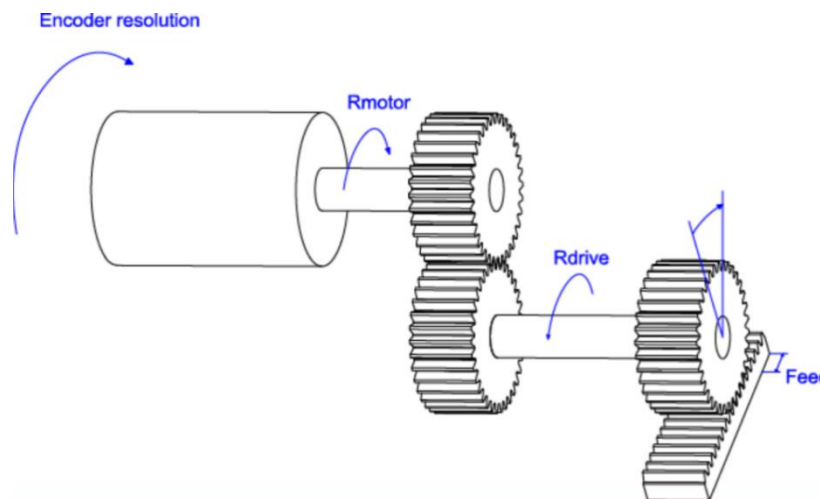
The bits in the table above: 0 is multiplied by 1, 1 is multiplied by -1. For example, if Position polarity =

0, position demand value will be multiplied by 1. The object description is specified in the table below:

Table 5-5

| Attribution    | Description       |
|----------------|-------------------|
| Index          | 607E <sub>h</sub> |
| Name           | Polarity          |
| Data structure | Variable          |
| Accessibility  | rw                |
| Data type      | Unsigned8         |
| Default value  | 0                 |

## 5.4 Example



As shown in the figure above,  $R_{motor}$  is the motor shaft and  $R_{drive}$  is the drive shaft. Suppose: the Encoder resolution = 10000 as the motor shaft rotates 1 revolution;  $R_{motor}$  rotates 3 revolutions when the  $R_{drive}$  rotates 1 revolution; from the conditions above, it can be seen that as the drive shaft rotates 1 revolution, the motor needs to operate  $3 * 10000$  encoder codes, which means that the motor rotates 3 revolutions. Parameters can be calculated according to the following formulas:

**position encoder resolution 608F<sub>h</sub>:**

$$\text{Resolution of position encoder} = \frac{\text{increment of encoder(608Fh:01h)}}{\text{motor turns (608Fh:02h)}} = \frac{10000}{1} = 10000$$

**gear ratio 6091<sub>h</sub>:** 
$$\text{Gear ratio} = \frac{\text{Motor shaft revolution s(6091h:01h)}}{\text{Drive shaft revolution s(6091h:02h)}} = \frac{3}{1} = 3$$

## 6 Operation Mode

### 6.1 Overview of Operation Mode

The control mode of integrated-servo is divided into CiA402 mode and NiMotion mode, 2002<sub>h</sub>:01<sub>h</sub> (control mode option) is used to determine whether the servo is in CiA402 mode or NiMotion mode. The object description is as follows:

Table 6-1

| Attribution    | Description             |
|----------------|-------------------------|
| Index          | 2002 <sub>h</sub>       |
| Name           | Basic control parameter |
| Data structure | Record                  |
| Data type      | -                       |

Sub index 01<sub>h</sub> is to determine the mode:

Table 6-1

|                  |                                                                                                                                                                  |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sub-Index        | 01 <sub>h</sub>                                                                                                                                                  |
| Description      | Control mode option                                                                                                                                              |
| Accessibility    | rw                                                                                                                                                               |
| PDO mapping      | No                                                                                                                                                               |
| Data type        | Unsigned8                                                                                                                                                        |
| Default value    | 0                                                                                                                                                                |
| Meaning of Value | 0x00: CiA402 mode<br>0x01: Manufacturer position mode<br>0x02: Manufacturer velocity mode<br>0x03: Manufacturer torque mode<br>0x04: Manufacturer open loop mode |

After selecting CiA402 mode, 6060<sub>h</sub> needs to be set to select specific motion mode (control mode selection, invalid operation state setting). The object description is as follows:

Table 6-3

|                  |                                                                                |
|------------------|--------------------------------------------------------------------------------|
| Sub-Index        | 6060 <sub>h</sub>                                                              |
| Description      | Mode Option                                                                    |
| Accessibility    | rw                                                                             |
| PDO mapping      | No                                                                             |
| Data type        | Unsigned8                                                                      |
| Default value    | 0x01                                                                           |
| Sub-Index        | -                                                                              |
| Meaning of Value | 0x00: Undefined<br>0x01: Profile position mode(PP)<br>0x02: Velocity mode (VM) |

|                  |                                                                                                                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Meaning of Value | 0x03: Profile velocity mode<br>0x04: Torque profile mode<br>0x05: Undefined<br>0x06: Homing mode (HM)<br>0x07: Interpolated position mode(IP)<br>0x08: Cyclic sync position mode(CSP)<br>0x09: Cyclic sync velocity mode (CSV)<br>0x0A: Cyclic sync Torque mode (CST) |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

When the servo is enabled and the motor shaft speed is 0, the working mode of the servo driver supports switching between PP and HM, as well as between CSP and HM.

## 6.2 Position Control Function

### 6.2.1 Structure Chart

#### Target Following Error

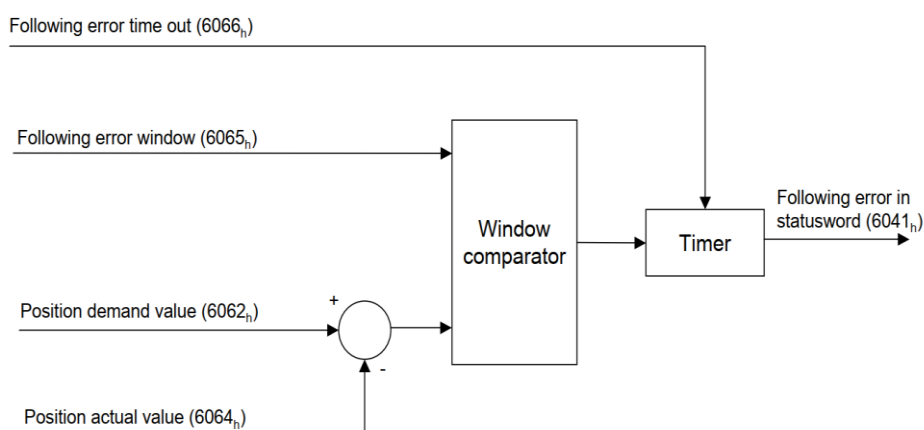


Figure 6-1

#### Target Reached

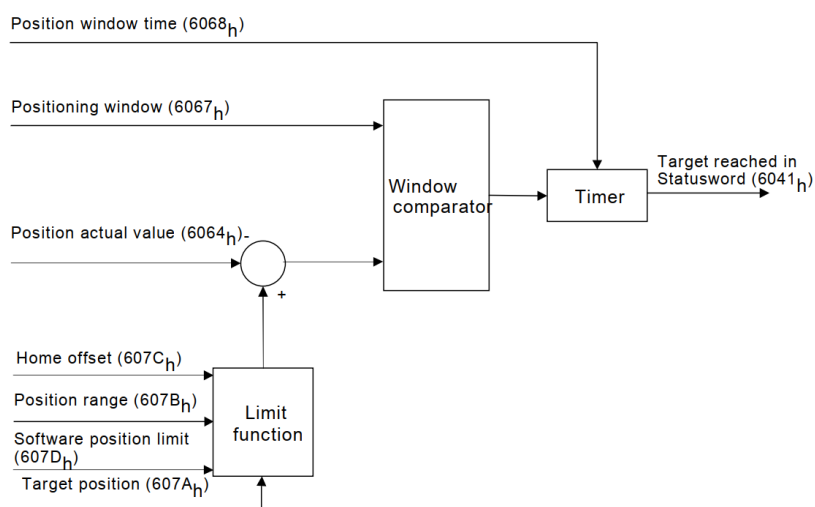


Figure 6-2

## 6.2.2 Objects related

### Target following error

Table 6-2

| Object Index                                 | Description                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6041 <sub>h</sub> (Status word)              | Status word                                                                                                                                                                                                                                                                                                                                           |
| 6062 <sub>h</sub> (Position demand value)    | Current position demand value inside the drive (user unit)                                                                                                                                                                                                                                                                                            |
| 6064 <sub>h</sub> (Position actual value)    | Current position actual value feedback (user unit)                                                                                                                                                                                                                                                                                                    |
| 6065 <sub>h</sub> (Following Error Window)   | This object shall indicate the configured range of tolerated position values symmetrically to the position demand value. If the position actual value is out of the following error window, a following error occurs. A following error may occur when a drive is blocked, unreachable profile velocity occurs, or at wrong closed-loop coefficients. |
| 6066 <sub>h</sub> (Following Error Time Out) | Following error time out (unit: ms)                                                                                                                                                                                                                                                                                                                   |

### Target Reached

Table 6-3

| Object Index                                | Description                                                                                                                                                                                                                       |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6041 <sub>h</sub> (Status word)             | Status word                                                                                                                                                                                                                       |
| 6064 <sub>h</sub> (Position actual value)   | Current position value feedback (user unit)                                                                                                                                                                                       |
| 6067 <sub>h</sub> (Position window)         | The configured symmetrical range of accepted positions relative to the target position. If the actual value of the position encoder is within the position window, this target position shall be regarded as having been reached. |
| 6068 <sub>h</sub> (Position window time)    | Position window time(unit: ms)                                                                                                                                                                                                    |
| 607A <sub>h</sub> (Target position)         | Target position(user unit)                                                                                                                                                                                                        |
| 607B <sub>h</sub> (Position range limit)    | Position range limit(user unit)                                                                                                                                                                                                   |
| 607C <sub>h</sub> (Home offset)             | Difference between the 0-position in the application and the machine home position (user unit)                                                                                                                                    |
| 607D <sub>h</sub> (Software position limit) | Target position limit (user unit)                                                                                                                                                                                                 |

## 6.2.3 Function Description

### Target Following Error

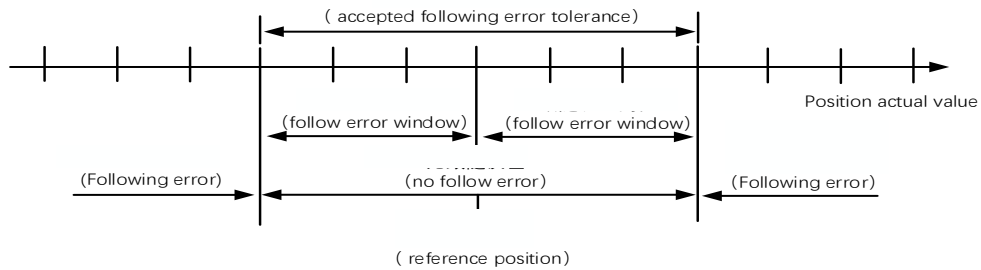


Figure 6-3

Following error refers to the deviation between Position demand value (6062<sub>h</sub>) and Position actual value (6064<sub>h</sub>). If following error is continually greater than value set in 6065<sub>h</sub> (following error windows) within the time set in 6066<sub>h</sub> (Following error timeout) (as shown in Figure 6.2, the following error exceeds acceptable range), Bit13 (following error) in 6041<sub>h</sub> (status word) will be set to 1, the sequence diagram is shown below:

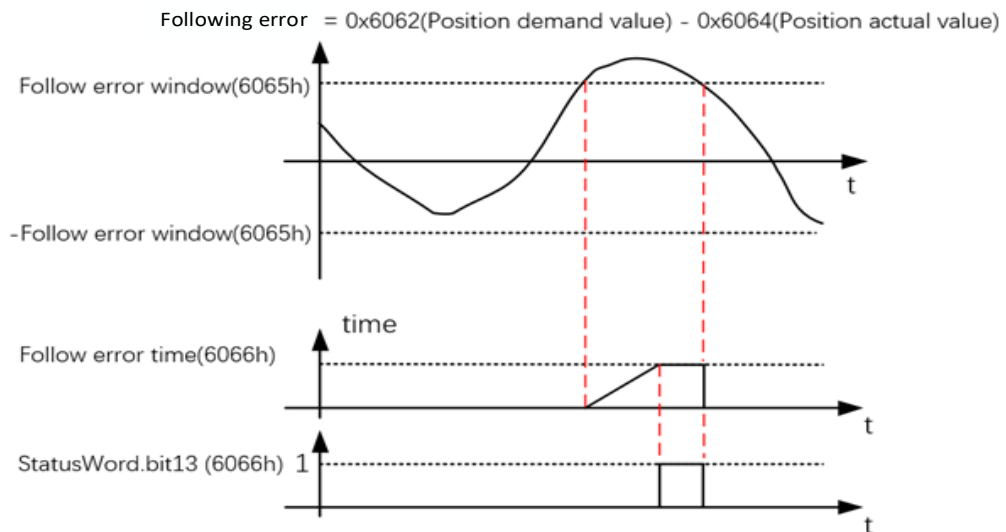


Figure 6-4

## Target Reached

Figure of Error Acceptable:

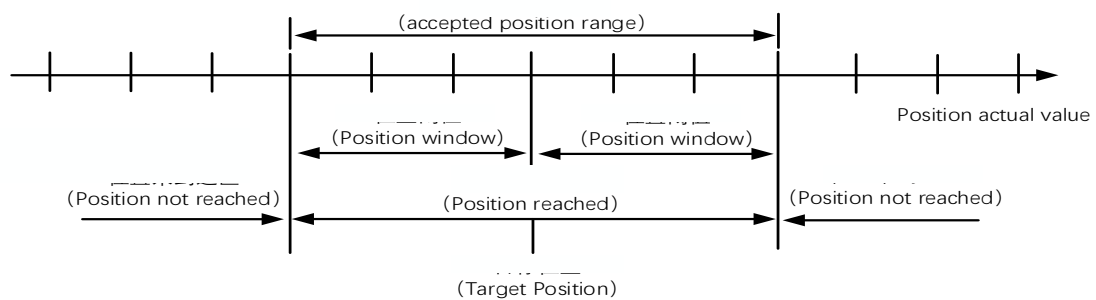


Figure 6-4

Position deviation is the difference between the Target position in 607A<sub>h</sub> and the Position actual value

in 6064<sub>h</sub>. If the deviation is in the acceptable range (as shown in the above figure) stably and span the time set in 6068<sub>h</sub> (position windows time), Bit10 (target reached) of the status word will be set to 1, that is, the target position is reached. The sequence diagram is as follows:

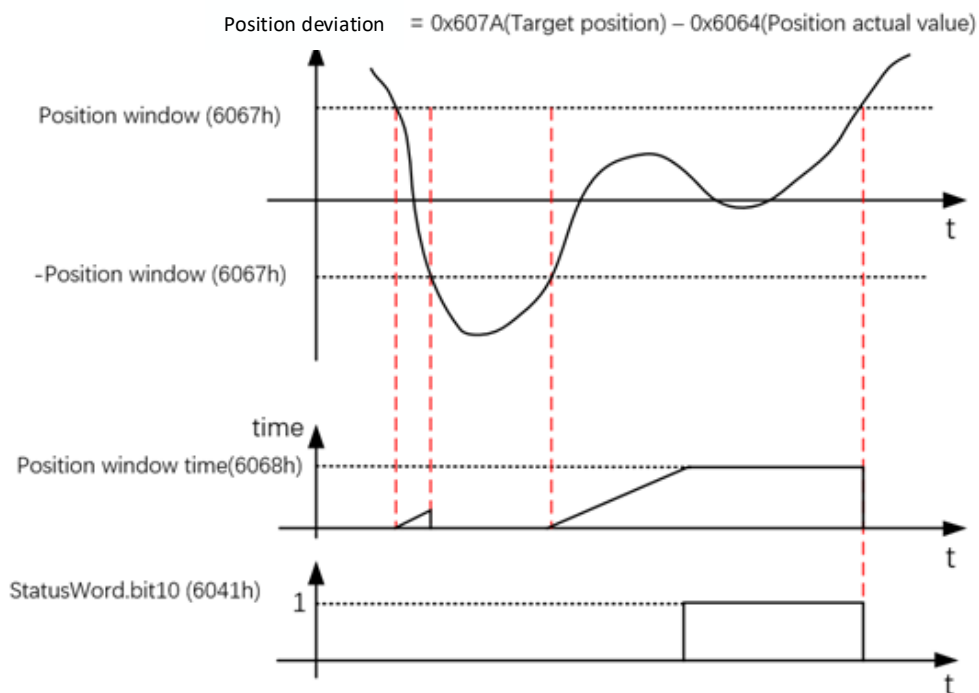


Figure 6-5

### 6.3 Profile Position Mode (PP)

This mode is mostly used in point-to-point positioning applications. In this mode, the master computer gives the target position (absolute or relative), speed, acceleration and deceleration of the position curve, the track generator in servo will generate target position curve command according to the settings, and the drive will complete the position, speed and torque control internally.

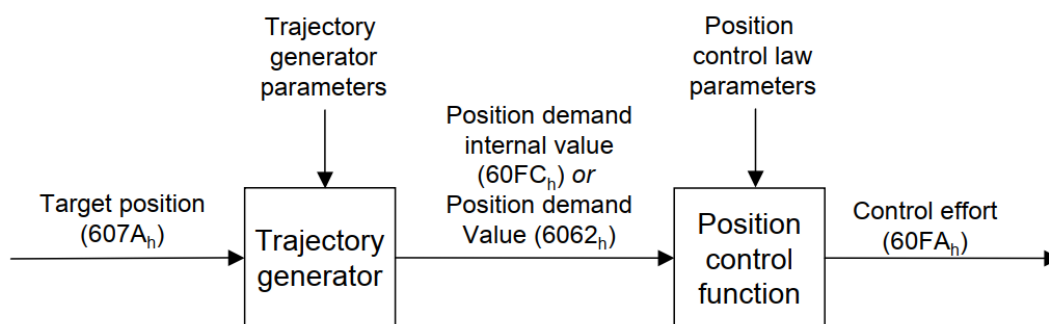


Figure 6-6

### 6.3.1 Structure Chart

The following figure introduces the detailed structure of the trace generator:

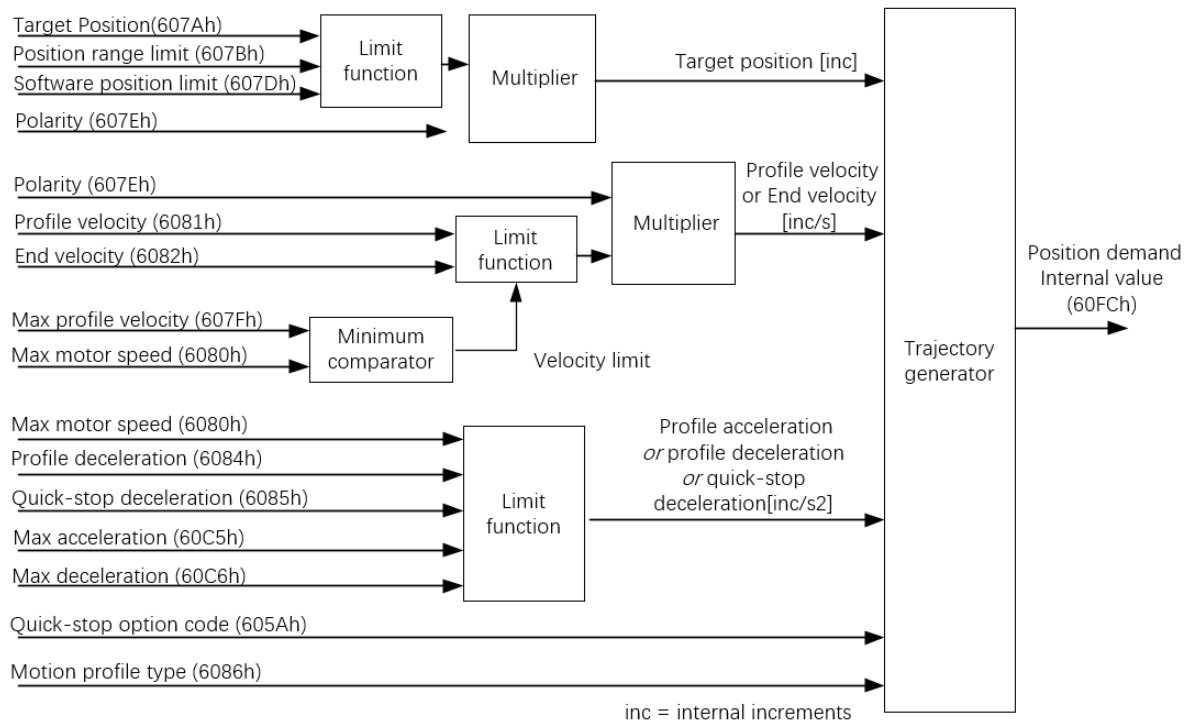


Figure 6-7

### 6.3.2 Object Related

Pay attention to the following objects in this mode :

Table 6-4

| Object Index                                   | Description                                                                                                                                                       |
|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 605D <sub>h</sub> (Halt option code)           | Halt option                                                                                                                                                       |
| 605A <sub>h</sub> (Quick stop option code)     | Quick stop option                                                                                                                                                 |
| 6062 <sub>h</sub> (Position Demand Value)      | Current position demand value inside the drive (user unit)                                                                                                        |
| 6063 <sub>h</sub> (Position Actual Enc Value)  | Current position actual value feedback (encoder unit)                                                                                                             |
| 6064 <sub>h</sub> (Position Actual User Value) | Current actual position (user unit)                                                                                                                               |
| 607A <sub>h</sub> (Target Position)            | Target position (user unit)                                                                                                                                       |
| 607B <sub>h</sub> (Position Range Limit)       | Position range limit (user unit)                                                                                                                                  |
| 607D <sub>h</sub> (Software Position Limit)    | Target position limit (user unit)                                                                                                                                 |
| 607E <sub>h</sub> (Polarity)                   | Rotation direction(polarity),See "5.3 607E <sub>h</sub> : Polarity" for details                                                                                   |
| 607F <sub>h</sub> (Max Profile Velocity)       | Maximum velocity (user unit / s), to limit the velocity                                                                                                           |
| 6080 <sub>h</sub> (Max motor speed)            | Max motor speed(rpm)                                                                                                                                              |
| 6081 <sub>h</sub> (Profile Velocity)           | Maximum velocity during uniform motion in this profile operation, (user unit / s), I.e. the velocity at the end of the acceleration slope during the positioning. |

| Object Index                                       | Description                                                                                                                                                                                                                                                |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6082 <sub>h</sub> (End Velocity)                   | The velocity when reaching the target position(user unit/s), and the velocity at the end of the slope. Usually, this object is set to 0, so that the velocity when reaching the target position is just down to 0.                                         |
| 6083 <sub>h</sub> (Profile Acceleration)           | The acceleration during the profile operation(user unit / s <sup>2</sup> ), limited by 60C5 <sub>h</sub> .                                                                                                                                                 |
| 6084 <sub>h</sub> (Profile Deceleration)           | The deceleration during the profile operation operation, (user unit / s <sup>2</sup> ), limited by 60C6 <sub>h</sub> .                                                                                                                                     |
| 6085 <sub>h</sub> (Quick Stop Deceleration)        | Deceleration during "quick stop" in cia402 state machine.                                                                                                                                                                                                  |
| 6086 <sub>h</sub> (Motion Profile Type)            | Choose the type of velocity curve.<br>If the value is "0", the impact ( jerk) will be not limited;<br>If the value is "3", the impact ( jerk) will be limited only by the value in 60a4 <sub>h</sub> : 01 <sub>h</sub> -02 <sub>h</sub> in this equipment. |
| 60C5 <sub>h</sub> (Max Acceleration)               | Max acceleration(user unit / s <sup>2</sup> )                                                                                                                                                                                                              |
| 60C6 <sub>h</sub> (Max Deceleration)               | Max deceleration(user unit / s <sup>2</sup> )                                                                                                                                                                                                              |
| 60F2 <sub>h</sub> (Positioning option code)        | Positioning option code                                                                                                                                                                                                                                    |
| 60FC <sub>h</sub> (Position Demand internal value) | Output of track generator, i.e.the real time position instruction which is internal planned(encoder unit)                                                                                                                                                  |

The following figure shows the effect of the velocity, acceleration and impact parameters:

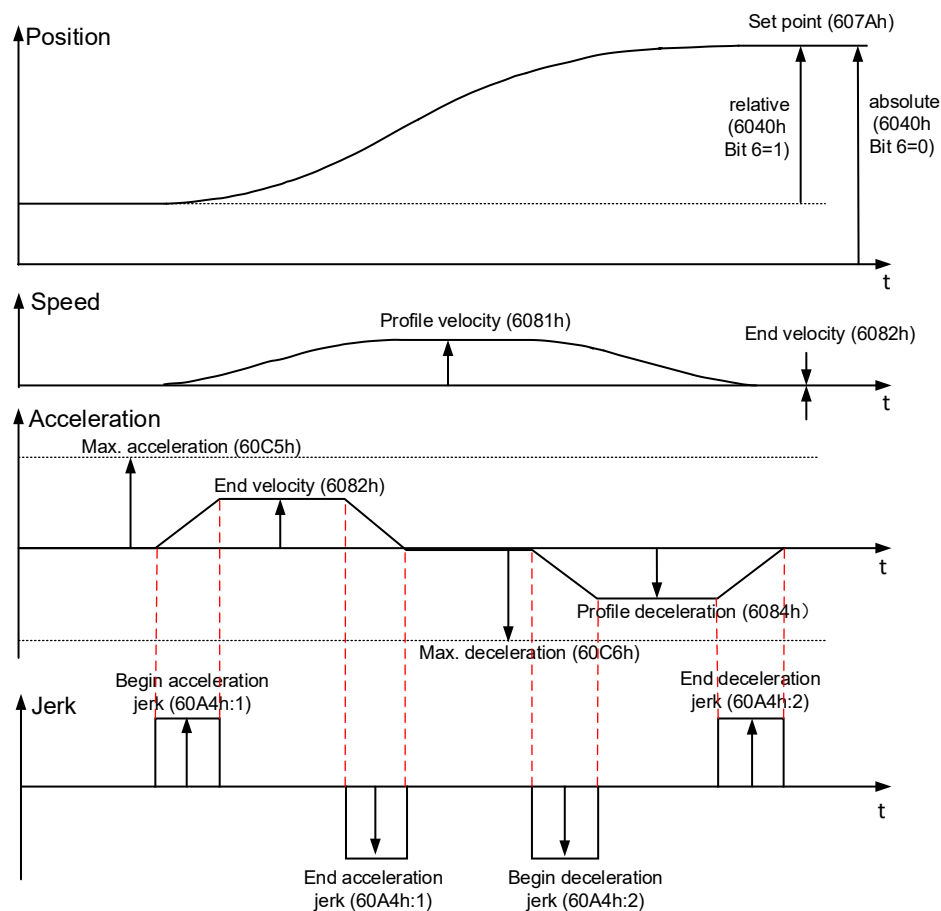


Figure 6-8

### 6.3.3 Control Instruction and Status Information

#### Enable

As this mode is enabled, the value in object 2002<sub>h</sub>:01<sub>h</sub> and object 6060<sub>h</sub> (Modes of Pperation) must be set to "0" and "1" respectively.

#### Control Word

|             |                     |      |             |         |                        |               |             |     |   |
|-------------|---------------------|------|-------------|---------|------------------------|---------------|-------------|-----|---|
| 15          | 10                  | 9    | 8           | 7       | 6                      | 5             | 4           | 3   | 0 |
| (see 4.1.2) | Change on set-point | Halt | (see 4.1.2) | abs/rel | Change set immediately | New set-point | (see 4.1.2) |     |   |
| MSB         |                     |      |             |         |                        |               |             | LSB |   |

In the Profile position mode, the following bits in object 6040<sub>h</sub> (control word) have special functions.

Table 6-5

| Bit 5 | Bit 4 | Description                                                                  |
|-------|-------|------------------------------------------------------------------------------|
| 0     | 0->1  | Not Update-now, the next task is started after the running task be completed |
| 1     | 0-> 1 | Update-now, the task triggered by bit 4 will be executed immediately.        |

Table 6-6

| Bit | Value | Description                                                                  |
|-----|-------|------------------------------------------------------------------------------|
| 6   | 0     | Target position is an absolute value                                         |
|     | 1     | Target position is a relative value (depending on object 60F2 <sub>h</sub> ) |
| 8   | 0     | Positioning is executed or continued                                         |
|     | 1     | Motor will be stopped accordingly to halt option code (605D <sub>h</sub> )   |

#### Status Word

|             |                 |                       |             |                |             |     |   |
|-------------|-----------------|-----------------------|-------------|----------------|-------------|-----|---|
| 15          | 14              | 13                    | 12          | 11             | 10          | 9   | 0 |
| (see 4.1.3) | Following error | Set-point acknowledge | (see 4.1.3) | reached Target | (see 4.1.3) |     |   |
| MSB         |                 |                       |             |                |             | LSB |   |

In Profile position mode, the following bits in object 6041<sub>h</sub> (status word) have special functions:

Table 6-9

| Bit | Value | Description                                                                                                                                                |
|-----|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | 0     | Halt (Bit 8 in control word 6040 <sub>h</sub> ) = 0: Target position not reached<br>Halt (Bit 8 in control word 6040 <sub>h</sub> ) = 1: Axis decelerates  |
|     | 1     | Halt (Bit 8 in control word 6040 <sub>h</sub> ) = 0: Target position reached<br>Halt (Bit 8 in control word 6040 <sub>h</sub> ) = 1: Velocity of axis is 0 |
| 12  | 0     | Previous set point already processed, waiting for new set point                                                                                            |
|     | 1     | Previous set point still in process, set point overwriting shall be accepted                                                                               |
| 13  | 0     | No following error                                                                                                                                         |
|     | 1     | Following error                                                                                                                                            |

### 6.3.4 Function Description

It is divided into immediate update and non immediate update to interpret the control instruction sequence:

#### 1) Control Instruction Sequence- Immediate Update

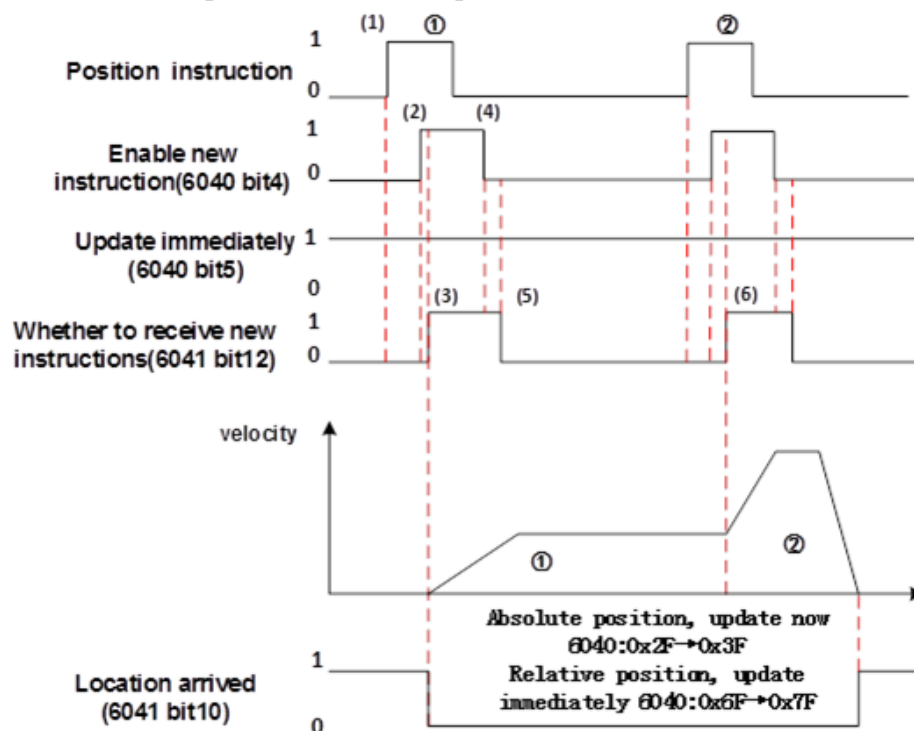


Figure 6-9

The following table provides some explanations marked in the process of the above figure:

Table 6-7

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (1) | The master computer updates instruction (including Target position 607A <sub>h</sub> , Acceleration time 6083 <sub>h</sub> , Deceleration time 6084 <sub>h</sub> , Profile velocity 6081 <sub>h</sub> ,etc.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| (2) | Change bit4 in 6040 <sub>h</sub> from 0 to 1, indicating that the slave station has new position instruction (bit5 in 6040 <sub>h</sub> is set to 1 in the immediate-updating case)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| (3) | <p>After receiving the rising edge of bit4 in 6040<sub>h</sub>,the slave station judges whether the new position instruction can be received or not:<br/>bit12 in 6041<sub>h</sub> being 0 ,indicates that the slave station can receive the new instruction ①; The slave station change bit12 in 6041<sub>h</sub> from 0 to 1 after receiving the new instruction, which indicates that the instruction ① has been received, and the slave station is unable to receive new instruction.</p> <p>In immediate update mode, the motor executes the position command immediately once the new position command is received (bit12 in 6041<sub>h</sub> changes from 0 to 1)</p> |
| (4) | The master computer shall release position instruction only when receiving the bit12 in 6041 <sub>h</sub> from the slave station being changed from 1 to 0. And,the master computer changes bit4 in control word 6040 <sub>h</sub> from 1 to 0,indicating that there is no new position instruction at present.                                                                                                                                                                                                                                                                                                                                                              |

- (5) The slave station changes bit12 in status word 6041<sub>h</sub> from 1 to 0 when it detects that bit4 in control word 6040<sub>h</sub> been changed from 1 to 0, indicating that the slave station is ready to receive new position instruction.

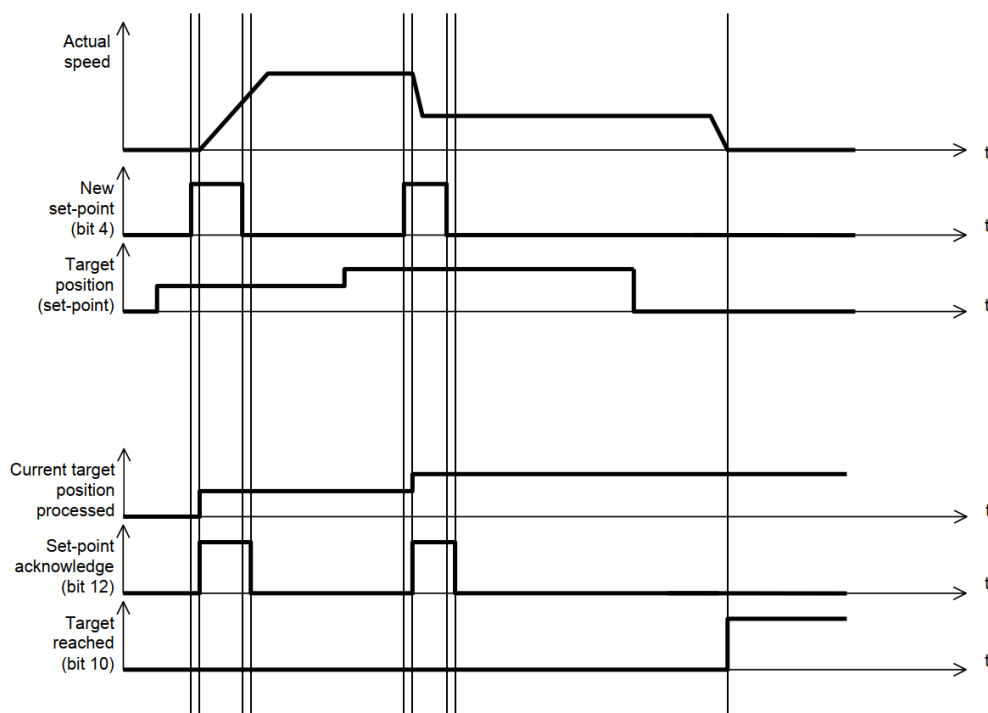


Figure 6-10

## 2) Control Instruction Sequence Non Immediate Update

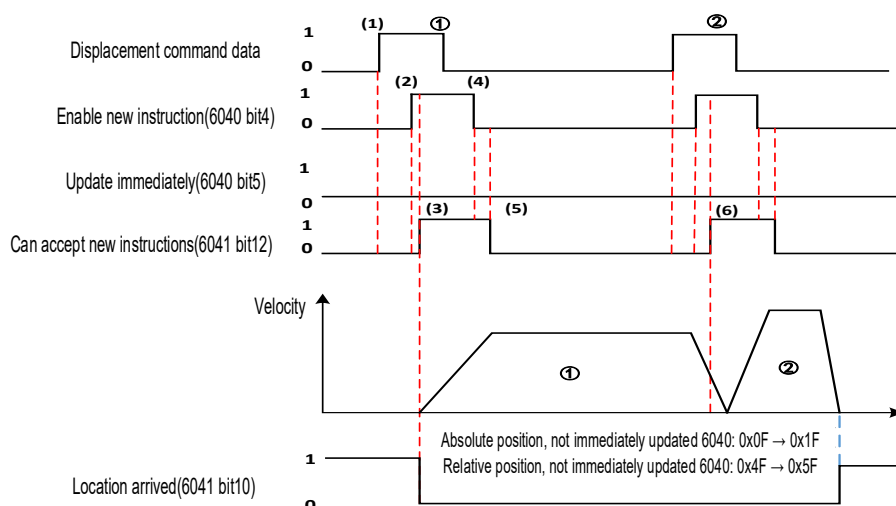


Figure 6-11

The notes (1) - (5) in the figure below are similar to the immediate-update mode. It can be seen from the comparison of position (6) in the figure, the difference is that in non immediate update mode, although the new target position ② has been accepted, it needs to reach position ① first, slow down and stop, and then move to new position ②.

In non immediate-update mode, the motor has 5 buffers, i.e. it can have 5 target positions in the sequence at the same time and the motor will operate to these positions in turn. If the buffers is full, new position can't be accepted until the buffers is empty. These buffers are cleared when the motor is stopped.

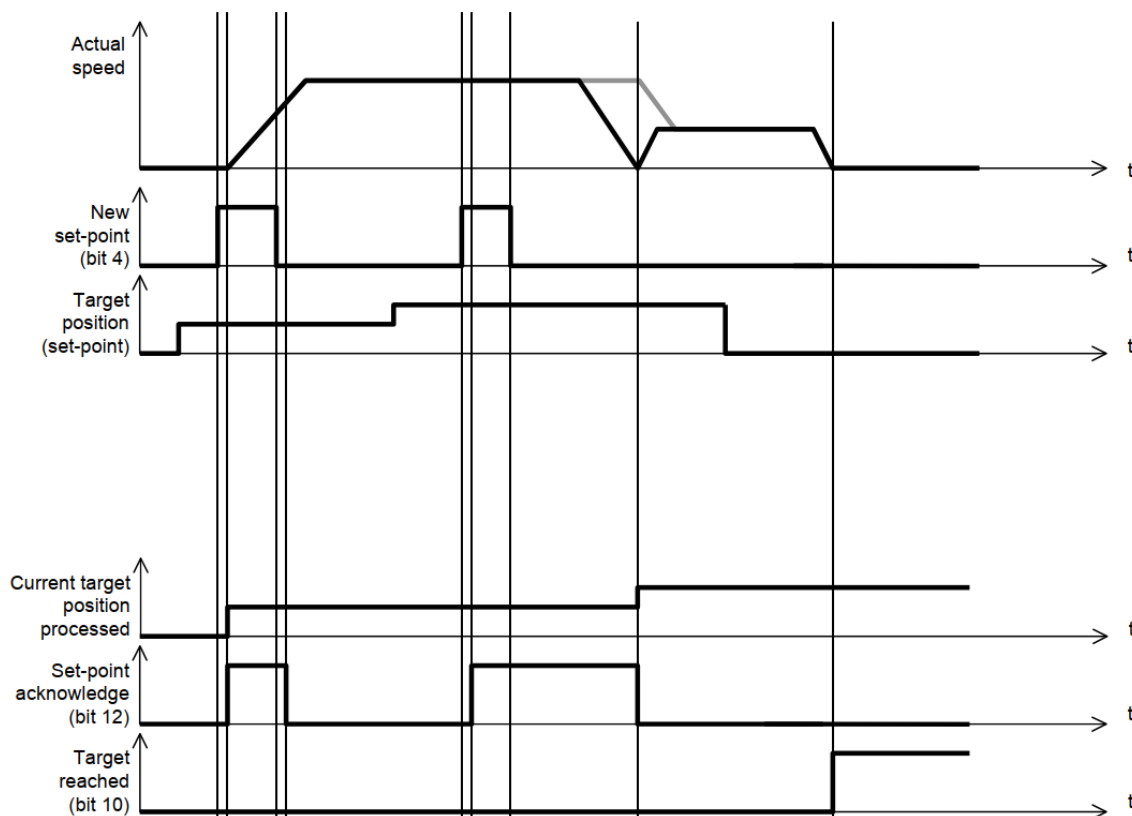


Figure 6-12

### 6.3.5 Impact Limited and Impact Unlimited Mode

In principle, the mode can be divided into "impact Limited" and "impact unlimited" according to impact type.

- Impact Limited

The impact-limited positioning is performed if the object 6086<sub>h</sub> is set to "3". The items in object 60a4<sub>h</sub>: 1<sub>h</sub>-4<sub>h</sub> related take effect concurrently.

- Impact Unlimited Mode

In this mode, there is no impact limit at each position of the characteristic curve. Step to run the "impact unlimited" ramp: set the items in object 6086<sub>h</sub> to "0".

### 6.3.6 Configuration Example

- Configuration of Mode

Set 2002<sub>h</sub>: 01<sub>h</sub> = 0, Operation mode 6060<sub>h</sub> = 0x01, to enable the motor operating in the Profile position mode;

- Configuration of Parameter

Set target position 607A<sub>h</sub>(user unit);

Set uniform velocity in the current segment position instruction 6081<sub>h</sub>(unit :inc/s);

Set Profile acceleration 6083<sub>h</sub>(user unit/s<sup>2</sup>)and Profile deceleration 6084<sub>h</sub>(user unit/s<sup>2</sup>);

### ● Setting of Control Word

6040<sub>h</sub> = 0x06→0x07→ 0x(n)F → 0x(n+1)F, motor operates,

Different instruction types are shown in the table below:

Table 6-8

| 6040 <sub>h</sub> -bit6 | 6040 <sub>h</sub> -bit5 | 6040 <sub>h</sub> Transform | Description                            |
|-------------------------|-------------------------|-----------------------------|----------------------------------------|
| 0                       | 0                       | 0x0F → 0x1F                 | Absolute position,Non Immediate Update |
| 0                       | 1                       | 0x2F → 0x3F                 | Absolute position,Immediate Update     |
| 1                       | 0                       | 0x4F → 0x5F                 | Relative position,Non Immediate Update |
| 1                       | 1                       | 0x6F → 0x7F                 | Relative position,Immediate Update     |

Monitoring of Parameters:

- Position Actual Enc Value: 6063<sub>h</sub> (encoder unit), Position Actual User Value6064<sub>h</sub> (user unit)

## 6.4 Velocity Mode

### 6.4.1 Structural Chart

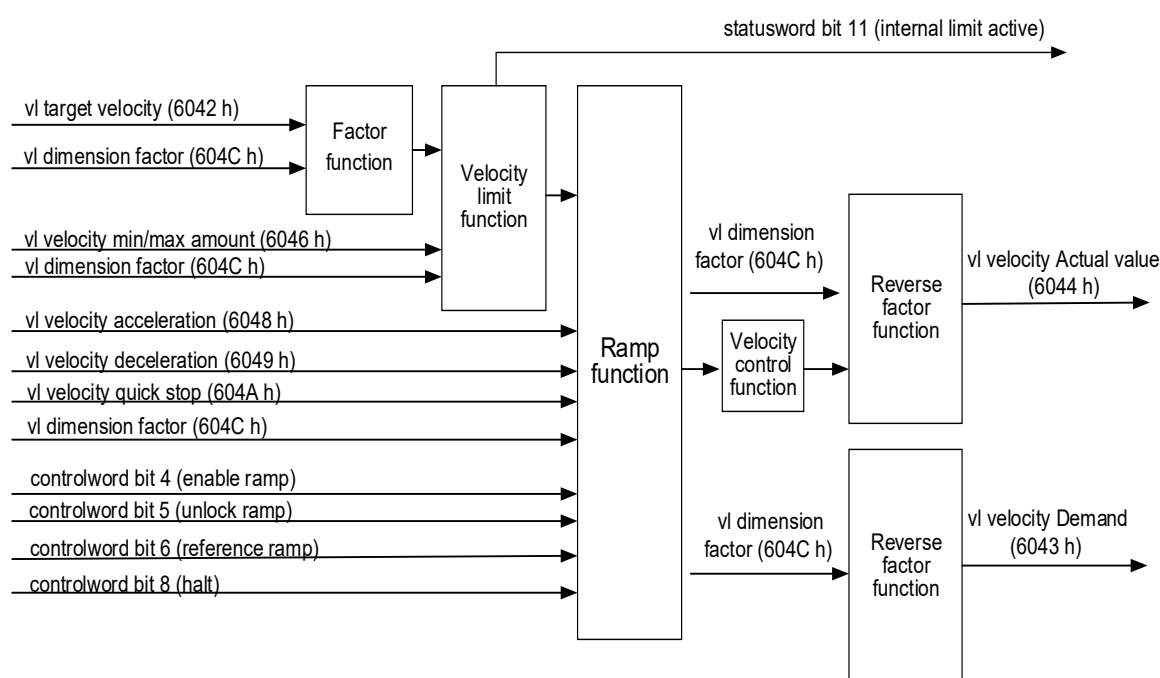


Figure 6-13

### 6.4.2 Objects Related

In this mode,the following objects need to be pay attention to:

Table 6-9

| Object Index                           | Description                                                                 |
|----------------------------------------|-----------------------------------------------------------------------------|
| 6042 <sub>h</sub> (VI target velocity) | Target velocity in VM mode,(default unit rpm,related to 604C <sub>h</sub> ) |

| Object Index                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6043 <sub>h</sub> (VI velocity demand)       | Target velocity as the VM mode is activate,(default unit rpm,same as 6042 <sub>h</sub> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 6044 <sub>h</sub> (VI velocity actual value) | Current feedback velocity actual value (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 604C <sub>h</sub> (VL dimension factor)      | <p>Scaling factor for speed units in VM mode(default unit: rpm)<br/> Sub-index 1 contains the numerator (multiplier) used to calculate speed, and sub index 2 contains the denominator (divisor).</p> <p>Velocity unit: <math>\text{rpm} * \frac{\text{Sub - index 1}}{\text{Sub - index 2}}</math></p> <p>If any of the sub indexes 1 and 2 is 0, the speed unit is rpm.</p>                                                                                                                                                                                |
| 6048 <sub>h</sub> (Velocity acceleration)    | <p>VI velocity acceleration =Delta speed (6048<sub>h</sub>:01<sub>h</sub>) / Delta time (6048<sub>h</sub>:02<sub>h</sub>)</p> <p>Acceleration in VM mode. Sub-index 1 contains the speed change (unit:rpm) and sub-index 2 the corresponding time(unit: second).<br/> The acceleration is calculated as follows:<br/> VI velocity acceleration =Delta speed (6048<sub>h</sub>:01<sub>h</sub>) / Delta time (6048<sub>h</sub>:02<sub>h</sub>)</p>                                                                                                             |
| 6049 <sub>h</sub> (Velocity deceleration)    | <p>Deceleration in VM mode. Sub-index 1 contains the speed change (unit:rpm) and sub-index 2 the corresponding time(unit: second).<br/> The acceleration is calculated as follows:<br/> VI velocity deceleration = Delta speed (6049<sub>h</sub>:01<sub>h</sub>) / Delta time (6049<sub>h</sub>:02<sub>h</sub>)</p>                                                                                                                                                                                                                                          |
| 604A <sub>h</sub> (Quick stop deceleration)  | <p>Deceleration during Quick stop in VM mode.Sub-index 1 contains the speed change (unit:rpm) and sub-index 2 the corresponding time(unit: second).<br/> The acceleration is calculated as follows:<br/> VI Quick stop deceleration = Delta speed (604A<sub>h</sub>:01<sub>h</sub>) / Delta time (604A<sub>h</sub>:02<sub>h</sub>)</p>                                                                                                                                                                                                                       |
| 6046 <sub>h</sub> (Velocity min max amount)  | <p>Speed limit in VM mode (default unit: rpm, related to 604C<sub>h</sub>).<br/> The details are as follows:<br/> 6046<sub>h</sub>: 01<sub>h</sub> set the minimum speed. If the target speed (6042<sub>h</sub>) is lower than the minimum speed, its value will be set to the minimum speed of 6046<sub>h</sub>: 01<sub>h</sub>.<br/> 6046<sub>h</sub>: 02<sub>h</sub> sets the maximum speed. If the target speed (6042<sub>h</sub>) is higher than the maximum speed, its value will be set to the maximum speed of 6046<sub>h</sub>: 02<sub>h</sub>.</p> |

The following figure shows the effect of acceleration and deceleration on the operation process:

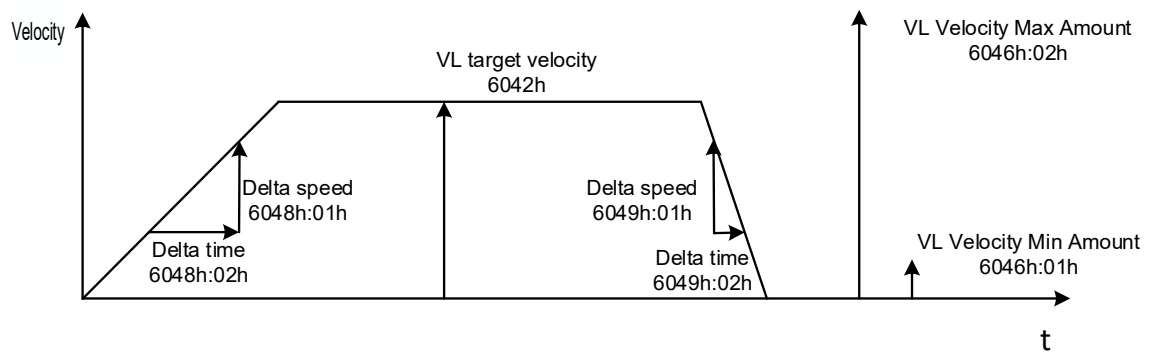


Figure 6-14

### 6.4.3 Control Instruction and Status Information

#### Enable

To enable this mode, the value must be set to "0" in object 2002<sub>h</sub>:01<sub>h</sub> and "2" in object 6060<sub>h</sub> (Modes of Operation).

#### Control Word

| 15          | 9    | 8           | 7              | 6           | 5           | 4           | 3 | 0   |
|-------------|------|-------------|----------------|-------------|-------------|-------------|---|-----|
| (see 4.1.2) | Halt | (see 4.1.2) | Reference ramp | Unlock ramp | Enable ramp | (see 4.1.2) |   |     |
| MSB         |      |             |                |             |             |             |   | LSB |

In Velocity mode, the following bits in the object 6040<sub>h</sub> (control word) have special functions:

Table 6-10

| Bit | Value | Description                                                                                                                                                                                                      |
|-----|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2   | 0     | When Quick stop is triggered, the motor will perform quick braking according to the Quick stop deceleration set in the object 604A <sub>h</sub> . The controller then switches to the "Switch on disabled" state |
|     | 1     | No Operation                                                                                                                                                                                                     |
| 4   | 0     | The output changes to the given immediately without acceleration and deceleration                                                                                                                                |
|     | 1     | Adjust the velocity according to the acceleration and deceleration setting                                                                                                                                       |
| 5   | 0     | No longer adjust velocity from the planner output, the velocity output shall be locked to the current value                                                                                                      |
|     | 1     | Adjust the speed according to the speed output of the planner                                                                                                                                                    |
| 6   | 0     | velocity curve planner input is 0                                                                                                                                                                                |
|     | 1     | velocity curve planner input is the given target velocity                                                                                                                                                        |

| Bit | Value | Description      |
|-----|-------|------------------|
| 8   | 0     | No Operation     |
|     | 1     | Motor suspension |

#### Status Word

|             |    |          |    |             |     |          |   |             |  |
|-------------|----|----------|----|-------------|-----|----------|---|-------------|--|
| 15          | 14 | 13       | 12 | 11          | 10  | 9        | 0 |             |  |
| (see 4.1.3) |    | reserved |    | (see 4.1.3) |     | reserved |   | (see 4.1.3) |  |
| MSB         |    |          |    |             | LSB |          |   |             |  |

In Velocity mode, the bit in the object **6041<sub>h</sub>** (control word) has no special function. For the definition of the general bit, see 4.1.3 status sub-word.

#### 6.4.4 Function Description

In this mode, the motor operates according to the preset target velocity, similar to the converter.

#### 6.4.5 Configuration Example

- Configuration mode:  
Set 2002<sub>h</sub>:01<sub>h</sub>=0、6060<sub>h</sub>=0x02, as velocity mode(VM)
- Parameter configuration :  
Set target velocity: 6042<sub>h</sub>=1000;  
Set acceleration:  
6048<sub>h</sub>:01<sub>h</sub>= 500, 6048<sub>h</sub>:02<sub>h</sub>= 1;  
6049<sub>h</sub>:01<sub>h</sub>= 500, 6049<sub>h</sub>:02<sub>h</sub>= 1。
- Set control word:  
6040<sub>h</sub>= 0x06→0x07→0x7F, motor operates;

Parameter monitor:

- Velocity actual value 606C<sub>h</sub> (unit rpm)

#### 6.5 Profile Velocity Mode (PV)

In this mode, the upper controller sends the Target velocity, acceleration and deceleration to the servo drive, and the servo adjusts velocity and torque internally.

### 6.5.1 Structure Chart

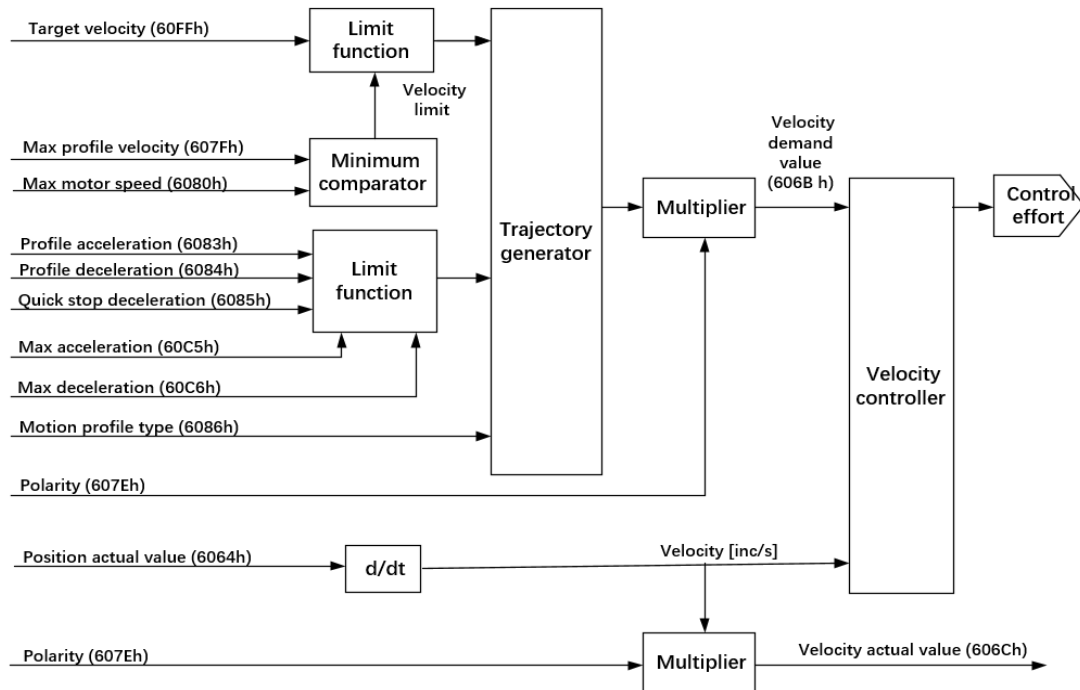


Figure 6-15

### 6.5.2 Objects Related

In this mode, the following objects need to be pay attention to:

Table 6-11

| Object index                                   | Description                                                                                                                     |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| 6063 <sub>h</sub> (Position Actual Enc Value)  | Position Actual Enc Value(encoder unit)                                                                                         |
| 6064 <sub>h</sub> (Position actual user value) | Position actual user value(user unit)                                                                                           |
| 606B <sub>h</sub> (Velocity demand value)      | Velocity demand value                                                                                                           |
| 606C <sub>h</sub> (Velocity actual value)      | Current velocity actual value feedback(unit:rpm)                                                                                |
| 607E <sub>h</sub> (Polarity)                   | Rotation direction(polarity),See "5.3 607E <sub>h</sub> : Polarity" for details                                                 |
| 607F <sub>h</sub> (Max profile velocity)       | Maximum profile velocity during operation (user unit / s), which is used to limit the velocity                                  |
| 6080 <sub>h</sub> (Max motor speed)            | Max motor speed(rpm)                                                                                                            |
| 6083 <sub>h</sub> (Profile acceleration)       | The profile acceleration (user unit / s <sup>2</sup> ) during operation, which is limited by 60C5 <sub>h</sub> .                |
| 6084 <sub>h</sub> (Profile deceleration)       | The profile deceleration (user unit / s <sup>2</sup> ) during operation, which is limited by 60C6 <sub>h</sub> .                |
| 6085 <sub>h</sub> (Quick stop deceleration)    | Deceleration during "Quick stop" (user unit/s <sup>2</sup> )                                                                    |
| 6086 <sub>h</sub> (Motion profile type)        | Choose the type of curve, i.e. slope,<br>If the value is "0", the impact (acceleration) will not be limited, i.e. ladder curve; |

| Object index                         | Description                                                                                                                                                                                                                 |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                      | If the value is "3", the value in 60A4 <sub>h</sub> : 01 <sub>h</sub> -02 <sub>h</sub> will be used to limit the impact (acceleration), i.e. S-curve. This equipment only uses 01 <sub>h</sub> and 02 <sub>h</sub> indexes. |
| 60C5 <sub>h</sub> (Max acceleration) | Max acceleration (user unit /s <sup>2</sup> )                                                                                                                                                                               |
| 60C6 <sub>h</sub> (Max deceleration) | Max deceleration (user unit /s <sup>2</sup> )                                                                                                                                                                               |
| 60FF <sub>h</sub> (Target velocity)  | Target velocity(user unit /s)                                                                                                                                                                                               |

### 6.5.3 Control Instruction and Status Information

#### Enable

When this mode is enabled, the value must be set to "0" in object 2002<sub>h</sub>:01<sub>h</sub> and "3" in object 6060<sub>h</sub> (Modes of Operation).

#### Control Word

|             |   |      |             |   |          |   |             |
|-------------|---|------|-------------|---|----------|---|-------------|
| 15          | 9 | 8    | 7           | 6 | 4        | 3 | 0           |
| (see 4.1.2) |   | Halt | (see 4.1.2) |   | reserved |   | (see 4.1.2) |
| MSB         |   |      |             |   |          |   | LSB         |

In Profile velocity mode, the following bits in the object 6040<sub>h</sub> (control word) have special functions

Table 6-12

| Bit | Value | Meaning              |
|-----|-------|----------------------|
| 8   | 0     | Motor keep operating |
|     | 1     | Suspend              |

#### Status Word

|             |    |    |       |             |                |   |             |
|-------------|----|----|-------|-------------|----------------|---|-------------|
| 15          | 14 | 13 | 12    | 11          | 10             | 9 | 0           |
| (see 4.1.3) |    | -  | Speed | (see 4.1.3) | Target reached |   | (see 4.1.3) |
| MSB         |    |    |       |             |                |   | LSB         |

In Position velocity mode, the following bits in the object 6041<sub>h</sub> (status word) have special function

Table 6-13

| Bit | Value | Definition                                                                                                                                               |
|-----|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | 0     | Halt(Bit8 in control word 6040 <sub>h</sub> )=0:Target position not reached<br>Halt (Bit8 in control word 6040 <sub>h</sub> ) = 1: Axis decelerates      |
|     | 1     | Halt (Bit8 in control word 6040 <sub>h</sub> ) = 0: Target position reached<br>Halt (Bit8 in control word 6040 <sub>h</sub> ) = 1: Velocity of axis is 0 |
| 12  | 0     | Velocity of axis is not 0                                                                                                                                |
|     | 1     | Velocity of axis is 0                                                                                                                                    |

### 6.5.4 Function Description

In this mode, the master controller sends target speed, acceleration and deceleration to the servo drive, and the servo adjust the speed and torque internally.

### 6.5.5 Configuration Example

- Configuration mode:

Set 2002<sub>h</sub>:01<sub>h</sub>=0、6060<sub>h</sub>=0x03, as Profile velocity mode(PV)

- Parameter configuration :

Set target velocity: Forward rotation:60FF<sub>h</sub>=50000; Reverse rotation:60FF<sub>h</sub>=-50000

Set acceleration: 6083<sub>h</sub>= 40000;

Set deceleration: 6084<sub>h</sub>= 40000;

- Set Control word:

6040<sub>h</sub>= 0x06→0x07→0x0F, motor operates;

Parameter monitor:

- Velocity actual value 606C<sub>h</sub> (unit: rpm)

## 6.6 Profile Torque Mode(PT)

In this mode, the master controller sends the target torque 6071<sub>h</sub> and the torque ramp constant 6087<sub>h</sub> to the servo drive, then the servo regulates torque internally. When the velocity reaches the limit , it will switches to the velocity regulation stage.

### 6.6.1 Structural Chart

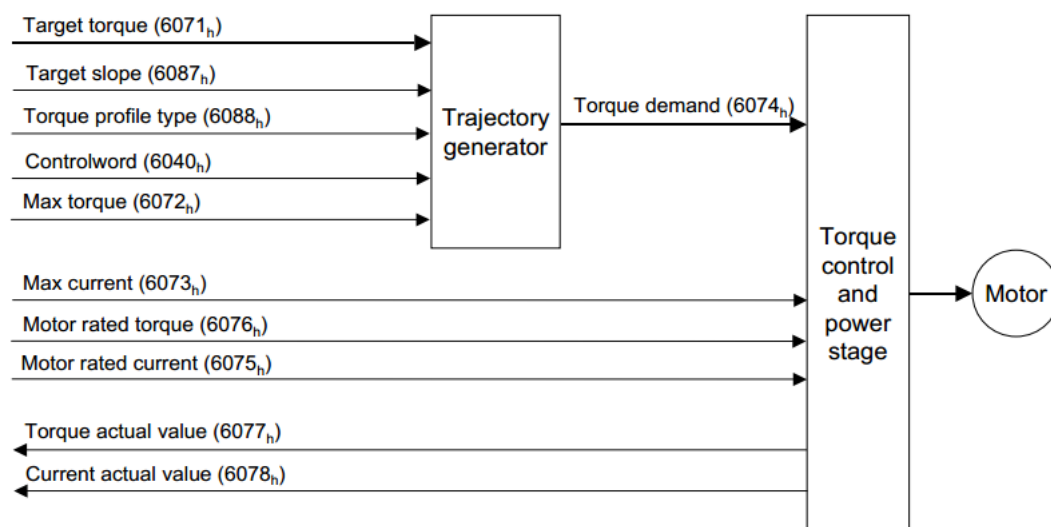


Figure 6-16

### 6.6.2 Objects Related

In this mode,the following objects need to be pay attention to:

Table 6-14

| Object Index                               | Description               |
|--------------------------------------------|---------------------------|
| 605D <sub>h</sub> (Halt option code)       | Halt option               |
| 605A <sub>h</sub> (Quick stop option code) | Quick stop option         |
| 6071 <sub>h</sub> (Target torque)          | Target torque(unit: 0.1%) |

| Object Index                                                | Description                                                                            |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------|
| 6072 <sub>h</sub> (Max torque)                              | Maximum torque on the entire slope (acceleration, holding torque, braking)(unit: 0.1%) |
| 2007 <sub>h</sub> :10 <sub>h</sub> (TorqCtrlFwrSpeedLimit ) | Forward velocity limit during torque control (rpm)                                     |
| 2007 <sub>h</sub> :11 <sub>h</sub> (TorqCtrlBwrSpeedLimit)  | Backward velocity limit during torque control (rpm)                                    |
| 6087 <sub>h</sub> (Torque slope)                            | Maximum torque change per second(unit: 0.1%)                                           |
| 6088 <sub>h</sub> (Torque profile type)                     | Torque ramp type (0-ramp, 2-none)                                                      |
| 6077 <sub>h</sub> (Torque actual value)                     | Torque actual value(unit: 0.1%)                                                        |

### 6.6.3 Control Instruction and Status Information

#### Enable

When this mode is enabled, the value in object 2002<sub>h</sub>:01<sub>h</sub> and object in 6060<sub>h</sub> (Modes of Pperation) must be set to "0" and "4" respectively.

#### Control Word

|             |      |             |          |             |   |   |     |
|-------------|------|-------------|----------|-------------|---|---|-----|
| 15          | 9    | 8           | 7        | 6           | 4 | 3 | 0   |
| (see 4.1.2) | Halt | (see 4.1.2) | reserved | (see 4.1.2) |   |   |     |
| MSB         |      |             |          |             |   |   | LSB |

In the Profile torque mode, the following bits in object 6040<sub>h</sub> (control word) have special functions.

Table 6-15

| Bit | Value | Description          |
|-----|-------|----------------------|
| 8   | 0     | Motor keep operating |
|     | 1     | Suspend              |

#### Status Word

|             |          |             |                |             |    |   |     |
|-------------|----------|-------------|----------------|-------------|----|---|-----|
| 15          | 14       | 13          | 12             | 11          | 10 | 9 | 0   |
| (see 4.1.3) | reserved | (see 4.1.3) | Target reached | (see 4.1.3) |    |   |     |
| MSB         |          |             |                |             |    |   | LSB |

In Position torque mode, the following bits in the object 6041<sub>h</sub> (status word) have special function

Table 6-16

| Bit | Value | Definition                                                                                                                                               |
|-----|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10  | 0     | Halt(Bit8 in control word 6040 <sub>h</sub> )=0:Target position not reached<br>Halt (Bit8 in control word 6040 <sub>h</sub> ) = 1: Axis decelerates      |
|     | 1     | Halt (Bit8 in control word 6040 <sub>h</sub> ) = 0: Target position reached<br>Halt (Bit8 in control word 6040 <sub>h</sub> ) = 1: Velocity of axis is 0 |

### 6.6.4 Function Description

#### Velocity Limit Function

The Integrated low-voltage servo motor operating in Position torque mode, when the motor velocity exceeds the velocity limit (2007<sub>h</sub>:10<sub>h</sub> and 2007<sub>h</sub>:11<sub>h</sub>), it will automatically switch to the Velocity mode and the current velocity will be controlled within the velocity limit. When the servo detects that the torque

command is less than the torque average at current velocity, the servo motor will exit Velocity mode and return to Position torque mode.

### 6.6.5 Configuration Example

- Configuration mode:

Set 2002<sub>h</sub>:01<sub>h</sub>=0、6060<sub>h</sub>=0x04, as Profile torque mode(PT)

- Parameter configuration :

Set target torque 6071<sub>h</sub>(user 0.1%);

Set Torque profile type 6088<sub>h</sub>=2;

Set Torque profile 6087<sub>h</sub> =10;

- Set control word:

6040<sub>h</sub> = 0x06→0x07→0x0F, motor operates;

Parameter monitor:

- Torque actual value 6077<sub>h</sub>(user 0.1%);

## 6.7 Homing Mode

The Homing mode is used to operate from the current position to the home position of the device. In the operation ,the maximum acceleration, minimum deceleration, maximum velocity and minimum velocity are all taken into account.

### 6.7.1 Structure Chart

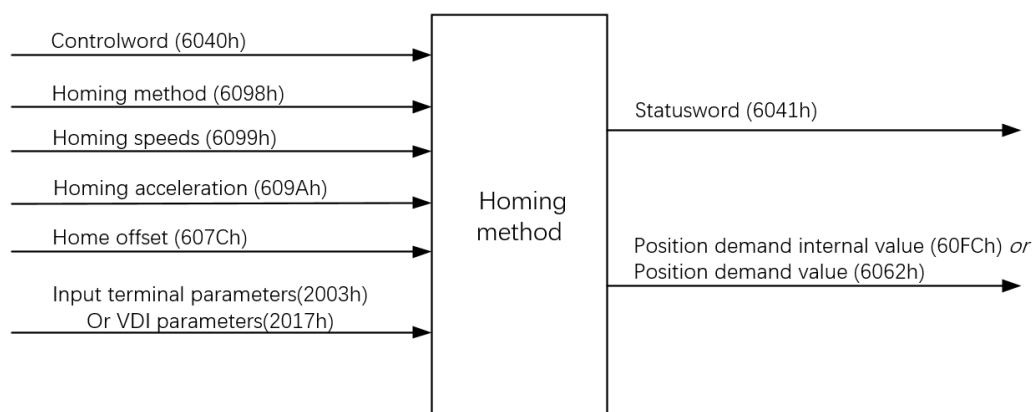


Figure 6-17

### 6.7.2 Objects Related

In this mode,the following objects need to be pay attention to:

Table 6-17

| Object Index                    | Description                                                      |
|---------------------------------|------------------------------------------------------------------|
| 6062h ( Position demand value ) | Target position instruction value in effect currently(user unit) |

| Object Index                                       | Description                                                                                                                                                                                                                  |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 607C <sub>h</sub> (Home Offset)                    | Set the physical deviation between the motor origin and the machine reference point; When the Homing operation is completed, Bit15= 1 in the status word 6041 <sub>h</sub> , it takes effect                                 |
| 6098 <sub>h</sub> (Homing Method)                  | Homing Method(See"6.7.4 Function description" )                                                                                                                                                                              |
| 6099 <sub>h</sub> (Speed)                          | Velocity(user unit/s)<br>Sub-index: 6099 <sub>h</sub> :01 <sub>h</sub> : the velocity to find the switch<br>6099 <sub>h</sub> :02 <sub>h</sub> : the velocity to find the origin                                             |
| 609A <sub>h</sub> (Homing Acceleration)            | Acceleration and deceleration in homing process(user unit/s <sup>2</sup> )                                                                                                                                                   |
| 60FC <sub>h</sub> (Position demand internal value) | Output of track generator, i.e.real-time position instruction internal planned(encoder unit)                                                                                                                                 |
| 6063 <sub>h</sub> (Position actual enc value)      | Position actual enc value(encoder unit)                                                                                                                                                                                      |
| 2003 <sub>h</sub> (Input terminal parameters)      | Function configuration of entity input terminals (see "7.1.1 Digital input")<br>Note: multiple input terminals cannot be configured as the same switch at the same time, otherwise terminal setting failure will be reported |
| 2017 <sub>h</sub> (VDI/VDO parameters)             | The parameters of virtual terminal input function and logic function                                                                                                                                                         |

### Example of Velocity Meaning

The following figure shows the velocity change during the homing method 18:

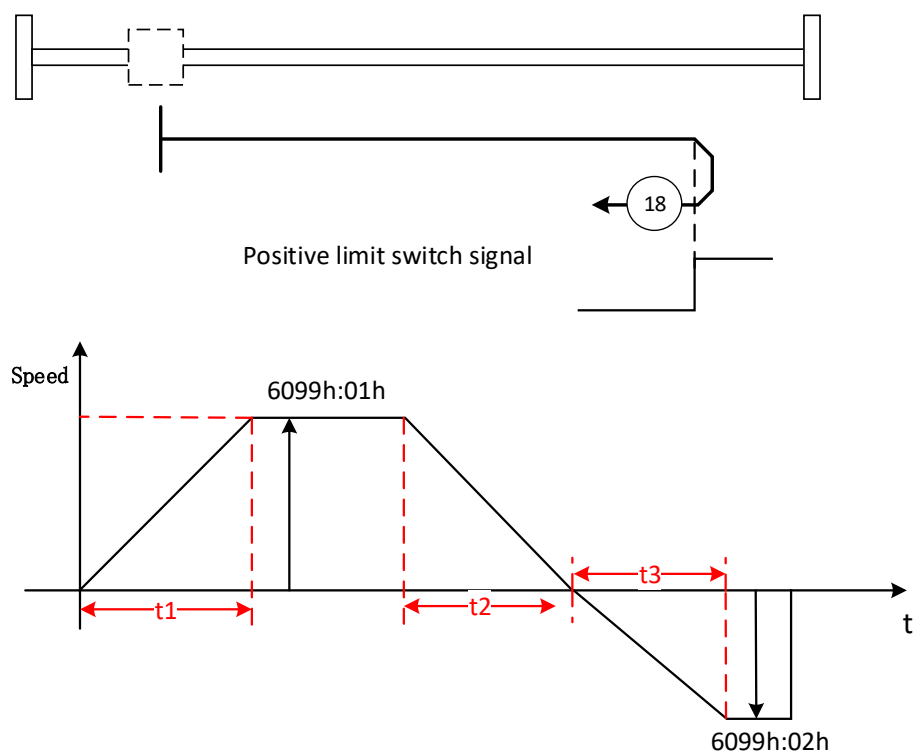


Figure 6-18

$$t1 = \frac{6099_h:01_h}{609A_h}; \quad t2 = \frac{6099_h:01_h}{609A_h}; \quad t3 = \frac{6099_h:02_h}{609A_h}$$

### 6.7.3 Control Instruction and Status Information

#### Enable

To enable this mode, the value in object 2002<sub>h</sub>:01<sub>h</sub> must be set to "0", the value in object 6060<sub>h</sub> (Modes of Operation) must be set to "6", and the multi-function terminals are configured to origin switch or limit switch function. See Section 7.1 for multi-function terminals configuration.

#### Control Word

|             |      |             |              |                        |             |   |   |     |
|-------------|------|-------------|--------------|------------------------|-------------|---|---|-----|
| 15          | 9    | 8           | 7            | 6                      | 5           | 4 | 3 | 0   |
| (see 4.1.2) | Halt | (see 4.1.2) | reserved (0) | Homing operation start | (see 4.1.2) |   |   |     |
| MSB         |      |             |              |                        |             |   |   | LSB |

In Homing mode, the following bits in the object 6040<sub>h</sub> (control word) have special functions

Table 6-18

| Bit | Value | Definition                                            |
|-----|-------|-------------------------------------------------------|
| 4   | 0     | Homing mode is not enable                             |
|     | 1     | Enable or continue Homing mode                        |
| 8   | 0     | Whether to enable the homing or not according to bit4 |
|     | 1     | Suspend according to the setting of 605D <sub>h</sub> |

#### Status Word

|             |              |                 |             |                |             |   |     |
|-------------|--------------|-----------------|-------------|----------------|-------------|---|-----|
| 15          | 14           | 13              | 12          | 11             | 10          | 9 | 0   |
| (see 4.1.3) | Homing error | Homing attained | (see 4.1.3) | Target reached | (see 4.1.3) |   |     |
| MSB         |              |                 |             |                |             |   | LSB |

In Homing mode, the following bits in the object 6041<sub>h</sub> (Status-word) have special function:

Table 6-19

| Bit | Value | Definition                  |
|-----|-------|-----------------------------|
| 10  | 0     | Target position not reached |
|     | 1     | Target position reached     |
| 12  | 0     | Homing not completed        |
|     | 1     | Homing completed            |

### 6.7.4 Function Description

#### 6.7.4.1 Switch to find the origin

The way of using the switch to return to the origin, currently supports 17 ~ 30 in CiA402. For the return to zero, we often need to start working from zero. Generally speaking, we need to run to the zero position command after returning to zero. For the convenience of users, this series of integrated motors will automatically return to the zero position after homing.

Function number configuration of input terminal DI which related to HM mode:

Table 6-20

| Function number | Function definition   |
|-----------------|-----------------------|
| 14              | Positive limit switch |
| 15              | Negative limit switch |
| 31              | Origin switch         |

The Homing method supports 17-30 in CiA402, Generally speaking, it is necessary to start from home position after the homing operation. For the convenience to users, PMM series integrated servo automatically returns to the home position after the homing operation.

The direction and switch status requiring homing are as follows:

Table 6-21

| Homing Method | Switch Related                       |
|---------------|--------------------------------------|
| 17            | Negative limit switch                |
| 18            | Positive limit switch                |
| 19            | Origin switch                        |
| 20            | Origin switch                        |
| 21            | Origin switch                        |
| 22            | Origin switch                        |
| 23            | Origin switch, Positive limit switch |
| 24            | Origin switch, Positive limit switch |
| 25            | Origin switch, Positive limit switch |
| 26            | Origin switch, Positive limit switch |
| 27            | Origin switch, Negative limit switch |
| 28            | Origin switch, Negative limit switch |
| 29            | Origin switch, Negative limit switch |
| 30            | Origin switch, Negative limit switch |
| 35            | -                                    |

#### ● Homing Method 17:

Mechanical origin: negative limit switch

When the negative limit switch is invalid, servo starts reversing to home position at high speed, once the negative limit switch is valid (edge-jump), slows down, reverses, moves forward at low speed, and halts until the negative limit switch is invalid (edge-jump).

When the negative limit switch is valid, servo starts reversing to home position at low speed directly, and halts until the negative limit switch is invalid (edge-jump).

The movement track is as follows:



Figure 6-19

### ● Homing Method 18:

Mechanical origin: positive limit switch

When the positive limit switch is invalid, servo starts moving to home position at high speed. once the positive limit switch is valid (edge-jump), slows down, reverses, moves backward at low speed , and halts until the positive limit switch is invalid (edge-jump).

When the positive limit switch is valid, servo starts reversing to home position at low speed directly , and halts until the positive limit switch is invalid (edge-jump).

The movement track is as follows:

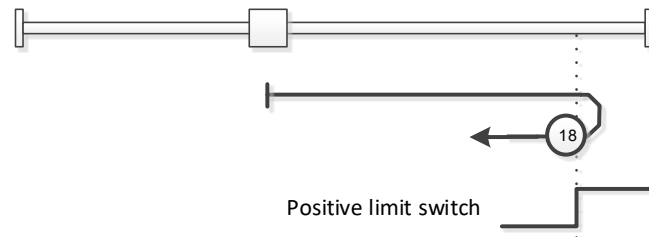


Figure 6-20

### ● Homing Method 19 and 20:

Mechanical origin: origin switch

pattern 19: When the origin switch is invalid, servo starts moving to home position at high speed. once the origin switch is valid (edge-jump), slows down, reverses, moves backward at low speed ,and halts until the origin switch is invalid (edge-jump);When the origin switch is valid, servo starts reversing to home position at low speed directly,and halts until the origin switch is invalid (edge-jump).

pattern 20: When the origin switch is invalid, servo starts moving to home position at low speed. and halts until the origin switch is valid (edge-jump).When the origin switch is valid, servo starts reversing to home position at low speed directly,once the origin switch is invalid (edge-jump), slows down,reverses,moves backward at low speed,and halts until the origin switch is valid (edge-jump).

The movement track is as follows:

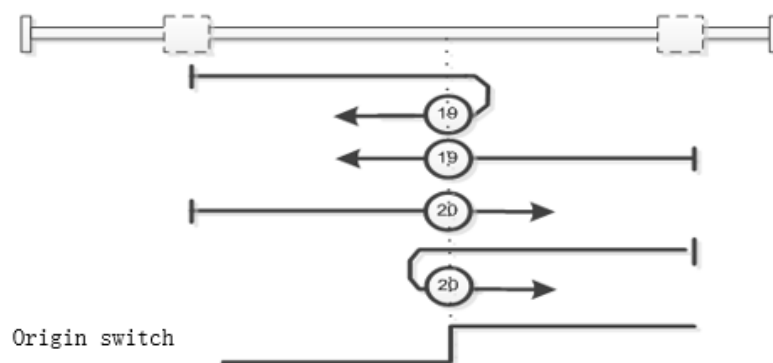


Figure 6-22

### ● Homing Method 21 and 22:

Mechanical origin: origin switch

pattern 21: When the origin switch is invalid, servo starts reversing to home position at high speed. once the origin switch is valid (edge-jump), slows down, reverses, moves backward at low speed ,and halts until the origin switch is invalid (edge-jump); When the origin switch is valid, servo starts moving to home

position at low speed directly , and halts until the origin switch is valid (edge-jump).

pattern 22: When the origin switch is invalid, servo starts moving to home position at low speed. and halts until the origin switch is valid (edge-jump).When the origin switch is valid, servo starts reversing to home position at low speed directly,once the origin switch is invalid (edge-jump), slows down, reverses, moves backward at low speed ,and halts until the origin switch is valid (edge-jump).

The movement track is as follows:

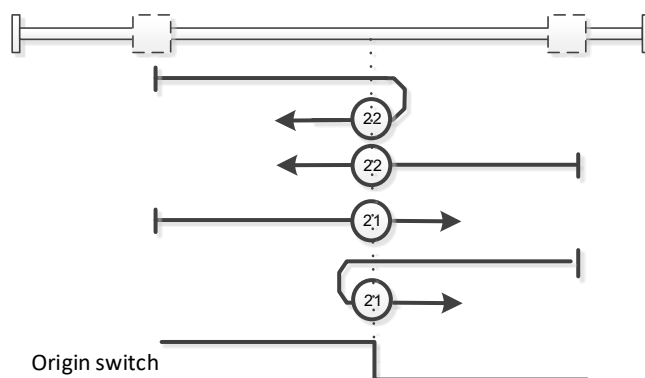


Figure 6-21

#### ● Homing Method 23 ~ 26:

Mechanical origin: origin switch

Actually,in these methods the motor moves in one direction to scan the origin switch.the relatively shorter track is find only when the origin switch is valid.

Homing Method 23:

A. when the origin switch is invalid, the servo start reversing to home position at the high speed in the positive direction when the origin switch is not encountered , when the origin switch is valid (edge-jump), moves backward at low speed ,and halts until the origin switch is invalid (edge-jump);

B. when the origin switch is invalid, the servo starts moving to home position at high speed, when the positive switch is valid (edge-jump) reverses,moves at high speed, when the origin switch is valid (edge-jump) slows down , continue to moves in the reverse direction at low speed, and halts until the origin switch is invalid (edge-jump);

C. when the origin switch is valid, the servo start reversing to home position at the low speed,and halts until the origin switch is invalid (edge-jump).

Homing Method 24:

A.when the origin switch is invalid, when the origin switch is not encountered,the motor start reversing to home position at the high speed, when the origin switch is valid (edge-jump), slows down, reverses, moves backward at low speed,when the origin switch is invalid (edge-jump), reverses, moves forward at low speed , and halts until the origin switch is valid (edge-jump);

B.When the origin switch is invalid, the motor start moving to home position at the high speed, when the positive switch is encountered, reverses,moves backward at high speed.When the origin switch is valid (edge-jump),slows down,, moves backward at low speed ,When the origin switch is invalid(edge-jump),reverses,moves forward at low speed,and halts until the origin switch is valid (edge-jump).

C. when the origin switch is invalid, the motor start reversing to home position at the low speed directly,

when the origin switch is invalid (edge-jump),reverses, moves forward at low speed,and halts until the origin switch is valid (edge-jump).

#### Homing Method 25:

A. when the origin switch is invalid, the motor start moving to home position at the high speed in the positive direction when the origin switch is not encountered , when the origin switch is valid (edge-jump),slows down,moves forward at low speed,when the origin switch is invalid (edge-jump),reverses , moves backward at low speed,and halts until the origin switch is valid (edge-jump);

B. when the origin switch is invalid, the motor starts moving to home position at high speed, when the positive switch is valid (edge-jump) reverses , moves backward at high speed, when the origin switch is valid (edge-jump) slows down , moves forward at low speed, when the origin switch is invalid (edge-jump)reverses , moves backward at low speed, and halts until the origin switch is valid (edge-jump);

C. when the origin switch is invalid, the motor start moving to home position at the low speed directly, when the origin switch is invalid (edge-jump), , reverses, moves backward at low speed,and halts until the origin switch is valid (edge-jump).

#### Homing Method 26:

A.when the origin switch is invalid, the motor start moving to home position at the high speed in the positive direction if the positive limit switch is not encountered, when the origin switch is valid (edge-jump) ,slow down, run at a positive low speed , and halts when the origin switch is invalid (edge-jump);

B.when the origin switch is invalid, the motor start moving to home position at the high speed in the positive direction ,when the positive limit switch is encountered reverses , moves backward at high speed,when the origin switch is valid (edge-jump) slows down, moves at a positive low speed, halts when the origin switch is invalid (edge-jump);

C. when the origin switch is valid, starts moving to home position at low speed, and halts when the origin switch is invalid (edge-jump).

The motion track is as follows:

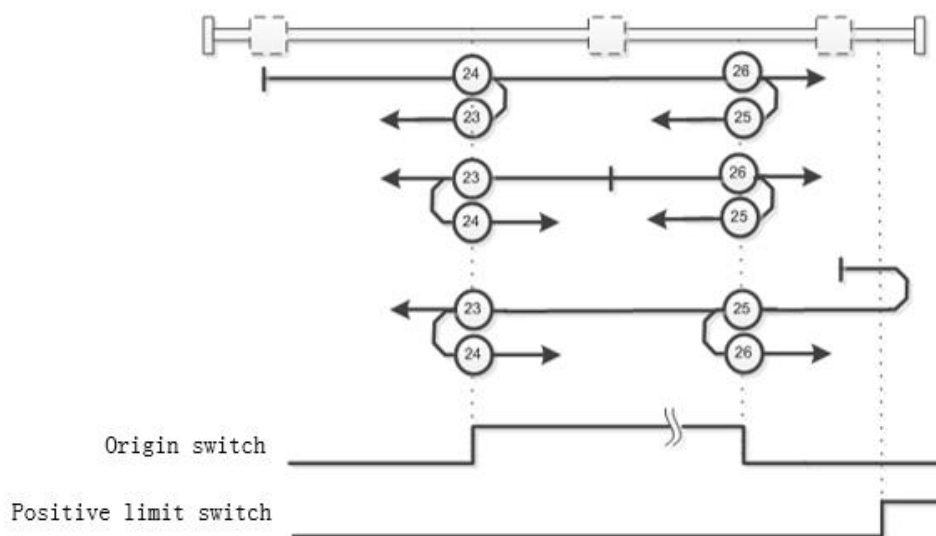


Figure 6-22

## ● Homing Method 27~30

Mechanical origin: origin switch

Actually, in these methods the motor moves in one direction to scan the origin switch. The relatively shorter track is found only when the origin switch is valid.

Homing Method 27:

A. If the origin switch is invalid, when the negative limit switch is not encountered, start to return to home position at reverse high speed, when the origin switch is valid (edge-jump), slow down, reverse, forward at low speed, and halts when the origin switch is invalid (edge-jump);

B. If the origin switch is invalid, the motor starts moving to home position at the high speed in the negative direction. When the negative limit switch is encountered, moves backward at high speed. When the origin switch is valid (edge-jump), slow down, slows down, moves forward at low speed, and halts when the origin switch is invalid (edge-jump);

C. When the origin switch is valid, the motor starts moving to home position at the low speed directly, and halts until the origin switch is invalid (edge-jump).

Homing Method 28:

A. When the origin switch is invalid and the negative limit switch is not encountered, the motor starts moving to home position at the high speed in the positive direction, when the origin switch is valid (edge-jump), slow down, reverse, moves forward at low speed, when the origin switch is invalid (edge-jump), reverse, moves backward at low speed, and halts until the origin switch is valid (edge-jump);

B. When the origin switch is invalid, the motor starts moving to home position at high speed, when the positive limit is valid, reverse, moves forward at high speed, when the origin switch is valid (edge-jump) slow down, moves forward at low speed, when the origin switch is invalid (edge-jump), reverses, moves backward at low speed, and halts until the origin switch is valid (edge-jump);

C. When the origin switch is valid, the motor starts moving to home position at the low speed directly, when the origin switch is invalid (edge-jump), reverses, moves backward at low speed, and halts until the origin switch is valid (edge-jump).

Homing Method 29:

A. When the origin switch is invalid, the motor starts moving to home position at the high speed in the positive direction when the negative switch is not encountered, when the origin switch is valid (edge-jump), slows down, moves backward at low speed, when the origin switch is invalid (edge-jump), reverses, moves backward at low speed, and halts until the origin switch is valid (edge-jump);

B. When the origin switch is invalid, the motor starts moving to home position at high speed, when the positive limit is valid, reverse, moves forward at high speed, when the origin switch is valid (edge-jump) slow down, moves backward at low speed, when the origin switch is invalid (edge-jump), reverses, moves forward at low speed, and halts until the origin switch is valid (edge-jump);

C. When the origin switch is valid, the motor starts moving to home position at the low speed directly, when the origin switch is invalid (edge-jump), reverses, moves forward at low speed, and halts when the origin switch is valid (edge-jump).

Homing Method 30:

A. When the origin switch is invalid, the motor starts moving to home position at the high speed in the negative direction when the origin switch is not encountered, when the origin switch is valid (edge-jump),

slows down, moves backward at low speed ,and halts until the origin switch is valid (edge-jump);

B.when the origin switch is invalid, the motor starts moving to home position at high speed, when the negative limit is valid, reverse,moves forward at high speed, when the origin switch is valid (edge-jump)slow down , moves backward at low speed, and halts when the origin switch is invalid (edge-jump);

C.when the origin switch is valid, the motor start moving to home position at the low speed in the negative direction directly,and halts when the origin switch is invalid (edge-jump).

The motion track is as follows:

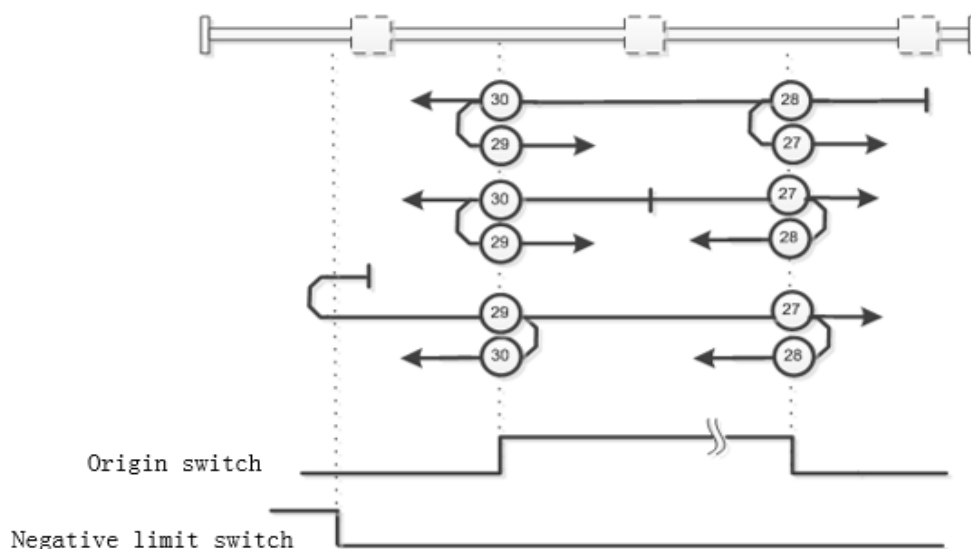


Figure 6-23

#### ● Homing Method 35:

After resetting the trigger origin to zero (with the control word 6040<sub>h</sub> changing from 0x0F to 0x1F), take the current position as the mechanical origin.

#### 6.7.4.2 Finding the origin by blocking rotation

The return-to-origin method currently only supports the closed-loop control mode. The method of returning to the origin of locked rotor is similar to the method of using the switch to find the origin. The difference is that the torque detection value of the locked rotor replaces the limit switch.

The method and running direction of the origin return are shown in the following table:

Table 6-22

| Origin return mode 6098 <sub>h</sub> | Running direction                                            |
|--------------------------------------|--------------------------------------------------------------|
| 37                                   | Press 6099 <sub>h</sub> : 02 <sub>h</sub> to run forward     |
| 38                                   | Reverse running at 6099 <sub>h</sub> : 02 <sub>h</sub> speed |

In addition, the method needs to set the following two parameters:

1. The detected torque when the locked rotor is looking for the origin (2007<sub>h</sub>: 13<sub>h</sub>)

The stall torque threshold should be greater than the actual running torque in the process of finding the origin, and should generally be less than the maximum torque to avoid triggering the stall protection.

2. Detection time when finding the origin by blocking rotation (2007<sub>h</sub>: 15<sub>h</sub>)

This time is the time during which the motor is locked to find the origin.

The specific schematic diagram of the process of the locked-rotation origin return method is as follows:

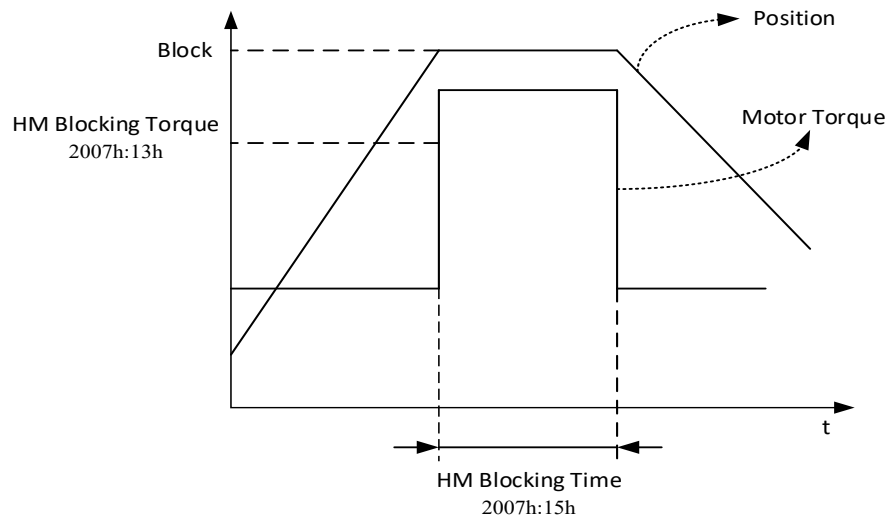


Figure 6-24

### 6.7.5 Configuration Example

- Configuration mode

Set 2002<sub>h</sub>:01<sub>h</sub>=06060<sub>h</sub>=0x06 as Homing mode(HM)

- Terminals configuration

2003<sub>h</sub>:03<sub>h</sub>=15(Negative limit switch)2003<sub>h</sub>:04<sub>h</sub>=0(Low-level-valid)

- set the homing mode

6098<sub>h</sub> =17;

- set the speed in searching the limit switch and home position

6099<sub>h</sub>:01<sub>h</sub>= 10000 6099<sub>h</sub>:02<sub>h</sub>=1000;

- set the homing acceleration

- Set Control word

6040<sub>h</sub> = 0x060x070x0F0x1F motor operates;

### 6.8 Interpolated Position Mode

Interpolated position mode is used to synchronize multiple axes. To do this, the advanced controller calculates slope and path, transmits corresponding axis position demanded at a specific to the controller. The controller interpolates between these intermediate positions.

### 6.8.1 Structure Chart

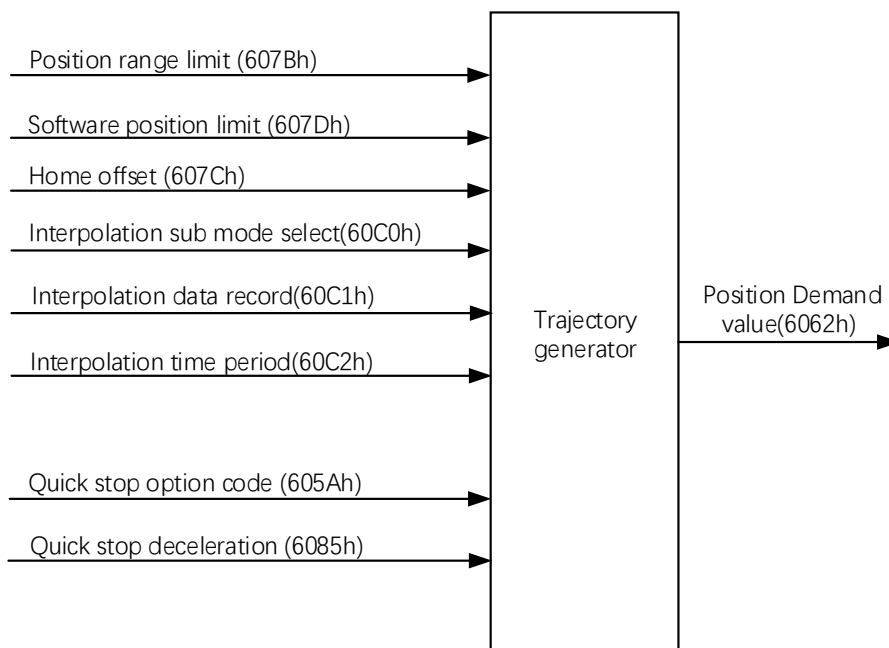


Figure 6-25

### 6.8.2 Objects Related

In this mode,the following objects need to be pay attention to:

Table 6-23

| Object index                                      | Description                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 607B <sub>h</sub> (Position Range Limit)          | Position range limit                                                                                                                                                                                                                                                                                                                                                              |
| 607D <sub>h</sub> (Software Position Limit)       | Software position limit(user unit)                                                                                                                                                                                                                                                                                                                                                |
| 60C0 <sub>h</sub> (Interpolation sub mode select) | 0<br>Choose the interpolation type. This device only supports linear interpolation. The default value is 0                                                                                                                                                                                                                                                                        |
| 60C1 <sub>h</sub> (Interpolation data record)     | Set interpolation target location(user unit)                                                                                                                                                                                                                                                                                                                                      |
| 60C2 <sub>h</sub> (Interpolation time period)     | Interpolation period(recommended 1-20ms), defined by sub indexes 01 <sub>h</sub> and 02 <sub>h</sub> , interpolation period = t * 10 <sup>n</sup> seconds<br>sub indexes:<br>60C2 <sub>h</sub> :01 <sub>h</sub> (Interpolation time period value): Interpolation time constant t.<br>60C2 <sub>h</sub> :02 <sub>h</sub> (Interpolation time index): Interpolation time constant n |
| 605A <sub>h</sub> (Quick stop option code)        | Quick stop option                                                                                                                                                                                                                                                                                                                                                                 |
| 605D <sub>h</sub> (Halt option code)              | Halt option                                                                                                                                                                                                                                                                                                                                                                       |
| 6085 <sub>h</sub> (Quick stop deceleration)       | Deceleration during "Quick stop" (user unit/s <sup>2</sup> )                                                                                                                                                                                                                                                                                                                      |
| 6062 <sub>h</sub> (Position Demand Value)         | Current position demand value inside the drive (user unit)                                                                                                                                                                                                                                                                                                                        |
| 6063 <sub>h</sub> (Position actual enc Value)     | Current position actual value feedback (encoder unit)                                                                                                                                                                                                                                                                                                                             |

### 6.8.3 Control Instruction and Status Information

#### Enable

As this mode is enabled, the value in object 2002<sub>h</sub>:01<sub>h</sub> and object 6060<sub>h</sub> (Modes of Operation) must be set to "0" and "7" respectively.

#### Control Word

|             |      |             |          |                      |             |   |   |     |
|-------------|------|-------------|----------|----------------------|-------------|---|---|-----|
| 15          | 9    | 8           | 7        | 6                    | 5           | 4 | 3 | 0   |
| (see 4.1.2) | Halt | (see 4.1.2) | reserved | Enable interpolation | (see 4.1.2) |   |   |     |
| MSB         |      |             |          |                      |             |   |   | LSB |

In Interpolated position mode, the following bits in object 6040<sub>h</sub> (control word) have special functions.

Table 6-24

| Bit | Value | Definition                                               |
|-----|-------|----------------------------------------------------------|
| 4   | 0     | Disable interpolation                                    |
|     | 1     | Enable interpolation                                     |
| 8   | 0     | Execute instruction of bit4                              |
|     | 1     | Halt according to the configuration of 605D <sub>h</sub> |

#### Status Word

|             |                 |                |             |                |             |   |     |
|-------------|-----------------|----------------|-------------|----------------|-------------|---|-----|
| 15          | 14              | 13             | 12          | 11             | 10          | 9 | 0   |
| (see 4.1.3) | following error | ip mode active | (see 4.1.3) | Target reached | (see 4.1.3) |   |     |
| MSB         |                 |                |             |                |             |   | LSB |

In Interpolated mode, the following bits in the object 6041<sub>h</sub> (status word) have special function

Table 6-25

| Bit | Value | Definition                      |
|-----|-------|---------------------------------|
| 10  | 0     | The target position not reached |
|     | 1     | The target position not reached |
| 12  | 0     | Interpolation not enable        |
|     | 1     | Interpolation enable            |
| 13  | 0     | No following error              |
|     | 1     | Following error                 |

### 6.8.4 Function Description

#### Interpolation Diagram

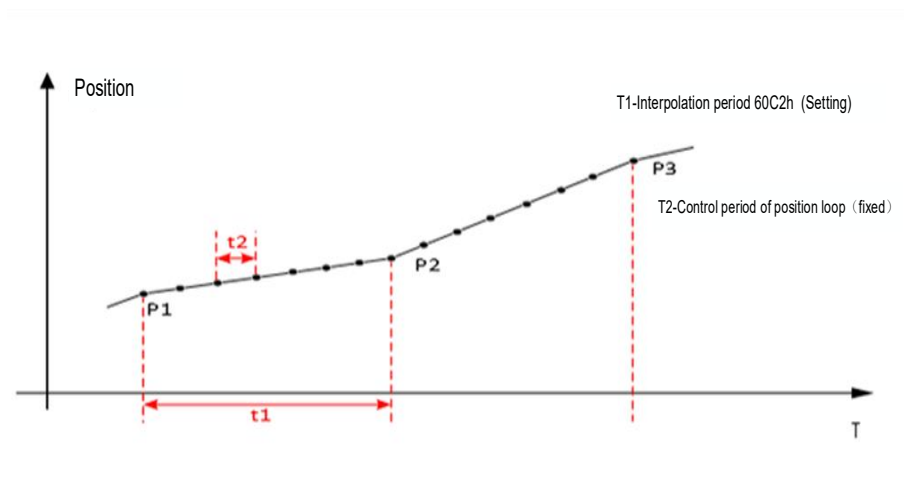


Figure 6-26

Notes:  $t_1$ : Interpolation period, which can be set in object dictionary 60C2<sub>h</sub>.

$t_2$ : Control period of position loop, determined by the servo drive internally.

P1 / P2 / P3: Absolute position. The absolute position instructions is sent by the object dictionary 60C1<sub>h</sub>:01<sub>h</sub>. The interpolation mode only supports the absolute position instructions.

### 6.8.5 Configuration Example

- Configuration to operates in Interpolation mode

Set 2002<sub>h</sub>:01<sub>h</sub> = 0, operation mode 6060<sub>h</sub> = 0x07;

- Set the interpolation time constant

60c2<sub>h</sub>: 01<sub>h</sub> = 20 and the interpolation time index 60c2<sub>h</sub>:02<sub>h</sub> = - 2;

- Set the control word 6040<sub>h</sub> = 0x06 0x07 0x1f, motor operates;
- when the motor is operating, the master computer set the interpolation position 60c1<sub>h</sub>: 01<sub>h</sub> according to interpolation period(only absolute position command is supported).

### 6.9 Cyclic Sync Position Mode (CSP)

In this mode, Preset absolute positions are sent to the controller through the field bus at fixed intervals (hereinafter call as "cycles"). In this mode, the controller no longer calculates the slope, only follows the preset value. The target position is transmitted by PDO, and the controller will react immediately. Bit4 in control word does not need to be set (different from Profile position mode). The preset target value is absolute and therefore independent to the transmitting times per cycle.

### 6.9.1 Structure Chart

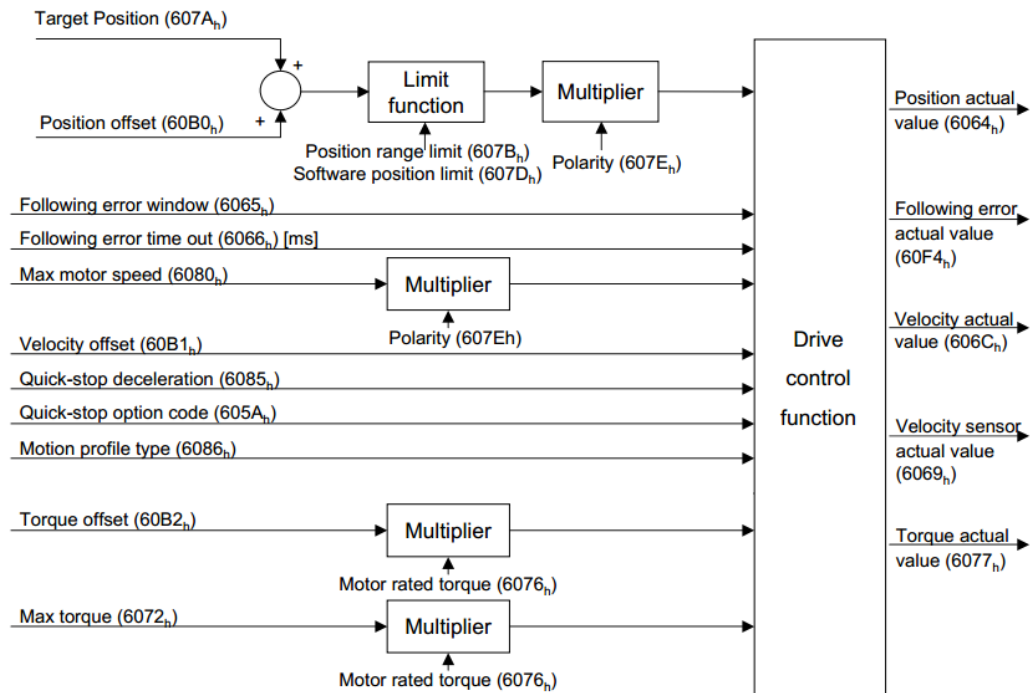


Figure 6-27

### 6.9.2 Objects Related

In this mode, the following objects need to be pay attention to:

Table 6-26

| Object Index                                  | Description                                                                                                                                                                                                                           |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 607A <sub>h</sub> (Target position)           | Target position(user unit)                                                                                                                                                                                                            |
| 607B <sub>h</sub> (Position Range Limit)      | Position Range Limit(user unit)                                                                                                                                                                                                       |
| 607D <sub>h</sub> (Software Position Limit)   | Target position limit (user unit)                                                                                                                                                                                                     |
| 607E <sub>h</sub> (Polarity)                  | Rotation direction(polarity),See "5.3 607E <sub>h</sub> : Polarity" for details                                                                                                                                                       |
| 6065 <sub>h</sub> (Following Error Window)    | this object specifies the allowed tolerance from the rated position. If the actual position exceeds this tolerance for longer than the specified time (6066 <sub>h</sub> ), tracking error will be reported, (user unit)              |
| 6066 <sub>h</sub> (Following Error Time Out): | Time range of following error , unit: millisecond.<br>If the actual position exceeds the tolerance (6065 <sub>h</sub> ) for longer than this time range, tracking error will be reported, Bit13 of the control word will be set to 1. |
| 6080 <sub>h</sub> (Max motor speed)           | Max motor speed(rpm)                                                                                                                                                                                                                  |
| 6085 <sub>h</sub> (Quick-Stop Deceleration)   | Deceleration during "Quick stop" (user unit/s <sup>2</sup> )                                                                                                                                                                          |
| 605A <sub>h</sub> (Quick-Stop Option Code)    | Quick-Stop Option                                                                                                                                                                                                                     |
| 605D <sub>h</sub> (Halt Option Code)          | Halt Option                                                                                                                                                                                                                           |

| Object Index                                     | Description                                                                                                                                                                                                                                                                   |
|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6086 <sub>h</sub> (Motion Profile Type)          | The slope type to be operated,if the value is "0", the impact will not be limited. If the value is "3", the impact will be limited with the value of 60a4 <sub>h</sub> : 01 <sub>h</sub> - 04 <sub>h</sub> . Only 01 <sub>h</sub> -02 <sub>h</sub> is used by This equipment. |
| 60B0 <sub>h</sub> (Position offset)              | Position offse(user unit)                                                                                                                                                                                                                                                     |
| 60B1 <sub>h</sub> (Velocity offset)              | Velocity offset(user unit)                                                                                                                                                                                                                                                    |
| 6064 <sub>h</sub> (Position Actual Value)        | Current absolute position feedback from motor(user unit)                                                                                                                                                                                                                      |
| 606C <sub>h</sub> (Velocity Actual Value)        | Current velocity actual value feedback(unit:rpm)                                                                                                                                                                                                                              |
| 60F4 <sub>h</sub> (Following Error Actual Value) | Following Error Actual Value(user unit)                                                                                                                                                                                                                                       |

### 6.9.3 Control Instruction and Status Information

#### Enable

As this mode is enabled, the value in object 2002<sub>h</sub>:01<sub>h</sub> and object 6060<sub>h</sub> (Modes of Pperation)must be set to "0" and "8" respectively.

#### Control Word

In the Cyclic sync position mode, the following bits in object 6040<sub>h</sub> (control word) have special functions. For the definition of the general bits, please refer to section 4.1.2 control words.

Note: The CSP mode only supports the absolute position instructions.

#### Status Word

|             |                 |                         |             |          |             |   |     |
|-------------|-----------------|-------------------------|-------------|----------|-------------|---|-----|
| 15          | 14              | 13                      | 12          | 11       | 10          | 9 | 0   |
| (see 4.1.2) | Following error | Target position ignored | (see 4.1.2) | reserved | (see 4.1.2) |   |     |
| MSB         |                 |                         |             |          |             |   | LSB |

the Cyclic sync position mode, the following bits in object **6041<sub>h</sub>** (status word) have special functions:

Table 6-27

| Bit | Value | Description                                                                                                                                     |
|-----|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 12  | 0     | The controller doesnt follow the target preset value,607A <sub>h</sub> (Target position) will be ignored.                                       |
|     | 1     | The controller follows the preset target value, and the object <b>607A<sub>h</sub></b> (target position) is used as the position control input. |
| 13  | 0     | No following error                                                                                                                              |
|     | 1     | Following error                                                                                                                                 |

### 6.9.4 Function Description

In this mode, absolute preset position values will be sent to the controller by the field bus at fixed time intervals (hereinafter call as "cycles")

### 6.9.5 Configuration Example

- Configuration mode

Set 2002<sub>h</sub>:01<sub>h</sub>=06060<sub>h</sub>=0x02 as velocity mode (VM)

- Set Control word

6040<sub>h</sub> = 0x060x070x7F motor operates;

- the master controller sends the target position 607A<sub>h</sub> periodically and synchronously (only absolute position command is supported).

### 6.10 Cyclic Sync Velocity Mode(CSV)

In the Cyclic sync velocity mode, the master controller sends the calculated target speed 60FF<sub>h</sub> to the servo drive periodically and synchronously, the speed and torque regulation are performed by the servo internally.

#### 6.10.1 Structural Chart

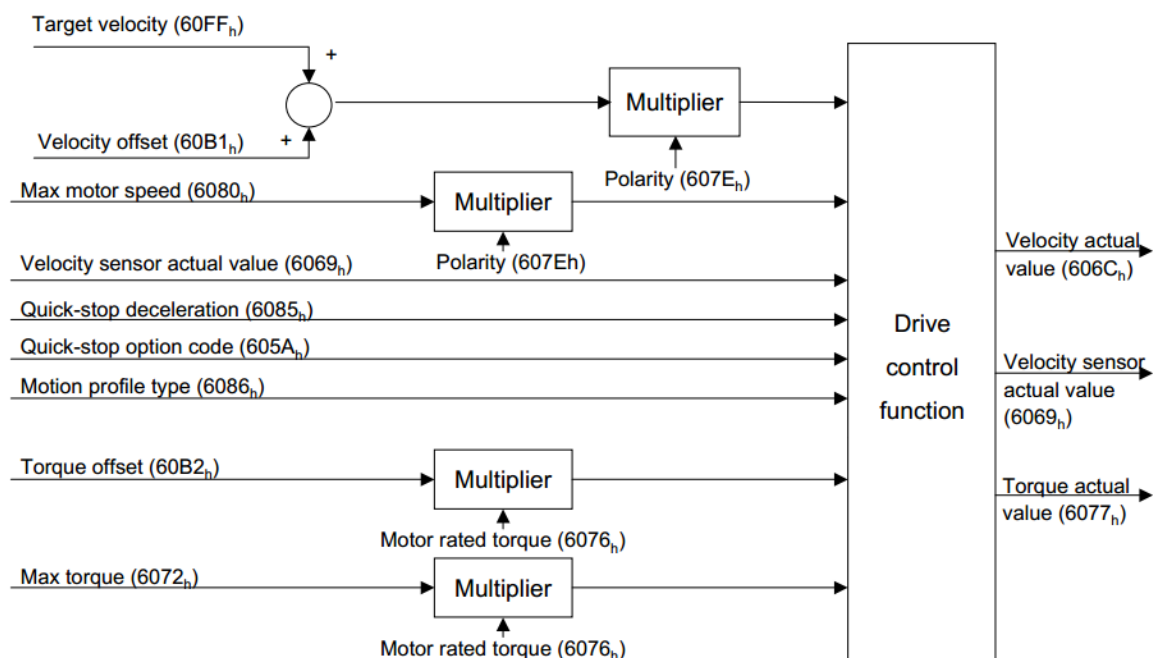


Figure 6-28

#### 6.10.2 Objects Related

In this mode, the following objects need to be pay attention to:

Table 6-28

| Object Index                               | Description                                                                      |
|--------------------------------------------|----------------------------------------------------------------------------------|
| 605A <sub>h</sub> (Quick-Stop Option Code) | Quick stop option                                                                |
| 605D <sub>h</sub> (Halt Option Code)       | Halt option                                                                      |
| 606C <sub>h</sub> Velocity actual value    | Current velocity actual value feedback (unit:rpm)                                |
| 607E <sub>h</sub> Polarity                 | Rotation direction(polarity), See "5.3 607E <sub>h</sub> : Polarity" for details |
| 60FF <sub>h</sub> Target velocity          | Target velocity (user unit:/s)                                                   |
| 6080 <sub>h</sub> Max motor speed          | Max motor speed                                                                  |

| Object Index                              | Description                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6085 <sub>h</sub> Quick-stop deceleration | Deceleration during "quick stop" (user unit/s <sup>2</sup> )                                                                                                                                                                                                                                                                                                   |
| 6086 <sub>h</sub> Motion profile type     | Choose the type of curve, i.e. slope,<br>If the value is "0", the impact (acceleration) will not be limited, i.e. ladder curve;<br>If the value is "3", the value in 60A4 <sub>h</sub> : 01 <sub>h</sub> -02 <sub>h</sub> will be used to limit the impact (acceleration), i.e. S-curve. This equipment only uses 01 <sub>h</sub> and 02 <sub>h</sub> indexes. |
| 60B1 <sub>h</sub> Velocity offset         | Velocity offset (user unit)                                                                                                                                                                                                                                                                                                                                    |
| 60B2 <sub>h</sub> Torque offset           | Torque offset (0.1%)                                                                                                                                                                                                                                                                                                                                           |
| 6072 <sub>h</sub> Max torque              | Maximum torque on the entire slope (acceleration, holding torque, braking)(unit: 0.1%)                                                                                                                                                                                                                                                                         |

### 6.10.3 Control Instruction and Status Information

#### Enable

When this mode is enabled, the value must be set to "0" in object 2002<sub>h</sub>:01<sub>h</sub> and "8" in object 6060<sub>h</sub> (Modes of Operation).

#### Control Word

In the Cyclic sync velocity mode, the bits in the object 6040<sub>h</sub> (control word) have no special function. For the definition of the general bits, please refer to section 4.1.2 Control words.

#### Status Word

|             |          |          |                         |             |          |          |             |
|-------------|----------|----------|-------------------------|-------------|----------|----------|-------------|
| 15          | 14       | 13       | 12                      | 11          | 10       | 9        | 0           |
| (see 4.1.3) | reserved | reserved | Target velocity ignored | (see 4.1.3) | reserved | reserved | (see 4.1.3) |
| MSB         |          |          |                         | LSB         |          |          |             |

In Cyclic sync velocity mode, the following bits in the object 6041<sub>h</sub> (status word) have special function

Table 6-29

| Bit | Value | Definition                    |
|-----|-------|-------------------------------|
| 12  | 0     | Target speed be discarded     |
|     | 1     | Target speed be planner input |

### 6.10.4 Function Description

In Cyclic sync velocity mode, the master controller sends the calculated target speed 60FF<sub>h</sub> to the motor drive periodically and synchronously, and the speed is adjusted by the motor internally.

### 6.10.5 Configuration Example

- Configuration mode

Set 2002<sub>h</sub>:01<sub>h</sub>=06060<sub>h</sub>=0x09 as Cyclic sync velocity mode(CSV)

- Set control word

6040<sub>h</sub> = 0x060x070x0F, motor operates; and the master computer needs to set the velocity object 60FF<sub>h</sub> periodically and synchronously.

## 6.11 Cyclic Sync Torque Mode (CST)

In this mode, the upper controller sends the calculated target torque 6071<sub>h</sub> periodically and synchronously to the servo drive, and the torque is adjusted by the servo internally. When the velocity reaches its limit, the servo will switch the velocity regulation stage.

### 6.11.1 Structure chart

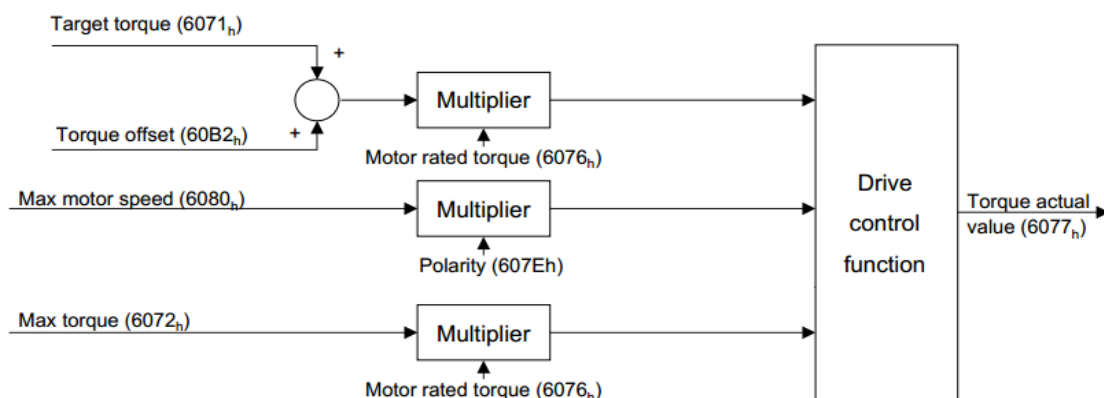


Figure 6-29

### 6.11.2 Objects Related

In this mode, the following objects need to be pay attention to:

Table 6-30

| Object index                               | Description                                                                            |
|--------------------------------------------|----------------------------------------------------------------------------------------|
| 605A <sub>h</sub> (Quick stop option code) | Quick stop option                                                                      |
| 605D <sub>h</sub> (Halt option code)       | Halt option                                                                            |
| 6071 <sub>h</sub> (Target torque)          | Target torque(unit: 0.1%)                                                              |
| 6072 <sub>h</sub> (Max torque)             | Maximum torque on the entire slope (acceleration, holding torque, braking)(unit: 0.1%) |
| 6073 <sub>h</sub> (Max current)            | Max current allowable (0.01A)                                                          |
| 6080 <sub>h</sub> (Max motor speed)        | Max motor speed (rpm)                                                                  |
| 60B2 <sub>h</sub> (Torque offset)          | Torque offset (0.1%)                                                                   |
| 6088 <sub>h</sub> (Torque profile type)    | Torque ramp type (0-ramp, 2-none)                                                      |
| 6077 <sub>h</sub> (Torque actual value)    | Torque actual value(unit: 0.1%)                                                        |

### 6.11.3 Control Instruction and Status Information

#### Enable

To enable this mode, the value of object 2002<sub>h</sub>: 01<sub>h</sub> and the value of object 6060<sub>h</sub> (Modes of Operation) must be set to "0" and "8" respectively.

#### Control Word

In the Cyclic sync torque mode, the bits in the object 6040<sub>h</sub> (control word) have no special function. For the definition of the general bits, please refer to section 4.1.2 Control words.

#### Status Word

15                  14                  13                  12                  11                  10                  9                  0

|             |          |                       |             |          |             |
|-------------|----------|-----------------------|-------------|----------|-------------|
| (see 4.1.3) | reserved | Target torque ignored | (see 4.1.3) | reserved | (see 4.1.3) |
| MSB         |          |                       |             |          | LSB         |

In the Cyclic sync torque mode, the following bits in the object 6041<sub>h</sub> (Status-word) have special function

Table 6-31

| Bit | Value | Definition                          |
|-----|-------|-------------------------------------|
| 12  | 0     | Target torque be discarded          |
|     | 1     | Target torquespeed be planner input |

### 6.11.4 Function Description

In this mode, the upper controller sends the calculated target torque 6071<sub>h</sub> periodically and synchronously to the servo drive.

### 6.11.5 Configuration Example

- Configuration mode

Set 2002<sub>h</sub>:01<sub>h</sub>=06060<sub>h</sub>=0x10as Profile velocity mode(CST)

- Set control word

6040<sub>h</sub> = 0x060x070x0Fmotor operates;and the master computer needs to set the velocity object 6071<sub>h</sub>.

## 6.12 NiMotion Mode

### 6.12.1 Summary

The NiMotion mode is different from CIA402 mode, without state machine management and controlled by multi-functional terminals. NiMotion modes include NiMotion position mode, NiMotion velocity mode, NiMotion torque mode. 2002<sub>h</sub>:01<sub>h</sub> (Control mode selection) is used to determine which mode the servo be in. See 6.1 Control mode overview for specific correspondence.

## 6.13 NiMotion Position Mode

### 6.13.1 Structural Chart

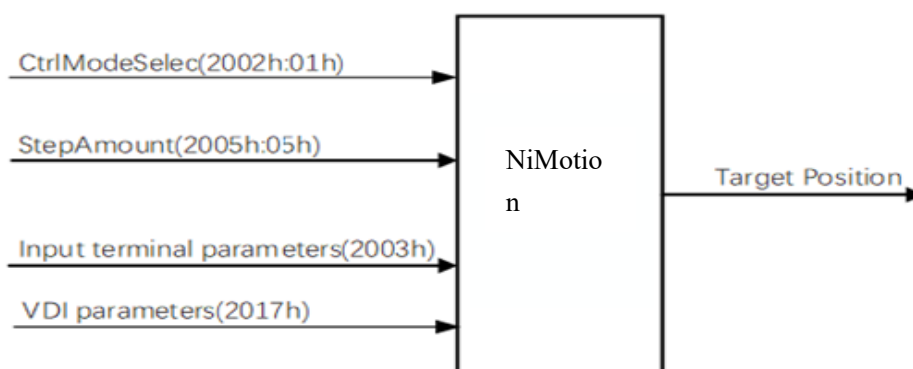


Figure 6-30

### 6.13.2 Objects Related

In this mode,the following objects need to be pay attention to:

Table 6-32

| Object Index                                       | Description                                                                                    |
|----------------------------------------------------|------------------------------------------------------------------------------------------------|
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSelec) | Operation mode selection                                                                       |
| 2005 <sub>h</sub> :05 <sub>h</sub> (StepAmount)    | Step amounts setting (encoder unit)                                                            |
| 2017 <sub>h</sub> (VDI parameters)                 | 7.1.1<br>Virtual terminal input function configuration (see "7.1.1 Digital input" for details) |
| 2003 <sub>h</sub> (Input terminal parameters)      | 7.1.1<br>Entity input terminal function configuration (see "7.1.1 Digital input" for details)  |

### 6.13.3 Control Instruction and Status Information

In this mode, there is no state machine, and the motor is enabled by the terminals.

#### Enable

The premise of this mode: the integrated low-voltage servo motor is switched to the Manufacturer position mode (2002<sub>h</sub>: 01<sub>h</sub> to 1).

##### ① Position source option:

Object (2005<sub>h</sub>: 01<sub>h</sub>) is the source of position instruction (2006<sub>h</sub>: 01<sub>h</sub>), meaning: 0-pulses, 1-step amounts;

##### ② set multi-function terminals (both physical terminals and virtual terminals are applicable. See 7.1 Digital input and output for specific configuration )

If position instructions is set to from 1, configure one input terminal as motor enable source, and set its valid logic level according to the actual situation (by default low-level-valid); and configure the other input terminal as step enabling source, set its valid logic level according to the actual situation, (by default low-level-valid);

If position instructions is set to from 0, (given by external pulses), it is necessary to configure the input terminals DI1 and DI2 as the corresponding pulse inputs, and set the enable terminal of motor in addition.

#### Position configure

If position instructions is set to from 1 It is necessary to preset the step amounts and set it to the object 2005<sub>h</sub>: 05<sub>h</sub>;

If position instructions is set to from 0, It is necessary to input pulses signal from input terminals DI1 and DI2.

#### Operation

If position instructions is set to from 1, enable the motor by the terminal, and enable the step amounts through the terminal, then the motor will operate the distance (unit: Inc) preset in (2005<sub>h</sub>: 05<sub>h</sub>) for each stepping enabled;

If the position command is from 0, enable the motor by terminal, then the motor operates according to the pulses from the input terminal.

### 6.13.4 Function Description

In this mode, the motor operates a controllable distance according to the signal from the input terminals.

### 6.13.5 Configuration Example

#### Position control by step amounts

Parameter configuration:

- Mode configurationSet 2002<sub>h</sub>:01<sub>h</sub>=0
- Configure position instructions source as step amounts: 2005<sub>h</sub>:01<sub>h</sub>=1
- Set step amounts: 2005<sub>h</sub>:05<sub>h</sub> = 50
- Enable the motor2003<sub>h</sub>:01<sub>h</sub>=1 (Low-level-valid: 2003<sub>h</sub>:02<sub>h</sub>=0)
- Enable step amounts: 2003<sub>h</sub>:03<sub>h</sub>=20 (Falling-edge is valid: 2003<sub>h</sub>:02<sub>h</sub>=0)

Operation:

- Enable the motorDI1 input is low-voltage.
- Enable step amounts: DI2 inputs a falling-edge, the motor steps a distance; each falling-edge steps one distance.

### Position control given by quadrature pulses

Parameter configuration:

- Mode configurationSet 2002<sub>h</sub>:01<sub>h</sub>=0
- Configure position instructions source as pulses: 2005<sub>h</sub>:01<sub>h</sub>=0
- Configure input terminal:  
Quadrature pulses input A from DI12003<sub>h</sub>:01<sub>h</sub>=40  
Quadrature pulses input B from DI22003<sub>h</sub>:03<sub>h</sub>=41  
Function number of DI3 is set as motor enable:  
Stepping enable: 2003<sub>h</sub>:05<sub>h</sub> =1  
Low-level-valid:2003<sub>h</sub>:06<sub>h</sub> =0

Operation:

- Enable the motorDI3 input is low-voltage.
- Pulses input control: orthogonal pulses is from terminals DI1 and DI2, and the motor is position controlled according to the input pulses.

## 6.14 Manufacturer Velocity Mode

### 6.14.1 Structure chart

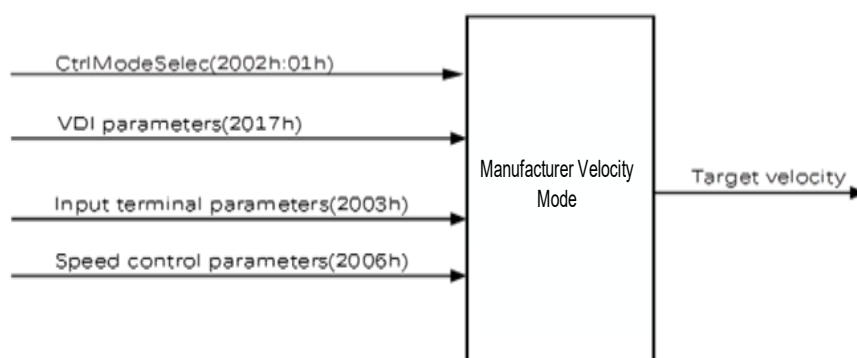


Figure 6-31

## 6.14.2 Objects Related

In this mode, the following objects need to be pay attention to:

Table 6-33

| Object index                                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2000 <sub>h</sub> :0F <sub>h</sub>                 | Max motor speed (rpm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSelec) | Operation mode selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 2006 <sub>h</sub> (Speed control parameters)       | <p>Parameter of Manufacturer velocity mode</p> <p>Sub-index</p> <p>2006<sub>h</sub>:01<sub>h</sub>: velocity source in Manufacturer velocity mode, 0-digital given,<br/>3-duty ratio given (20Hz-20KHz, recommended 1kHz)</p> <p>2006<sub>h</sub>:04<sub>h</sub> : Velocity command digital given (unit rpm),</p> <p>2006<sub>h</sub>:07<sub>h</sub> : Time constant of velocity command acceleration ramp (unit ms), representing the acceleration time from 0rpm to 1000rpm.</p> <p>2006<sub>h</sub>:08<sub>h</sub> : Time constant of velocity command deceleration ramp(unit: ms).</p> |
| 2017 <sub>h</sub> (VDI parameters)                 | Virtual terminal input function configuration (see "7.1.1 Digital input" for details)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 2003 <sub>h</sub> (Input terminal parameters)      | <p>Function configuration of entity input terminals (see "7.1.1 Digital input")</p> <p>Note: multiple input terminals cannot be configured as the same switch at the same time, otherwise terminal setting failure will be reported</p>                                                                                                                                                                                                                                                                                                                                                    |

## 6.14.3 Control Instruction and Status Information

In this mode, there is no state machine, and the motor is enabled by the terminals.

### Enable

The premise of the mode operation: the integrated motor is switched to the Manufacturer velocity mode (2002<sub>h</sub>: 01<sub>h</sub> is set to 2).

#### ①velocity source option:

Object (2006<sub>h</sub>: 01<sub>h</sub>) is the source of velocity instruction: 0-digit given, 3-duty ratio given;

#### ②Configure multi-function terminal (both physical terminal and virtual terminal are applicable, see "7.1 Digital input and output" for terminal setting):

Set one input terminal to enable the motor, and configure its valid logic level voltage according to the actual situation(by default low-level-valid).

If the velocity command source is set from 3 (duty ratio given),It is necessary to set duty ratio given from input terminals DI1 and DI2.

#### ③The setting of velocity, acceleration and maximum velocity

If velocity instructions is set to from 0-digit givenIt is necessary to preset the velocity and set it to the object 2006<sub>h</sub>: 04<sub>h</sub>;

If velocity instructions is set to from 3-duty ratio givenIt is necessary to input pulses signal from input

terminals DI0 (duty ratio) and DI1 (direction).

Set acceleration and deceleration speed 2006<sub>h</sub>: 07<sub>h</sub> and 2006<sub>h</sub>: 08<sub>h</sub>

Set the maximum speed of 2000<sub>h</sub>: 0F<sub>h</sub>, the maximum speed corresponding to the duty ratio being 100%.

#### ④ Operation

Enable the motor according to the motor terminal, and the motor operates at the preset speed.

### 6.14.4 Function Description

In this mode, the motor will operate at the corresponding velocity according to the input from terminals or digital I/Os.

### 6.14.5 Configuration Example

Velocity Regulation By Digital Given

#### ① Parameter configuration:

- Set the velocity mode to 2 (manufacturer velocity mode) 2002<sub>h</sub>:01<sub>h</sub>=2
- Set the velocity command source to 0 (digital I/O) 2006<sub>h</sub>:01<sub>h</sub>=0
- Set time constant of the acceleration slope to 100ms: 2006<sub>h</sub>:07<sub>h</sub>=100  
Set time constant of the deceleration slope to 100ms: 2006<sub>h</sub>:08<sub>h</sub>=100
- Set the number given to 60rpm, 2006<sub>h</sub>:04<sub>h</sub>=60
- Terminal configuration  
Set DI1 terminal:  
Set function option as stepping enable 2003<sub>h</sub>:01<sub>h</sub>=1  
Set Logic option as low-level-valid 2003<sub>h</sub>:02<sub>h</sub>=0

#### ② Operation

- Input low-voltage from DI0, motor velocity is regulated according to digital preset (2006<sub>h</sub>: 02<sub>h</sub>)

Velocity Regulation By Duty Ratio:

#### ① Parameter configuration:

- Set the velocity mode to 2 (manufacturer velocity mode) 2002<sub>h</sub>:01<sub>h</sub>=2
- Set the velocity command source to 3 (duty ratio) 2006<sub>h</sub>:01<sub>h</sub>=3
- Set time constant of the acceleration slope to 100ms: 2006<sub>h</sub>:03<sub>h</sub>=100  
Set time constant of the deceleration slope to 100ms: 2006<sub>h</sub>:04<sub>h</sub>=100
- Set the maximum velocity to 3000rpm: 2000<sub>h</sub>:0F<sub>h</sub>=3000
- Terminal configuration  
Set DI1 terminal as duty ratio: 2003<sub>h</sub>:01<sub>h</sub>=44  
Set DI2 terminal as duty ratio direction: 2003<sub>h</sub>:04<sub>h</sub>=45  
Set DI3 terminal as stepping enable:  
Set function option as stepping enable 2003<sub>h</sub>:05<sub>h</sub>=1  
Set Logic option as low-level-valid 2003<sub>h</sub>:06<sub>h</sub>=0

#### ② Operation

- Input the square wave with a certain duty ratio from DI0, low-level valid signal is input from DI3 to enable motor and the velocity is adjusted according to the duty ratio.

Parameter monitoring : 200B<sub>h</sub>: 07<sub>h</sub> is displayed as real-time duty ratio of input.

## 6.15 Manufacturer Torque Mode

### 6.15.1 Structural Chart

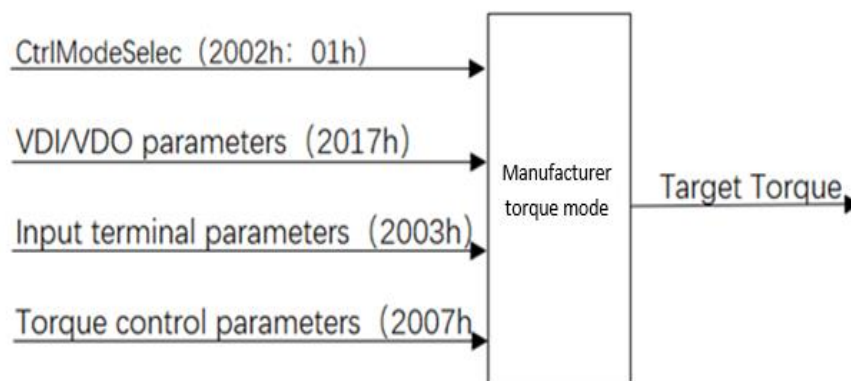


Figure 6-32

### 6.15.2 Objects Related

In this mode, the following objects need to be pay attention to:

Table 6-34

| Object Index                                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSelec) | Operation mode selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2007 <sub>h</sub> (Speed control parameters)       | Sub-index:<br>2007 <sub>h</sub> :01 <sub>h</sub> :Torque source in Manufacturer torque mode, 0-digital given<br>2007 <sub>h</sub> :04 <sub>h</sub> : Torque command digital given (0.1%)<br>2007 <sub>h</sub> :0A <sub>h</sub> : Positive limit of Internal torque (0.1%)<br>2007 <sub>h</sub> :0B <sub>h</sub> : Negative limit of Internal torque (0.1%)<br>2007 <sub>h</sub> :10 <sub>h</sub> : Positive velocity limit of torque controlrpm<br>2007 <sub>h</sub> :11 <sub>h</sub> : Negative velocity limit of torque controlrpm |
| 2017 <sub>h</sub> (VDI parameters)                 | Virtual terminal input function configuration (see "7.1.1 Digital input" for details)                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2003 <sub>h</sub> (Input terminal parameters)      | Function configuration of entity input terminals (see "7.1.1 Digital input")<br>Note: multiple input terminals cannot be configured as the same switch at the same time, otherwise terminal setting failure will be reported                                                                                                                                                                                                                                                                                                         |

### 6.15.3 Control Instruction and Status Information

In this mode, there is no state machine, and the motor is enabled by the terminals.

#### Enable

The premise of the mode operation: the integrated motor is switched to the Manufacturer velocity mode (2002<sub>h</sub>: 01<sub>h</sub> is set to 3).

mode (2002<sub>H</sub>: 01<sub>h</sub> is set to 3).

① Torque source selection:

Object (2007<sub>h</sub>: 01<sub>h</sub>) is the source of torque command: 0-digit given;

② Configure multi-function terminal (both physical terminal and virtual terminal are applicable, see "7.1 Digital input and output" for terminal setting):

Configure one input terminal to enable the motor, and configure its valid voltage-level according to the actual situation. by default low-level-valid.

③ The setting of torque, torque limit and velocity limit:

The source of velocity instruction is digital given, so the torque value needs to be given and set in the object 2007<sub>h</sub>: 04<sub>h</sub>;

Set positive and negative internal torque limits 2007<sub>h</sub>:0A<sub>h</sub> and 2007<sub>h</sub>:0B<sub>h</sub>

Set positive and negative velocity limits 2007<sub>h</sub>: 10<sub>h</sub> and 2007<sub>h</sub>: 11<sub>h</sub>

④ Operation

Enable the motor according to the motor terminal, and the motor operates at the preset speed.

#### 6.15.4 Function Description

In this mode, the motor will operate to the corresponding torque, enabled by entity or virtual terminals and the digital torque given. When the motor velocity exceeds its limit (positive velocity limits 2007<sub>h</sub>:10<sub>h</sub> and negative velocity limits 2007<sub>h</sub>:11<sub>h</sub>), it will automatically switch to velocity mode and control the current velocity within its limit. When the given target torque is detected to be less than its average at the current velocity, the servo motor exits velocity control and switches to torque mode.

#### 6.15.5 Configuration Example

① Parameter configuration:

- Set the velocity mode to 3 (manufacturer torque mode) 2002<sub>h</sub>:01<sub>h</sub>=3
- Set the velocity command source to 0 (digital I/O) 2007<sub>h</sub>:01<sub>h</sub>=0
- Set positive and negative internal torque limits: 2007<sub>h</sub>:0A<sub>h</sub>=1000 and 2007<sub>h</sub>:0B<sub>h</sub>=1000  
Set positive and negative velocity limits 2007<sub>h</sub>:10<sub>h</sub>=3000 2007<sub>h</sub>:11<sub>h</sub>=3000

- Set the number given to 100% 2007<sub>h</sub>:04<sub>h</sub>=1000
- Terminal configuration  
Set DI0 terminal:  
Set function option as stepping enable 2003<sub>h</sub>:01<sub>h</sub>=1  
Set Logic option as low-level-valid 2003<sub>h</sub>:02<sub>h</sub>=0

② Operation

- Input low-voltage from DI0, motor operated according to the torque digital given in (2007<sub>h</sub>: 04<sub>h</sub>).

## 6.16 Multi-Segment Position Mode

### 6.16.1 Structure diagram

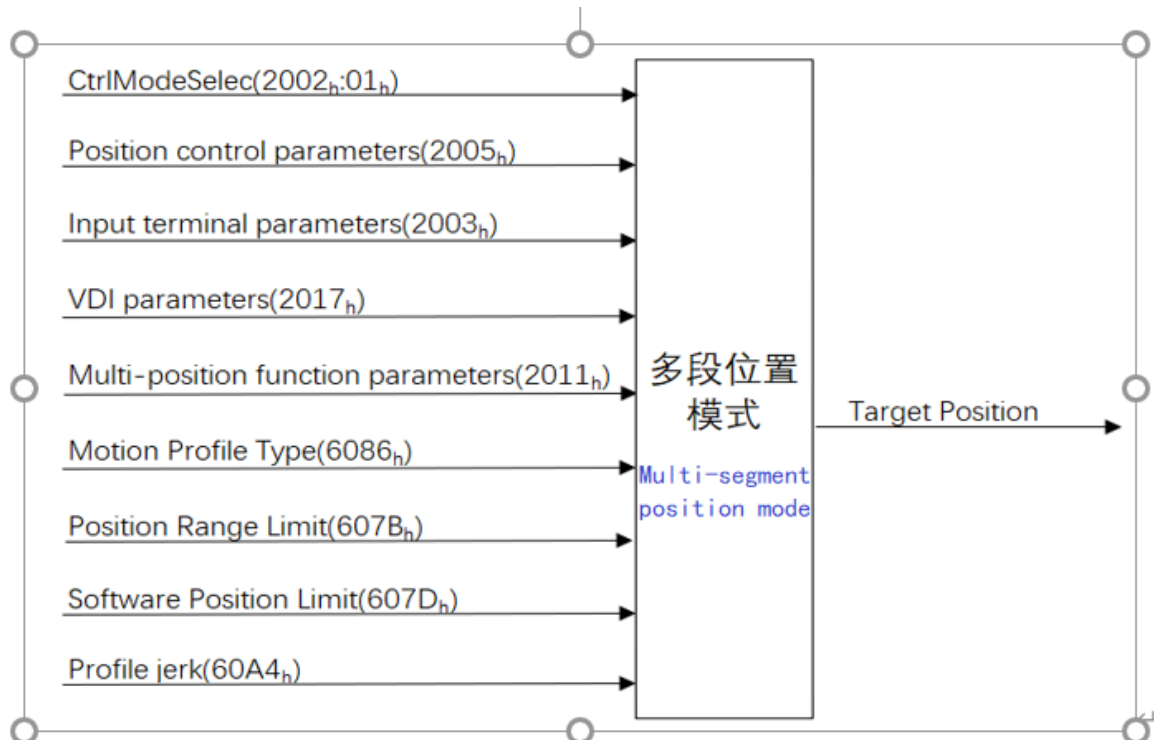


Figure 6-33

### 6.16.2 Related Objects

The following objects need to be noted in this mode:

Table 6-35

| Object index                                           | Description                                                                                                                                                                                                                                                    |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSelc)      | Selection of operating mode                                                                                                                                                                                                                                    |
| 2005 <sub>h</sub> (Position control parameters)        | 2005 <sub>h</sub> : 01 <sub>h</sub> : Source of position command, 0-pulse, 1-step amount, 2-multi-segment position<br>2005 <sub>h</sub> : 05 <sub>h</sub> : Step amount setting (encoder unit)                                                                 |
| 2017 <sub>h</sub> (VDI parameters)                     | Virtual input terminal function configuration (see: "7.1.1 Digital input" for details)                                                                                                                                                                         |
| 2003 <sub>h</sub> (Input terminal parameters)          | Physical input terminal function configuration (see: "7.1.1 Digital input" for details)<br>It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting failure will be reported. |
| 2011 <sub>h</sub> (Multi-position function parameters) | Multi-segment position function parameter group                                                                                                                                                                                                                |
| 607B <sub>h</sub> (Position Range Limit)               | Location range limitation (user unit)                                                                                                                                                                                                                          |
| 607D <sub>h</sub> (Software Position Limit)            | Limitation of target location (user unit)                                                                                                                                                                                                                      |

| Object index                            | Description                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6086 <sub>h</sub> (Motion Profile Type) | Select the type of planner curve that is the slope,<br>If the value is "0", the impact (acceleration) will not be limited, that is, the trapezoid curve;<br>If the value is "3", the value in 60A4 <sub>h</sub> : 01h-02h will be used to limit the shock (acceleration), that is, S-shaped curve, this device only uses the 01h and 02h indexes. |
| 60A4 <sub>h</sub> (Profile jerk)        | The profile is accelerated, see 6.3.2 for the specific implementation process                                                                                                                                                                                                                                                                     |

### 6.16.3 Control instructions and status information

There is no state machine management in this mode, the motor is enabled through the terminal.

#### Enable

The operating premise of this mode: the integrated low voltage servo motor is switched to the NiMotion position mode (2002<sub>h</sub>: 01<sub>h</sub> write 1).

#### ① Location source selection:

The object (2005<sub>h</sub>: 01<sub>h</sub>) is the source of the position command (2005<sub>h</sub>: 01<sub>h</sub>), meaning: 0-pulse, 1-step amount, 2-multi-segment position;

#### ② Set multi-function terminals (both physical terminals and virtual terminals are applicable, please refer to "7.1 Digital Input and Output" for terminal settings)

Set the position command source to 2, configure one input terminal as the motor enable, and configure its effective logic level according to the actual situation, the default low level is effective; configure the other input terminal as multi-stage enable (function number 28), according to the actual Configure its effective logic level, the default low level is effective;

#### ③ Position setting

Set the corresponding operating mode and operating parameters of each segment through the multi-segment position function parameter group (2011<sub>h</sub>).

#### ④ Run

First enable the motor through one terminal, and then enable the multi-segment position command through the other terminal. The motor will run according to the operating mode set by the multi-segment position function parameter group (2011<sub>h</sub>) and the operating parameters of each segment.

### 6.16.4 Function description

There are three operation modes for the multi-stage position mode, which are single operation, cyclic operation and DI switching operation. When using the multi-segment position function, the DI port must be set to servo enable (function number 1) and multi-segment enable (function number 28); during each segment operation, the servo enable must be valid; under non-DI switching operation mode, If the servo enable is valid, it must be ensured that the multi-segment enable is valid. If the multi-segment enable is turned off, the servo will give up the displacement command not sent by this segment and stop.

The detailed description of each operation mode is shown in the following table:

Table 6-36

| Operation mode | Description | Running curve |
|----------------|-------------|---------------|
|----------------|-------------|---------------|

| Single operation                                                                                                                                                                                                                                                                | <p>Paragraphs 1 to 16 run once;<br/>Automatic segment number switching<br/>Waiting time can be set between segments;<br/>Multi-segment position enable is active level.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |     |     |                |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|----------------|-----|----------------|---|---|---|---|--|---|---|---|---|---|---|---|---|---|---|-------|--|--|--|--|---|---|---|---|----|--|
| Cyclic operation                                                                                                                                                                                                                                                                | <p>The start segment set from 2011h: 06h runs to the end segment set from 2011h: 02h<br/>2011h: 04h setting times;<br/>Automatic segment number switching<br/>Waiting time can be set between segments;<br/>Multi-level position enable is active level;<br/>Note: If the setting value of the end segment is smaller than the start segment, the first segment to the 16th segment will cycle once.</p>                                                                                                                                                                                                                                                                                                                                                                          |     |     |                |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
| DI switching operation<br>2011h:01h=2<br><b>Note:</b> The physical terminal and the virtual terminal can be used in combination, and the combination must be 4 digits; for example:<br>Physical terminal selection<br>DI1 = 6, DI2 = 7,<br>Virtual terminal<br>VI1 = 8, VI2 = 9 | <p>The position segment number switch is determined by the decimal 0 ~ 15 corresponding to the 4-digit binary number composed of multifunctional numbers 6, 7, 8, and 9;<br/>The waiting time set between segments is invalid;<br/>Multi-segment position enable is effective along the change;<br/>The relationship between segment numbers and multifunction numbers is as follows:</p> <table><tr><th>Fun</th><th>Fun</th><th>Fun</th><th>Fun</th><th>Section number</th></tr><tr><td>9</td><td>8</td><td>7</td><td>6</td><td></td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr><tr><td colspan="4">.....</td><td></td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16</td></tr></table> | Fun | Fun | Fun            | Fun | Section number | 9 | 8 | 7 | 6 |  | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | ..... |  |  |  |  | 1 | 1 | 1 | 1 | 16 |  |
| Fun                                                                                                                                                                                                                                                                             | Fun                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Fun | Fun | Section number |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
| 9                                                                                                                                                                                                                                                                               | 8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 7   | 6   |                |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
| 0                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0   | 0   | 1              |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
| 0                                                                                                                                                                                                                                                                               | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 0   | 1   | 2              |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
| .....                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |     |     |                |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |
| 1                                                                                                                                                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1   | 1   | 16             |     |                |   |   |   |   |  |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |

### 6.16.5 Configuration Examples

#### Multi-segment position-single operation control

- Parameter setting

Set to NiMotion position mode: 2002h: 01h = 1;

Set the position command source to multi-segment position: 2005h: 01h = 2;

Set multi-segment position function parameter group:

Segment position operation mode: 2011h: 01h = 0 (single operation);

Position command type selection: 2011h: 04h = 0 (relative displacement);

Operating parameters of the first stage displacement:

Movement displacement 2011h: 07h = 10000 (user unit), the maximum allowable speed 2011h: 08h = 500 (unit rpm),

Acceleration / deceleration time 2011h: 09h = 500 (unit ms), waiting time after displacement completion 2011h: 0Ah = 1000 (unit ms)

Paragraphs 2 to 16 refer to the operating parameter settings for displacement in paragraph 1;

Set motor enable: 2003h: 01h = 1, logic is active low: 2003h: 02h = 0;

Set multi-segment enable: 2003h: 03h = 28, logic is active low: 2003h: 04h = 0;

#### ● Run

Motor enable: DI1 input low level;

Multi-stage enable, DI2 input low level, the motor runs according to the operating mode and operating parameters set by the 2011h multi-stage position function parameter group.

## 6.17 Multi-speed mode

### 6.17.1 Structure

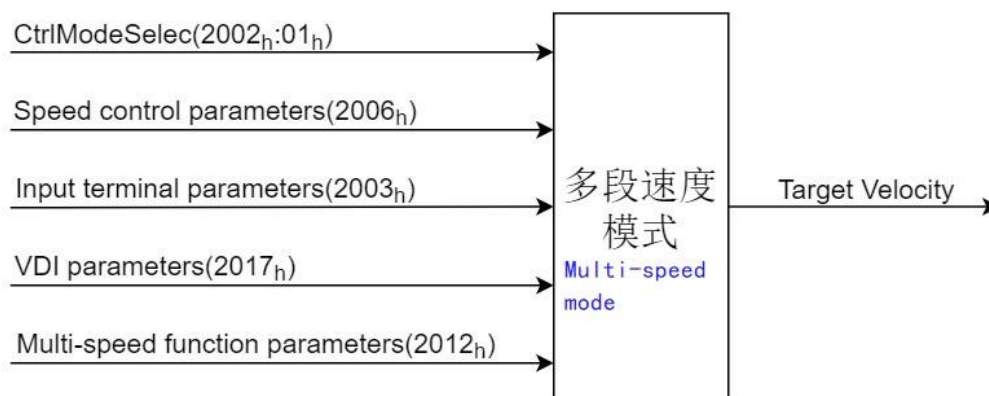


Figure 6-34

### 6.17.2 Related Object

The following objects need to be noted in this mode:

Table 6-37

| Object index                     | Description                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2002h:01h (CtrlModeSelec)        | Selection of operating mode                                                                                                                                                                                                                                                                                                                                               |
| 2006h (Speed control parameters) | <p>2006h: 01h: NiMotion speed mode main speed reference source, 0-digital reference, 3-duty cycle reference (20Hz-20kHz, 1kHz recommended)</p> <p>2006h: 02h: NiMotion speed mode auxiliary speed reference source, 0-digital reference, 3-multi-step speed</p> <p>2006h: 03h: NiMotion speed mode speed command selection, 0-main speed reference, 1-secondary speed</p> |

| Object index                                        | Description                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                     | reference, 2-main speed and auxiliary speed reference (default 0)<br>2006h: 04h: digital reference value of speed command, unit rpm<br>2006h: 07h: Speed command acceleration ramp time constant, the unit is ms, which means the time it takes to accelerate from 0rpm to 1000rpm.<br>2006h: 08h: Speed command deceleration ramp time constant, unit ms |
| 2017 <sub>h</sub> (VDI parameters)                  | Virtual input terminal function configuration (see: "7.1.1 Digital input" for details)                                                                                                                                                                                                                                                                    |
| 2003 <sub>h</sub> (Input terminal parameters)       | Physical input terminal function configuration (see: "7.1.1 Digital input" for details)<br>It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting failure will be reported.                                                                                            |
| 2012 <sub>h</sub> (Multi-speed function parameters) | Multi-stage speed function parameter group                                                                                                                                                                                                                                                                                                                |

### 6.17.3 Control instructions and status information

There is no state machine management in this mode, the motor is enabled through the terminal.

#### Enable

The operating premise of this mode: the integrated low-voltage servo motor is switched to the NiMotion speed mode (2002 h: 01h is set to 2).

#### ① Speed source selection:

The object is the source of auxiliary speed command (2006h: 02h), meaning: 0-number given, 3-multi-speed,

The speed command selection (2006h: 03h) actually takes effect is the main speed command (enabled by default), auxiliary speed command, or main speed command.

#### ② Set multi-function terminals (both physical terminals and virtual terminals are applicable, please refer to "7.1 Digital Input and Output" for terminal settings):

Configure one input terminal to enable the motor and configure its valid logic level according to the actual configuration. The default low level is valid.

#### ③ Speed setting

Set multi-stage speed function parameter group (2012h) to set the corresponding operating mode and operating parameters of each stage

#### ④ Run

The motor is enabled through one terminal, and the motor runs according to the operating mode set by the multi-stage speed function parameter group (2012h) and the operating parameters of each stage

### 6.17.4 Function description

There are three operation modes for the multi-speed mode, which are single operation, cycle operation and DI switching operation. When using multi-stage speed function, the DI port must be set to servo enable (function number 1) and multi-stage enable (function number 28); during each stage of operation, the servo

enable must be valid; in non-DI switching operation mode, except Servo enable is effective, it must be ensured that the multi-stage enable is effective. If the multi-stage enable is turned off, the servo motor will not be able to perform multi-stage speed switching.

The detailed description of each operation mode is shown in the following table:

Table 6-38

| Operation mode                                                                          | Description                                                                                                                                                                                                                                                                                                                            | Running curve                                                                                                                                                                                                                                                                                                            |      |                |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|------|------|----------------|---|---|---|---|---|---|---|---|---|---|-------|--|--|--|--|---|---|---|---|----|
| Single operation                                                                        | Paragraphs 1 to 16 run once;<br>The segment number is automatically incremented.                                                                                                                                                                                                                                                       | <p>The first and second section speed<br/><math>V_{1max}</math>, <math>V_{2max}</math>: 第1段、第2段指令速度<br/>第1段运行时间为 <math>t_1+t_2</math>, 第2段运行时间为 <math>t_3+t_4</math>, 以此类推<br/>The first run time is <math>T_1 + T_2</math>, the second run time is <math>T_3 + T_4</math>, and so on</p>                                |      |                |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| Cyclic operation                                                                        | The first segment to the end point set at 2012h: 02h runs the number of times set at 2012h: 02h; the segment number is automatically increased and switched.                                                                                                                                                                           | <p><math>V_{1max}</math>, <math>V_{2max}</math>: 第1段、第2段指令速度 First, second instruction speed<br/>第1段运行时间为 <math>t_1+t_2</math>, 第2段运行时间为 <math>t_3+t_4</math>, 以此类推<br/>The first run time is <math>T_1 + T_2</math>, the second run time is <math>T_3 + T_4</math>, and so on</p>                                       |      |                |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| DI switching operation<br>2012h:01h=2                                                   | The speed segment number switch is determined by the decimal 0 ~ 15 corresponding to the 4-digit binary number composed of multifunctional numbers 6, 7, 8, and 9;<br>Servo enable is effective, that is, continuous operation;<br>The running time of each speed command is only determined by the speed interval switching interval. | <p><math>V_{xmax}</math>, <math>V_{ymin}</math>, <math>V_{zmax}</math>: 第x段、第y段、第z段指令速度<br/>Section x, y, z instruction speed</p>                                                                                                                                                                                        |      |                |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| Physical terminal selection<br>DI1 = 6, DI2 = 7<br>Virtual terminal<br>VI1 = 8, VI2 = 9 | Correspondence table between segment number and multifunction number                                                                                                                                                                                                                                                                   | <table><tr><th>Fun9</th><th>Fun8</th><th>Fun7</th><th>Fun6</th><th>Section number</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr><tr><td colspan="5">.....</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16</td></tr></table> | Fun9 | Fun8           | Fun7 | Fun6 | Section number | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | ..... |  |  |  |  | 1 | 1 | 1 | 1 | 16 |
| Fun9                                                                                    | Fun8                                                                                                                                                                                                                                                                                                                                   | Fun7                                                                                                                                                                                                                                                                                                                     | Fun6 | Section number |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| 0                                                                                       | 0                                                                                                                                                                                                                                                                                                                                      | 0                                                                                                                                                                                                                                                                                                                        | 0    | 1              |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| 0                                                                                       | 0                                                                                                                                                                                                                                                                                                                                      | 0                                                                                                                                                                                                                                                                                                                        | 1    | 2              |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| .....                                                                                   |                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                          |      |                |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |
| 1                                                                                       | 1                                                                                                                                                                                                                                                                                                                                      | 1                                                                                                                                                                                                                                                                                                                        | 1    | 16             |      |      |                |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |

### 6.17.5 Configuration Examples

#### Multi-stage speed-single operation control

- Parameter setting:

Set to NiMotion speed mode 2002h: 01h = 2;

Set the speed command source to multiple speeds: 2006h: 02h = 3, 2006h: 03h = 1;

Set multi-speed function parameter group:

Multi-speed operation mode 2012h: 01h = 0 (single operation);

The operating parameters of the first stage speed:

Speed instruction 2012h: 0Ch = 500 (unit rpm), instruction running time 2012h: 0Dh = 2000 (unit ms),

Acceleration / deceleration time 2012h: 0Eh = 500 (unit: ms);

The operating parameters of the 2nd to 16th paragraphs refer to the operating parameters of the 1st speed;

Set motor enable: 2003h: 01h = 1, logic is active low: 2003h: 02h = 0;

Set multi-stage enable: 2003h: 05h = 28, the logic is low level effective: 2003h: 06h = 0.

- Run:

Motor enable: DI1 input low level;

Multi-stage enable, DI2 input low level, the motor operates according to the operation mode set by the 2012h multi-stage speed function parameter group and the operation parameters of each stage.

## 7 Special Functions

### 7.1 Digital Inputs and Output

The integrated low-voltage servo motor has input and output interfaces. The integrated digital inputs is used to connect auxiliary sensors of motion control, such as fretting limit switch, photoelectric switch, Hall sensor, etc. Digital output function can output 8mA current to drive solid-state relay or indicator light, etc.

#### 7.1.1 Digital Inputs

Table 7-1

| Object Index                                                 | Description                                                                      |
|--------------------------------------------------------------|----------------------------------------------------------------------------------|
| 2003 <sub>h</sub> Input terminal parameters                  | Function configuration of entity input terminals                                 |
| 2017 <sub>h</sub> VDI parameters                             | Virtual terminal input function configuration                                    |
| 2004 <sub>h</sub> Output terminal parameters                 | DX1 terminal function configuration                                              |
| 200C:07 <sub>h</sub> (CommunicationVDI)                      | Virtual digital input enable, 0-disable1-enable                                  |
| 2031 <sub>h</sub> :01 <sub>h</sub> (VDI_VirtualLevelCommSet) | VDI virtual voltage level given by communication                                 |
| 200B <sub>h</sub> :05 <sub>h</sub> MonitoredDiStates         | Actual state of voltage level corresponding to entity terminalsbit0-DI1~bit3-DI4 |

#### Control instructions

The maximum number of digital entity input terminals is 4:

Fixed input DI1 ~ 3; when DX0 is configured as input and DoFunSelec in object 2004<sub>h</sub> sub-index is 0, DX0 port is configured as input.

The communication virtual input terminal is set in parameter group 2017<sub>h</sub>.The corresponding level state of communication virtual terminal(bit0-VDI1~bit15-VDI16) is set in 2031<sub>h</sub>: 01<sub>h</sub> .

- Entity Terminals

#### Selection of Special Functions

The specific values are as follows:

Table 7-2

| Function Number | Function Definition     |
|-----------------|-------------------------|
| 0               | Undefined               |
| 1               | Stepping enable         |
| 2               | Warning reset           |
| 12              | Halt                    |
| 14              | Positive limit switch   |
| 15              | Negative limit switch   |
| 20              | Stepping amounts enable |

| Function Number | Function Definition                     |
|-----------------|-----------------------------------------|
| 28              | Multi-segment enable                    |
| 31              | Homing switch                           |
| 33              | Homing setting                          |
| 38              | Error recording reset                   |
| 39              | Power-on time reset                     |
| 40              | Quadrature pulses input A(Fixed DI1)    |
| 41              | Quadrature pulses Input B(Fixed DI2)    |
| 42              | Pulses Input A (Fixed DI1)              |
| 43              | Pulses Input direction(Fixed DI2)       |
| 44              | Duty ratio (Fixed DI1)                  |
| 45              | Duty ratio direction (Fixed DI2)        |
| 46              | Incremental encoder input A (fixed DI1) |
| 47              | Incremental encoder input B (fixed DI2) |
| 48              | Incremental encoder input Z (fixed DI4) |

### Terminal Logic Selection

The logic selection of multi-function terminal is set in parameter group 2003<sub>h</sub> (entity input terminal) . Its specific values are as follows:

Table 7-3

| Preset Value | Logic Definition                        |
|--------------|-----------------------------------------|
| 0            | Low-level-valid                         |
| 1            | High-level-valid                        |
| 2            | Rising-edge-valid                       |
| 3            | Falling-edge-valid                      |
| 4            | Both rising-edge and falling-edge valid |

### Notes:

- "1-stepping enable" is only valid in NiMotion mode, equivalent to setting the Enable control word 6040<sub>h</sub> in 402 mode.
- Different terminals cannot be set to the same function Number.If the setting is wrong, a parameter fault will be reported.
- If the operation mode is set to HM mode in CiA402, parameter fault will also be reported if function numbers 14, 15 and 31 are not set.
- The terminal function and logic selection are set to Stop activate.
- The digital input is detected once per millisecond,unable to process input jump less than 1ms.
- If the function number corresponding to the detection physical terminal is set to 46, 47, and 48, the initial angle of the servo motor 2000<sub>h</sub>: 1E<sub>h</sub> will be automatically reset to 0. The first time the servo motor enters the state of finding the initial angle of the motor (In 402 mode, the state machine will return to the Switch on disable state, and the control word needs to be changed to the Operation enabled state again.); When using an external incremental encoder, the servo motor needs to find the initial angle of the motor for the first time when it is powered on. Does not work properly.

### ● Virtual Terminals

Special function definition of virtual VDI terminal

The specific values are as follows:

Table 7-4

| Function Number | Function Definition                         |
|-----------------|---------------------------------------------|
| 0               | Undefined                                   |
| 1               | Stepping enable                             |
| 2               | Warning Reset                               |
| 6               | Multi-segment operation command switching 1 |
| 7               | Multi-segment operation command switching 2 |
| 8               | Multi-segment operation command switching 3 |
| 9               | Multi-segment operation command switching 4 |
| 12              | Halt                                        |
| 14              | Positive limit switch                       |
| 15              | Negative limit switch                       |
| 20              | Stepping amounts enable                     |
| 31              | Homing switch                               |
| 33              | Homing setting                              |
| 38              | Error recording reset                       |
| 39              | Power-on time reset                         |

### Logic selection of virtual VDI terminal

The logic selection of multi-functional terminals is by the parameter group 2017<sub>h</sub> (virtual input terminal).

The specific values are as follows:

Table 7-5

| Preset Value | Logic Definition  |
|--------------|-------------------|
| 0            | High-level-valid  |
| 1            | Rising-edge-valid |

### Enable

The virtual VDI terminal of the integrated low-voltage servo motor is enabled when the index 200C<sub>h</sub>: 07<sub>h</sub> is 1, and the virtual DI terminal function is closed when the value of 200C<sub>h</sub>: 07<sub>h</sub> is 0, by terminal function number setting and logic selection in sub index 2017<sub>h</sub>. When the logic selection is enabled, the function of corresponding function number is valid. The index 2031<sub>h</sub>:01<sub>h</sub> is the corresponding state of virtual input terminal (bit0-VDI1 ~ bit15-VDI16), which can only be given by communication. The specific definition is as follows:

Table 7-6

### 2031<sub>h</sub>:01<sub>h</sub>

| Bit         | 15-7       | 6    | 5    | 4    | 3    | 2    | 1    | 0    |
|-------------|------------|------|------|------|------|------|------|------|
| Description | VDI16-VDI8 | VDI7 | VDI6 | VDI5 | VDI4 | VDI3 | VDI2 | VDI1 |

### Example

Setting input terminal VDI1 to positive limit switch is as follow

- Set VDI1 as positive limit switch, 2017<sub>h</sub>: 01<sub>h</sub> = 14

- Logic selection is low-level-valid, 2017<sub>h</sub>: 02<sub>h</sub> = 0

Note: When using IO to control the movement of the motor, the communication alarm at 0x7501 must be disabled; otherwise, the motor will not be able to rotate.

### 7.1.2 Digital output

#### Related object settings

Table 7-6

|                                                     |                                         |
|-----------------------------------------------------|-----------------------------------------|
| 2004 <sub>h</sub> Output terminal parameters        | Output terminal parameters              |
| 2031 <sub>h</sub> :02 <sub>h</sub> (DoStateCommSet) | D0 output status given by communication |

#### Control Instruction

One of DX1 can be configured as digital output in this device, which needs configuration of 2004<sub>h</sub>. When a certain group of parameters DoFunSelec in the sub index of 2004<sub>h</sub> are set to 1, DX is as output, and the output status is given by the object 2031<sub>h</sub>:02<sub>h</sub>.

#### Function Selection of Output Terminal:

Table 7-7

| Function number | Function definition             |
|-----------------|---------------------------------|
| 0               | Configure DX1 as input          |
| 1               | Configure DX1 as output         |
| 2               | Motor running stopped           |
| 3               | Goal reached                    |
| 4               | Alarm Output                    |
| 5               | Motor brake status output       |
| 30              | Brake power-saving drive output |

#### Logic Selection of Output Terminal:

Table 7-8

| Set value | Logic Definition |
|-----------|------------------|
| 0         | Low-level-valid  |
| 1         | High-level-valid |

#### Example

Example 1: Set DX1 as user-controlled and high-level output:

- Set DX1 as output, 2004<sub>h</sub>: 01<sub>h</sub> = 1;
- set DX1 as high-level-valid: 2004<sub>h</sub>: 02<sub>h</sub> = 1;
- DX1 output given by communication, 2031<sub>h</sub>: 02<sub>h</sub> = 0x01, at this time, DX1 outputs high-level.

## 7.2 Analog Input

Note: When using IO to control the movement of the motor, the communication alarm at 0x7501 must be disabled; otherwise, the motor will not be able to rotate.

### 7.2.1 Analog Position Control

Table 7-9 Related objects

| Object Index                                       | Description                                                                                                                                                                                                                                                                                       |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSelec) | Control Mode Selection                                                                                                                                                                                                                                                                            |
| 2005 <sub>h</sub> (Position control parameters)    | 2005 <sub>h</sub> :01 <sub>h</sub> : Position command source, 3-Analog control mode 1, 4-Analog control mode 2<br>2005 <sub>h</sub> :2A <sub>h</sub> : AI1 Deadband judgment time window, unit 1ms<br>2005 <sub>h</sub> :2C <sub>h</sub> : Analog 10V corresponding position value (encoder unit) |
| 2017 <sub>h</sub> (VDI parameters)                 | Virtual input terminal function configuration (see: "7.1.1 Digital input" for details)                                                                                                                                                                                                            |
| 2003 <sub>h</sub> (Input terminal parameters)      | 2003 <sub>h</sub> :17 <sub>h</sub> : AI1 Bias, unit 1mV<br>2003 <sub>h</sub> :18 <sub>h</sub> : AI1 Input filter time constant in 1ms<br>2003 <sub>h</sub> :19 <sub>h</sub> : AI1 Deadband, unit 0.01mV<br>2003 <sub>h</sub> :1A <sub>h</sub> : AI1 Multiplier, unit 0.001                        |

## Enable

There is no state machine management in this mode, and the motor is enabled to run via the terminals.

Prerequisite for this mode of operation: Integrated low-voltage servo motor switched to NiMotion position mode (2002<sub>h</sub>:01<sub>h</sub> write 1).

### 1. Position source selection“

Set the position command source (2005<sub>h</sub>:01<sub>h</sub>), meaning: 3 - Analog control mode 1, 4 - Analog control mode 2.

### 2. Set multi-function terminals (both physical and virtual terminals are applicable, see "7.1 Digital Inputs and Outputs" for details of terminal settings)

Configure one input terminal as motor enable, and configure its valid logic level according to the actual situation, the default low level is valid.

If the set position command source is 3, you need to set the corresponding input terminal DI1 or DI2 for the analog input position control direction function (multi-function number 36).

### 3. Position Setting

Configure the analog 10V corresponding position value (2005<sub>h</sub>:2C<sub>h</sub>), which is the absolute position of the motor.

### 4. Operation

Enable the motor through one terminal, and the motor will run according to the analog input for the corresponding position.

**Note:** Analog position control is absolute position control, you need to clear the current position to 0 before use.

## Analog Position Control Method

There are two ways of analog input position control: analog control mode 1 and analog control mode 2.

### 1. Analog control method 1.

The given position before deadband = symbol (corresponding to the level of multi-function number 36) \* analog 10V corresponding position value \* (input voltage \* AI1 multiplier + AI1 bias)/10000, multi-function number 36 is valid for negative direction, invalid for positive direction.

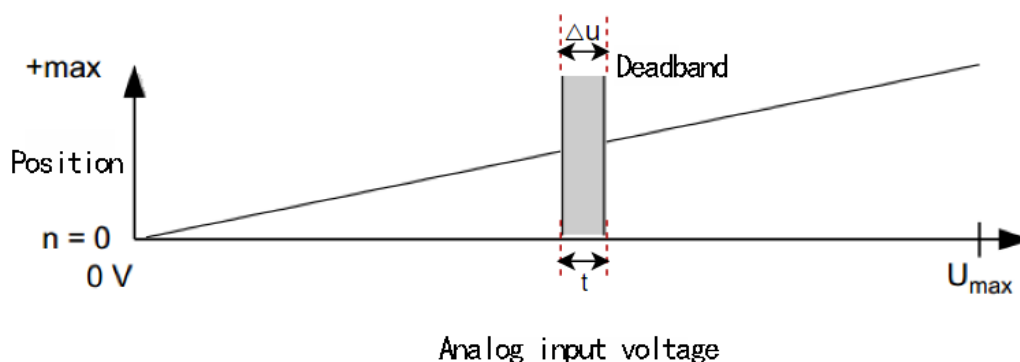


Figure 7-1

### 2. Analog control mode 2:

Input voltage 5~10V: given position before deadband = analog 10V corresponding position value \* (input voltage \* AI1 multiplier + AI1 offset)/10000.

Input voltage 0~5V: given position before deadband = - analog 10V corresponding speed value \* (input voltage \* AI1 multiplier + AI1 bias)/10000.

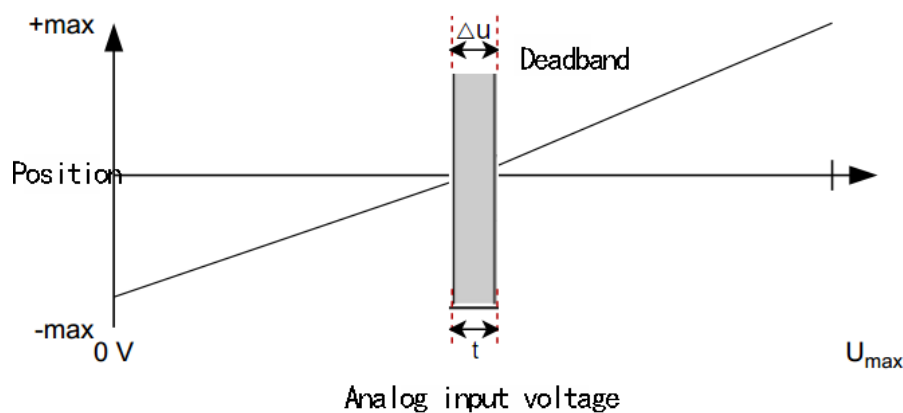


Figure 7-2

**Note:** The given position before the dead zone is the analog voltage ( $\Delta u/t$ ) after input filtering and multiplier bias in the AI1 dead zone judgment time window ( $2005h:2A_h$ ) changes continuously greater than the AI1 dead zone ( $2003h:19_h$ ) setting, otherwise the given position maintains the value of the previous moment,

through this setting can eliminate the position jitter caused by analog voltage jitter.

### Configuration Examples

- Parameter Setting

Setting to NiMotion position mode: 2002<sub>h</sub>:01<sub>h</sub>=1.

Setting the position command source to 3: 2005<sub>h</sub>:01<sub>h</sub>=3;

Setting motor enable: 2003<sub>h</sub>:03<sub>h</sub>=1, logic is active low: 2003<sub>h</sub>:04<sub>h</sub>=0.

Set analog input position control direction: 2003<sub>h</sub>:05<sub>h</sub>=36, logic is valid for falling edge: 2003<sub>h</sub>:06<sub>h</sub>=3.

- Operation

DI1 input low, the motor runs according to the position given by the analog quantity, DI2 controls the motor running direction.

## 7.2.2 Analog Velocity Control

Table 7-10 Related Objects

| Object Index                                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSeleC) | Control mode selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 2006 <sub>h</sub> (Speed control parameters)       | <p>2006<sub>h</sub>:01<sub>h</sub> : NiMotion velocity mode primary speed giving source, 1-analog control mode 1</p> <p>2006<sub>h</sub>:02<sub>h</sub> : NiMotion velocity mode auxiliary speed giving source, 1-Analog control mode 2</p> <p>2006<sub>h</sub>:03<sub>h</sub> : NiMotion velocity mode speed command selection, 0-Main speed given, 1-Auxiliary speed given</p> <p>2006<sub>h</sub>:04<sub>h</sub> : Speed command digital given value, unit rpm</p> <p>2006<sub>h</sub>:07<sub>h</sub> : Speed command acceleration ramp time constant unit ms, indicating the time used to accelerate from 0rpm to 1000rpm</p> <p>2006<sub>h</sub>:08<sub>h</sub> : Speed command deceleration ramp time constant, Unit: ms</p> <p>2006<sub>h</sub>:0A<sub>h</sub> : Forward speed threshold, unit rpm</p> <p>2006<sub>h</sub>:0B<sub>h</sub> : Forward speed threshold, unit rpm</p> |
| 2017 <sub>h</sub> (VDI parameters)                 | Virtual input terminal function configuration (For details, see: "7.1.1 Digital input")                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2003 <sub>h</sub> (Input terminal parameters)      | <p>2003<sub>h</sub>:17<sub>h</sub> : AI1 bias, unit 1mV</p> <p>2003<sub>h</sub>:18<sub>h</sub> : AI1 input filter time constant in 1ms</p> <p>2003<sub>h</sub>:19<sub>h</sub> : AI1 deadband in 1mV</p> <p>2003<sub>h</sub>:1A<sub>h</sub> : AI1 multiplier, unit 0.001</p> <p>2003<sub>h</sub>:1F<sub>h</sub> : Analog 10V corresponding speed value in rpm</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

### Enable

There is no state machine management in this mode, and the motor is enabled to run via the terminals.

Prerequisite for operation: The integrated low-voltage servo motor is switched to NiMotion

velocity mode (2002 h:01h set to 2).

#### 1. Speed source selection.

Set the primary speed command source (2006h:01h) and the secondary speed command source (2006h:02h) to 1. Meaning: 1 - analog control mode.

Select by speed command (2006h:03h) the actual effective is the main speed command (analog control mode 1) or auxiliary speed command (analog control mode 2), meaning: 0 - main speed given, 1 - auxiliary speed given.

#### 2. Set multi-function terminals (both physical and virtual terminals are applicable, see "7.1 Digital Inputs and Outputs" for details of terminal settings).

Configure one input terminal as motor enable, and configure its valid logic level according to the actual configuration, the default low level is valid.

If the speed command selection (2006h:03h) set in the previous step is 0, you need to set the corresponding input terminal DI1 or DI2 for the analog input speed control direction function (multi-function number 36); 3.

#### 3. Speed, acceleration and maximum speed setting

If the speed command selection (2006h:03h) is 0, the analog 10V corresponding speed value (2003h:1Fh) needs to be configured.

If the speed command selection (2006h:03h) is 1, the forward and reverse speed thresholds (2006h:0Ah and 2006h:0Bh) need to be configured.

Configuration of plus and minus speeds (2006h:07h and 2006h:08h).

#### 4. Operation

Enable the motor via one terminal, and the motor runs at the corresponding speed according to the analog input.

### Analog speed control methods

There are two mode for analog input speed control: analog control mode 1 and analog control mode 2.

#### 1. Analog control mode 1.

The given speed before deadband = sign (corresponding to the level of multi-function number 36) \* analog 10V corresponding speed value \* (input voltage \* AI1 multiplier + AI1 bias)/10000, multi-function number 36 is valid for negative direction, invalid for positive direction.

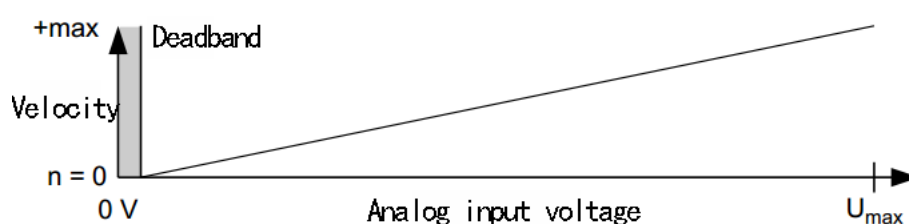


Figure 7-3

## 2. Analog control mode 2.

Input voltage 5~10V: given speed before deadband = speed value corresponding to analog 10V \* (input voltage \* AI1 multiplier + AI1 bias)/10000.

Input voltage 0~5V: the given speed before deadband = - the speed value corresponding to analog 10V \* (input voltage \* AI1 multiplier + AI1 bias)/10000.

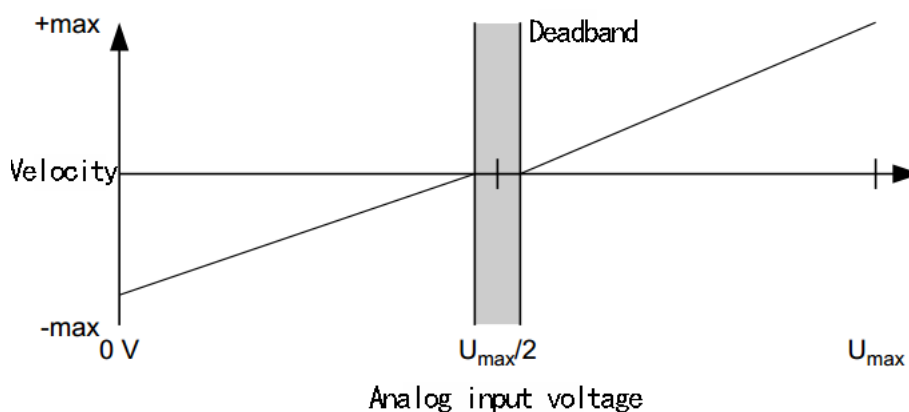


Figure 7-4

## Configuration example

### ● Parameter setting

Setting to NiMotion velocity mode: 2002<sub>h</sub>:01<sub>h</sub>=2.

setting the main speed command source to 1: 2006<sub>h</sub>:01<sub>h</sub>=1 and setting the speed command selection 2006<sub>h</sub>:03<sub>h</sub>=0.

Setting the acceleration ramp time constant to 100ms: 2006<sub>h</sub>:07<sub>h</sub>=100 (unit ms).

Setting the deceleration ramp time constant to 100ms: 2006<sub>h</sub>:08<sub>h</sub>=100 (unit ms).

Setting the analog 10V corresponding speed value, 2003<sub>h</sub>:1F<sub>h</sub>=3000 (unit rpm).

Setting DI1 and DI2 terminals.

DI1 function selected as servo enable: 2003<sub>h</sub>:03<sub>h</sub> = 1.

DI1 logic selection active low: 2003<sub>h</sub>:04<sub>h</sub> = 0.

DI2 function selected for analog input speed control direction: 2003<sub>h</sub>:05<sub>h</sub> = 36.

DI2 logic selection active low: 2003<sub>h</sub>:06<sub>h</sub> = 0.

### ● Operation:

DI1 input low, the motor runs according to the speed given by analog (2006<sub>h</sub>:06<sub>h</sub>), and DI2 controls the motor running direction.

## 7.2.3 Analog torque control

Table 7-11 Related objects

| Object Index                                       | Description            |
|----------------------------------------------------|------------------------|
| 2002 <sub>h</sub> :01 <sub>h</sub> (CtrlModeSelec) | Control mode selection |

| Object Index                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2007 <sub>h</sub> (Torque control parameters) | 2007 <sub>h</sub> :01 <sub>h</sub> : NiMotion Torque Mode Primary Torque Feed Source, 1-Analog Control Mode 1<br>2007 <sub>h</sub> :02 <sub>h</sub> : NiMotion Torque Mode Auxiliary Torque Feed Source, 1-Analog Control Mode 2<br>2007 <sub>h</sub> :03 <sub>h</sub> : NiMotion Torque mode torque command selection, 0-Main torque setting, 1-Auxiliary torque setting<br>2007 <sub>h</sub> :04 <sub>h</sub> : Torque command digital setting value (0.1%)<br>2007 <sub>h</sub> :0A <sub>h</sub> : Positive internal torque limit (0.1%)<br>2007 <sub>h</sub> :0B <sub>h</sub> : Reverse internal torque limit (0.1%)<br>2007 <sub>h</sub> :10 <sub>h</sub> : Torque control positive speed limit value (rpm)<br>2007 <sub>h</sub> :11 <sub>h</sub> : Torque control reverse speed limit value (rpm) |
| 2017 <sub>h</sub> (VDI parameters)            | Virtual input terminal function configuration (For details, see: "7.1.1 Digital input")                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 2003 <sub>h</sub> (Input terminal parameters) | 2003 <sub>h</sub> :17 <sub>h</sub> : AI1 bias, unit 1mV<br>2003 <sub>h</sub> :18 <sub>h</sub> : AI1 input filter time constant, unit 1ms<br>2003 <sub>h</sub> :19 <sub>h</sub> : AI1 deadband, unit 1mV<br>2003 <sub>h</sub> :1A <sub>h</sub> : AI1 multiplier, unit 0.001<br>2003 <sub>h</sub> :20 <sub>h</sub> : Analog 10V corresponding torque value, unit 0.1%                                                                                                                                                                                                                                                                                                                                                                                                                                     |

### Enable

There is no state machine management in this mode, and the motor is enabled to run via the terminals.

Prerequisite for operation: The integrated low-voltage servo motor is switched to NiMotion torque mode (2002<sub>h</sub>:01<sub>h</sub> set to 3).

#### 1. Torque source selection.

Set the primary torque command source (2007<sub>h</sub>:01<sub>h</sub>) and the secondary torque command source (2007<sub>h</sub>:02<sub>h</sub>) to 1. Meaning: 1 - analog control mode.

The actual effective by torque command selection (2007<sub>h</sub>:03<sub>h</sub>) is either the main torque command (analog control mode 1) or the auxiliary torque command (analog control mode 2), meaning: 0 - main torque given, 1 - auxiliary torque given.

#### 2. Set multi-function terminals (both physical and virtual terminals are applicable, see "7.1 Digital Inputs and Outputs" for details of terminal settings).

Configure one input terminal as motor enable, and configure its valid logic level according to the actual situation, the default low level is valid.

If the torque command selection (2007<sub>h</sub>:03<sub>h</sub>) set in the previous step is 0, the corresponding input terminal DI1 or DI2 should be set as the analog input torque control direction function (multi-function number 36).

#### 3. Torque giving and torque and speed limit setting

If the torque command selection (2007<sub>h</sub>:03<sub>h</sub>) is 0, it is necessary to configure the analog 10V corresponding torque value (2003<sub>h</sub>:20<sub>h</sub>).

If the torque command selection (2007<sub>h</sub>:03<sub>h</sub>) is 1, the forward and reverse internal torque limit values (2007<sub>h</sub>:0A<sub>h</sub> and 2007<sub>h</sub>:0B<sub>h</sub>) need to be configured.

Configure forward and reverse speed limit values (2007<sub>h</sub>:10<sub>h</sub> and 2007<sub>h</sub>:11<sub>h</sub>).

#### 4. Operation

Enable the motor via one terminal, and the motor will be controlled with the corresponding torque according to the analog input.

### Analog torque control mode

There are two modes of analog input torque control: analog control mode 1 and analog control mode 2.

#### 1. Analog control mode 1:

The given torque before deadband = sign (corresponding to the level of multi-function number 36) \* analog 10V corresponding torque value \* (input voltage \* AI1 multiplier + AI1 bias)/10000, Note: Multi-function number 36 is valid for negative direction and invalid for positive direction.

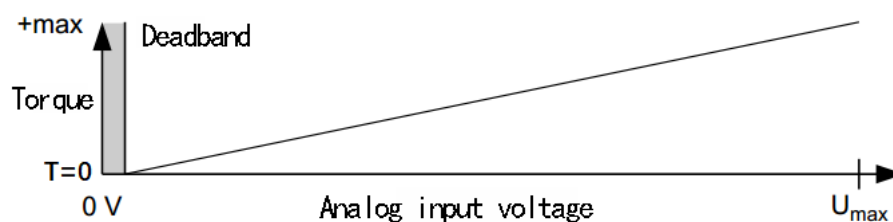


Figure 7-5

#### 2. Analog control mode 2:

Input voltage 5~10V: given torque before deadband = analog 10V corresponding torque value \* (input voltage \* AI1 multiplier + AI1 offset)/10000.

Input voltage 0~5V: given torque before deadband = - analog 10V corresponding torque value \* (input voltage \* AI1 multiplier + AI1 bias)/10000.

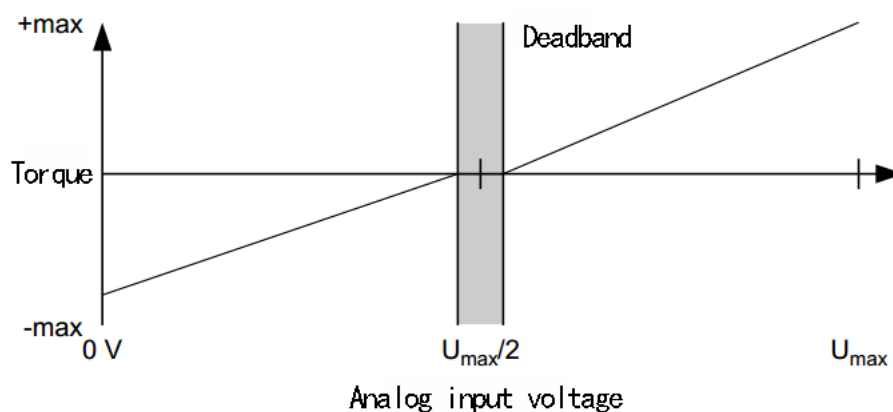


Figure 7-6

### Configuration example

- Parameter setting

Setting to NiMotion torque mode: 2002<sub>h</sub>:01<sub>h</sub>=3.

Setting the source of the main torque command to 1: 2007<sub>h</sub>:01<sub>h</sub>=1.

Setting the torque command selection to the main torque command: 2007<sub>h</sub>:03<sub>h</sub>=0.

Setting the forward and reverse internal torque limit to 100%: 2007<sub>h</sub>:0A<sub>h</sub>=1000 and 2007<sub>h</sub>:0B<sub>h</sub>=1000 (unit 0.1%).

Setting forward and reverse speed limit to 3000rpm: 2007<sub>h</sub>:10<sub>h</sub>=3000 and 2007<sub>h</sub>:11<sub>h</sub>=3000 (unit rpm).

Setting the analog 10V corresponding torque value: 2003<sub>h</sub>:20<sub>h</sub>=1000 (unit 0.1%).

Setting DI1 and DI2 terminals.

DI1 function selected as servo enable: 2003<sub>h</sub>:03<sub>h</sub> = 1.

DI1 logic selection active low: 2003<sub>h</sub>:04<sub>h</sub> = 0.

DI2 function selected for analog input torque control direction: 2003<sub>h</sub>:05<sub>h</sub> = 36.

DI2 logic selection active low: 2003<sub>h</sub>:06<sub>h</sub> = 0.

- Operation

DI1 input low, the motor runs according to the torque given by the analog quantity (2007<sub>h</sub>:04<sub>h</sub>),  
DI2 controls the motor running direction.

## 7.3 Brake Setting

The brake is to prevent the servo motor shaft from moving when the servo motor is in the disabled state, thereby locking the position of the motor. The integrated low-voltage servo motor automatically switches the state of the brake output according to the CiA402 state machine, as shown below:

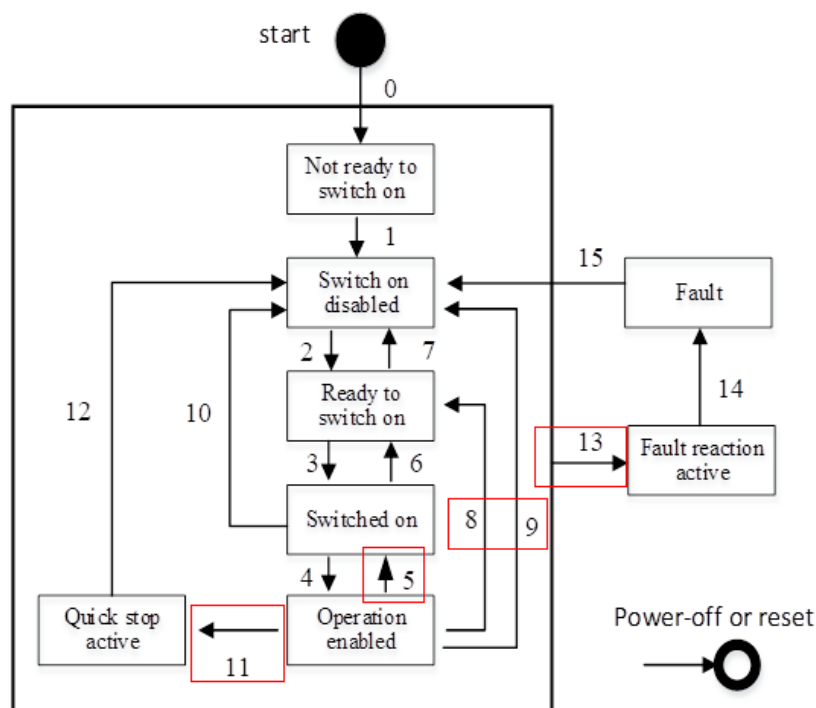


Figure 7-7

**Note:**When the integrated servo state machine leaves the running state (Operation enable), the brake output is closed.

Table 7-12

| Bit | Name                           | Description                                                                       |
|-----|--------------------------------|-----------------------------------------------------------------------------------|
| 0   | Servo ready                    | When the status word Bit0~bit3 are all 1, the brake output terminal is turned on. |
| 1   | Connect the main circuit power |                                                                                   |
| 2   | Fast shutdown                  |                                                                                   |
| 3   | Servo operation                |                                                                                   |

### Related objects

Table 7-13

| Object index                                                   | Description                                                                                                              |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 2002 <sub>h</sub> :0A <sub>h</sub> (BrkOffToStopMotorOffDelay) | The delay from when the brake output is closed to when the motor is not energized, unit ms                               |
| 200A <sub>h</sub> :1F <sub>h</sub> (BrakeDetectionEn)          | Brake detection enable, 0-zero-gravity preset, 1-enable gravity preset;                                                  |
| 200A <sub>h</sub> :20 <sub>h</sub> (BrakeLoadGravity)          | Brake load gravity (default value of gravity, torque output by the motor when the brake is opened), 0.1% of rated torque |
| 200D <sub>h</sub> :0B <sub>h</sub> (BrakeLoadTun)              | Brake load identification, 0-disable gravity identification, 1-enable online gravity identification                      |

### Note:

1. When the servo motor is used for a vertical axis, the gravity preset and online gravity recognition functions need to be turned on, and the gravity preset value is used to prevent the brake loosening and the load drop when the motor starts due to the load's own weight or external force.
2. When the servo motor is used for a vertical axis, it is necessary to properly set the brake output to the motor's non-energized delay to prevent the load from falling due to its own weight or external force when the motor is stopped from operation to stop or failure.
3. Enable online real-time identification of load gravity. When the servo motor speed is below 300rpm, the default value of gravity (200A<sub>h</sub>:20<sub>h</sub>) will be automatically updated.

### Enable and disable

- 1 The brake output control can be enabled through the object dictionary 2004<sub>h</sub>:05<sub>h</sub>. When the function number is set to 30, the brake function will be automatically enabled;  
  
When the terminal function of DX1 (2004<sub>h</sub>:01<sub>h</sub>) is configured as multi-function number 5 (motor brake status output) and the logic is active high, DX1 outputs high level when the brake is opened.
- 2 The brake output control can be closed through the object dictionary 2004<sub>h</sub>:05<sub>h</sub>. When the function number is set to 0, the brake function will be automatically closed.

When the terminal function of DX1 (2004h:01h) is configured as multifunction number 5 (motor brake status output) and the logic is active high, DX1 outputs low level when the brake is closed.

### Duty cycle

The output of the brake triggers a PWM signal with an adjustable duty cycle. The duty cycle (the ratio of pulse time to cycle time) is set in 2002h:04h, and its value is a percentage value, which can be selected between 1 and 100 (it is recommended to configure above 90). When the value is 100, the brake output will be continuously connected.

## 7.4 I<sup>2</sup>t Overload Protection of Motor

After the integrated low-voltage servo motor is powered on, heat will be generated continuously due to the thermal effect of current, and be released to the surrounding environment at the same time. The temperature of the motor will rise when the heat generated exceeds the heat released, which will cause the motor to burn out. The purpose of i<sup>2</sup>t overload protection of motor is to ensure the motor operating normally under the temperature limit and to prevent the motor from damage.

### Objects Related

Table 7-14

| Object Index               | Description                |
|----------------------------|----------------------------|
| 2000h:09hRatedCurrent      | Rated Current (unit0.01A)  |
| 2000h:0AhMaximumCurrent    | MaximumCurrent (unit0.01A) |
| 2000h:0BhMaxCurrentDurTime | MaxCurrentDurTime (unitms) |

### Enable

To enable this protection, the three object items above must be described correctly. When the motor operates above the rated current, the servo drive detects and calculates the time integral of I<sup>2</sup>. When the integral value is greater than the product of the set maximum current (2000h: 0Ah) and the maximum current duration (2000h: 0Bh), the motor will give an overload warning and limit the torque output to the rated value. If these conditions are not met, the i<sup>2</sup>t function will be disabled.

## 7.5 Brake Configuration

When the directions of torque and the motor velocity are opposite, the energy is fed back to the drive from the motor, which causing the bus voltage increasing. If it reaches the braking point, the energy will be consumed by the braking resistance, otherwise the drive will be damaged. There are two types of braking resistance: internal and external (setting in 2002h: 13h: 0 ~ internal, 1 ~ external), which can not be used at the same time. The specifications of the built-in braking resistor are shown in the following table.

Table 7-15

| Power | Motor Type | Specification of built-in | Processable power |
|-------|------------|---------------------------|-------------------|
|-------|------------|---------------------------|-------------------|

|      |          | braking resistor |     |
|------|----------|------------------|-----|
| 100W | PMM4010B | 50Ω, 10W         | 3W  |
| 200W | PMM6020B | 15Ω, 25W         | 8W  |
| 400W | PMM6040B | 15Ω, 25W         | 8W  |
| 750W | PMM8075B | 15Ω, 35W         | 11W |

### 7.5.1 Without External Load Torque

When the motor reciprocates, the braking energy will be converted to electrical energy and fed back into the bus capacitance. If the bus voltage exceeds the braking voltage (2001<sub>h</sub>: 0F<sub>h</sub>), the braking resistance will consume the redundant feedback energy. The following table shows the braking energy E generated by the motor from 3000rpm to 0 rpm:

Table 7-16

| Capacity | Servo Motor Model | Rotor Inertia (10 <sup>-4</sup> kgm <sup>2</sup> ) | Braking Energy (J) |
|----------|-------------------|----------------------------------------------------|--------------------|
| 100W     | PMM4010B          | 0.034                                              | 0.17               |
| 200W     | PMM6020B          | 0.19                                               | 0.94               |
| 400W     | PMM6040B          | 0.3                                                | 1.48               |
| 750W     | PMM8075B          | 1.2                                                | 5.94               |

The selection of braking resistance power P is related to the cycle T (unit s) of motor reciprocating, the rotation velocity and the ratio N of load inertia to the motor inertia. The specific calculation formula is as follows:

$$P = \frac{2 \times (N+1) \times E}{T}$$

In case of the servo motor operating from 3000rpm to 0rpm, the specific speed curve is as follows:

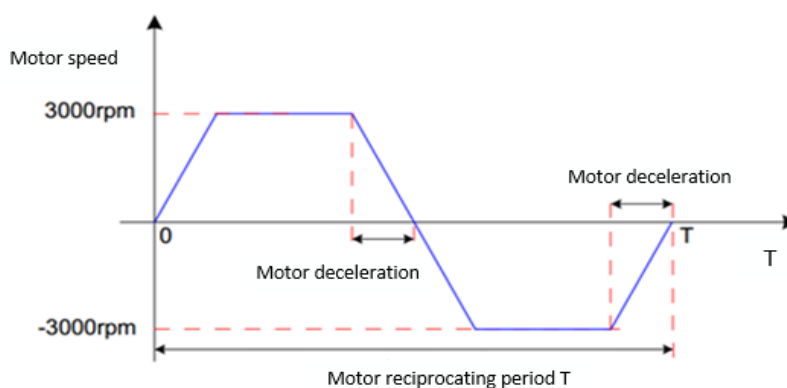


Figure 7-8

Taking 200W motor as an example, assuming that the period of reciprocating motion T = 2s, the maximum velocity is 3000rpm, and the load inertia is 10 times of the motor inertia, the braking resistance power is required:

$$P_a = \frac{2 \times (N+1) \times E}{T} = \frac{2 \times (10+1) \times 0.94}{2} = 10.34W$$

P<sub>a</sub> is less than 12.5W, which is the power limit of the internal braking resistance, so the internal resistance

meets this requirements.

If the load inertia in the above conditions is changed from 10 times to 30 times, and other conditions remained, the braking resistance power  $P_b$  is required:

$$P_b = \frac{2 \times (N+1) \times E}{T} = \frac{2 \times (30+1) \times 0.94}{2} = 29.14W$$

$P_b$  is greater than the power limit of the internal braking resistance. Therefore, an external braking resistance which is reduced by 70% is required. i.e.  $P_b / (1-70\%) = 97.13w$ .

## 7.5.2 With External Load Torque

In some special cases, the rotation direction of the motor is opposite to the torque, the motor will output energy, and feed back to the servo drive.

Taking 400W (rated torque 1.27Nm) capacity as an example, when the external load torque is 60% of the rated torque and the velocity reaches 1000rpm, the power fed back to the servo drive is calculated as follows:

$$P = \frac{2\pi \times n \times M}{60} \times 60\% = \frac{2\pi \times 1000 \times 1.27}{2} \times 60\% = 79.76W$$

Considering that the braking resistance needs to be used at 30% of the rated value, the external braking resistance power  $P$  is actually  $79.76 / (1-70\%) = 265.85w$ , and the resistance value is 15Ω.

**Note:**  $n$  is rotation velocity (rpm),  $M$  is torque (N.m)

## 7.6 Position recovery

The motor can return to its absolute position after losing power and then being powered on again.

When the position recovery mode (2005h:18h) value is 1, it is suitable for single-circle round-trip motion. When the motor is in the negative direction relative to the zero point, forward operation is required to return to the zero point. When the motor is in the positive direction relative to zero point, it needs to run in the negative direction to return to zero point.

For the position recovery of a single lap, the maximum forward rotation Angle (2005h:1Dh) can be set to change the direction of returning to zero, as shown in the following figure:

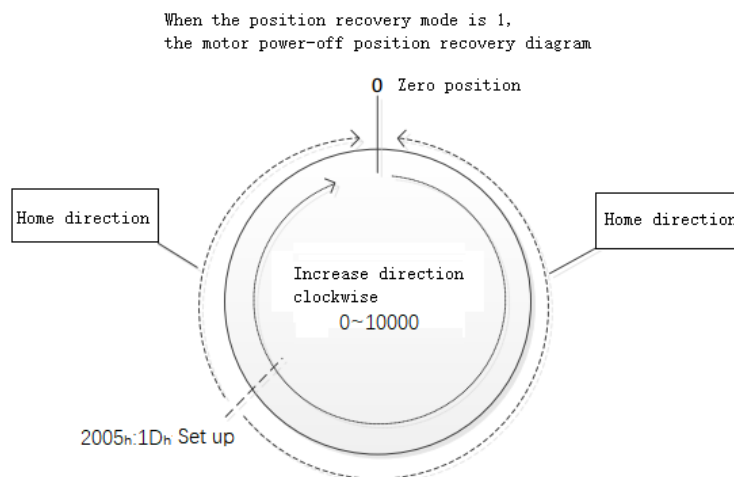


Figure 7-9

When the position recovery mode (2005<sub>h</sub>:18<sub>h</sub>) value is 0, it is suitable for multi-turn motion trajectory, and the motor can recover the current absolute position.

## 7.7 Parameter Saving and Restore

Parameter management is written according to the CiA301 standard, 1010<sub>h</sub> is the function object for saving parameters, and 1011<sub>h</sub> is the function object for reading parameters.

### 7.7.1 Parameter Saving

In the sub-index of 1010<sub>h</sub>, a value of 1 indicates that the corresponding save operation is supported. 0x65766173 is the save parameter commands. Write the save parameter command word to the corresponding sub-index of 1010<sub>h</sub>. Return 1 to save the parameters successfully, and return non-1 to unsuccessful.

For example: 1010<sub>h</sub>:01<sub>h</sub> write 0x65766173 to save the parameters to the user area.

### 7.7.2 Parameter Restore

In the sub-index of 1011<sub>h</sub>, a value of 1 indicates that the corresponding recovery operation is supported. 0x64616F6C is the recovery parameter commands. Write the recovery parameter command word to the corresponding sub-index of 1011<sub>h</sub>. Return 1 means the recovery parameter is successful, and return non-1 means unsuccessful.

For example: 1011<sub>h</sub>:01<sub>h</sub> write 0x64616F6C to restore the factory area parameters to the user area.

## 7.8 Absolute Value Encoder

The integrated motor detects the battery voltage once each time it is powered on and updates it to the parameter 200F<sub>h</sub>:0B<sub>h</sub>. When the battery voltage of the integrated motor drops below the specified value during operation, the integrated motor will issue a warning and fault information.

Table 7-18

| Battery Voltage | Alarm Information | Alarm Recovery                                                                        | Battery Replacement Method                                                                                                           |
|-----------------|-------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 2.6V>DC>2.4V    | 0x7302            | The counting of multi-turn encoders may have errors. Recommend replacing the battery. | 1.The integrated motor is powered on and in a non-operating state;<br>2.Replace the battery;<br>3.The alarm is automatically lifted. |
| DC≤2.4V         | 0x7301            | Please replace the battery immediately.                                               |                                                                                                                                      |
| DC≥2.6V         | 0x7309            | Power off and restart                                                                 |                                                                                                                                      |

## 7.9 STO Function

Safe Torque Off is a safety function. The STO function is triggered by the external hardware terminals STO1 and STO2 of the driver. Once the STO function is triggered, the driver will turn off the input signal of the driver chip, simultaneously shut off the drive control signal, and cut off the input current of the motor to prevent the driver from generating torque at the motor shaft end, causing the motor to stop running.

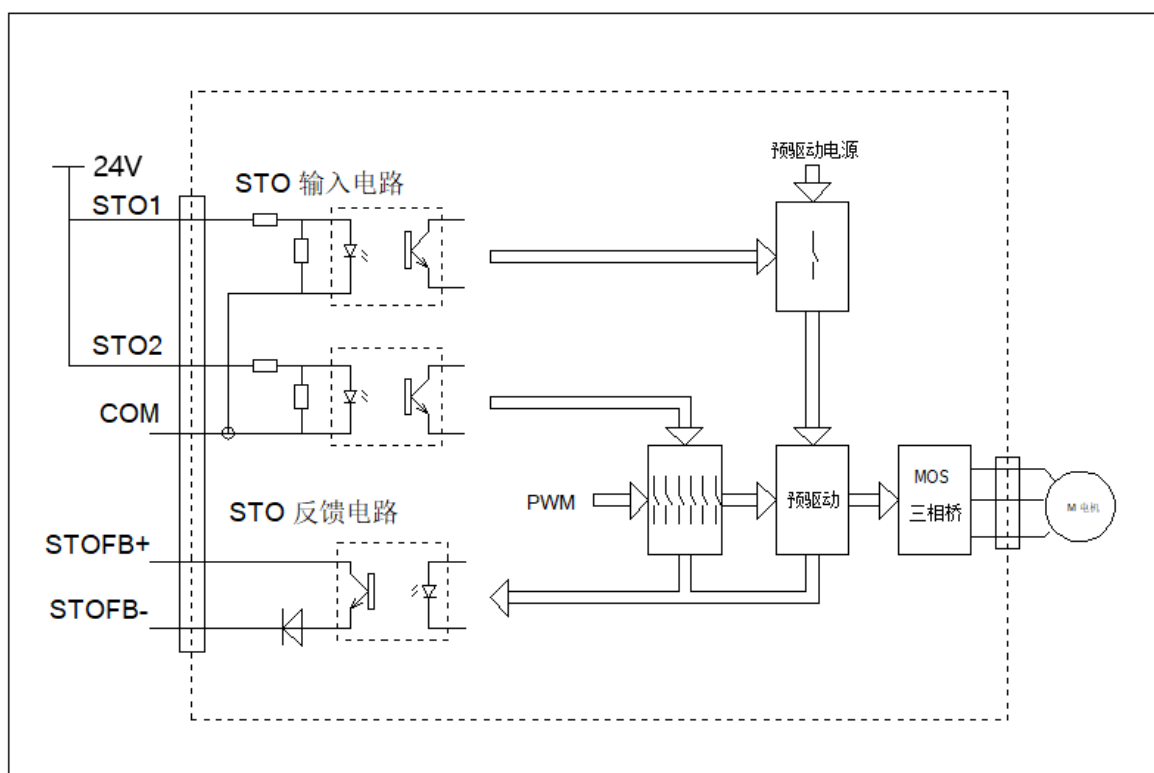


Figure 7-10 STO function wiring diagram

STO1/STO2 must be simultaneously connected to the +24VDC signal to keep them at a high level to enable the normal operation of the driver. If either one or both of them are set to a low level simultaneously, the input current of the motor will be blocked.

Table 7-19 STO Function List

| STO1 Input | STO2 Input | Motor Input Current |
|------------|------------|---------------------|
| H          | H          | Normal              |
| L          | H          | Block               |
| H          | L          | Block               |
| L          | L          | Block               |

The sequence diagram is as follows:

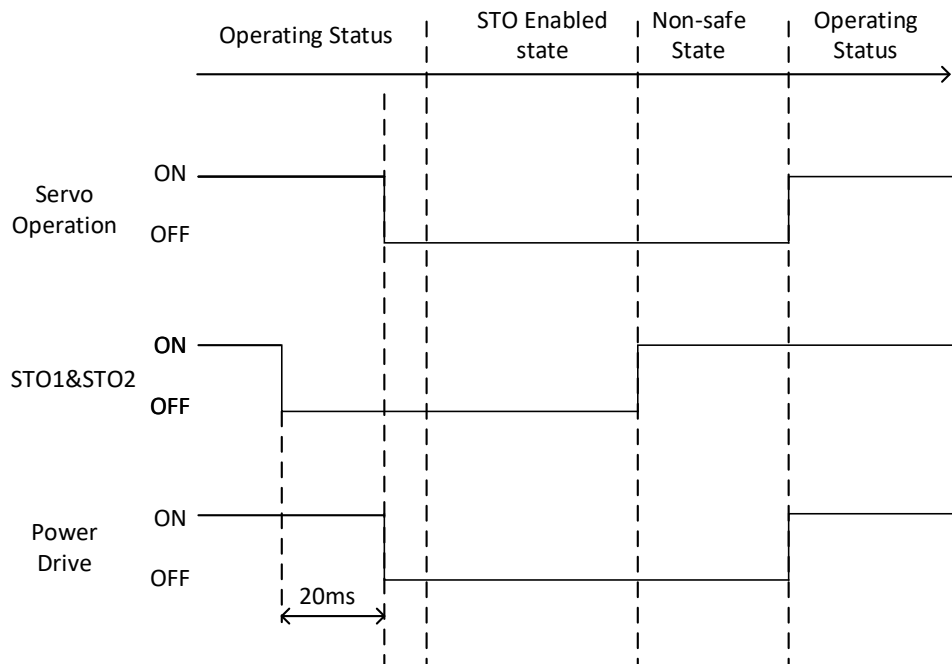


Figure 7-11 The sequence diagram of STO function

Table 7-20 STO Relevant Information

| Item              | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Definition        | Only cut off the power of the motor; It will not cut off the power supply to the driver.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description       | The STO function enables the servo motor to safely enter a torque-free state and prevents accidental start-up. When the STO function is activated, if the motor is running, the driver will immediately block the output and the servo motor will enter a free stop state. If the servo motor has a brake, the brake will close immediately and the motor will stop immediately.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| STO Enabled State | When at least one of the input signals of STO_1 or STO_2 becomes low, the STO enable state is entered. The power drive power supply and drive signal are cut off, and the servo enable command is invalid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Non-Safe State    | When switching from the STO enable state to the normal operation state, it will first enter an unsafe state. In this state, the power drive part will no longer work, and the STO_1/STO_2 input signals and servo enable instructions will not take effect. The servo will start self-checking. If the self-check is passed, the non-safe state will be exited and switched to the normal operating state. If the self-check fails, it will remain in a non-safe state and alarm for the detected faults. After clearing the faults, the self-check will be conducted again until it passes and the non-safe state will be exited.<br>2. After the servo motor is powered on, it will first enter an unsafe state. In this state, the power drive part will no longer work, and the STO_1/STO_2 input signals and servo enable instructions will not take effect. The servo will start a self-check. If the self-check is passed, it will exit the unsafe state and switch to the normal operation state or the STO enable state. If the self-check fails, it will remain in a non-safe state and alarm for the detected faults. After clearing the faults, the self-check will be conducted again until it passes and the non-safe state will be exited. |

## 8 Adjust

### 8.1 Summary

Servo gain must be adjusted reasonably according to the characteristics of the driving load, in order to maximize the performance of the integrated low-voltage servo motor and make the equipment respond quickly and accurately to the internal instructions or instructions from the master computer. Servo gain includes velocity loop gain, position loop gain, velocity loop integration time, filtering, etc, which is affected by each other. Therefore the balance between each other must be considered when adjusting servo gain parameters.

Note: before servo gain adjustment, inching test first is recommended to perform to confirm that the motor can operate normally; during the adjustment process, the vibration of the motor may be accompany, please pay full attention to safety.

### 8.2 Manual Gain Adjustment

#### 8.2.1 Objects Related

Table 8-1

| Object Index                                             | Description                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2008 <sub>h</sub> :01 <sub>h</sub> (SpeedLoopGain)       | Velocity loop gain (unit: 0.1Hz), Increasing this parameter without causing noise or vibration can accelerate the positioning , with better velocity stability and following; when there is noise arising, reduce the parameter value.                                                                                  |
| 2008 <sub>h</sub> :02 <sub>h</sub> (SpdLoopIntergrTime)  | Velocity-loop integration time constant(unit:0.01ms), reducing this value can strengthen the integral effect and accelerate positioning. but if the value is set too small,mechanical vibration will be raised.                                                                                                         |
| 2008 <sub>h</sub> :03 <sub>h</sub> (PosLoopGain)         | Gain of position-loop,increasing it can accelerate positioning and improve the anti-disturbance capacity during the motor operating stably.But setting too large can cause system instability and oscillation.                                                                                                          |
| 2008 <sub>h</sub> :0F <sub>h</sub> (SpdFdFwrFilterTime)  | Speed feedforward filter time constant (unit:0.01ms)                                                                                                                                                                                                                                                                    |
| 2008 <sub>h</sub> :10 <sub>h</sub> (SpeedFdFwrGain)      | Speed feedforward gain                                                                                                                                                                                                                                                                                                  |
| 2008 <sub>h</sub> :11 <sub>h</sub> (TorqFdFwrFilterTime) | Torque feedforward filter time constant (unit:0.01ms)                                                                                                                                                                                                                                                                   |
| 2008 <sub>h</sub> :12 <sub>h</sub> (TorqFdFwrGain)       | Torque feedforward gain                                                                                                                                                                                                                                                                                                 |
| 2007 <sub>h</sub> :06 <sub>h</sub> (TorqRefFilterTime)   | Torque command filter time constant,which can eliminate high frequency noise and mechanical resonance. The vibration raised by 2008 <sub>h</sub> :01 <sub>h</sub> can be restrained by adjusting 2007 <sub>h</sub> : 06 <sub>h</sub> . If the value is set too large, the response of the current-loop will be reduced. |

#### 8.2.2 Basic Gain Adjustment Instructions

The integrated low-voltage servo motor is composed of three control loops, which are current loop, speed loop and position loop. The current loop has the highest response frequency. The factory-default current

loop gain of servo have ensured sufficient responsiveness, and generally do not need to be adjusted, so only the position loop gain, speed loop gain and speed loop integration time constant need to be adjusted. In order to ensure the system stability, the position loop gain and the speed loop gain should be increased simultaneously.

The basic gain adjustment is as follows:

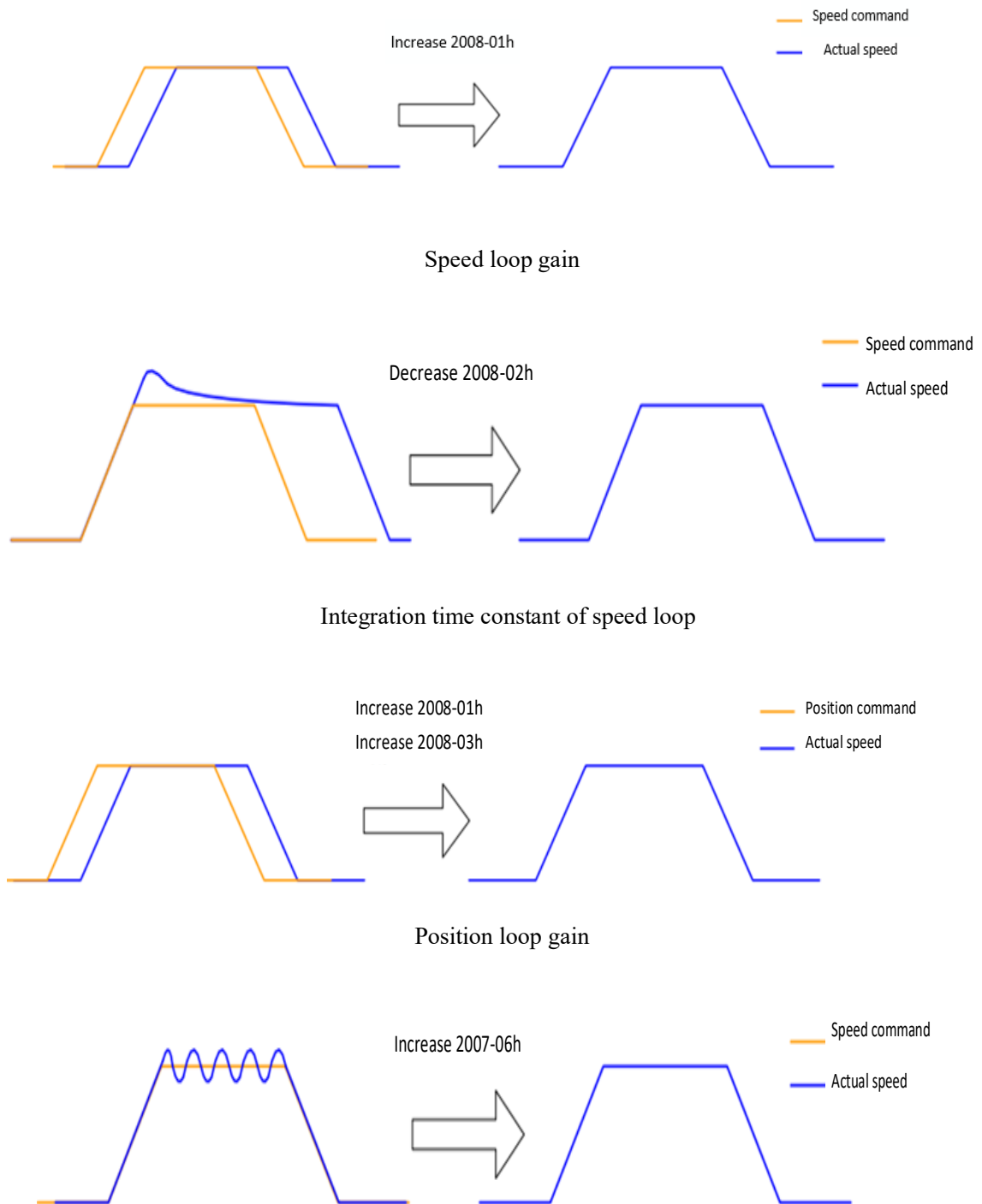


Figure 8-1 Torque instruction filter time constant

### 8.2.3 Parameter Adjustment Based on Rigid Table

The parameter adjustment based on the rigidity table refers to setting the PID parameters corresponding to different rigidity grades through the rigidity table provided by the manufacturer (as shown in the table below), in order to achieve the purpose of quickly adjusting the stability of the integrated motor.

Table 8-2 The parameters updated in the rigid table parameter adjustment mode

| Rigidity | 2008-03 <sub>h</sub> Position gain(Hz) | 2008-01 <sub>h</sub> SpeedLoop Gain(0.1Hz) | 2008-02 <sub>h</sub> Velocity Integral Time Constant(0.01ms) |
|----------|----------------------------------------|--------------------------------------------|--------------------------------------------------------------|
| 1        | 2                                      | 15                                         | 37000                                                        |
| 2        | 3                                      | 20                                         | 28000                                                        |
| 3        | 3                                      | 25                                         | 22000                                                        |
| 4        | 4                                      | 30                                         | 19000                                                        |
| 5        | 5                                      | 35                                         | 16000                                                        |
| 6        | 6                                      | 45                                         | 12000                                                        |
| 7        | 8                                      | 60                                         | 9000                                                         |
| 8        | 10                                     | 75                                         | 7000                                                         |
| 9        | 12                                     | 90                                         | 6000                                                         |
| 10       | 14                                     | 110                                        | 5000                                                         |
| 11       | 18                                     | 140                                        | 4000                                                         |
| 12       | 32                                     | 180                                        | 3100                                                         |
| 13       | 39                                     | 220                                        | 2500                                                         |
| 14       | 48                                     | 270                                        | 2100                                                         |
| 15       | 63                                     | 350                                        | 1600                                                         |
| 16       | 72                                     | 400                                        | 1400                                                         |
| 17       | 90                                     | 500                                        | 1200                                                         |
| 18       | 108                                    | 600                                        | 1100                                                         |
| 19       | 135                                    | 750                                        | 900                                                          |
| 20       | 162                                    | 900                                        | 800                                                          |
| 21       | 206                                    | 1150                                       | 700                                                          |
| 22       | 251                                    | 1400                                       | 600                                                          |
| 23       | 305                                    | 1700                                       | 500                                                          |
| 24       | 377                                    | 2100                                       | 400                                                          |
| 25       | 449                                    | 2500                                       | 400                                                          |
| 26       | 500                                    | 2800                                       | 350                                                          |
| 27       | 560                                    | 3100                                       | 300                                                          |
| 28       | 610                                    | 3400                                       | 300                                                          |
| 29       | 660                                    | 3700                                       | 250                                                          |
| 30       | 720                                    | 4000                                       | 250                                                          |
| 31       | 810                                    | 4500                                       | 200                                                          |
| 32       | 900                                    | 5000                                       | 200                                                          |

Under no-load conditions, it is recommended that the PID parameters be set to the parameters corresponding to rigidity level 12 or 13.

When parameter adjustment is required, it is recommended to prioritize PID parameters with a low rigidity grade and then gradually increase the rigidity grade until the usage requirements are met.

When the expected effect is not achieved by setting the parameters in the rigid table, the PID parameters can be fine-tuned. Optimize the effect through more meticulous adjustments.

Note: Before applying the rigid table for parameter adjustment, please confirm with the technical support personnel whether the purchased integrated motor supports this function.

## 8.2.4 Feedforward Gain Adjustment Instructions

### Speed Feedforward

Velocity feedforward can improve the responsiveness of velocity command and reduce the position deviation when the velocity is fixed. It is mainly used in the full-closed-loop position control mode. The basic adjustment method is as follows:

Set 2008<sub>h</sub>:13<sub>h</sub> to a fixed value; then, adjust the value in 2008<sub>h</sub>:14<sub>h</sub> to increase gradually from 0, until a certain value, speed feedforward effects. During the adjustment, adjust 2008<sub>h</sub>:13<sub>h</sub> and 2008<sub>h</sub>:14<sub>h</sub> repeatedly to get good balance.

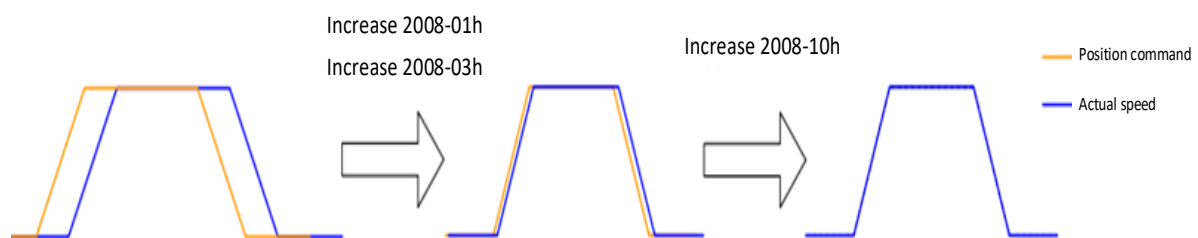


Figure 8-2 Speed feed-forward

### Torque Feedforward

Position control mode, using torque feedforward, can improve the responsiveness of torque command and reduce the position deviation when fixed acceleration and deceleration; speed control mode, using torque feedforward, can improve the responsiveness of torque command and reduce the speed deviation at fixed speed. The basic adjustment method is as follows:

Set 2008<sub>h</sub>:15<sub>h</sub> as a fixed value; then set the value of 2008<sub>h</sub>:16<sub>h</sub> to increase gradually from 0, until a certain value, speed feedforward effect. During the adjustment, adjust 2008<sub>h</sub>:15<sub>h</sub> and 2008<sub>h</sub>:16<sub>h</sub> repeatedly to find the setting with good balance.

### 8.3.4 Description of Gain Switching Adjustment

The gain switching function of the servo motor is triggered by the external DI or internal state. When the switching conditions are met, the servo motor switches to the first group or the second group of gains according to the effectiveness of the relevant parameter settings, to meet the actual use requirements. The specific functions are as follows:

- The state of motor switches from the running state to a higher gain to obtain better command tracking performance;
- The state of motor switches from the static state to a higher gain to shorten the positioning time;
- The state of motor switches from the static state (servo is enabled) to a lower gain to suppress vibration;

- The state of motor switches to different gain settings through external signals according to load conditions, etc;

### Flow Chart of Gain Switching

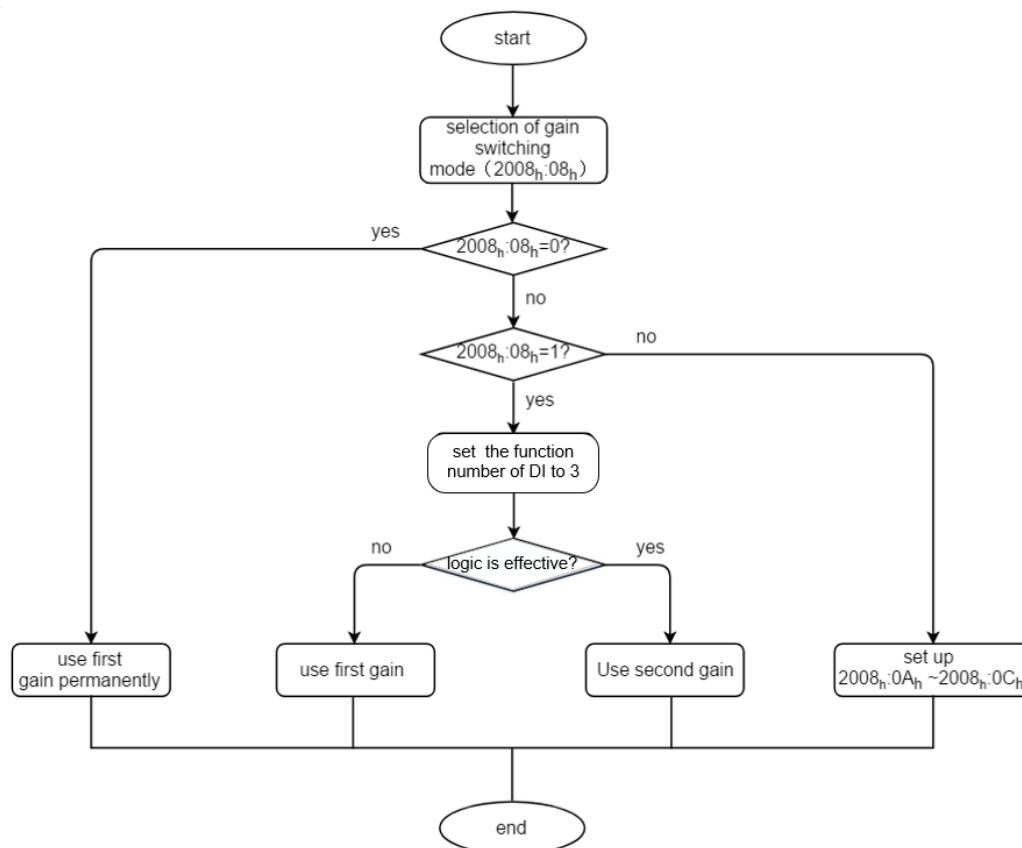


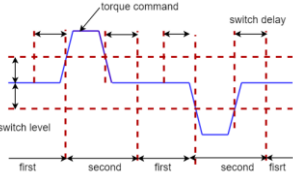
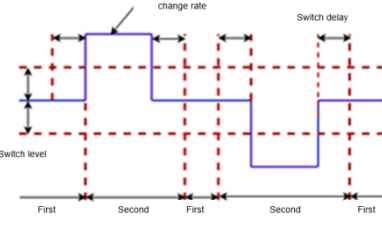
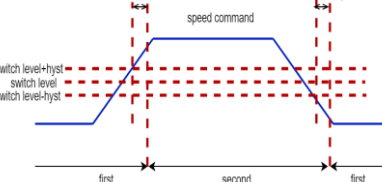
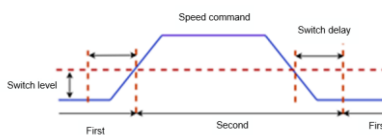
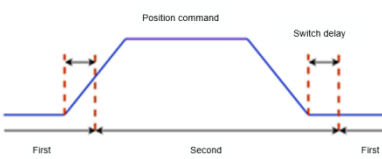
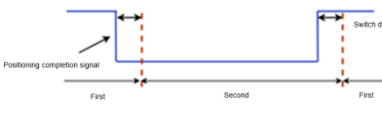
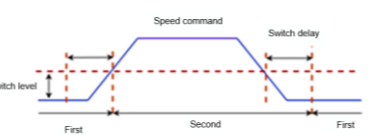
Figure 8-3

### Conditions of Gain Switching

There are 10 modes for switching the first gain (2008<sub>h</sub>: 01<sub>h</sub> ~ 2008<sub>h</sub>: 03<sub>h</sub>) and the second gain (2008<sub>h</sub>: 04<sub>h</sub> ~ 2008<sub>h</sub>: 06<sub>h</sub>). The schematic diagram and associated parameters of different modes are shown in the table below:

Table 8-1

| Gain Switching Mode                 |                                     |            | Correlation Parameters                           |                                                       |                                                       |
|-------------------------------------|-------------------------------------|------------|--------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|
| 2008 <sub>h</sub> : 08 <sub>h</sub> | Mode name                           | Sketch map | Delay time (2008 <sub>h</sub> :0A <sub>h</sub> ) | Switching level(2008 <sub>h</sub> : 0B <sub>h</sub> ) | Switching delay(2008 <sub>h</sub> : 0C <sub>h</sub> ) |
| 0                                   | Fixed use of the first set of gains | -          | Ineffective                                      | Ineffective                                           | Ineffective                                           |
| 1                                   | Use external DI to switch           | -          | Ineffective                                      | Ineffective                                           | Ineffective                                           |

| Gain Switching Mode |                                          |                                                                                                                                                                                             | Correlation Parameters |                          |                          |
|---------------------|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------|--------------------------|
| 2                   | Torque instruction                       |                                                                                                            | Effective (ms)         | Effective(%)             | Effective(%)             |
| 3                   | Speed instruction                        | The internal effective speed instruction value (606B <sub>h</sub> ) is maintained for 25ms, the first set of gains is used fixedly, and the second set of gains is used when it is changed; | Effective (ms)         | Ineffective              | Ineffective              |
| 4                   | The variation ratio of speed instruction |                                                                                                            | Effective (ms)         | Effective (rpm/ms)       | Effective (rpm/ms)       |
| 5                   | Speed instruction                        |                                                                                                          | Effective (ms)         | Effective (rpm)          | Effective (rpm)          |
| 6                   | Position deviation                       |                                                                                                          | Effective (ms)         | Effective (encoder unit) | Effective (encoder unit) |
| 7                   | Position instruction                     |                                                                                                          | Effective (ms)         | Ineffective              | Ineffective              |
| 8                   | Positioning is completed                 |                                                                                                          | Effective (ms)         | Ineffective              | Ineffective              |
| 9                   | Actual speed                             |                                                                                                          | Effective (ms)         | Effective(rpm)           | Effective(rpm)           |

**Note:** the delay time (2008<sub>h</sub>: 0A<sub>h</sub>) is effective when the first gain is switched to the second gain or the second gain is switched to the first gain.

## 8.3 Resonance Suppression

### 8.3.1 Mechanical resonance suppression

Due to the inherent resonance characteristics of the mechanical system, as the basic servo gain is increased, the servo motor may resonate at the mechanical resonance frequency, which may affect the servo performance. The notch filter can suppress resonance by reducing the gain at a specific frequency.

The integrated low-voltage servo motor has 4 groups of manual notch filters, each group of which has three parameters, namely, the frequency, band, width and depth.

Each parameter is set manually by the user, as shown in the table below:

Table 8-2

| Name           | Manual notch filters               |                                    |                                    |                                    |
|----------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
|                | 1                                  | 2                                  | 3                                  | 4                                  |
| Frequency(Hz)  | 2009 <sub>h</sub> :0D <sub>h</sub> | 2009 <sub>h</sub> :10 <sub>h</sub> | 2009 <sub>h</sub> :13 <sub>h</sub> | 2009 <sub>h</sub> :16 <sub>h</sub> |
| Notch band(Hz) | 2009 <sub>h</sub> :0E <sub>h</sub> | 2009 <sub>h</sub> :11 <sub>h</sub> | 2009 <sub>h</sub> :14 <sub>h</sub> | 2009 <sub>h</sub> :17 <sub>h</sub> |
| Notch depth(%) | 2009 <sub>h</sub> :0F <sub>h</sub> | 2009 <sub>h</sub> :12 <sub>h</sub> | 2009 <sub>h</sub> :15 <sub>h</sub> | 2009 <sub>h</sub> :18 <sub>h</sub> |

Note: The notch filter is invalid when the depth level is 0.

When using the manual notch filter, it is necessary to set the frequency of the notch filter to the actual central resonance frequency, and input the width level (central resonance frequency range) and depth level of the notch filter group. If the resonance is suppressed, the notch filter will have effect.

#### Notch Depth

When the depth level of the notch is 100, the input is completely suppressed at the center frequency; when the depth level of the notch is 0, the notch is invalid. Therefore, the larger the depth level of the notch, the deeper the notch depth, the stronger the suppression of mechanical resonance, but it may cause system instability, so it should be pay attention to when adjustment.

The principle of notch filter suppression is shown in the figure below:

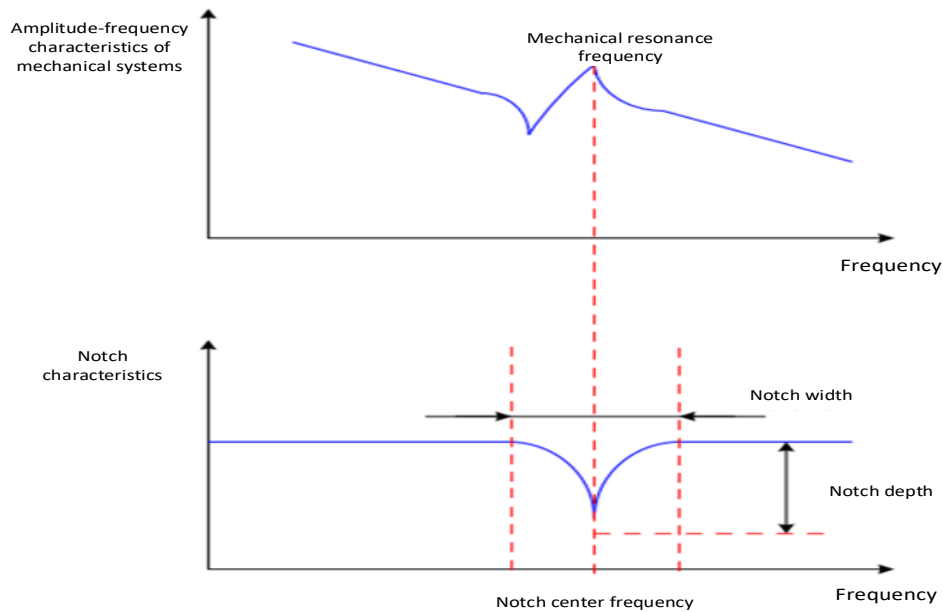


Figure 8-4

### 8.3.2 Low frequency vibration suppression

Due to the inherent characteristics of the dual inertial system during position control, end vibrations are prone to occur during an emergency stop, which affects the positioning effect. The frequency of such vibrations is generally within 100 Hz. The low frequency vibration suppression function can reduce the vibrations here.

#### Related objects

Table 8-3

| Object index                                                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2009 <sub>h</sub> :05 <sub>h</sub> (LowFreqResonantDepressMode)   | Low frequency resonance suppression mode selection, 0-off, 1-on                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 2009 <sub>h</sub> :1D <sub>h</sub> (LowFreqResonantFreq)          | Low frequency vibration frequency (unit: 0.1Hz), set the low frequency vibration suppression center frequency, the limit range is 1 ~ 1000                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 2009 <sub>h</sub> :1E <sub>h</sub> (LowFreqResonantFreqFilterSet) | Vibration suppression width level (unit%), set the effective frequency range of vibration suppression, 0 means only suppress the vibration at the center frequency; increase the setting value, you can increase the frequency range of low frequency vibration suppression, but it will lead to longer positioning time ; If the setting value is too small, the vibration suppression (such as belt load) cannot be completed when the load vibration frequency will change, and the setting can be debugged according to the actual situation. Limit range 0 ~ 100 |
| 2009 <sub>h</sub> :23 <sub>h</sub> (Reserve0)                     | Damping ratio coefficient, set the system vibration damping ratio coefficient, this value defaults to 5, generally not modified, the limit range is 0 ~ 50                                                                                                                                                                                                                                                                                                                                                                                                            |

### Set low frequency vibration suppression parameters

- Turn on the low-frequency vibration suppression mode, set 1 at 2009h: 05h;
- Use NiMStudio host computer software to collect the waveform of the motor in the position positioning state, and automatically calculate the frequency of low-frequency resonance after the movement stops;

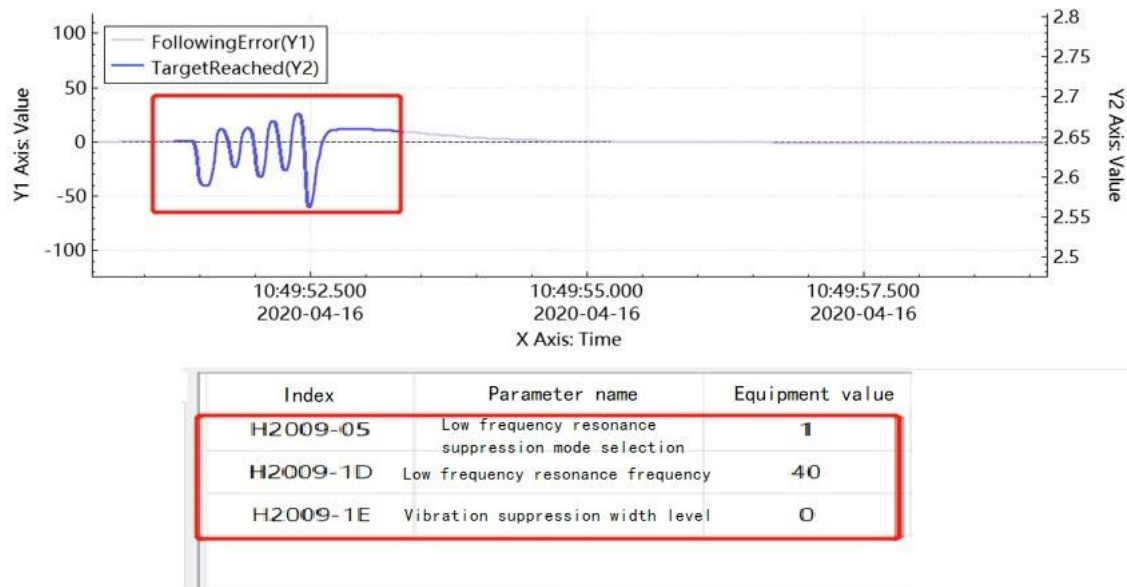


Figure 8-5

- Set the low-frequency vibration frequency and vibration suppression width level according to the low-frequency vibration frequency recognized by the NiMStudio host computer software;
- Observe the effect of motor positioning after using the low frequency vibration suppression function. If it is within the acceptable range, it means that the low frequency vibration suppression is effective; if it is not within the acceptable range, repeat the above two steps or manually set the low frequency vibration frequency and vibration suppression width grade.



Figure 8-6

## 9 Error Management

### 9.1 Alarm Codes

When the integrated servo has a warning or fault, the servo will actively alarm (indicator light - yellow light flashes, flashing frequency being 2Hz indicates warning, 4Hz indicates fault), and execute corresponding actions. The corresponding alarm code will be stored in object 1003<sub>h</sub>: 02<sub>h</sub> ~ 1003<sub>h</sub>: 11<sub>h</sub>, and the current fault number be stored in object 1003<sub>h</sub>: 01<sub>h</sub>.

There are 16 alarm queues in object 1003<sub>h</sub>, which are stored in stack mode and follow the first in, first out rule. If the historical alarm storage is occupied, a new alarm will be generated, and the earliest errors be deleted, the previous errors move downward in turn. The specific alarm codes are as follows:

Table 9-1

| Alarm codes | Content of Alarms                    | Alarm Type          | Response Code | Self Reset Allowed | (Error Code) |
|-------------|--------------------------------------|---------------------|---------------|--------------------|--------------|
| 0x2300      | Over current                         | Fault               | 0             | No                 | 0x2301       |
| 0x4012311   | Over load                            | Warning             | 4             | Yes                | 0x2311       |
| 0x3002312   | Lock motor                           | Halt and Lock Motor | 3             | No                 | 0x2312       |
| 0x13210     | Power over-voltage                   | Fault               | 0             | Yes                | 0x3210       |
| 0x13211     | Over pressure relief value fault *   | Fault               | 1             | Yes                | 0x3211       |
| 0x1013220   | Power under-voltage                  | Fault               | 1             | Yes                | 0x3220       |
| 0x14210     | Over temperature alarm               | Fault               | 0             | Yes                | 0x4210       |
| 0x14220     | Under temperature alarm              | Fault               | 0             | Yes                | 0x4220       |
| 0x5080      | Drive fault                          | Fault               | 0             | No                 | 0x5080       |
| 0x5081      | Phase-A upper-bridge Gate fault      | Fault               | 0             | No                 | 0x5081       |
| 0x5082      | Phase-A lower-bridge Gate fault      | Fault               | 0             | No                 | 0x5082       |
| 0x5083      | Phase-B upper-bridge Gate fault      | Fault               | 0             | No                 | 0x5083       |
| 0x5084      | Phase-B lower-bridge Gate fault      | Fault               | 0             | No                 | 0x5084       |
| 0x5085      | Phase-C upper-bridge Gate fault      | Fault               | 0             | No                 | 0x5085       |
| 0x5086      | Phase-C lower-bridge Gate fault      | Fault               | 0             | No                 | 0x5086       |
| 0x5540      | Flash fault                          | Fault               | 0             | No                 | 0x5540       |
| 0x5541      | Flash initialization fault           | Fault               | 0             | No                 | 0x5541       |
| 0x4005542   | Flash validation error warning *     | caveat              | 4             | No                 | 0x5542       |
| 0x5543      | Flash user area without parameters * | Fault               | 0             | No                 | 0x5543       |
| 0x4005544   | Power down position storage          | Warning             | 4             | No                 | 0x5544       |

| Alarm codes | Content of Alarms                            | Alarm Type          | Response Code | Self Reset Allowed | (Error Code) |
|-------------|----------------------------------------------|---------------------|---------------|--------------------|--------------|
|             | abnormal                                     |                     |               |                    |              |
| 0x4005545   | Data saved after power failure is not stored | Warning             | 4             | No                 | 0x5545       |
| 0x6000      | Hardware initialization fault                | Fault               | 0             | No                 | 0x6000       |
| 0x16320     | Parameter setting fault                      | Fault               | 0             | Yes                | 0x6320       |
| 0x6321      | Registration fault *                         | Fault               | 0             | No                 | 0x6321       |
| 0x7305      | Encoder fault                                | Fault               | 0             | No                 | 0x7305       |
| 0x7306      | Encoder fault *                              | Fault               | 0             | No                 | 0x7306       |
| 0x4017307   | Encoder warning *                            | Warning             | 4             | Yes                | 0x7307       |
| 0x1007309   | Encoder battery failure fault                | Fault               | 1             | No                 | 0x7309       |
| 0x17310     | Over velocity                                | Fault               | 0             | Yes                | 0x7310       |
| 0x17501     | Communication fault                          | Fault               | 0             | Yes                | 0x7501       |
| 0x17502     | Communication warning                        | Warning             | 4             | Yes                | 0x7502       |
| 0x8610      | Homing timeout                               | Fault               | 0             | No                 | 0x8610       |
| 0x8611      | Tracking fault                               | Fault               | 0             | No                 | 0x8611       |
| 0x3018613   | Software over limit fault                    | Halt and Lock Motor | 3             | No                 | 0x8613       |
| 0x3018614   | Overrun switch                               | Halt and Lock Motor | 3             | No                 | 0x8614       |
| 0x8700      | Tracking fault                               | Fault               | 0             | No                 | 0x8700       |
| 0x4018615   | Curve planning calculation fault             | Warning             | 4             | Yes                | 0x8615       |
| 0x18616     | Target position overflow                     | Fault               | 0             | No                 | 0x8616       |
| 0x5018617   | Curve planning parameter too small           | Ignore              | 5             | Yes                | 0x8617       |
| 0xFF01      | Motor parameter identification fault         | Fault               | 0             | No                 | 0xFF01       |
| 0x401FF02   | Unexecutable commands *                      | Warning             | 4             | No                 | 0xFF02       |
| 0xFF05      | STO_1 failed to close                        | Fault               | 0             | No                 | 0xFF05       |
| 0xFF06      | STO_1 failed to enable                       | Fault               | 0             | No                 | 0xFF06       |
| 0xFF07      | STO_2 failed to close                        | Fault               | 0             | No                 | 0xFF07       |
| 0xFF08      | STO_2 failed to enable                       | Fault               | 0             | No                 | 0xFF08       |
| 0xFF09      | STO input abnormal fault                     | Fault               | 0             | No                 | 0xFF09       |
| 0xFF0A      | STO enabled state                            | Fault               | 0             | No                 | 0xFF0A       |
| 0xFF0B      | Non-safe state                               | Fault               | 0             | No                 | 0xFF0B       |
| 0xFF0C      | Encoder calibration timeout                  | Fault               | 0             | No                 | 0xFF0C       |

**Note:**

- Alarm contents with \* symbol cannot be configured by object fault code parameter group 200Eh. The integrated servo motor can only operate normally after the drive and hardware initialization failure requires restarting.
- 603F<sub>h</sub> contains the last error of the integrated servo motor, corresponding to the fault code in the lower 16 digits of the alarm code.

## 9.2 Fault action setting

The alarm code is composed of a fault code (16 digits), a fault response code (8 digits), and a self-reset permission (8 digits). The fault code indicates the failure phenomenon of the servo motor under abnormal conditions. The current status of the servo motor is determined by the fault code, which generally corresponds to the object 603Fh (error code). 0 indicates that the servo motor is currently free of faults; fault response codes indicate that the servo motor is faulty. After the corresponding action mode and the treatment of status word fault bits, such as free stop-fault status, stop at a certain deceleration-fault status, suspended shaft lock-non-fault status, etc.; self-reset allows the servo motor's fault to be eliminated. Whether to allow the servo motor to automatically reset the fault bit of the current status word, 1-enabled, 0-not allowed. The order of the corresponding bits is as follows:

|                         |    |    |    |    |    |    |    |                        |    |    |    |    |    |    |    |
|-------------------------|----|----|----|----|----|----|----|------------------------|----|----|----|----|----|----|----|
| 31                      | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23                     | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| Fault response code [8] |    |    |    |    |    |    |    | Self-reset enabled [8] |    |    |    |    |    |    |    |
| 15                      | 14 | 13 | 12 | 11 | 10 | 9  | 8  | 7                      | 6  | 5  | 4  | 3  | 2  | 1  | 0  |
| Fault code [16]         |    |    |    |    |    |    |    |                        |    |    |    |    |    |    |    |

### Specific definition of fault response code

- 0- The state machine is switched to the fault state (refer to “4.1 CiA402 State Machine”). If 605E ≥ 0, the fault shutdown mode selected by 605E is adopted; otherwise: the power tube is fully closed and the machine stops freely.
- 1- The state machine is switched to the fault state (refer to “4.1 CiA402 State Machine”). If 605E ≥ 0, then the fault stop mode selected by 605E; otherwise: stop according to the slow curve to turn off the output.
- 2- The state machine is switched to the fault state (refer to “4.1 CiA402 State Machine”). If 605E ≥ 0, then the fault stop mode selected by 605E; otherwise: stop and close the output according to the fast curve.
- 3- Press the quick curve to suspend the locked axis without switching to the fault state and not affected by the object 605Eh.
- 4- Warning and do not change the current operating state, do not switch to the fault state and are not affected by the object 605Eh.
- 5- Ignore and record in 1003h. Not switching to fault state is not affected by object 605Eh.
- 6- Ignored but not recorded in 1003h, does not switch to fault state and is not affected by object 605Eh.

### Alarm code configuration

The fault code group 200Eh exemplifies the alarm codes that can be freely configured by the user, as follows:

Table 9-2

| Fault code group<br>200Eh | Meaning                | Default fault action |
|---------------------------|------------------------|----------------------|
| 0x4012311                 | Motor overload         | No                   |
| 0x3002312                 | Motor stalled          | No                   |
| 0x13210                   | Power overvoltage      | Yes                  |
| 0x1013220                 | Power undervoltage     | Yes                  |
| 0x14210                   | High temperature alarm | Yes                  |

| Fault code group<br>200Eh | Meaning                                 | Default fault action |
|---------------------------|-----------------------------------------|----------------------|
| 0x14220                   | Low temperature alarm                   | Yes                  |
| 0x16320                   | Parameter setting error                 | Yes                  |
| 0x17310                   | Over Speed                              | Yes                  |
| 0x17501                   | Communication failure                   | Yes                  |
| 0x8610                    | Origin return timeout                   | Yes                  |
| 0x8611                    | Out of position                         | Yes                  |
| 0x3018613                 | Software limit error                    | No                   |
| 0x3018614                 | Limit switch error                      | No                   |
| 0x3285                    | Output phase failure                    | Yes                  |
| 0x4018615                 | Curve planning calculation error        | No                   |
| 0x18616                   | Target position overflow                | Yes                  |
| 0x5018617                 | Curve planning parameters are too small | No                   |

Note: "Yes (No)" of the fault action in the above list indicates whether the motor enters the fault state after this fault occurs.

### Example of alarm code configuration

Power undervoltage setting

200Eh: 04h (power undervoltage) is set to 0x1003220. When the servo motor is running, the power supply voltage is lower than the detection threshold (default 24V), the servo motor stops according to the stop mode set by 605E (refer to the corresponding bit sequence, the fault response code Correspondence is 1); when the power supply voltage returns to normal, the motor can perform normal operation through manual reset operation (refer to the corresponding bit sequence, self-reset permission corresponds to 0).

## 9.3 Fault Reset

After the integrated servo fault recovers, the fault codes that are not allowed for self-reset must be manually reset before the motor can perform normal operation. There are three ways of manual reset operation, as follows:

- After the motor is dis-enable,clear fault status by sending control 0x80 (rising edge of control word bit7 is valid)
- One of the functions is configured as the function code 2 (alarm reset) through the physical input terminal (2003h), and the corresponding logic selection is set. The logic selection of the setting terminal makes it valid to reset.
- One of the functions is configured as the function code 2 (alarm reset) through the virtual input terminal (2017h), and the corresponding logic selection is set, and it can be reset according to the logic selection of its setting terminal.

## 9.4 fault detection description

- Drive fault detection

The fault is triggered by the interrupt response of the error signal from the drive chip, and the drive fault will be reported if it is triggered.

- I<sup>2</sup>t Overload and Locked rotor error detection

The time integration of I<sup>2</sup> will be calculated as the motor is operating above the rated current. When the

integral value is greater than the product of the set maximum current (2000<sub>h</sub>: 0A<sub>h</sub>) and the maximum current duration (2000<sub>h</sub>: 0B<sub>h</sub>), it will trigger Overload or Locked rotor (the velocity is lower than 5 revolutions/min) error. If Locked rotor error occurs, the output of servo will be forbade; if Overload warning occurs, the torque output of servo will be limited to rated value, and the limit will be released after 30s.

- Over temperature and Under temperature fault detection

When the temperature of the servo drive is higher than 90 , Over temperature error will be triggered, which is removed when the temperature is lower than 70 ; when the temperature of the servo drive is lower than - 25 , Under temperature error will be triggered, which is removed when the temperature is higher than - 20 .

- Over voltage and Under voltage error detection

When the voltage of servo power-supply is higher than the set voltage (2001<sub>h</sub>: 11<sub>h</sub>), Over voltage error is triggered; when the voltage of servo power-supply is lower than the set voltage (2001<sub>h</sub>: 10<sub>h</sub>), Under voltage error is triggered.

- Parameter setting error detection

Parameter setting error is triggered when the multi-function terminal setting is wrong, including different terminals (physical terminal and virtual terminal) with the same function number or the 14th, 15th and 31th function numbers being not set in cia402 Homing mode.

- Over-velocity error detection

When the velocity of the servo motor is higher than the velocity set in (200A<sub>h</sub>: 06<sub>h</sub>) and maintaining for 10ms, the Over-velocity error will be triggered, and the error will be removed when the velocity is lower than the set speed.

- Communication error detection

This error is identified by the slave protocol-error flag-bit in EtherCAT communication.

- Hardware initialization error detection

When the servo is powered on, if the hardware (drive, encoder) is not initialized successfully, the hardware initialization error will be triggered.

- Flash error detection

When the flash of servo is operated, flash error will be triggered if the parameters storing is fail or the parameters reading is failed in power-on storage.

- Homing timeout error detection

When Homing mode in cia402 is enabled, if it fails to complete the Homing action within the limited time (2005<sub>h</sub>: 1C<sub>h</sub>), it will trigger the Homing timeout error.

- Tracking error detection

When the position deviation of servo motor exceeds 6065<sub>h</sub> and maintaining for 6066<sub>h</sub> (ms), the Tracking error will be triggered in position mode.

- Software over limit error detection

In the position control mode, this error is judged according to the software limit value (user unit) set in 607B<sub>h</sub> and 607D<sub>h</sub>. If the actual position exceeds the set value, it will trigger the Software over limit error.

- Overrun switch error detection

According to the 14th and 15th function numbers set by the multi-function terminal, check whether the positive and negative limit switches are triggered, and the overrun switch error occurs when it is triggered.

- Phase failure error detection

When the integrated servo operates with one or more phase is lack, the phase failure error will be triggered.

- Target position overflow error detection

In the position control mode, if the product of the given position (607A<sub>h</sub>) and the gear ratio (6091<sub>h</sub>) exceeds the data range of int32 (- 2147483648 ~ + 2147483647) , the target position overflow error will be triggered.

- Curve planning parameter too small error detection

In the position control mode, if the S-shaped curve can't be operated in the given displacement range under the given shock or acceleration, the curve planning parameters too small error will be triggered.

- Unexecutable commands detection

When the servo motor operates the save word command in the enabled state (write 0x65766173 for 1010h:01h), operates the save word command when the current power supply voltage is lower than 80% of the rated voltage of the servo motor (2000<sub>h</sub>:07<sub>h</sub>), and operates the save word command after the power-off parameters are saved, the servo motor reports a fault of being unable to execute the command.

- Encoder low voltage fault detection

When the servo motor is powered on, the encoder battery voltage is detected to be  $\leq 2.4V$ , and a fault 0x1007301 is reported.

- Encoder low voltage alarm detection

When the servo motor is powered on, the encoder battery voltage is detected to be between 2.4V and 2.6V, and a alarm 0x4017302 is reported.

- Encoder communication fault detection

The servo motor fails to communicate with the encoder and reports a 0x7303 fault.

- Encoder multi-turn counting error detection

If the encoder is not calibrated or the calibration fails, a 0x7304 fault is reported.

- Encoder battery failure fault

①During power off, if no battery is connected, it will report a 0x7309 fault.

②The charged hot-swappable IO battery extension cable will report a 0x7309 fault.

When this fault is reported, connect the battery, restart the power supply of the servo motor, and reset the position to zero.

- STO\_1 failed to close detection

STO\_1 The input signal is high, the power drive power supply is disconnected, and the 0XFF05 fault is reported. The STO\_2 input signal is high, the power drive power supply is disconnected, and a 0XFF07 fault is reported.

- STO\_1 failed to enable detection

The input signal of STO\_1 is low, the power drive power supply is connected, and the 0XFF06 fault is reported. The input signal of STO\_2 is low, the power drive power supply is connected, and the 0XFF08 fault is reported.

- STO input abnormal fault detection

If either of the input signals STO\_1 or STO\_2 becomes high and the other remains low for more than 6ms, a 0xFF09 fault is reported.

- STO enabled state detection

When at least one input signal of STO\_1 or STO\_2 drops, the STO enable state is entered. The power drive power supply and drive signal are cut off, and the servo enable command becomes invalid, reporting 0xFF0A.

- Non-safe state

Each time the power is turned on or the STO is restored, the motor and encoder are not inspected completely or fail the inspection.

## 10 Object Dictionary

Object dictionary is an important part of device specification. It is an ordered set of parameters and variables, including all parameters of device description and device network status. Each object includes index, sub-index, name, description, data type, data range, accessibility, mappability, factory-setting, unit and activate method.

### Noun interpretation

Index: Specifies the position of the same type of object in the object dictionary, expressed in hexadecimal

Sub index: ,the offset of each object in this class , there are multiple objects under the same index

"Data type and range": refer to the following table for details please

| Data type | Data range             | Data length |
|-----------|------------------------|-------------|
| Int8      | -128~127               | 1 bit       |
| Int16     | -32768~32767           | 2 bits      |
| Int32     | -2147483648~2147483647 | 4 bits      |
| UInt8     | 0~255                  | 1 bit       |
| UInt16    | 0~65535                | 2 bits      |
| UInt32    | 0~4294967295           | 4 bits      |
| String    | ASCII                  | ~           |

"Accessibility": please refer to the following table for details

| Accessibility | Description           |
|---------------|-----------------------|
| RW            | Readable and writable |
| WO            | just writable         |
| RO            | Just Readable         |

Mappability: please refer to the following table for details

| Mappability | Description         |
|-------------|---------------------|
| NO          | Not mappable in PDO |
| RPDO        | Can be used as RPDO |
| TPDO        | Can be used as TPDO |

"Activate method": please refer to the following table for details

| activate method    | Description                                                                              |
|--------------------|------------------------------------------------------------------------------------------|
| Immediate activate | After parameter setting, the set value takes effect immediately                          |
| Stop activate      | After the parameter setting, the set value takes effect until the drive is in stop state |
| Restart activate   | After the parameter setting , the set value takes effect until the drive is restart      |

## 10.1 Communication Parameter Group 1000h Description

| Index                   | Sub-index       | Name                    | Description                            | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|-------------------------|----------------------------------------|-----------|------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1000<sub>h</sub></b> | 00 <sub>h</sub> | Device type             | Device type                            | uint32    | -          | RO                 | NO               | 0x20192            | -    | -                  |
| <b>1001<sub>h</sub></b> | 00 <sub>h</sub> | Error Register          | Error Register                         | uint16    | -          | RO                 | NO               | 0                  | -    | -                  |
| <b>1003<sub>h</sub></b> | 01 <sub>h</sub> | Pre-defined error field | Number of alarms in the current device | uint8     | 0~255      | RO                 | NO               | 0                  | -    | -                  |
|                         | 02 <sub>h</sub> | s01_NumberErrors        | Historical alarm cache                 | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 03 <sub>h</sub> | s02_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 04 <sub>h</sub> | s03_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 05 <sub>h</sub> | s04_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 06 <sub>h</sub> | s05_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 07 <sub>h</sub> | s06_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 08 <sub>h</sub> | s07_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 09 <sub>h</sub> | s08_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0A <sub>h</sub> | s09_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0B <sub>h</sub> | s10_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0C <sub>h</sub> | s11_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0D <sub>h</sub> | s12_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0E <sub>h</sub> | s13_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0F <sub>h</sub> | s14_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 10 <sub>h</sub> | s15_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 11 <sub>h</sub> | s16_ErrorField          |                                        | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
| <b>1008<sub>h</sub></b> | 00 <sub>h</sub> | Device name             | Device name                            | String    | -          | RO                 | NO               | NiMotion Servo     | -    | -                  |
| <b>1009<sub>h</sub></b> | 00 <sub>h</sub> | Hardware verison        | Hardware verison                       | String    | -          | RO                 | NO               | VDB6040B-COE-A     | -    | -                  |

| Index                   | Sub-index       | Name                | Description                                     | Data type | Data range    | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|---------------------|-------------------------------------------------|-----------|---------------|--------------------|------------------|--------------------|------|--------------------|
| <b>100A<sub>h</sub></b> | 00 <sub>h</sub> | Software version    |                                                 | String    | -             | RO                 | NO               | 1.1                | -    | -                  |
| <b>1010<sub>h</sub></b> | 01 <sub>h</sub> | SaveAllParam        |                                                 | uint32    | -             | RW                 | NO               | 1                  | -    | -                  |
|                         | 09 <sub>h</sub> | SaveNimFltMnitParam | Save factory power-down parameters              | uint32    | -             | RW                 | NO               | 1                  | -    | -                  |
|                         | 0A <sub>h</sub> | SaveNimFunParam     | Save factory version information parameters     | uint32    | -             | RW                 | NO               | 1                  | -    | -                  |
|                         | 0B <sub>h</sub> | SaveNimOriParam     | Save all factory parameters                     | uint32    | -             | RW                 | NO               | 1                  | -    | -                  |
| <b>1011<sub>h</sub></b> | 0               | RestAllParam        | Read all parameters                             | uint32    | -             | RW                 | NO               | 1                  | -    | -                  |
|                         | 0B <sub>h</sub> | RestNimOriParam     | Read all factory parameters                     | uint32    | -             | RW                 | NO               | 1                  | -    | -                  |
| <b>1018<sub>h</sub></b> | 01 <sub>h</sub> | Vendor ID           | unique manufacturer ID number authorized by ETG | uint32    | -             | RO                 | NO               | 0x2D               | -    | -                  |
|                         | 02 <sub>h</sub> | Product code        | product code                                    | uint32    | -             | RO                 | NO               | 0x02               | -    | -                  |
|                         | 03 <sub>h</sub> | Revision            | Software version number                         | uint32    | -             | RO                 | NO               | -                  | -    | -                  |
|                         | 04 <sub>h</sub> | Serial number       | Product Serial Number                           | uint32    | -             | RO                 | NO               | -                  | -    | -                  |
| <b>1600<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001        | RPDO entry 1                                    | uint32    | 0x1000~0x6FFF | RO                 | NO               | 0x60400010         | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002        | RPDO entry 2                                    | uint32    | 0x1000~0x6FFF | RO                 | NO               | 0x60600010         | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003        | RPDO entry 3                                    | uint32    | 0x1000~0x6FFF | RO                 | NO               | 0x607A0020         | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004        | RPDO entry 4                                    | uint32    | 0x1000~0x6FFF | RO                 | NO               | 0x60420010         | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005        | RPDO entry 5                                    | uint32    | 0x1000~0x6FFF | RO                 | NO               | 0x60710010         | -    | -                  |
|                         | 06 <sub>h</sub> | SubIndex 006        | RPDO entry 6                                    | uint32    | 0x1000~0x6FFF | RO                 | NO               | 0x60C10020         | -    | -                  |

| Index                   | Sub-index       | Name         | Description  | Data type | Data range        | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|--------------|--------------|-----------|-------------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1600<sub>h</sub></b> | 07 <sub>h</sub> | SubIndex 002 | RPDO entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x60FF002<br>0     | -    | -                  |
|                         | 08 <sub>h</sub> | SubIndex 003 | RPDO entry 3 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6072001<br>0     | -    | -                  |
|                         | 09 <sub>h</sub> | SubIndex 004 | RPDO entry 4 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x607F002<br>0     | -    | -                  |
|                         | 0A <sub>h</sub> | SubIndex 005 | RPDO entry 5 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6080002<br>0     | -    | -                  |
|                         | 0B <sub>h</sub> | SubIndex 006 | RPDO entry 6 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x2031021<br>0     | -    | -                  |
| <b>1601<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | RPDO entry 1 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6040001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | RPDO entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6060001<br>0     | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003 | RPDO entry 3 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x607A002<br>0     | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004 | RPDO entry 4 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x60FF002<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | RPDO entry 5 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6072001<br>0     | -    | -                  |
|                         | 06 <sub>h</sub> | SubIndex 006 | RPDO entry 6 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x2031021<br>0     | -    | -                  |
| <b>1602<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | RPDO entry 1 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6040001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | RPDO entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6060001<br>0     | -    | -                  |

| Index                   | Sub-index       | Name         | Description   | Data type | Data range        | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|--------------|---------------|-----------|-------------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1602<sub>h</sub></b> | 03 <sub>h</sub> | SubIndex 003 | RPDO entry 3  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x607A002<br>0     | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004 | RPDO entry 4  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6071001<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | RPDO entry 5  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x60FF002<br>0     | -    | -                  |
|                         | 06 <sub>h</sub> | SubIndex 006 | RPDO entry 6  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6072001<br>0     | -    | -                  |
|                         | 07 <sub>h</sub> | SubIndex 007 | RPDO entry 7  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x2031021<br>0     | -    | -                  |
| <b>1603<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | RPDO entry 1  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6040001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | RPDO entry 2  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6060001<br>0     | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003 | RPDO entry 3  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x60FF002<br>0     | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004 | RPDO entry 4  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x607F002<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | RPDO entry 5  | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6080002<br>0     | -    | -                  |
| <b>1A00<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | TPDO0 entry 1 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x603F001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | TPDO0 entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6041001<br>0     | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003 | TPDO0 entry 3 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6061001<br>0     | -    | -                  |

| Index                   | Sub-index       | Name         | Description   | Data type | Data range        | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|--------------|---------------|-----------|-------------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1A00<sub>h</sub></b> | 04 <sub>h</sub> | SubIndex 004 | TPDO0 entry 4 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6064002<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | TPDO0 entry 5 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6063002<br>0     | -    | -                  |
|                         | 06 <sub>h</sub> | SubIndex 006 | TPDO0 entry 6 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6069002<br>0     | -    | -                  |
|                         | 07 <sub>h</sub> | SubIndex 007 | TPDO0 entry 7 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x606C002<br>0     | -    | -                  |
|                         | 08 <sub>h</sub> | SubIndex 007 | TPDO0 entry 7 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6077001<br>0     | -    | -                  |
|                         | 09 <sub>h</sub> | SubIndex 007 | TPDO0 entry 7 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6078001<br>0     | -    | -                  |
|                         | 0A <sub>h</sub> | SubIndex 007 | TPDO0 entry 7 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x200B051<br>0     | -    | -                  |
| <b>1A01<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | TPDO1 entry 1 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x603F001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | TPDO1 entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6041001<br>0     | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003 | TPDO1 entry 3 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6061001<br>0     | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004 | TPDO1 entry 4 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6063002<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | TPDO1 entry 5 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x606C002<br>0     | -    | -                  |
|                         | 06 <sub>h</sub> | SubIndex 006 | TPDO1 entry 6 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6077001<br>0     | -    | -                  |

| Index                   | Sub-index       | Name         | Description   | Data type | Data range        | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|--------------|---------------|-----------|-------------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1A01<sub>h</sub></b> | 07 <sub>h</sub> | SubIndex 007 | TPDO1 entry 7 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x200B051<br>0     | -    | -                  |
| <b>1A02<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | TPDO2 entry 1 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x603F001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | TPDO2 entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6041001<br>0     | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003 | TPDO2 entry 3 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6061001<br>0     | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004 | TPDO2 entry 4 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6069002<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | TPDO2 entry 5 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x606C002<br>0     | -    | -                  |
| <b>1A03<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001 | TPDO3 entry 1 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x603F001<br>0     | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002 | TPDO3 entry 2 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6041001<br>0     | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003 | TPDO3 entry 3 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6061001<br>0     | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004 | TPDO3 entry 4 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6064002<br>0     | -    | -                  |
|                         | 05 <sub>h</sub> | SubIndex 005 | TPDO3 entry 5 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6063002<br>0     | -    | -                  |
|                         | 06 <sub>h</sub> | SubIndex 006 | TPDO3 entry 6 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x6069002<br>0     |      |                    |
|                         | 07 <sub>h</sub> | SubIndex 007 | TPDO3 entry 7 | uint32    | 0x1000~0x6<br>FFF | RO                 | NO               | 0x606C002<br>0     |      |                    |

| Index                   | Sub-index       | Name                                         | Description                  | Data type | Data range  | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|----------------------------------------------|------------------------------|-----------|-------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1C00<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001                                 | Communication type of SM0    | uint8     | -           | RO                 | NO               | 1                  | -    | -                  |
|                         | 02 <sub>h</sub> | SubIndex 002                                 | Communication type of SM1    | uint8     | -           | RO                 | NO               | 2                  | -    | -                  |
|                         | 03 <sub>h</sub> | SubIndex 003                                 | Communication type of SM2    | uint8     | -           | RO                 | NO               | 3                  | -    | -                  |
|                         | 04 <sub>h</sub> | SubIndex 004                                 | Communication type of SM3    | uint8     | -           | RO                 | NO               | 4                  | -    | -                  |
| <b>1C12<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001                                 | Assign PDO1                  | uint16    | 0x1600~1606 | RO                 | NO               | 0x1600             | -    | -                  |
| <b>1C13<sub>h</sub></b> | 01 <sub>h</sub> | SubIndex 001                                 | Assign PDO1                  | uint16    | 0x1A00~1A06 | RO                 | NO               | 0x1A00             | -    | -                  |
| <b>1C32<sub>h</sub></b> | 01 <sub>h</sub> | Sync <sub>h</sub> ronization Type            |                              | uint16    |             | RO                 | NO               | 1                  | -    | -                  |
|                         | 02 <sub>h</sub> | Cycle Time                                   |                              | uint32    | -           | RO                 | NO               | -                  | -    | -                  |
|                         | 04 <sub>h</sub> | Synchronization Types supported              |                              | uint16    | -           | RO                 | NO               | 16415              | -    | -                  |
|                         | 05 <sub>h</sub> | Minimum Cycle Time                           |                              | uint32    | -           | RO                 | NO               | 100000             | -    | -                  |
|                         | 06 <sub>h</sub> | Calc and Copy Time                           |                              | uint32    | -           | RO                 | NO               | 0                  | -    | -                  |
|                         | 08 <sub>h</sub> | Get Cycle Time                               |                              | uint16    | -           | RO                 | NO               | 0                  | -    | -                  |
|                         | 09 <sub>h</sub> | Delay Time                                   |                              | uint32    | -           | RO                 | NO               | 0                  | -    | -                  |
|                         | 0A <sub>h</sub> | Sync0 Cycle Time                             |                              | uint32    | -           | RO                 | NO               | 0                  | -    | -                  |
|                         | 0B <sub>h</sub> | SM-Event Missed                              | SM event-missed counter      | uint16    | -           | RO                 | NO               | 0                  | -    | -                  |
|                         | 0C <sub>h</sub> | Cycle Time Too Small                         | Cycle time too small counter | uint16    | -           | RO                 | NO               | 0                  | -    | -                  |
|                         | 20 <sub>h</sub> | Sync Error                                   |                              | bool      | -           | RO                 | NO               | Flase              | -    | -                  |
| <b>1C33<sub>h</sub></b> | 01 <sub>h</sub> | Sync <sub>h</sub> ronization Type            |                              | uint16    | -           | RO                 | NO               | 1                  | -    | -                  |
|                         | 02 <sub>h</sub> | Cycle Time                                   |                              | uint32    | -           | RO                 | NO               | -                  | -    | -                  |
|                         | 04 <sub>h</sub> | Sync <sub>h</sub> ronization Types supported |                              | uint16    | -           | RO                 | NO               | 16415              | -    | -                  |
|                         | 05 <sub>h</sub> | Minimum Cycle Time                           |                              | uint32    | -           | RO                 | NO               | 100000             | -    | -                  |
|                         | 06 <sub>h</sub> | Calc and Copy Time                           |                              | uint32    | -           | RO                 | NO               | 0                  | -    | -                  |

| Index                   | Sub-index       | Name                 | Description                  | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------|-----------------|----------------------|------------------------------|-----------|------------|--------------------|------------------|--------------------|------|--------------------|
| <b>1C33<sub>h</sub></b> | 08 <sub>h</sub> | Get Cycle Time       |                              | uint16    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 09 <sub>h</sub> | Delay Time           |                              | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0A <sub>h</sub> | Sync0 Cycle Time     |                              | uint32    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0B <sub>h</sub> | SM.Event Missed      | SM event-missed counter      | uint16    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 0C <sub>h</sub> | Cycle Time Too Small | Cycle time too small counter | uint16    | -          | RO                 | NO               | 0                  | -    | -                  |
|                         | 20 <sub>h</sub> | Sync Error           |                              | bool      | -          | RO                 | NO               | Flase              | -    | -                  |

## 10.2 Manufacturer Defined Parameter Group 2000h Description

| Index                                                   | Sub-index       | Name              | Description              | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit   | Activate<br>method |
|---------------------------------------------------------|-----------------|-------------------|--------------------------|-----------|------------|--------------------|------------------|--------------------|--------|--------------------|
| <b>2000<sub>h</sub> (Servo<br/>Motor<br/>Parameter)</b> | 06 <sub>h</sub> | SerialEncoderType |                          | uint16    | 0~1        | RW                 | NO               | 1                  | -      | Stop activate      |
|                                                         | 07 <sub>h</sub> | RatedVoltage      |                          | uint16    | 24~48      | RW                 | NO               | 48                 | 1V     | Stop activate      |
|                                                         | 08 <sub>h</sub> | RatedPower        |                          | uint16    | -          | RW                 | NO               | 40                 | 0.01KW | Stop activate      |
|                                                         | 09 <sub>h</sub> | RatedCurrent      |                          | uint16    | -          | RW                 | NO               | 1250               | 0.01A  | Stop activate      |
|                                                         | 0A <sub>h</sub> | MaximumCurrent    |                          | uint16    | -          | RW                 | NO               | 2250               | 0.01A  | Stop activate      |
|                                                         | 0B <sub>h</sub> | MaxCurrentDurTime |                          | uint16    | -          | RW                 | NO               | 3000               | 0.1s   | Stop activate      |
|                                                         | 0C <sub>h</sub> | RatedTorque       |                          | uint16    | -          | RW                 | NO               | 127                | 0.01Nm | Stop activate      |
|                                                         | 06 <sub>h</sub> | SerialEncoderType | Bus encoder type         | uint16    | 0~1        | RW                 | NO               | 1                  | -      | Stop activate      |
|                                                         | 07 <sub>h</sub> | RatedVoltage      | Rated voltage            | uint16    | 24~48      | RW                 | NO               | 48                 | 1V     | Stop activate      |
|                                                         | 08 <sub>h</sub> | RatedPower        | rated power              | uint16    |            | RW                 | NO               | 40                 | 0.01KW | Stop activate      |
|                                                         | 09 <sub>h</sub> | RatedCurrent      | Rated current            | uint16    |            | RW                 | NO               | 1250               | 0.01A  | Stop activate      |
|                                                         | 0A <sub>h</sub> | MaximumCurrent    | Maximum current          | uint16    |            | RW                 | NO               | 2250               | 0.01A  | Stop activate      |
|                                                         | 0B <sub>h</sub> | MaxCurrentDurTime | Maximum current duration | uint16    |            | RW                 | NO               | 3000               | 0.1s   | Stop activate      |
|                                                         | 0C <sub>h</sub> | RatedTorque       | Rated torque             | uint16    |            | RW                 | NO               | 127                | 0.01Nm | Stop activate      |
|                                                         | 0D <sub>h</sub> | MaxTorque         | Torque                   | uint16    | -          | RW                 | NO               | 2000               | 0.01Nm | Stop activate      |

| Index                                           | Sub-index       | Name                | Description                                                  | Data type | Data range | Access-ability | Mapp-ability | Factory setting | Unit                      | Activate method |
|-------------------------------------------------|-----------------|---------------------|--------------------------------------------------------------|-----------|------------|----------------|--------------|-----------------|---------------------------|-----------------|
| <b>2000<sub>h</sub> (Servo Motor Parameter)</b> | 0E <sub>h</sub> | RatedMotorSpeed     | Rated speed                                                  | uint16    | -          | RW             | NO           | 3000            | 1rpm                      | Stop activate   |
|                                                 | 0F <sub>h</sub> | MaxMotorSpeed       | Max Speed                                                    | uint16    | -          | RW             | NO           | 6000            | 1rpm                      | Stop activate   |
|                                                 | 10 <sub>h</sub> | RotorInertiaJm      | Moment of inertia Jm                                         | uint16    | -          | RW             | NO           | 30              | 0.01kgc<br>m <sup>2</sup> | Stop activate   |
|                                                 | 11 <sub>h</sub> | PolePairsNum        | Number of pole pairs for permanent magnet synchronous motors | uint16    | -          | RW             | NO           | 4               | 1                         | Stop activate   |
|                                                 | 12 <sub>h</sub> | StatorResistance    | Stator resistance                                            | uint16    | -          | RW             | NO           | 115             | 0.001Ω                    | Stop activate   |
|                                                 | 13 <sub>h</sub> | StatorInductanceLq  | Stator inductance Lq                                         | uint16    | -          | RW             | NO           | 25              | 0.01mH                    | Stop activate   |
|                                                 | 14 <sub>h</sub> | StatorInductanceLd  | Stator inductance Ld                                         | uint16    | -          | RW             | NO           | 25              | 0.01mH                    | Stop activate   |
|                                                 | 16 <sub>h</sub> | TorqueCoeffKt       | Torque coefficient Kt                                        | uint16    | -          | RW             | NO           | 11              | 0.01Nm<br>/Arms           | Stop activate   |
|                                                 | 19 <sub>h</sub> | EncoderBitPR        | Absolute bits of encoder                                     | uint32    | -          | RW             | NO           | 14              | 1bit                      | Stop activate   |
|                                                 | 1A <sub>h</sub> | EncoderPoleNum      | Encoder Poles                                                | uint16    | -          | RW             | NO           | 1               | 1                         | Stop activate   |
|                                                 | 1C <sub>h</sub> | SensorSelect        | Position sensor selection                                    | uint16    | -          | RW             | NO           | 2               | -                         | Stop activate   |
|                                                 | 1D <sub>h</sub> | SignalZ_ElecAngle   | Electric angle corresponding to Z signal                     | uint16    | -          | RW             | NO           | 0               | 1/4096                    | Stop activate   |
| <b>2001<sub>h</sub>(Drive Parameters)</b>       | 04 <sub>h</sub> | VoltageClass        | Voltage grade                                                | uint16    | 0~65535    | RW             | NO           | 0               | 1                         | Stop activate   |
|                                                 | 07 <sub>h</sub> | RatedOutputCurrent  |                                                              | uint16    | 0~65535    | RO             | NO           | 1200            | 0.01A                     | Stop activate   |
|                                                 | 08 <sub>h</sub> | MaxOutputCurrent    |                                                              | uint16    | 0~65535    | RO             | NO           | 1500            | 0.01A                     | Stop activate   |
|                                                 | 0D <sub>h</sub> | DeadZoneTime        | Switching dead time                                          | uint16    | 0~65535    | RW             | NO           | 100             | us                        | Stop activate   |
|                                                 | 0E <sub>h</sub> | BusOverVoltVal      |                                                              | uint16    | 0~65535    | RW             | NO           | 100             | 1V                        | Stop activate   |
|                                                 | 0F <sub>h</sub> | BusDischargeVoltVal |                                                              | uint16    | 0~65535    | RW             | NO           | 55              | 1V                        | Stop activate   |
|                                                 | 10 <sub>h</sub> | BusLowVoltVal       |                                                              | uint16    | 0~65535    | RW             | NO           | 24              | 1V                        | Stop activate   |

| Index                                                     | Sub-index       | Name                                                                                                                                          | Description                                             | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit  | Activate<br>method                               |
|-----------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-----------|------------|--------------------|------------------|--------------------|-------|--------------------------------------------------|
|                                                           | 11 <sub>h</sub> | OverCurrentVal                                                                                                                                |                                                         | uint16    | 0~65535    | RW                 | NO               | 10                 | 1V    | Stop activate                                    |
|                                                           | 18 <sub>h</sub> | CurrentFilterCoeff                                                                                                                            |                                                         | uint16    | 0~65535    | RW                 | NO               | 100                | 0.01  | Stop activate                                    |
|                                                           | 1C <sub>h</sub> | CurLoopCutOffFrq                                                                                                                              |                                                         | uint16    | 0~65535    | RW                 | NO               | 800                | 1Hz   | Stop activate                                    |
|                                                           | 1D <sub>h</sub> | OpenLoopCurrent                                                                                                                               |                                                         | uint16    | 0~65535    | RW                 | NO               | 625                | 0.01A | Stop activate                                    |
| <b>2002<sub>h</sub>(Basic<br/>Control<br/>Parameters)</b> | 01 <sub>h</sub> | CtrlModeSelec                                                                                                                                 |                                                         | uint16    | 0~4        | RW                 | NO               | 4                  | -     | Immediate<br>activate                            |
|                                                           |                 | Description: 0~CIA402 mode,1~Manufacturer position mode,2~Manufacturer velocity mode,3~Manufacturer torque mode,4~Manufacturer open-loop mode |                                                         |           |            |                    |                  |                    |       |                                                  |
|                                                           | 04 <sub>h</sub> | OutputPulsePhase                                                                                                                              |                                                         | uint16    | 0~100      | RW                 | NO               | 50                 | 1%    | Stop activate                                    |
|                                                           | 0A <sub>h</sub> | BrkOffToStopMotor<br>OffDelay                                                                                                                 | Hold brake output off to motor<br>non-energy delay time | uint16    | 0~65535    | RW                 | NO               | 1                  | 1ms   | Shutdown<br>Settings<br>Effective<br>immediately |
|                                                           | 13 <sub>h</sub> | BreakResistorType                                                                                                                             | See section 7.4 for details                             | uint16    | 0~2        | RW                 | NO               | 0                  | 1     | Restart<br>activate                              |
|                                                           | 1D <sub>h</sub> | MCUId0                                                                                                                                        |                                                         | uint32    | -          | RO                 | NO               | 0                  | -     | -                                                |
|                                                           | 1E <sub>h</sub> | MCUId1                                                                                                                                        |                                                         | uint32    | -          | RO                 | NO               | 0                  | -     | -                                                |
|                                                           | 1F <sub>h</sub> | MCUId2                                                                                                                                        |                                                         | uint32    | -          | RO                 | NO               | 0                  | -     | -                                                |
|                                                           | 03 <sub>h</sub> | DI1FunSelec                                                                                                                                   |                                                         | uint16    | 0~45       | RW                 | NO               | 1                  | 1     | Stop activate                                    |
|                                                           |                 | Description:See Section7.1 for details                                                                                                        |                                                         |           |            |                    |                  |                    |       |                                                  |
|                                                           | 04 <sub>h</sub> | DI1LogicSelec                                                                                                                                 |                                                         | uint16    | 0~4        | RW                 | NO               | 0                  | 1     | Stop activate                                    |
|                                                           |                 | Description:See Section7.1 for details                                                                                                        |                                                         |           |            |                    |                  |                    |       |                                                  |
|                                                           | 05 <sub>h</sub> | DI2FunSelec                                                                                                                                   |                                                         | uint16    | 0~45       | RW                 | NO               | 2                  | 1     | Stop activate                                    |
|                                                           | 06 <sub>h</sub> | DI2LogicSelec                                                                                                                                 |                                                         | uint16    | 0~4        | RW                 | NO               | 2                  | 1     | Stop activate                                    |
|                                                           | 07 <sub>h</sub> | DI3FunSelec                                                                                                                                   |                                                         | uint16    | 0~45       | RW                 | NO               | 12                 | 1     | Stop activate                                    |
|                                                           | 08 <sub>h</sub> | DI3LogicSelec                                                                                                                                 |                                                         | uint16    | 0~4        | RW                 | NO               | 0                  | 1     | Stop activate                                    |
|                                                           | 09 <sub>h</sub> | DI4FunSelec                                                                                                                                   |                                                         | uint16    | 0~45       | RW                 | NO               | 0                  | 1     | Stop activate                                    |

| Index                                                                      | Sub-index                                                                                                                          | Name                                   | Description                                      | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------------|-----------|------------|--------------------|------------------|--------------------|------|--------------------|
| <b>2003<sub>h</sub></b><br>(Entity<br>Terminal<br>Input<br>Parameters<br>) | 0A <sub>h</sub>                                                                                                                    | DI4LogicSelec                          |                                                  | uint16    | 0~4        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 0B <sub>h</sub>                                                                                                                    | DI5FunSelec                            |                                                  | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 0C <sub>h</sub>                                                                                                                    | DI5LogicSelec                          |                                                  | uint16    | 0~4        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 0D <sub>h</sub>                                                                                                                    | DI6FunSelec                            |                                                  | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 0E <sub>h</sub>                                                                                                                    | DI6LogicSelec                          |                                                  | uint16    | 0~4        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 0F <sub>h</sub>                                                                                                                    | DI7FunSelec                            |                                                  | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 10 <sub>h</sub>                                                                                                                    | DI7LogicSelec                          |                                                  | uint16    | 0~4        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 11 <sub>h</sub>                                                                                                                    | DI8FunSelec                            |                                                  | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 12 <sub>h</sub>                                                                                                                    | DI8LogicSelec                          |                                                  | uint16    | 0~4        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 13 <sub>h</sub>                                                                                                                    | DI9FunSelec                            |                                                  | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 14 <sub>h</sub>                                                                                                                    | DI9LogicSelec                          |                                                  | uint16    | 0~4        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 15 <sub>h</sub>                                                                                                                    | DinFunAllocation3                      | Function distribution when<br>power on effective | uint16    | 0~65535    | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | Description: bit0-DI1, bit1-DI2, bit2-DI3;the corresponding bit is 1, indicating that the corresponding DI Port is high-level 3.0V |                                        |                                                  |           |            |                    |                  |                    |      |                    |
|                                                                            |                                                                                                                                    |                                        |                                                  |           |            |                    |                  |                    |      |                    |
| <b>2004<sub>h</sub></b><br>(Terminal<br>Output<br>Parameters<br>)          | 01 <sub>h</sub>                                                                                                                    | DO1FunSelec                            |                                                  | uint16    | 0~30       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            |                                                                                                                                    | Description:See Section7.1 for details |                                                  |           |            |                    |                  |                    |      |                    |
|                                                                            | 02 <sub>h</sub>                                                                                                                    | DO1LogicSelec                          |                                                  | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            |                                                                                                                                    | Description:See Section7.1 for details |                                                  |           |            |                    |                  |                    |      |                    |
|                                                                            | 03 <sub>h</sub>                                                                                                                    | DO2FunSelec                            |                                                  | uint16    | 0~30       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 04 <sub>h</sub>                                                                                                                    | DO2LogicSelec                          |                                                  | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 05 <sub>h</sub>                                                                                                                    | DO3FunSelec                            |                                                  | uint16    | 0~30       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 06 <sub>h</sub>                                                                                                                    | DO3LogicSelec                          |                                                  | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 07 <sub>h</sub>                                                                                                                    | DO4FunSelec                            |                                                  | uint16    | 0~30       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 08 <sub>h</sub>                                                                                                                    | DO4LogicSelec                          |                                                  | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 09 <sub>h</sub>                                                                                                                    | DO5FunSelec                            |                                                  | uint16    | 0~30       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                            | 0A <sub>h</sub>                                                                                                                    | DO5LogicSelec                          |                                                  | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |

| Index                                                           | Sub-index       | Name                                                                                                                                                                                                                                  | Description                       | Data type | Data range       | Access-ability | Mapp-ability | Factory setting | Unit | Activate method    |
|-----------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------|------------------|----------------|--------------|-----------------|------|--------------------|
| <b>2005<sub>h</sub></b><br><b>(Position Control Parameters)</b> | 01 <sub>h</sub> | PosRefSource                                                                                                                                                                                                                          | Position instruction source       | uint16    | 0~65535          | RW             | NO           | 1               | 1    | Stop activate      |
|                                                                 |                 | Description: 0-pluse, 1-step amount                                                                                                                                                                                                   |                                   |           |                  |                |              |                 |      |                    |
|                                                                 | 05 <sub>h</sub> | StepAmount                                                                                                                                                                                                                            |                                   | int16     | -<br>32768~32767 | RW             | NO           | 100             | inc  | Stop activate      |
|                                                                 | 18 <sub>h</sub> | HomingMode                                                                                                                                                                                                                            | Homing Mode                       | uint16    | 0~1              | RW             | NO           | 0               | -    | Stop activate      |
|                                                                 |                 | Specific description: 0~multi-turn position recovery, 1~single-turn position recovery                                                                                                                                                 |                                   |           |                  |                |              |                 |      |                    |
|                                                                 | 1C              | HomingDurationLimit                                                                                                                                                                                                                   |                                   | uint16    | 0~65535          | RW             | NO           | 10000           | ms   | Stop activate      |
|                                                                 | 1D <sub>h</sub> | HomeMechOffset                                                                                                                                                                                                                        | Maximum forward rotation position | Int32     | 0~10000          | RW             | NO           | 0               |      | Stop activate      |
|                                                                 | 2A <sub>h</sub> | PosingWindowTime                                                                                                                                                                                                                      | All deadband judgment time window | uint16    | 0~65535          | RW             | NO           | 0               | 1ms  | Stop activate      |
| <b>2006<sub>h</sub></b><br><b>(Velocity Control Parameters)</b> | 01 <sub>h</sub> | MainSpeedRefSourceA                                                                                                                                                                                                                   |                                   | uint16    | 0~65535          | RW             | NO           | 0               | 1    | Stop activate      |
|                                                                 |                 | Description: 0 ~ digital setting ( setting value in 2006 <sub>h</sub> : 04 <sub>h</sub> ), 3 ~ duty ratio setting                                                                                                                     |                                   |           |                  |                |              |                 |      |                    |
|                                                                 | 02 <sub>h</sub> | AuxSpeedRefSourceB                                                                                                                                                                                                                    |                                   | uint16    | 0~65535          | RW             | NO           | 0               | 1    | Stop activate      |
|                                                                 |                 | Description: 0 ~ digital setting ( setting value in 2006 <sub>h</sub> : 04 <sub>h</sub> )                                                                                                                                             |                                   |           |                  |                |              |                 |      |                    |
|                                                                 | 03 <sub>h</sub> | SpeedRefSourceSelect                                                                                                                                                                                                                  |                                   | uint16    | 0~65535          | RW             | NO           | 0               | 1    | Stop activate      |
|                                                                 |                 | Description: 0-A (only 2006 <sub>h</sub> : 01 <sub>h</sub> effective), 1-B (only 2006 <sub>h</sub> : 02 <sub>h</sub> effective), 2-A + B (both 2006 <sub>h</sub> : 01 <sub>h</sub> and 2006 <sub>h</sub> : 02 <sub>h</sub> effective) |                                   |           |                  |                |              |                 |      |                    |
|                                                                 | 04 <sub>h</sub> | KeypadSpeedRef                                                                                                                                                                                                                        |                                   | int16     | -<br>32768~32767 | RW             | NO           | 10              | 1rpm | Immediate activate |

| Index                                                           | Sub-index       | Name                                                                                                                                                                                                                                  | Description              | Data type | Data range       | Access-ability | Mapp-ability | Factory setting | Unit | Activate method    |
|-----------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------|------------------|----------------|--------------|-----------------|------|--------------------|
| <b>2006<sub>h</sub></b><br><b>(Velocity Control Parameters)</b> | 06 <sub>h</sub> | ValidSpeedRef                                                                                                                                                                                                                         |                          | int16     | -<br>32768~32767 | RW             | NO           | 0               | 1rpm | Immediate activate |
|                                                                 | 07 <sub>h</sub> | SpeedRefAccelRamp Time                                                                                                                                                                                                                |                          | uint16    | 0~65535          | RW             | NO           | 10              | 1ms  | Immediate activate |
|                                                                 | 08 <sub>h</sub> | SpeedRefDecelRamp Time                                                                                                                                                                                                                |                          | uint16    | 0~65535          | RW             | NO           | 10              | 1ms  | Immediate activate |
|                                                                 | 09 <sub>h</sub> | MaxSpeedLimit                                                                                                                                                                                                                         |                          | uint16    | 0~65535          | RW             | NO           | 6000            | 1rpm | Immediate activate |
|                                                                 | 0A <sub>h</sub> | FwrSpeedLimit                                                                                                                                                                                                                         | Forward speed threshold  | uint16    | 0~65535          | RW             | NO           | 4000            | 1rpm | Immediate activate |
|                                                                 | 0B <sub>h</sub> | BwrSpeedLimit                                                                                                                                                                                                                         | Backward speed threshold | uint16    | 0~65535          | RW             | NO           | 4000            | 1rpm | Immediate activate |
| <b>2007<sub>h</sub></b><br><b>(Torque Control Parameters)</b>   | 01 <sub>h</sub> | MainTorqRefSourceA                                                                                                                                                                                                                    |                          | uint16    | 0~65535          | RW             | NO           | 0               | 1    | Stop activate      |
|                                                                 |                 | Description: 0 ~ digital setting (setting value in 2007 <sub>h</sub> : 04 <sub>h</sub> )                                                                                                                                              |                          |           |                  |                |              |                 |      |                    |
|                                                                 | 02 <sub>h</sub> | AuxTorqRefSourceB                                                                                                                                                                                                                     |                          | uint16    | 0~65535          | RW             | NO           | 0               | 1    | Stop activate      |
|                                                                 |                 | Description: 0 ~ digital setting (setting value in 2007 <sub>h</sub> : 04 <sub>h</sub> )                                                                                                                                              |                          |           |                  |                |              |                 |      |                    |
|                                                                 | 03 <sub>h</sub> | TorqRefSource                                                                                                                                                                                                                         |                          | uint16    | 0~65535          | RW             | NO           | 0               | 1    | Stop activate      |
|                                                                 |                 | Description: 0-A (only 2007 <sub>h</sub> : 01 <sub>h</sub> effective), 1-B (only 2007 <sub>h</sub> : 02 <sub>h</sub> effective), 2-A + B (both 2007 <sub>h</sub> : 01 <sub>h</sub> and 2007 <sub>h</sub> : 02 <sub>h</sub> effective) |                          |           |                  |                |              |                 |      |                    |
|                                                                 | 04 <sub>h</sub> | KeypadTorqRef                                                                                                                                                                                                                         |                          | int16     | -<br>32768~32767 | RW             | NO           | 10              | 0.1% | Stop activate      |
|                                                                 | 05 <sub>h</sub> | ValidTorqRef                                                                                                                                                                                                                          |                          | int16     | -<br>32768~32767 | RW             | NO           | 10              | 0.1% | Stop activate      |

| Index                                                         | Sub-index       | Name                                                                                                                                                                                                                                                                                                                                                                 | Description                          | Data type | Data range | Access-ability | Mapp-ability | Factory setting | Unit   | Activate method    |
|---------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------|------------|----------------|--------------|-----------------|--------|--------------------|
| <b>2007<sub>h</sub></b><br><b>(Torque Control Parameters)</b> | 06 <sub>h</sub> | TorqRefFilterTime                                                                                                                                                                                                                                                                                                                                                    |                                      | uint16    | 0~65535    | RW             | NO           | 0               | 0.01ms | Immediate activate |
|                                                               |                 | Description: low-pass filtering of torque command can make the torque command smoother and reduce vibration.<br>If the setting value is too large, the responsiveness will be reduced.                                                                                                                                                                               |                                      |           |            |                |              |                 |        |                    |
|                                                               | 0A <sub>h</sub> | FwrTorqInterLimit                                                                                                                                                                                                                                                                                                                                                    |                                      | uint16    | 0~65535    | RW             | NO           | 1000            | 0.1%   | Immediate activate |
|                                                               | 0B <sub>h</sub> | BwrTorqInterLimit                                                                                                                                                                                                                                                                                                                                                    |                                      | uint16    | 0~65535    | RW             | NO           | 1000            | 0.1%   | Immediate activate |
|                                                               | 10 <sub>h</sub> | TorqCtrlFwrSpeedLimit                                                                                                                                                                                                                                                                                                                                                |                                      | uint16    | 0~65535    | RW             | NO           | 3000            | 1rpm   | Immediate activate |
|                                                               | 11 <sub>h</sub> | TorqCtrlBwrSpeedLimit                                                                                                                                                                                                                                                                                                                                                |                                      | uint16    | 0~65535    | RW             | NO           | 3000            | 1rpm   | Immediate activate |
| <b>2008<sub>h</sub></b><br><b>(Gain Parameter)</b>            | 01 <sub>h</sub> | SpeedLoopGain                                                                                                                                                                                                                                                                                                                                                        |                                      | uint16    | 1~20000    | RW             | NO           | 500             | 0.1Hz  | Immediate activate |
|                                                               |                 | Description: set the proportional gain of the speed loop. This parameter determines the response of the speed loop. The larger the setting value is, the faster the response is. However, setting it too large may cause vibration. In the position mode, if you want to increase the position loop gain, you need to increase the speed loop gain at the same time. |                                      |           |            |                |              |                 |        |                    |
|                                                               | 02 <sub>h</sub> | SpdLoopIntegrTime                                                                                                                                                                                                                                                                                                                                                    | Speed loop integration time constant | uint16    | 0~51200    | RW             | NO           | 800             | 0.01ms | Immediate activate |
|                                                               |                 | Description: set the integral time constant of the speed loop. The smaller the setting value is, the stronger the integration effect is, and the deviation is closer to 0 at the stopping time. If this parameter is set to 51200, there is no integration effect.                                                                                                   |                                      |           |            |                |              |                 |        |                    |
|                                                               | 03 <sub>h</sub> | PosLoopGain                                                                                                                                                                                                                                                                                                                                                          | Position loop gain                   | uint16    | 0~20000    | RW             | NO           | 1500            | 1      | Immediate activate |
|                                                               |                 | Description: set the proportional gain of the position loop. This parameter determines the response of the position loop. Setting a larger position loop gain can shorten the positioning time, but setting too large may cause vibration.                                                                                                                           |                                      |           |            |                |              |                 |        |                    |

| Index                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Sub-index       | Name                 | Description                                    | Data type | Data range | Access-ability | Mapp-ability | Factory setting | Unit   | Activate method    |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------------------|------------------------------------------------|-----------|------------|----------------|--------------|-----------------|--------|--------------------|
| 2008 <sub>h</sub><br>(Gain Parameter)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 04 <sub>h</sub> | SpeedLoop2ndGain     | Second speed loop gain                         | uint16    | 1~20000    | RW             | NO           | 1               | 0.1Hz  | Immediate activate |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 05 <sub>h</sub> | SpdLoop2ndIntegrTime | Second velocity loop integration time constant | uint16    | 0~51200    | RW             | NO           | 15              | 0.01ms | Immediate activate |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 06 <sub>h</sub> | PosLoop2ndGain       | Second position loop gain                      | uint16    | 0~20000    | RW             | NO           | 0               | 1      | Immediate activate |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 08 <sub>h</sub> | GainSwitchModeSet    | Gain switching mode selection                  | uint16    | 0~1        | RW             | NO           | 0               | 1      | Immediate activate |
| Description: description:<br>0 ~ fixed use of the first set of gains;<br>1 ~ use external DI to switch. If DI is ineffective, it is the first set of gains; if DI is effective, it is the second set of gains;<br>2 ~ torque instruction, when the absolute value of torque instruction exceeds (level + delay) [%] and lasts for a period of delay time, it switches to the second set of gains; when the absolute value of torque instruction is less than (level- delay) [%] and lasts for a period of delay time, it returns to the first set of gains;<br>3 ~ the internal effective speed instruction value (606B <sub>h</sub> ) is maintained for 25ms, the first set of gains is used fixedly, and the second set of gains is used when it is changed;<br>4 ~ the variation ratio of speed instruction. When the absolute value of the variation ratio of speed instruction exceeds (level + delay) [rpm / ms] and the state lasts during the delay time, it switches to the second set of gains; when the absolute value of the variation ratio of speed instruction is less than (level-delay)[rpm / ms] and the state lasts during the delay time, it returns to the first set of gains;<br>5 ~ speed instruction, when the absolute value of speed instruction exceeds (level + delay) [rpm] and lasts for a period of delay time, it switches to the second set of gains; when the absolute value of speed instruction is less than (level-delay) [rpm] and lasts for a period of delay time, it returns to the first set of gains;<br>6 ~ position deviation, when the absolute value of position deviation exceeds (level + delay) [encoder unit] and lasts during the delay time, it switches to the second set of gains; when the absolute value of position deviation is less than (level-delay) [encoder unit] and lasts during the delay time, it returns to the first set of gains;<br>7 ~ position instruction, when the state of position deviation instruction is not 0 and lasts in the delay time, it switches to the second set of gains; when the state of position instruction is 0 and lasts in the delay time, it returns to the first set of gains;<br>8 ~ after the positioning is completed, if the positioning is not completed and lasts in the delay time, it switches to the second set of gains; if the positioning is completed and lasts in the delay time, it returns to the first set of gains; except for the position control mode, the rest are fixed as the second set of gains; |                 |                      |                                                |           |            |                |              |                 |        |                    |

| Index                                 | Sub-index       | Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Description                               | Data type | Data range | Access-ability | Mapp-ability | Factory setting | Unit   | Activate method    |
|---------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-----------|------------|----------------|--------------|-----------------|--------|--------------------|
| 2008 <sub>h</sub><br>(Gain Parameter) |                 | 9 ~ actual speed. When the absolute value of the actual speed exceeds (level + delay) [rpm] and lasts during the delay time, it switches to the second set of gains; when the absolute value of the actual speed is less than (level-delay) [rpm] and lasts during the delay time, it returns to the first set of gains.                                                                                                                                                                                                                                           |                                           |           |            |                |              |                 |        |                    |
|                                       | 09 <sub>h</sub> | GainSwitchCondition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Effective gain group number               | uint16    | 0~10       | RW             | NO           | 0               | 1      | Immediate activate |
|                                       |                 | Description:<br>0 ~ the first group of gains, 1 ~ the second switching conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                           |           |            |                |              |                 |        |                    |
|                                       | 0A <sub>h</sub> | GainSwitch <sub>h</sub> Delay                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 增益切换延迟时间                                  | uint16    | 0~10000    | RW             | NO           | 0               | 0.1ms  | Immediate activate |
|                                       | 0B <sub>h</sub> | GainSwitch <sub>h</sub> Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Gain switching level                      | uint16    | 0~20000    | RW             | NO           | 0               | 1      | Immediate activate |
|                                       |                 | Description:<br>The actual switching action is affected by the two conditions of level and time delay. See the description of 2008 <sub>h</sub> : 08 <sub>h</sub> for the specific influence mode. Depending on the gain switching mode, the unit of switching level will change accordingly.                                                                                                                                                                                                                                                                      |                                           |           |            |                |              |                 |        |                    |
|                                       | 0C <sub>h</sub> | GainSwitch <sub>h</sub> Hyst                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Gain switching delay                      | uint16    | 0~20000    | RW             | NO           | 0               | 1      | Immediate activate |
|                                       |                 | Description:<br>The actual switching action is affected by the two conditions of level and time delay. See the description of 2008 <sub>h</sub> : 08 <sub>h</sub> for the specific influence mode. Depending on the gain switching mode, the unit of switching level will change accordingly.                                                                                                                                                                                                                                                                      |                                           |           |            |                |              |                 |        |                    |
|                                       | 0F <sub>h</sub> | SpdFdFwrFilterTime                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Speed feedforward filtering time constant | uint16    | 0~65535    | RW             | NO           | 0               | 0.01ms | Immediate activate |
|                                       | 10 <sub>h</sub> | SpeedFdFwrGain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Speed feedforward gain                    | uint16    | 0~65535    | RW             | NO           | 0               | 0.1%   | Immediate activate |
|                                       |                 | Description: in the position control mode, increasing this parameter can improve the position command response and reduce the position deviation at a fixed speed. During the adjustment, set 2008 <sub>h</sub> :0F <sub>h</sub> as a fixed value, and gradually increase the setting value in 2008 <sub>h</sub> :10 <sub>h</sub> from 0 to a certain value, until the speed feedforward effect is achieved. During the adjustment, adjust 2008 <sub>h</sub> :0F <sub>h</sub> and 2008 <sub>h</sub> :10 <sub>h</sub> repeatedly to get the value with good balance |                                           |           |            |                |              |                 |        |                    |

| Index                                              | Sub-index       | Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Description                                        | Data type | Data range | Access-ability | Mapp-ability | Factory setting | Unit   | Activate method    |
|----------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|-----------|------------|----------------|--------------|-----------------|--------|--------------------|
| <b>2008<sub>h</sub></b><br><b>(Gain Parameter)</b> | 11 <sub>h</sub> | TorqFdFwrFilterTime                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Torque feedforward filtering time constant         | uint16    | 0~65535    | RW             | NO           | 0               | 0.01ms | Immediate activate |
|                                                    | 12 <sub>h</sub> | TorqFdFwrGain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Torque feedforward gain                            | uint16    | 0~65535    | RW             | NO           | 0               | 0.001  | Immediate activate |
|                                                    |                 | Description: in non torque mode, increasing this parameter can improve the responsiveness to the changing speed command, improve the position command response, and reduce the position deviation at fixed speed.<br>During the adjustment, set 2008 <sub>h</sub> :11 <sub>h</sub> as a fixed value, and gradually increase the setting value in 2008 <sub>h</sub> :12 <sub>h</sub> to increase the torque feedforward effect; when speed overshoot occurs, keep 2008 <sub>h</sub> :12 <sub>h</sub> unchanged, and increase 2008 <sub>h</sub> :11 <sub>h</sub> .<br>During the adjustment, adjust 2008 <sub>h</sub> :11 <sub>h</sub> and 2008 <sub>h</sub> :12 <sub>h</sub> repeatedly to get the value with good balance |                                                    |           |            |                |              |                 |        |                    |
|                                                    |                 | SpdFdBckFilterCutOf fFreq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Speed feedback low-pass filter cutoff frequency    | uint16    | 0~4000     | RW             | NO           | 900             | 1Hz    | Immediate activate |
|                                                    | 14 <sub>h</sub> | Description: the smaller the setting is, the smaller the speed feedback fluctuation is, but the greater the feedback delay is. Generally, the default parameters are maintained.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                    |           |            |                |              |                 |        |                    |
|                                                    | 05 <sub>h</sub> | LowFreqResonantDepr essMode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Low frequency vibration suppression mode selection | uint16    | 0~1        | RW             | NO           | 0               | 1      | Stop activate      |
|                                                    | 06 <sub>h</sub> | Offline recognition status display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | OfflInertiaAutoTunMode                             | uint16    | 0~65535    | RO             | NO           | 0               | 1      |                    |
|                                                    |                 | Specific description: see section 8.2.2 for details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                    |           |            |                |              |                 |        |                    |
|                                                    | 0D <sub>h</sub> | Notch1Freq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Speed feedback low-pass filter cutoff frequency    | uint16    | 0~2000     | RW             | NO           | 0               | 1Hz    | Immediate activate |
|                                                    |                 | Description: set the center frequency of the notch filter, i.e. mechanical resonance frequency.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                    |           |            |                |              |                 |        |                    |
|                                                    | 0E <sub>h</sub> | Notch1Width 调整 Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Band 1 notch notch width                           | uint16    | 0~2000     | RW             | NO           | 0               | 1Hz    | Immediate activate |
|                                                    |                 | Description: set the frequency band width on both sides of the mechanical resonance center frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                    |           |            |                |              |                 |        |                    |
|                                                    | 0F <sub>h</sub> | Notch1DepthLevel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Group 1 notch depth                                | uint16    | 0~100      | RW             | NO           | 0               | %      | Immediate activate |

| Index                                                  | Sub-index       | Name                                                 | Description                       | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit  | Activate<br>method    |
|--------------------------------------------------------|-----------------|------------------------------------------------------|-----------------------------------|-----------|------------|--------------------|------------------|--------------------|-------|-----------------------|
| <b>2009<sub>h</sub></b><br><b>(Gain<br/>Parameter)</b> |                 | Description: 0 ~ no notch, 100 ~ maximum notch depth |                                   |           |            |                    |                  |                    |       |                       |
|                                                        | 10 <sub>h</sub> | Notch2Freq                                           | Group 2 notch frequency           | uint16    | 0~2000     | RW                 | NO               | 0                  | 1Hz   | Immediate<br>activate |
|                                                        | 11 <sub>h</sub> | Notch2WidthLevel                                     | Group 2 notch width               | uint16    | 0~2000     | RW                 | NO               | 0                  | 1Hz   | Immediate<br>activate |
|                                                        | 12 <sub>h</sub> | Notch2DepthLevel                                     | Group 2 notch depth               | uint16    | 0~100      | RW                 | NO               | 0                  | 1     | Immediate<br>activate |
|                                                        | 13 <sub>h</sub> | Notch3Freq                                           | Group 3 notch frequency           | uint16    | 0~2000     | RW                 | NO               | 0                  | 1Hz   | Immediate<br>activate |
|                                                        | 14 <sub>h</sub> | Notch3WidthLevel                                     | Group 3 notch notch width         | uint16    | 0~2000     | RW                 | NO               | 0                  | 1Hz   | Immediate<br>activate |
|                                                        | 15 <sub>h</sub> | Notch3DepthLevel                                     | Group 3 notch depth               | uint16    | 0~100      | RW                 | NO               | 0                  | 1     | Immediate<br>activate |
|                                                        | 16 <sub>h</sub> | Notch4Freq                                           | Group 4 notch frequency           | uint16    | 0~2000     | RW                 | NO               | 0                  | 1Hz   | Immediate<br>activate |
|                                                        | 17 <sub>h</sub> | Notch4WidthLevel                                     | Group 4 notch notch width         | uint16    | 0~2000     | RW                 | NO               | 0                  | 1Hz   | Immediate<br>activate |
|                                                        | 18 <sub>h</sub> | Notch4DepthLevel                                     | Group 4 notch depth               | uint16    | 0~100      | RW                 | NO               | 0                  | 1     | Immediate<br>activate |
|                                                        | 1D <sub>h</sub> | LowFreqResonantFreq                                  | Low frequency resonance frequency | uint16    | 10~1000    | RW                 | NO               | 10                 | 0.1Hz | Stop activate         |
|                                                        |                 | Specific description: See section 8.4.2 for details  |                                   |           |            |                    |                  |                    |       |                       |
|                                                        | 1E <sub>h</sub> | LowFreqResonantFreqFilterSet                         | Vibration suppression width level | uint16    | 0~100      | RW                 | NO               | 0                  | 1     | Stop activate         |
|                                                        |                 | Description: See section 8.4.2 for details           |                                   |           |            |                    |                  |                    |       |                       |
|                                                        | 23 <sub>h</sub> | Reserve0                                             | Damping ratio coefficient         | uint16    | 0~10       | RW                 | NO               | 5                  | 1     | Stop activate         |

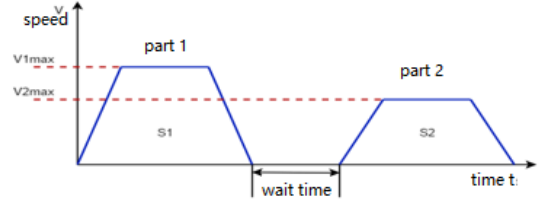
| Index                                             | Sub-index | Name                                                                                                                                           | Description                                 | Data type | Data range       | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit  | Activate<br>method |
|---------------------------------------------------|-----------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|-----------|------------------|--------------------|------------------|--------------------|-------|--------------------|
|                                                   |           | Description: See section 8.4.2 for details                                                                                                     |                                             |           |                  |                    |                  |                    |       |                    |
| <b>200Ah</b><br>(Fault and Protection Parameters) | 06h       | OverSpeedThrh                                                                                                                                  | Overspeed fault threshold                   | uint16    | 0~65535          | RW                 | NO               | 0                  | 1     | Immediate activate |
|                                                   | 1Bh       | Encoder multi-turn overflow fault selection                                                                                                    | Encoder multi-turn overflow fault selection | uint16    | 0~1              | RW                 | NO               | 0                  | 1     | Immediate activate |
|                                                   | 1Fh       | BrakeDetectionEn                                                                                                                               | Lock detection enable                       | uint16    | 0~65535          | RW                 | NO               | 0                  | 1     | Stop activate      |
|                                                   | 20h       | BrakeLoadGravity                                                                                                                               | Brake load gravity                          | int16     | 0~2000           | RW                 | NO               | 0                  | 0.1%  | Stop activate      |
| <b>200Bh</b><br>(Monitoring Parameters)           | 01h       | DriveState                                                                                                                                     | Internal state of servo motor driver        | uint16    | 0~12             | RO                 | NO               | 0                  | 1     | -                  |
|                                                   |           | Description: 0 ~ not ready, 1 ~ ready, 6 ~ position closed-loop, 8 ~ speed closed-loop, 9 ~ torque control, 10 ~ open-loop control, 12 ~ error |                                             |           |                  |                    |                  |                    |       |                    |
|                                                   | 02h       | ActualMotorSpeed                                                                                                                               | Actual motor speed                          | int16     | -<br>32768~32767 | RO                 | NO               | -                  | 1rpm  | -                  |
|                                                   | 04h       | InterTorqueRef                                                                                                                                 | Internal torque command                     | int16     | -<br>32768~32767 | RO                 | NO               | 0                  | 0     | -                  |
|                                                   | 05h       | MonitoredDiStates                                                                                                                              | DI signal monitoring                        | uint16    | 0~65535          | RO                 | NO               | 0                  | 1     | -                  |
|                                                   | 06h       | MonitoredDoStates                                                                                                                              | DO signal monitoring                        | uint16    | 0~65535          | RO                 | NO               | 0                  | 1     | -                  |
|                                                   | 0Ah       | PosRefToSpeed                                                                                                                                  | Input PWM frequency                         | uint16    | 0~65535          | RO                 | NO               | 0                  | 1Hz   | -                  |
|                                                   | 0Fh       | TotalPowerOnTime                                                                                                                               | Total power-on time                         | uint32    | 0~4294967295     | RO                 | NO               | 0                  | 0.1s  | -                  |
|                                                   | 12h       | PhCurrentEffectValA                                                                                                                            | Phase A current rms                         | uint16    | 0~65535          | RO                 | NO               | 0                  | 0.01A | -                  |
|                                                   | 13h       | PhCurrentEffectValB                                                                                                                            | Phase B current rms                         | uint16    | 0~65535          | RO                 | NO               | 0                  | 0.01A | -                  |
|                                                   | 14h       | PhCurrentEffectValC                                                                                                                            | Phase C current rms                         | uint16    | 0~65535          | RO                 | NO               | 0                  | 0.01A | -                  |
|                                                   | 15h       | BusVoltage                                                                                                                                     | Bus voltage value                           | uint16    | 0~65535          | RO                 | NO               | 0                  | 0.1V  | -                  |

| Index                                           | Sub-index       | Name                                                                                                                                                                                                                                                        | Description                    | Data type | Data range  | Access-ability | Mapp-ability | Factory setting   | Unit   | Activate method    |
|-------------------------------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------|-------------|----------------|--------------|-------------------|--------|--------------------|
|                                                 | 16 <sub>h</sub> | ModuleTemperature                                                                                                                                                                                                                                           | Module temperature value       | int16     | 32768~32767 | RO             | NO           | 0                 | 1°C    | -                  |
|                                                 | 2D <sub>h</sub> | ActualMotorSpeed01                                                                                                                                                                                                                                          | Actual motor speed             | uint16    | 0~65535     | RO             | NO           | -                 | 0.1rpm | -                  |
| 200C <sub>h</sub><br>(Communication parameters) | 01 <sub>h</sub> | CommunicationSelect                                                                                                                                                                                                                                         | Communication method selection | uint16    | 0~2         | RW             | NO           | 1                 | 1      | Restart activate   |
|                                                 |                 | Description: 0 ~ external pulse control (default CAN communication), 1~EtherCAT, 2~CAN                                                                                                                                                                      |                                |           |             |                |              |                   |        |                    |
|                                                 | 02 <sub>h</sub> | ServoShaftAddress                                                                                                                                                                                                                                           | Drive shaft address            | uint16    | 1~247       | RW             | NO           | 1                 | 1      | Restart activate   |
|                                                 |                 | Description: set the drive shaft address when using CANopen communication.<br>1 ~ 247: when multiple servo motors are networked, each servo motor can only have a unique address, otherwise, the communication will be abnormal or unable to communicate.   |                                |           |             |                |              |                   |        |                    |
|                                                 | 03 <sub>h</sub> | SerialPortBaudRate                                                                                                                                                                                                                                          | Serial ports baud-rate setting | uint16    | 0~8         | RW             | NO           | 8                 | 1      | Restart activate   |
|                                                 |                 | Description: set the communication rate between the servo motor and the master computer, as shown in the table below:<br><br>The communication rate of the servo motor must be the same as that of the master computer, otherwise it cannot be communicated |                                |           |             | Setting value  |              | Baud-rate setting |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 8              |              | 1MBit/sec         |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 7              |              | 800kBit/sec       |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 6              |              | 500kBit/sec       |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 5              |              | 250kBit/sec       |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 4              |              | 125kBit/sec       |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 3              |              | 100kBit/sec       |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 2              |              | 50kBit/sec        |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 1              |              | 20kBit/sec        |        |                    |
|                                                 |                 |                                                                                                                                                                                                                                                             |                                |           |             | 0              |              | 10kBit/sec        |        |                    |
|                                                 | 0A <sub>h</sub> | CommunicationVDI                                                                                                                                                                                                                                            | Communication VDI              | uint16    | 0~1         | RW             | NO           | 1                 | 1      | Immediate activate |
|                                                 |                 | Description: set whether to use virtual VDI or not, 0-disable, 1-enable.                                                                                                                                                                                    |                                |           |             |                |              |                   |        |                    |

| Index                                                     | Sub-index       | Name                                                                                                                                                                                                                                                                                                       | Description                                                 | Data type | Data range                | Access-ability | Mapp-ability | Factory setting | Unit | Activate method    |
|-----------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------|---------------------------|----------------|--------------|-----------------|------|--------------------|
|                                                           | 10 <sub>h</sub> | EtherCatSynchLossPermiTimes                                                                                                                                                                                                                                                                                | Allowed times of EtherCAT synchronization interruption loss | uint16    | 0~65535                   | RW             | NO           | 10              | 1    | Immediate activate |
|                                                           |                 | Description: set the maximum times allow the slave station to lose the master station signal. If the value is exceeded, synchronization error will be triggered.                                                                                                                                           |                                                             |           |                           |                |              |                 |      |                    |
|                                                           | 19 <sub>h</sub> | SynchErrorThrh                                                                                                                                                                                                                                                                                             | Synchronization error threshold                             | uint16    | 0~65535                   | RW             | NO           | 500             | 6ns  | Immediate activate |
|                                                           |                 | Description: it takes effect under the EtherCAT communication mode. When the EtherCAT state machine switches to the OP mode, if the jitter range of the synchronous signal exceeds 200C <sub>h</sub> : 19 <sub>h</sub> , the servo detection unit loses the signal once in the artificial synchronization. |                                                             |           |                           |                |              |                 |      |                    |
| <b>200D<sub>h</sub></b><br>(auxiliary function parameter) | 0A <sub>h</sub> | Encoder reset enable                                                                                                                                                                                                                                                                                       | Encoder reset enable                                        | uint16    | 0~2                       | RW             | NO           | -               | 1    | Restart activate   |
|                                                           | 0B <sub>h</sub> | BrakeLoadTun                                                                                                                                                                                                                                                                                               | Load identification of holding brake                        | uint16    | 0~1                       | RW             | NO           | 0               | 1    | Stop activate      |
| <b>200E<sub>h</sub></b><br>(Error Code)                   | 01 <sub>h</sub> | MotorOverLoad                                                                                                                                                                                                                                                                                              | Motor overload                                              | int32     | 2147483648<br>~2147483647 | RW             | NO           | 67183377        | 1    | Immediate activate |
|                                                           | 02 <sub>h</sub> | MotorlockRotor                                                                                                                                                                                                                                                                                             | Motor stalled                                               | int32     | 2147483648<br>~2147483647 | RW             | NO           | 8978            | 1    | Immediate activate |
|                                                           | 03 <sub>h</sub> | OverVoltage                                                                                                                                                                                                                                                                                                | Power overvoltage                                           | int32     | 2147483648<br>~2147483647 | RW             | NO           | 78352           | 1    | Immediate activate |
|                                                           | 04 <sub>h</sub> | UnderVoltage                                                                                                                                                                                                                                                                                               | Power undervoltage                                          | int32     | 2147483648<br>~2147483647 | RW             | NO           | 16855584        | 1    | Immediate activate |

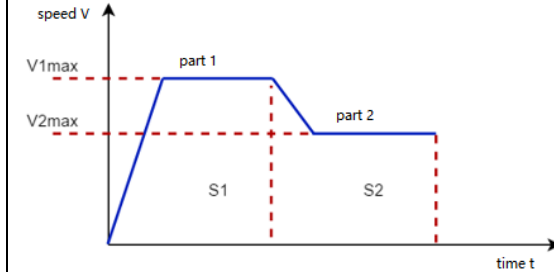
| Index                                              | Sub-index       | Name            | Description                 | Data type | Data range                    | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method    |
|----------------------------------------------------|-----------------|-----------------|-----------------------------|-----------|-------------------------------|--------------------|------------------|--------------------|------|-----------------------|
| <b>200E<sub>h</sub></b><br><b>(Error<br/>Code)</b> | 05 <sub>h</sub> | OverDriveTemp   | Temperature is too high     | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 82448              | 1    | Immediate<br>activate |
|                                                    | 06 <sub>h</sub> | UnderDriveTemp  | Temperature is too low      | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 82464              | 1    | Immediate<br>activate |
|                                                    | 07 <sub>h</sub> | ParameterError  | Parameter setting error     | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 90912              | 1    | Immediate<br>activate |
|                                                    | 08 <sub>h</sub> | OverSpeed       | Motor overspeed             | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 94992              | 1    | Immediate<br>activate |
|                                                    | 09 <sub>h</sub> | CommError       | Communication failure       | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 95489              | 1    | Immediate<br>activate |
|                                                    | 0A <sub>h</sub> | HomingError     | Origin return timeout error | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 34320              | 1    | Immediate<br>activate |
|                                                    | 0B <sub>h</sub> | FollowingError  | Out of position error       | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 34321              | 1    | Immediate<br>activate |
|                                                    | 0C <sub>h</sub> | PosSwlimitError | Software overrun fault      | int32     | 2147483648<br>~214748364<br>7 | RW                 | NO               | 50431507           | 1    | Immediate<br>activate |

| Index                                                     | Sub-index       | Name                                                             | Description                                                    | Data type | Data range                     | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method    |
|-----------------------------------------------------------|-----------------|------------------------------------------------------------------|----------------------------------------------------------------|-----------|--------------------------------|--------------------|------------------|--------------------|------|-----------------------|
|                                                           | 0D <sub>h</sub> | PosGaugeError                                                    | Over limit switch failure                                      | int32     | 2147483648<br>~214748364<br>7  | RW                 | NO               | 50431507           | 1    | Immediate<br>activate |
|                                                           | 0E <sub>h</sub> | PhaseOutputError                                                 | Output phase failure                                           | int32     | 2147483648<br>~214748364<br>7  | RW                 | NO               | 12933              | 1    | Immediate<br>activate |
|                                                           | 0F <sub>h</sub> | ProfileCalcFault                                                 | Curve planning calculation fault                               | int32     | 2147483648<br>~214748364<br>7  | RW                 | NO               | 67208725           | 1    | Immediate<br>activate |
|                                                           | 10 <sub>h</sub> | ProfilePosTargetOver<br>flow                                     | Position target overflow                                       | int32     | 2147483648<br>~214748364<br>7  | RW                 | NO               | 99862              | 1    | Immediate<br>activate |
|                                                           | 11 <sub>h</sub> | ProfileParaTooSmall                                              | Curve planning parameters too<br>small                         | int32     | 2147483648<br>~214748364<br>7  | RW                 | NO               | 83985943           | 1    | Immediate<br>activate |
| <b>200F<sub>h</sub></b><br><b>(Encoder<br/>Parameter)</b> | 0A <sub>h</sub> | Functional detection<br>of multi-turn absolute<br>value encoders | Functional detection of multi-<br>turn absolute value encoders | int32     | -214748364<br>8~2147483<br>647 | RO                 | NO               | 0                  | 1    | Stop activate         |
|                                                           | 0B <sub>h</sub> | Battery voltage of<br>multi-turn encoder                         | Battery voltage of multi-turn<br>encoder                       | int32     | -214748364<br>8~2147483<br>647 | RO                 | NO               | 0                  | mv   | Stop activate         |
|                                                           | 0C <sub>h</sub> | Calibration<br>instructions for multi-<br>turn encoders          | Calibration instructions for<br>multi-turn encoders            | int32     | -214748364<br>8~2147483<br>647 | RW                 | NO               | 0                  | 1    | Immediate<br>activate |

| Index                          | Sub-index       | Name                                                                                                                                                    | Description                                                                                                                                                     | Data type                                                                             | Data range                     | Access-ability | Mapp-ability | Factory setting | Unit | Activate method    |
|--------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------|----------------|--------------|-----------------|------|--------------------|
|                                | 0D <sub>h</sub> | The multi-turn encoder calibration has completed the detection command                                                                                  | The multi-turn encoder calibration has completed the detection command                                                                                          | int32                                                                                 | -214748364<br>8~2147483<br>647 | RO             | NO           | 0               | 1    | Immediate activate |
|                                | 0E <sub>h</sub> | The absolute zero value A of the multi-turn absolute value encoder                                                                                      | The absolute zero value A of the multi-turn absolute value encoder                                                                                              | int32                                                                                 | -214748364<br>8~2147483<br>647 | RW             | NO           | 0               | 1    | Immediate activate |
|                                | 0F <sub>h</sub> | The absolute zero value B of the multi-turn absolute value encoder                                                                                      | The absolute zero value B of the multi-turn absolute value encoder                                                                                              | int32                                                                                 | -214748364<br>8~2147483<br>647 | RW             | NO           | 0               | 1    | Immediate activate |
| 2011h (multi-segment position) | 01 <sub>h</sub> | MultiPosRunMode                                                                                                                                         | Multi-segment position operation                                                                                                                                | uint16                                                                                | 0~3                            | RW             | NO           | 0               | 1    | Shutdown effective |
|                                |                 | Detailed description: Set the connection mode between segments, 0-single operation; 1-cycle operation; 2-DI switching operation; 3-sequential operation |                                                                                                                                                                 |                                                                                       |                                |                |              |                 |      |                    |
|                                |                 | Operation mode                                                                                                                                          | Description                                                                                                                                                     | Running curve                                                                         |                                |                |              |                 |      |                    |
|                                |                 | Single run                                                                                                                                              | Paragraphs 1 to 16 run once;<br>Automatic segment number switching<br>Waiting time can be set between segments;<br>Multi-level position enable is active level; |  |                                |                |              |                 |      |                    |

| Index                                                          | Sub-index | Name | Description               | Data type                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
|----------------------------------------------------------------|-----------|------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------|------------------|--------------------|------|--------------------|---|---|---|---|---|---|---|---|---|---|-------|--|--|--|--|---|---|---|---|----|--|--|
| function<br>parameter)                                         |           |      | Cyclic<br>operation       | The number of times the 2011h: 06h set the starting segment to 2011h: 02h set the 2011h: 04h set to run;<br>Automatic segment number switching<br>Waiting time can be set between segments;<br>Multi-level position enable is active level;<br>Note: If the setting value of the end segment is smaller than the start segment, the first segment to the 16th segment will cycle once.                                                                                                                                                                                                                                                                                                       |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
|                                                                |           |      | DI switching<br>operation | The position segment number switch is determined by the decimal 0 ~ 15 corresponding to the 4-digit binary number composed of multifunctional numbers 6, 7, 8, and 9;<br>The waiting time set between segments is invalid;<br>Multi-segment position enable is effective along the change;<br>The relationship between segment numbers and multifunction numbers is as follows: <table><tr><th>Fun9</th><th>Fun8</th><th>Fun7</th><th>Fun6</th><th>段号</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr><tr><td colspan="5">.....</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16</td></tr></table> |            | Fun9               | Fun8             | Fun7               | Fun6 | 段号                 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | ..... |  |  |  |  | 1 | 1 | 1 | 1 | 16 |  |  |
| Fun9                                                           | Fun8      | Fun7 | Fun6                      | 段号                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
| 0                                                              | 0         | 0    | 0                         | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
| 0                                                              | 0         | 0    | 1                         | 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
| .....                                                          |           |      |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
| 1                                                              | 1         | 1    | 1                         | 16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |
| 2011h (multi-<br>segment<br>position<br>function<br>parameter) |           |      |                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |            |                    |                  |                    |      |                    |   |   |   |   |   |   |   |   |   |   |       |  |  |  |  |   |   |   |   |    |  |  |

| Index                                             | Sub-index | Name                                                                                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                   | Data type | Data range | Access-ability | Mapp-ability | Factory setting | Unit | Activate method    |
|---------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|------------|----------------|--------------|-----------------|------|--------------------|
| 2011h (multi-segment position function parameter) |           |                                                                                                  | <p>Run sequentially</p> <p>The number of times the 2011h: 06h set the starting segment to 2011h: 02h set the 2011h: 04h set to run;</p> <p>Automatic segment number switching</p> <p>The waiting time set between segments is invalid;</p> <p>Multi-level position enable is active level;</p> <p>Note: If the setting value of the end segment is smaller than the start segment, the first segment to the 16th segment will cycle once.</p> |           |            |                |              |                 |      |                    |
|                                                   |           |                                                                                                  | Note:                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |            |                |              |                 |      |                    |
|                                                   |           |                                                                                                  | During each period of operation, the servo enable must be effective;                                                                                                                                                                                                                                                                                                                                                                          |           |            |                |              |                 |      |                    |
|                                                   |           |                                                                                                  | In non-DI switching operation mode, during a certain period of operation, the servo enable is effective, and when the multi-stage position enable is turned off, the servo will give up the displacement command not sent in this segment and stop;                                                                                                                                                                                           |           |            |                |              |                 |      |                    |
|                                                   | 02h       | PosRefProfileNum                                                                                 | Position command end segment number                                                                                                                                                                                                                                                                                                                                                                                                           | uint16    | 1~16       | RW             | NO           | 1               | 1    | Shutdown effective |
|                                                   |           | Detailed description: Set the total number of segments of the multi-segment position instruction |                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |            |                |              |                 |      |                    |
|                                                   | 04h       | MultiPosTimeUnit                                                                                 | Multi-segment position cycle times                                                                                                                                                                                                                                                                                                                                                                                                            | uint16    | 0~65535    | RW             | NO           | 0               | 1    | Shutdown effective |
|                                                   |           | Detailed description: The number of cycles of multi-segment position operation mode 1 and 3      |                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |            |                |              |                 |      |                    |
|                                                   | 05h       | DisplaceRefType                                                                                  | Position command type selection                                                                                                                                                                                                                                                                                                                                                                                                               | uint16    | 0~1        | RW             | NO           | 0               | 1    | Shutdown effective |
|                                                   |           | Detailed description: 0-relative displacement; 1-absolute displacement                           |                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |            |                |              |                 |      |                    |
|                                                   | 06h       | StartPosSequRunSelc                                                                              | Multi-segment position cycle starting segment                                                                                                                                                                                                                                                                                                                                                                                                 | uint16    | 0~16       | RW             | NO           | 0               | 1    | Shutdown effective |
|                                                   |           | Detailed description: Multi-segment position starting mode is 1 and 3                            |                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |            |                |              |                 |      |                    |



| Index | Sub-index       | Name                                                                                                                                                                                       | Description                                                            | Data type | Data range                | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting  | Unit          | Activate<br>method    |
|-------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|-----------|---------------------------|--------------------|------------------|---------------------|---------------|-----------------------|
|       | 07 <sub>h</sub> | Displace1                                                                                                                                                                                  | 1st stage displacement                                                 | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |
|       | 08 <sub>h</sub> | Displace1MaxSpeed                                                                                                                                                                          | 1st stage displacement<br>maximum running speed                        | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|       | 09 <sub>h</sub> | Displace1AccelDecel<br>Time                                                                                                                                                                | 1st stage displacement<br>acceleration / deceleration time             | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|       |                 | Detailed description: Set the time for the first stage of the multi-stage position to change from 0rpm to 1000rpm.                                                                         |                                                                        |           |                           |                    |                  |                     |               |                       |
|       | 0A <sub>h</sub> | Displace1DoneWaitTi<br>me                                                                                                                                                                  | Waiting time after completion<br>of the first stage of<br>displacement | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|       |                 | Detailed description: After the first stage of the multi-stage position displacement operation is completed, the waiting time before the next stage of displacement operation is completed |                                                                        |           |                           |                    |                  |                     |               |                       |
|       | 0B <sub>h</sub> | Displace2                                                                                                                                                                                  | 2nd stage displacement                                                 | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |
|       | 0C <sub>h</sub> | Displace2MaxSpeed                                                                                                                                                                          | 2nd stage displacement<br>maximum running speed                        | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|       | 0D <sub>h</sub> | Displace2AccelDecel<br>Time                                                                                                                                                                | 2nd stage displacement<br>acceleration / deceleration time             | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|       | 0E <sub>h</sub> | Displace2DoneWaitTi<br>me                                                                                                                                                                  | Waiting time after completion<br>of the second stage<br>displacement   | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|       | 0F <sub>h</sub> | Displace3                                                                                                                                                                                  | 3rd stage displacement                                                 | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |

| Index                                                    | Sub-index       | Name                     | Description                                                    | Data type | Data range            | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit       | Activate<br>method |
|----------------------------------------------------------|-----------------|--------------------------|----------------------------------------------------------------|-----------|-----------------------|--------------------|------------------|--------------------|------------|--------------------|
| <b>2011h (multi-segment position function parameter)</b> | 10 <sub>h</sub> | Displace3MaxSpeed        | 3rd stage displacement maximum running speed                   | uint16    | 0~3000                | RW                 | NO               | 1                  | rpm        | Shutdown effective |
|                                                          | 11 <sub>h</sub> | Displace3AccelDecel Time | Stage 3 displacement acceleration / deceleration time          | uint16    | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 12 <sub>h</sub> | Displace3DoneWaitTime    | Waiting time after the third stage displacement is completed   | uint16    | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 13 <sub>h</sub> | Displace4                | 4th stage displacement                                         | int32     | 2147483648~2147483647 | RW                 | NO               | -1073741824        | User units | Shutdown effective |
|                                                          | 14 <sub>h</sub> | Displace4MaxSpeed        | 4th stage displacement maximum running speed                   | uint16    | 0~3000                | RW                 | NO               | 1                  | rpm        | Shutdown effective |
|                                                          | 15 <sub>h</sub> | Displace4AccelDecel Time | 4th stage displacement acceleration / deceleration time        | uint16    | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 16 <sub>h</sub> | Displace4DoneWaitTime    | Waiting time after completion of the fourth stage displacement | uint16    | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 17 <sub>h</sub> | Displace5                | Step 5 displacement                                            | int32     | 2147483648~2147483647 | RW                 | NO               | 1073741824         | User units | Shutdown effective |
|                                                          | 18 <sub>h</sub> | Displace5MaxSpeed        | 5th stage displacement maximum running speed                   | uint16    | 0~3000                | RW                 | NO               | 1                  | rpm        | Shutdown effective |
|                                                          | 19 <sub>h</sub> | Displace5AccelDecel Time | Stage 5 displacement acceleration / deceleration time          | uint16    | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 1A <sub>h</sub> | Displace5DoneWaitTime    | Waiting time after completion of the 5th stage displacement    | uint16    | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
| <b>2011h (multi-segment)</b>                             | 1B <sub>h</sub> | Displace6                | Step 6 displacement                                            | int32     | 2147483648~2147483647 | RW                 | NO               | -1073741824        | User units | Shutdown effective |

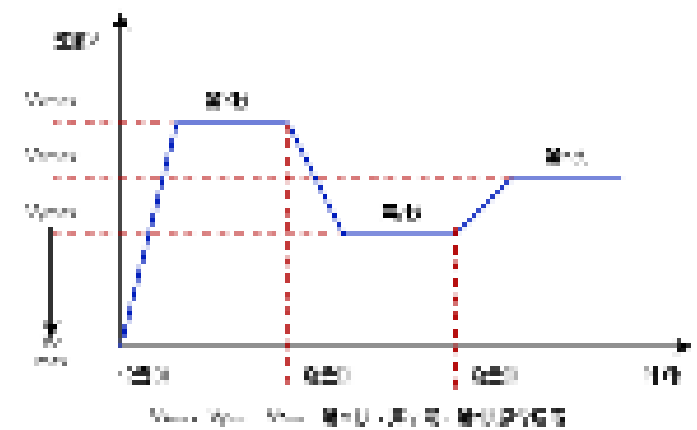
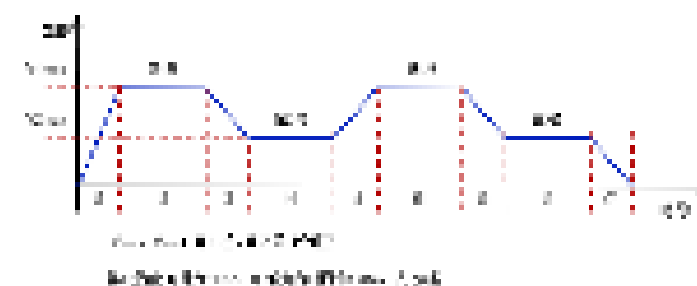
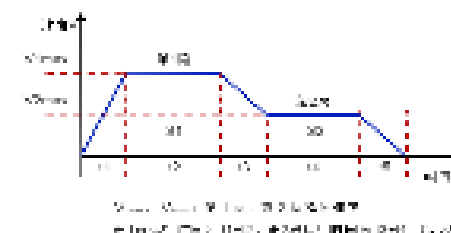
| Index                                       | Sub-index | Name                        | Description                                                                           | Data type | Data range                | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting  | Unit          | Activate<br>method    |
|---------------------------------------------|-----------|-----------------------------|---------------------------------------------------------------------------------------|-----------|---------------------------|--------------------|------------------|---------------------|---------------|-----------------------|
| <b>position<br/>function<br/>parameter)</b> | 1Ch       | Displace6MaxSpeed           | 6th stage displacement<br>maximum running speed                                       | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|                                             | 1Dh       | Displace6AccelDecel<br>Time | 6th stage displacement<br>acceleration / deceleration time                            | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 1Eh       | Displace6DoneWaitTi<br>me   | Waiting time after completion<br>of the 6th stage displacement                        | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 1Fh       | Displace7                   | Step 7 displacement                                                                   | int32     | 2147483648~<br>2147483647 | RW                 | NO               | 10737418<br>24      | User<br>units | Shutdown<br>effective |
|                                             | 20h       | Displace7MaxSpeed           | 7th stage displacement<br>maximum running speed                                       | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|                                             | 21h       | Displace7AccelDecel<br>Time | 7th stage displacement<br>acceleration / deceleration time                            | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 22h       | Displace7DoneWaitTi<br>me   | Waiting time after completion<br>of the 7th displacement                              | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 23h       | Displace8                   | 8th stage displacement                                                                | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |
|                                             | 24h       | Displace8MaxSpeed           | 8th stage displacement<br>maximum running speed                                       | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|                                             | 25h       | Displace8AccelDecel<br>Time | 8th stage displacement<br>acceleration / deceleration time                            | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
| <b>2011h (multi-<br/>segment</b>            | 26h       | Displace8DoneWaitTi<br>me   | Waiting time after completion<br>of the 8th stage displacement<br>Step 9 displacement | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |

| Index                                       | Sub-index       | Name                         | Description                                                 | Data type | Data range                | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting  | Unit          | Activate<br>method            |
|---------------------------------------------|-----------------|------------------------------|-------------------------------------------------------------|-----------|---------------------------|--------------------|------------------|---------------------|---------------|-------------------------------|
| <b>position<br/>function<br/>parameter)</b> | 27 <sub>h</sub> | Displace9                    | 9th stage displacement<br>maximum running speed             | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective         |
|                                             | 28 <sub>h</sub> | Displace9MaxSpeed            | 9th stage displacement<br>acceleration / deceleration time  | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective         |
|                                             | 29 <sub>h</sub> | Displace9AccelDecel<br>Time  | 9th stage displacement<br>acceleration / deceleration time  | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective         |
|                                             | 2A <sub>h</sub> | Displace9DoneWaitTi<br>me    | Waiting time after completion<br>of the 9th displacement    | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective         |
|                                             | 2B <sub>h</sub> | Displace10                   | Step 10 displacement                                        | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective         |
|                                             | 2C <sub>h</sub> | Displace10MaxSpeed           | 10th stage displacement<br>maximum running speed            | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective         |
|                                             | 2D <sub>h</sub> | Displace10AccelDece<br>lTime | 10th stage displacement<br>acceleration / deceleration time | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective         |
|                                             | 2E <sub>h</sub> | Displace10DoneWait<br>Time   | Waiting time after completion<br>of the 10th shift          | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective         |
|                                             | 2F <sub>h</sub> | Displace11                   | Step 11 Displacement                                        | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | 停机生效<br>Shutdown<br>effective |
|                                             | 30 <sub>h</sub> | Displace11MaxSpeed           | Maximum operating speed of<br>the 11th displacement         | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective         |
|                                             | 31 <sub>h</sub> | Displace11AccelDece<br>lTime | 11th stage displacement<br>acceleration / deceleration time | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective         |
| <b>2011h (multi-<br/>segment</b>            |                 |                              |                                                             |           |                           |                    |                  |                     |               |                               |

| Index                                       | Sub-index       | Name                         | Description                                                 | Data type | Data range                | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting  | Unit          | Activate<br>method    |
|---------------------------------------------|-----------------|------------------------------|-------------------------------------------------------------|-----------|---------------------------|--------------------|------------------|---------------------|---------------|-----------------------|
| <b>position<br/>function<br/>parameter)</b> | 32 <sub>h</sub> | Displace11DoneWait<br>Time   | Wait time after completion of<br>the 11th shift             | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 33 <sub>h</sub> | Displace12                   | Step 12 displacement                                        | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |
|                                             | 34 <sub>h</sub> | Displace12MaxSpeed           | 12th stage displacement<br>maximum running speed            | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|                                             | 35 <sub>h</sub> | Displace12AccelDece<br>lTime | 12th stage displacement<br>acceleration / deceleration time | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 36 <sub>h</sub> | Displace12DoneWait<br>Time   | Waiting time after the 12th<br>displacement is completed    | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 37 <sub>h</sub> | Displace13                   | Step 13 displacement                                        | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |
|                                             | 38 <sub>h</sub> | Displace13MaxSpeed           | 13th stage displacement<br>maximum running speed            | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |
|                                             | 39 <sub>h</sub> | Displace13AccelDece<br>lTime | 13th stage displacement<br>acceleration / deceleration time | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 3A <sub>h</sub> | Displace13DoneWait<br>Time   | Waiting time after completion<br>of the 13th displacement   | uint16    | 0~65535                   | RW                 | NO               | 0                   | ms            | Shutdown<br>effective |
|                                             | 3B <sub>h</sub> | Displace14                   | 14th stage displacement                                     | int32     | 2147483648~<br>2147483647 | RW                 | NO               | -<br>10737418<br>24 | User<br>units | Shutdown<br>effective |
|                                             | 3C <sub>h</sub> | Displace14MaxSpeed           | 14th stage displacement<br>maximum running speed            | uint16    | 0~3000                    | RW                 | NO               | 1                   | rpm           | Shutdown<br>effective |

| Index                                                    | Sub-index       | Name                                                                                                                         | Description                                                 | Data type       | Data range            | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit       | Activate<br>method |
|----------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------|-----------------------|--------------------|------------------|--------------------|------------|--------------------|
| <b>2011h (multi-segment position function parameter)</b> | 3D <sub>h</sub> | Displace14AccelDeceITime                                                                                                     | 14th stage displacement acceleration / deceleration time    | uint16          | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 3E <sub>h</sub> | Displace14DoneWaitTime                                                                                                       | Waiting time after the 14th stage displacement is completed | uint16          | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 3F <sub>h</sub> | Displace15                                                                                                                   | Step 15 Displacement                                        | int32           | 2147483648~2147483647 | RW                 | NO               | -1073741824        | User units | Shutdown effective |
|                                                          | 40 <sub>h</sub> | Displace15MaxSpeed                                                                                                           | 15th stage displacement maximum running speed               | uint16          | 0~3000                | RW                 | NO               | 1                  | rpm        | Shutdown effective |
|                                                          | 41 <sub>h</sub> | Displace15AccelDeceITime                                                                                                     | 15th stage displacement acceleration / deceleration time    | uint16          | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 42 <sub>h</sub> | Displace15DoneWaitTime                                                                                                       | Waiting time after completion of the 15th displacement      | uint16          | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 43 <sub>h</sub> | Displace16                                                                                                                   | 16th stage displacement                                     | int32           | 2147483648~2147483647 | RW                 | NO               | -1073741824        | User units | Shutdown effective |
|                                                          | 44 <sub>h</sub> | Displace16MaxSpeed                                                                                                           | 16th stage displacement maximum running speed               | uint16          | 0~3000                | RW                 | NO               | 1                  | rpm        | Shutdown effective |
|                                                          | 45 <sub>h</sub> | Displace16AccelDeceITime                                                                                                     | 16th stage displacement acceleration / deceleration time    | uint16          | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 46 <sub>h</sub> | Displace16DoneWaitTime                                                                                                       | Waiting time after the 16th stage displacement is completed | uint16          | 0~65535               | RW                 | NO               | 0                  | ms         | Shutdown effective |
|                                                          | 01 <sub>h</sub> | MultiSpeedRunMode                                                                                                            | Multi-step speed instruction operation mode                 | uint16          | 0~2                   | RW                 | NO               | 0                  | 1          | Shutdown effective |
|                                                          |                 | Detailed description: Set the connection mode between segments, 0-single operation; 1-cycle operation; 2-DI switch operation |                                                             |                 |                       |                    |                  |                    |            |                    |
|                                                          |                 | Operating mode                                                                                                               | Description                                                 | Operating curve |                       |                    |                  |                    |            |                    |

| Index                               | Sub-index | Name                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Data type      | Data range | Access-ability | Mapp-ability | Factory setting | Unit | Activate method |   |   |   |  |  |  |  |
|-------------------------------------|-----------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------|----------------|--------------|-----------------|------|-----------------|---|---|---|--|--|--|--|
| 2012h (multi-stage speed parameter) |           | Single run             | Paragraphs 1 to 16 run once;<br>Automatic segment number switching                                                                                                                                                                                                                                                                                                                                                                                                                  |                |            |                |              |                 |      |                 |   |   |   |  |  |  |  |
|                                     |           | Cyclic operation       | The first segment to the end point set at 2012h: 02h runs the number of times set at 2012h: 02h; the segment number is automatically incremented and switched;                                                                                                                                                                                                                                                                                                                      |                |            |                |              |                 |      |                 |   |   |   |  |  |  |  |
|                                     |           | DI switching operation | The speed segment number switch is determined by the decimal 0 ~ 15 corresponding to the 4-digit binary number composed of multifunctional numbers 6, 7, 8, and 9;<br>Servo enable is effective, that is, continuous operation;<br>The relationship between segment numbers and multifunction numbers is as follows: <table><tr><td>Fun9</td><td>Fun8</td><td>Fun7</td><td>Fun6</td><td>Section number</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr></table> | Fun9           | Fun8       | Fun7           | Fun6         | Section number  | 0    | 0               | 0 | 0 | 1 |  |  |  |  |
| Fun9                                | Fun8      | Fun7                   | Fun6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Section number |            |                |              |                 |      |                 |   |   |   |  |  |  |  |
| 0                                   | 0         | 0                      | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1              |            |                |              |                 |      |                 |   |   |   |  |  |  |  |



| Index                                           | Sub-index                                                                      | Name                     | Description                                                                                                                                                               |   |    |  |        | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit               | Activate<br>method |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|-------------------------------------------------|--------------------------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|----|--|--------|-----------|------------|--------------------|------------------|--------------------|--------------------|--------------------|--|--|--|---|---|---|---|----|--|--|--|--|--|--|--|--|--|
| 2012h (multi-<br>stage speed<br>parameter)<br>) |                                                                                |                          | <table><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>2</td></tr><tr><td colspan="5">.....</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>16</td></tr></table> |   |    |  |        | 0         | 0          | 0                  | 1                | 2                  | .....              |                    |  |  |  | 1 | 1 | 1 | 1 | 16 |  |  |  |  |  |  |  |  |  |
|                                                 | 0                                                                              | 0                        | 0                                                                                                                                                                         | 1 | 2  |  |        |           |            |                    |                  |                    |                    |                    |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | .....                                                                          |                          |                                                                                                                                                                           |   |    |  |        |           |            |                    |                  |                    |                    |                    |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | 1                                                                              | 1                        | 1                                                                                                                                                                         | 1 | 16 |  |        |           |            |                    |                  |                    |                    |                    |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | Note: During each speed command operation, the servo enable must be effective. |                          |                                                                                                                                                                           |   |    |  |        |           |            |                    |                  |                    |                    |                    |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | 02h                                                                            | SpeedRefProfileNum       | Speed command end segment selection                                                                                                                                       |   |    |  |        | uint16    | 0~16       | RW                 | NO               | 1                  | 1                  | Shutdown effective |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | 03h                                                                            | MultiSpeedTimeUnit       | Multi-stage speed cycle times                                                                                                                                             |   |    |  |        | uint16    | 0~65535    | RW                 | NO               | 0                  | 1                  | Shutdown effective |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | 0C <sub>h</sub>                                                                | SpeedRef1                | 1st speed command                                                                                                                                                         |   |    |  |        | int16     | 0~3000     | RW                 | NO               | -6000              | rpm                | Shutdown effective |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | 0D <sub>h</sub>                                                                | SpeedRef1RunTime         | The first instruction run time                                                                                                                                            |   |    |  |        | uint16    | 0~65535    | RW                 | NO               | 0                  | ms                 | Shutdown effective |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
|                                                 | 0E <sub>h</sub>                                                                | SpeedRef1AccelDecelTime  | 1st stage acceleration / deceleration time                                                                                                                                |   |    |  |        | uint16    | 0~65535    | RW                 | NO               | 0                  | ms                 | Shutdown effective |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
| 0F <sub>h</sub>                                 | SpeedRef2                                                                      | Paragraph 2 instruction  |                                                                                                                                                                           |   |    |  | int16  | 0~3000    | RW         | NO                 | -6000            | rpm                | Shutdown effective |                    |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |
| 10 <sub>h</sub>                                 | SpeedRef2RunTime                                                               | 2nd instruction run time |                                                                                                                                                                           |   |    |  | uint16 | 0~65535   | RW         | NO                 | 0                | ms                 | Shutdown effective |                    |  |  |  |   |   |   |   |    |  |  |  |  |  |  |  |  |  |

| Index                                               | Sub-index       | Name                        | Description                                                 | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method    |
|-----------------------------------------------------|-----------------|-----------------------------|-------------------------------------------------------------|-----------|------------|--------------------|------------------|--------------------|------|-----------------------|
| <b>2012h (multi-<br/>stage speed<br/>parameter)</b> | 11 <sub>h</sub> | SpeedRef2AccelDece<br>lTime | 2nd stage acceleration /<br>deceleration time               | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 12 <sub>h</sub> | SpeedRef3                   | Paragraph 3 instruction                                     | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                                     | 13 <sub>h</sub> | SpeedRef3RunTime            | Operation time of the third<br>instruction                  | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 14 <sub>h</sub> | SpeedRef3AccelDece<br>lTime | Acceleration and deceleration<br>time of the third section  | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 15 <sub>h</sub> | SpeedRef4                   | Paragraph 4 instruction                                     | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                                     | 16 <sub>h</sub> | SpeedRef4RunTime            | Operation time of the fourth<br>instruction                 | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 17 <sub>h</sub> | SpeedRef4AccelDece<br>lTime | Acceleration and deceleration<br>time of the fourth segment | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 18 <sub>h</sub> | SpeedRef5                   | Paragraph 5 instruction                                     | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                                     | 19 <sub>h</sub> | SpeedRef5RunTime            | Operation time of the 5th<br>instruction                    | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 1A <sub>h</sub> | SpeedRef5AccelDece<br>lTime | Acceleration and deceleration<br>time of the fifth segment  | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 1B <sub>h</sub> | SpeedRef6                   | Paragraph 6 instruction                                     | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                                     | 1C <sub>h</sub> | SpeedRef6RunTime            | Operation time of the 6th<br>instruction                    | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                     | 1D <sub>h</sub> | SpeedRef6AccelDece<br>lTime | Acceleration and deceleration<br>time of the sixth segment  | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |

| Index                                      | Sub-index       | Name                         | Description                                                  | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method    |
|--------------------------------------------|-----------------|------------------------------|--------------------------------------------------------------|-----------|------------|--------------------|------------------|--------------------|------|-----------------------|
| 2012h (multi-<br>stage speed<br>parameter) | 1E <sub>h</sub> | SpeedRef7                    | Paragraph 7 instruction                                      | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                            | 1F <sub>h</sub> | SpeedRef7RunTime             | Operation time of segment 7<br>instruction                   | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 20 <sub>h</sub> | SpeedRef7AccelDece<br>lTime  | Acceleration and deceleration<br>time of the seventh segment | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 21 <sub>h</sub> | SpeedRef8                    | Paragraph 8 instruction                                      | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                            | 22 <sub>h</sub> | SpeedRef8RunTime             | Operation time of segment 8<br>instruction                   | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 23 <sub>h</sub> | SpeedRef8AccelDece<br>lTime  | Acceleration and deceleration<br>time of the eighth segment  | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 24 <sub>h</sub> | SpeedRef9                    | Paragraph 9 instruction                                      | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                            | 25 <sub>h</sub> | SpeedRef9RunTime             | Operation time of the 9th<br>instruction                     | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 26 <sub>h</sub> | SpeedRef9AccelDece<br>lTime  | Acceleration and deceleration<br>time of the 9th segment     | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 27 <sub>h</sub> | SpeedRef10                   | Paragraph 10 instruction                                     | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                            | 28 <sub>h</sub> | SpeedRef10RunTime            | Operation time of the 10th<br>instruction                    | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 29 <sub>h</sub> | SpeedRef10AccelDec<br>elTime | Acceleration and deceleration<br>time of the 10th segment    | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                            | 2A <sub>h</sub> | SpeedRef11                   | Paragraph 11 instruction                                     | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |

| Index                               | Sub-index       | Name                     | Description                                            | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|-------------------------------------|-----------------|--------------------------|--------------------------------------------------------|-----------|------------|--------------------|------------------|--------------------|------|--------------------|
| 2012h (multi-stage speed parameter) | 2B <sub>h</sub> | SpeedRef11RunTime        | Operation time of the 11th instruction                 | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 2C <sub>h</sub> | SpeedRef11AccelDecelTime | Acceleration and deceleration time of the 11th segment | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 2D <sub>h</sub> | SpeedRef12               | Paragraph 12 instruction                               | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown effective |
|                                     | 2E <sub>h</sub> | SpeedRef12RunTime        | Operation time of the 12th instruction                 | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 2F <sub>h</sub> | SpeedRef12AccelDecelTime | Acceleration and deceleration time of the 12th segment | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 30 <sub>h</sub> | SpeedRef13               | Operation time of the 13th instruction                 | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown effective |
|                                     | 31 <sub>h</sub> | SpeedRef13RunTime        | Acceleration and deceleration time of the 13th section | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 32 <sub>h</sub> | SpeedRef13AccelDecelTime | Acceleration and deceleration time of the 13th section | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 33 <sub>h</sub> | SpeedRef14               | Paragraph 14 instruction                               | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown effective |
|                                     | 34 <sub>h</sub> | SpeedRef14RunTime        | Operation time of the 14th instruction                 | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 35 <sub>h</sub> | SpeedRef14AccelDecelTime | Acceleration and deceleration time of the 14th segment | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |
|                                     | 36 <sub>h</sub> | SpeedRef15               | Paragraph 15 instruction                               | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown effective |
|                                     | 37 <sub>h</sub> | SpeedRef15RunTime        | Operation time of the 15th instruction                 | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown effective |

| Index                                                                 | Sub-index       | Name                                   | Description                                               | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method    |
|-----------------------------------------------------------------------|-----------------|----------------------------------------|-----------------------------------------------------------|-----------|------------|--------------------|------------------|--------------------|------|-----------------------|
|                                                                       | 38 <sub>h</sub> | SpeedRef15AccelDec<br>elTime           | Acceleration and deceleration<br>time of the 15th segment | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                                       | 39 <sub>h</sub> | SpeedRef16                             | Paragraph 16 instruction                                  | int16     | 0~3000     | RW                 | NO               | -6000              | rpm  | Shutdown<br>effective |
|                                                                       | 3A <sub>h</sub> | SpeedRef16RunTime                      | Operation time of the 16th<br>instruction                 | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
|                                                                       | 3B <sub>h</sub> | SpeedRef16AccelDec<br>elTime           | Acceleration and deceleration<br>time of the 16th section | uint16    | 0~65535    | RW                 | NO               | 0                  | ms   | Shutdown<br>effective |
| 2017 <sub>h</sub><br>(Virtual<br>Input<br>Terminal<br>parameters<br>) | 01 <sub>h</sub> | VDI1FunSelec                           | Vdi1 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       |                 | Description:See Section7.1 for details |                                                           |           |            |                    |                  |                    |      |                       |
|                                                                       | 02 <sub>h</sub> | VDI2LogicSelec                         | Vdi2 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       |                 | Description:See Section7.1 for details |                                                           |           |            |                    |                  |                    |      |                       |
|                                                                       | 03 <sub>h</sub> | VDI2FunSelec                           | Vdi2terminal logic selection                              | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 04 <sub>h</sub> | VDI2LogicSelec                         | Vdi2 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 05 <sub>h</sub> | VDI3FunSelec                           | Vdi3 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 06 <sub>h</sub> | VDI3LogicSelec                         | Vdi3 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 07 <sub>h</sub> | VDI4FunSelec                           | Vdi4 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 08 <sub>h</sub> | VDI4LogicSelec                         | Vdi4 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 09 <sub>h</sub> | VDI5FunSelec                           | Vdi5 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 0A <sub>h</sub> | VDI5LogicSelec                         | Vdi5 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 0B <sub>h</sub> | VDI6FunSelec                           | Vdi6 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 0C <sub>h</sub> | VDI6LogicSelec                         | Vdi6 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 0D <sub>h</sub> | VDI7FunSelec                           | Vdi7 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 0E <sub>h</sub> | VDI7LogicSelec                         | Vdi7 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 0F <sub>h</sub> | VDI8FunSelec                           | Vdi8 terminal logic selection                             | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate         |
|                                                                       | 10 <sub>h</sub> | VDI8LogicSelec                         | Vdi8 terminal logic selection                             | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate         |

| Index                                                                                  | Sub-index       | Name                                                                                                                                                                                                                                                                                                                                                                                                         | Description                    | Data type | Data range | Access-<br>ibility | Mapp-<br>ability | Factory<br>setting | Unit | Activate<br>method |
|----------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------|------------|--------------------|------------------|--------------------|------|--------------------|
| <b>2017<sub>h</sub></b><br>(Virtual<br>Input<br>Terminal<br>parameters<br>)            | 11 <sub>h</sub> | VDI9FunSelec                                                                                                                                                                                                                                                                                                                                                                                                 | Vdi9 terminal logic selection  | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 12 <sub>h</sub> | VDI9LogicSelec                                                                                                                                                                                                                                                                                                                                                                                               | Vdi9 terminal logic selection  | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 13 <sub>h</sub> | VDI10FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi10 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 14 <sub>h</sub> | VDI10LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi10 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 15 <sub>h</sub> | VDI11FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi11 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 16 <sub>h</sub> | VDI11LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi11 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 17 <sub>h</sub> | VDI12FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi12 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 18 <sub>h</sub> | VDI12LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi12 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 19 <sub>h</sub> | VDI13FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi13 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 1A <sub>h</sub> | VDI13LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi13 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 1B <sub>h</sub> | VDI14FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi14 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 1C <sub>h</sub> | VDI14LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi14 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 1D <sub>h</sub> | VDI15FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi15 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 1E <sub>h</sub> | VDI15LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi15 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 1F <sub>h</sub> | VDI16FunSelec                                                                                                                                                                                                                                                                                                                                                                                                | Vdi16 terminal logic selection | uint16    | 0~45       | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        | 20 <sub>h</sub> | VDI16LogicSelec                                                                                                                                                                                                                                                                                                                                                                                              | Vdi16 terminal logic selection | uint16    | 0~1        | RW                 | NO               | 0                  | 1    | Stop activate      |
| <b>2031<sub>h</sub></b><br>(Communic-<br>ation Given<br>Servo<br>Related<br>Variables) | 01 <sub>h</sub> | VDI_VirtualLevelCo<br>mmSet                                                                                                                                                                                                                                                                                                                                                                                  |                                | uint16    | 0~65535    | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        |                 | Description: bit (n) = 1 in 2031 <sub>h</sub> :01 <sub>h</sub> means VDI (n + 1) is high-level; bit (n) = 0 means VDI (n + 1) is low-level                                                                                                                                                                                                                                                                   |                                |           |            |                    |                  |                    |      |                    |
|                                                                                        | 02 <sub>h</sub> | DoStateCommSet                                                                                                                                                                                                                                                                                                                                                                                               |                                | uint16    | 0~65535    | RW                 | NO               | 0                  | 1    | Stop activate      |
|                                                                                        |                 | description: when the logical selection in 2004 <sub>h</sub> is positive, if 2031 <sub>h</sub> : 02 <sub>h</sub> = 1, Do output high-level, if 2031 <sub>h</sub> : 02 <sub>h</sub> = 0, Do output low-level;<br>when the logic selection in 2004 <sub>h</sub> is negative, if 2031 <sub>h</sub> : 02 <sub>h</sub> = 1, Do output low-level; if 2031 <sub>h</sub> : 02 <sub>h</sub> = 0, Do output high-level |                                |           |            |                    |                  |                    |      |                    |

### 10.3 Sub-protocol Definition Parameter Group 6000<sub>h</sub> Description

| Index                                                                                                                                                                                                                                                                                                                                   | Sub-index       | Name                            | Description                   | Data type | Data range                 | Access-ability | Mapp-ability | Factory setting | Unit | Activate method |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------|-------------------------------|-----------|----------------------------|----------------|--------------|-----------------|------|-----------------|
| 603F <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | Error Code                      | See section 9.1 for details   | uint16    | 0~65535                    | RO             | TPDO         | 0               | -    | -               |
| 6040 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | Control word                    |                               | uint16    | 0~65535                    | RW             | RPDO         | 0               | 1    | Stop activate   |
| 6041 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | Status word                     |                               | uint16    | 0~65535                    | RO             | TPDO         | 0               | 1    | -               |
| 6042 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | VI target velocity              | Target velocity in VM mode    | int16     | -3000~3000                 | RW             | RPDO         | 0               | 1rpm | Stop activate   |
| 6043 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | VI velocity demand              | Velocity demand in VM         | int16     | -3000~3000                 | RO             | TPDO         | 0               | 1rpm | -               |
| 6044 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | VI velocity actual value        | Actual speed in VM mode       | int16     | -3000~3000                 | RO             | TPDO         | 0               | 1rpm |                 |
| 6046 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 01 <sub>h</sub> | VI velocity min amount          | Minimum speed in VM mode      | uint32    | 0~3000                     | RW             | RPDO         | 10              | 1rpm | Stop activate   |
|                                                                                                                                                                                                                                                                                                                                         | 02 <sub>h</sub> | VI velocity max amount          | Maximum speed in VM mode      | uint32    | 0~3000                     | RW             | RPDO         | 3000            | 1rpm | Stop activate   |
| 6048 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 01 <sub>h</sub> | delta speed                     | Acceleration in VM=delta      | uint32    | 0~4294967295               | RW             | RPDO         | 500             | 1rpm | Stop activate   |
|                                                                                                                                                                                                                                                                                                                                         | 02 <sub>h</sub> | delta time                      | speed/delta time              | uint16    | 1~65535                    | RW             | RPDO         | 1               | 1s   | Stop activate   |
| 6049 <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 01 <sub>h</sub> | delta speed                     | Deceleration in VM=delta      | uint32    | 0~4294967295               | RW             | RPDO         | 500             | 1rpm | Stop activate   |
|                                                                                                                                                                                                                                                                                                                                         | 02 <sub>h</sub> | delta time                      | speed/delta time              | uint16    | 1~65535                    | RW             | RPDO         | 1               | 1s   | Stop activate   |
| 604A <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 01 <sub>h</sub> | delta speed                     | Braking acceleration in       | uint32    | 0~4294967295               | RW             | RPDO         | 800             | 1rpm | Stop activate   |
|                                                                                                                                                                                                                                                                                                                                         | 02 <sub>h</sub> | delta time                      | VM=delta speed/delta time     | uint16    | 1~65535                    | RW             | RPDO         | 1               | 1s   | Stop activate   |
| 604C <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 01 <sub>h</sub> | vl dimension factor numerator   | Scaling factor in VM          | int32     | -<br>2147483648~2147483647 | RW             | RPDO         | 0               | 1    | Stop activate   |
|                                                                                                                                                                                                                                                                                                                                         | 02 <sub>h</sub> | vl dimension factor denominator |                               | int32     | -<br>2147483648~2147483647 | RW             | RPDO         | 0               | 1    | Stop activate   |
| Sub index 1 contains the numerator (multiplier) used to calculate speed, and sub index 2 contains the denominator (divisor).<br>Speed unit: rpm * sub index 1 / sub index 2. For example, if sub index 1 is set to 2 and sub index 2 is set to 1, then speed unit: 2rpm. If any of the sub indexes 1 and 2 is 0, the speed unit is rpm. |                 |                                 |                               |           |                            |                |              |                 |      |                 |
| 605A <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | Quick stop option code          | See section 4.1.4 for details | int16     | 0~2                        | RW             | NO           | 2               | 1    | Stop activate   |
| 605D <sub>h</sub>                                                                                                                                                                                                                                                                                                                       | 00 <sub>h</sub> | Halt option code                | See section 4.1.4 for details | int16     | 1~2                        | RW             | NO           | 1               | 1    | Stop activate   |

| Index             | Sub-index       | Name                                                                                                                                                                                                    | Description                                                | Data type | Data range                 | Access-ability | Mapp-ability | Factory setting | Unit      | Activate method |
|-------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------|----------------------------|----------------|--------------|-----------------|-----------|-----------------|
| 605E <sub>h</sub> | 00 <sub>h</sub> | Fault reaction option code                                                                                                                                                                              | See section 4.1.4 for details                              | int16     | 0~2                        | RO             | NO           | 0               | 1         | Stop activate   |
| 6060 <sub>h</sub> | 00 <sub>h</sub> | ModeOperation                                                                                                                                                                                           | See section 6.1 for details                                | int8      | 0~10                       | RW             | RPDO         | 1               | 1         | Stop activate   |
| 6061 <sub>h</sub> | 00 <sub>h</sub> | Modes of operation display                                                                                                                                                                              | See section 6.2 for details                                | int8      | 0~10                       | RO             | TPDO         | 1               | 1         | -               |
| 6062 <sub>h</sub> | 00 <sub>h</sub> | Position demand value                                                                                                                                                                                   | Position instruction value in effect inside the controller | int32     | -<br>2147483648~2147483647 | RO             | TPDO         | 0               | User unit | -               |
| 6063 <sub>h</sub> | 00 <sub>h</sub> | Position actual encoder value                                                                                                                                                                           |                                                            | int32     | -<br>2147483648~2147483647 | RO             | TPDO         | 0               | 编码器单位     | -               |
| 6064 <sub>h</sub> | 00 <sub>h</sub> | Position actual user value                                                                                                                                                                              |                                                            | int32     | -<br>2147483648~2147483647 | RO             | TPDO         | 0               | User unit | -               |
|                   |                 | Description: position feedback 6064 <sub>h</sub> × gear ratio (6091 <sub>h</sub> ) = position feedback 6063 <sub>h</sub>                                                                                |                                                            |           |                            |                |              |                 |           |                 |
| 6065 <sub>h</sub> | 00 <sub>h</sub> | Following error Window                                                                                                                                                                                  |                                                            | uint32    | 0~4294967295               | RW             | RPDO         | 50              | User unit | Stop activate   |
|                   |                 | Description: when the position deviation exceeds ± 6065 <sub>h</sub> and the duration time reaches 6066 <sub>h</sub> , Tracking error is triggered                                                      |                                                            |           |                            |                |              |                 |           |                 |
| 6066 <sub>h</sub> | 00 <sub>h</sub> | Following error time out                                                                                                                                                                                |                                                            | uint16    | 0~65535                    | RW             | RPDO         | 30000           | 1ms       | Stop activate   |
|                   |                 | Description: when the position deviation exceeds ± 6065 <sub>h</sub> and the duration time reaches 6066 <sub>h</sub> , Tracking error is triggered                                                      |                                                            |           |                            |                |              |                 |           |                 |
| 6067 <sub>h</sub> | 00 <sub>h</sub> | Position Window                                                                                                                                                                                         |                                                            | uint32    | 0~4294967295               | RW             | RPDO         | 10              | User unit | Stop activate   |
|                   |                 | Description: when the position deviation exceeds ± 6067 <sub>h</sub> and the duration reaches 6068 <sub>h</sub> , Target position is reached.Bit10 of status word 6041 <sub>h</sub> =1 in position mode |                                                            |           |                            |                |              |                 |           |                 |
| 6068 <sub>h</sub> | 00 <sub>h</sub> | Position Window time                                                                                                                                                                                    |                                                            | uint16    | 0~65535                    | RW             | RPDO         | 5               | 1ms       | Stop activate   |
| 6068 <sub>h</sub> |                 | Description: when the position deviation exceeds ± 6067 <sub>h</sub> and the duration reaches 6068 <sub>h</sub> , Target position is reached.Bit10 of status word 6041 <sub>h</sub> =1 in position mode |                                                            |           |                            |                |              |                 |           |                 |

| Index                   | Sub-index       | Name                                                                                                                                                                                                                                                                                                      | Description                                                | Data type | Data range                 | Access-ability | Mapp-ability | Factory setting | Unit        | Activate method |
|-------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------|----------------------------|----------------|--------------|-----------------|-------------|-----------------|
| <b>6069<sub>h</sub></b> | 00 <sub>h</sub> | Velocity sensor actual value                                                                                                                                                                                                                                                                              |                                                            | int32     | -<br>2147483648~2147483647 | RO             | TPDO         | 0               | User unit/s | -               |
| <b>606B<sub>h</sub></b> | 00 <sub>h</sub> | Velocity demand value                                                                                                                                                                                                                                                                                     | Velocity instruction value in effect inside the controller | int32     | -<br>2147483648~2147483647 | RO             | TPDO         | 0               | User unit/s | -               |
| <b>606C<sub>h</sub></b> | 00 <sub>h</sub> | Velocity actual value                                                                                                                                                                                                                                                                                     | Current velocity actual value feedback                     | int32     | -<br>2147483648~2147483647 | RO             | TPDO         | 0               | rpm         | -               |
| <b>606D<sub>h</sub></b> | 00 <sub>h</sub> | Velocity Window                                                                                                                                                                                                                                                                                           |                                                            | uint16    | 0~65535                    | RW             | TPDO         | 500             | rpm         | Stop activate   |
|                         |                 | Description: when the difference between the target speed in 60FF <sub>h</sub> (converted into motor speed rpm) and the actual speed of the motor is within ± 606D, and the duration time reaches 606E <sub>h</sub> , means that the speed is reached, and the bit10 in status word 6041 <sub>h</sub> = 1 |                                                            |           |                            |                |              |                 |             |                 |
| <b>606E<sub>h</sub></b> | 00 <sub>h</sub> | Velocity Window time                                                                                                                                                                                                                                                                                      |                                                            | uint16    | 0~65535                    | RW             | TPDO         | 5               | ms          | Stop activate   |
|                         |                 | Description: when the difference between the target speed in 60FF <sub>h</sub> (converted into motor speed rpm) and the actual speed of the motor is within ± 606D, and the duration time reaches 606E <sub>h</sub> , means that the speed is reached, and the bit10 in status word 6010 <sub>h</sub> = 1 |                                                            |           |                            |                |              |                 |             |                 |
| <b>606F<sub>h</sub></b> | 00 <sub>h</sub> | Velocity t <sub>h</sub> res <sub>h</sub> old                                                                                                                                                                                                                                                              | Threshold of 0° arrival                                    | uint16    | 0~65535                    | RW             | TPDO         | 5               | User unit/s | Stop activate   |
|                         |                 | Description: the current speed is under 6069 <sub>h</sub> within ± 606F <sub>h</sub> , and the duration time reaches 6070 <sub>h</sub> , means that the speed is 0, and the bit12 in status word 6041 <sub>h</sub> = 1                                                                                    |                                                            |           |                            |                |              |                 |             |                 |
| <b>6070<sub>h</sub></b> | 00 <sub>h</sub> | Velocity t <sub>h</sub> res <sub>h</sub> old time                                                                                                                                                                                                                                                         | Time window when 0° arrival                                | uint16    | 0~65535                    | RW             | TPDO         | 5               | ms          | Stop activate   |
|                         |                 | Description: the current speed is under 6069 <sub>h</sub> within ± 606F, and the duration time reaches 6070 <sub>h</sub> , means that the speed is 0, and the bit12 in status word 6041 <sub>h</sub> = 1                                                                                                  |                                                            |           |                            |                |              |                 |             |                 |
| <b>6071<sub>h</sub></b> | 00 <sub>h</sub> | Target torque                                                                                                                                                                                                                                                                                             |                                                            | int16     | -1000~1000                 | RW             | RPDO         | 0               | 0.10%       | Stop activate   |
|                         |                 | Description: 100.0% corresponds to 1 times of motor rated torque                                                                                                                                                                                                                                          |                                                            |           |                            |                |              |                 |             |                 |
| <b>6072<sub>h</sub></b> | 00 <sub>h</sub> | Max torque                                                                                                                                                                                                                                                                                                |                                                            | uint16    | 0~2000                     | RW             | RPDO         | 1000            | 0.10%       | Stop activate   |
| <b>6073<sub>h</sub></b> | 00 <sub>h</sub> | Max current                                                                                                                                                                                                                                                                                               |                                                            | uint16    | 0~2000                     | RW             | NO           | 1500            | 0.10%       | Stop activate   |

| Index                   | Sub-index       | Name                                                                                                                                                                                                                                    | Description                                                                 | Data type | Data range             | Access-ability | Mapp-ability | Factory setting | Unit        | Activate method |
|-------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------|------------------------|----------------|--------------|-----------------|-------------|-----------------|
| <b>6074<sub>h</sub></b> | 00 <sub>h</sub> | Torque demand value                                                                                                                                                                                                                     | Torque instruction, reflecting the input torque command in the Enable state | int16     | -32768~32767           | RO             | TPDO         | 0               | 0.10%       | -               |
| <b>6075<sub>h</sub></b> | 00 <sub>h</sub> | Motor rated current                                                                                                                                                                                                                     |                                                                             | uint32    | 0~11700                | RW             | RPDO         | 11700           | 0.001A      | Stop activate   |
| <b>6076<sub>h</sub></b> | 00 <sub>h</sub> | Motor rate torque                                                                                                                                                                                                                       |                                                                             | uint32    | 0~1270                 | RW             | RPDO         | 1270            | 0.01N.m     | Stop activate   |
| <b>6077<sub>h</sub></b> | 00 <sub>h</sub> | Torque actual value                                                                                                                                                                                                                     |                                                                             | int16     | -32768~32767           | RO             | TPDO         | -               | 0.10%       | -               |
| <b>6078<sub>h</sub></b> | 00 <sub>h</sub> | Current actual value                                                                                                                                                                                                                    |                                                                             | int16     | -32768~32767           | RO             | TPDO         | -               | 0.01A       | -               |
| <b>607A<sub>h</sub></b> | 00 <sub>h</sub> | Target position                                                                                                                                                                                                                         |                                                                             | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit   | Stop activate   |
| <b>607B<sub>h</sub></b> | 01 <sub>h</sub> | MinPosRangLimt                                                                                                                                                                                                                          |                                                                             | int32     | -2147483648~2147483647 | RW             | RPDO         | -1048576        | User unit   | Stop activate   |
|                         | 02 <sub>h</sub> | MaxPosRangLimt                                                                                                                                                                                                                          |                                                                             | int32     | -2147483648~2147483647 | RW             | RPDO         | 1048576         | User unit   | Stop activate   |
| <b>607C<sub>h</sub></b> | 00 <sub>h</sub> | Home offset                                                                                                                                                                                                                             |                                                                             | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit   | Stop activate   |
|                         |                 | Description: set the physical position where the mechanical home position deviates from the motor home position in the Homing mode; when the homing operation is completed, takes effect when bit15= 1 in status word 6041 <sub>h</sub> |                                                                             |           |                        |                |              |                 |             |                 |
| <b>607D<sub>h</sub></b> | 01 <sub>h</sub> | MinPosLimt                                                                                                                                                                                                                              |                                                                             | int32     | -2147483648~2147483647 | RW             | RPDO         | -65535          | User unit   | Stop activate   |
|                         | 02 <sub>h</sub> | MaxPosLimt                                                                                                                                                                                                                              |                                                                             | int32     | -2147483648~2147483647 | RW             | RPDO         | 65535           | User unit   | Stop activate   |
| <b>607E<sub>h</sub></b> | 00 <sub>h</sub> | Polarity                                                                                                                                                                                                                                | See section 4.1.4 for details                                               | uint8     | 0~255                  | RW             | NO           | 0               | 1           | Stop activate   |
| <b>607F<sub>h</sub></b> | 00 <sub>h</sub> | Max profile velocity                                                                                                                                                                                                                    |                                                                             | uint32    | 0~500000               | RW             | RPDO         | 500000          | User unit/s | Stop activate   |
| <b>6080<sub>h</sub></b> | 00 <sub>h</sub> | Max motor speed                                                                                                                                                                                                                         |                                                                             | uint32    | 0~4000                 | RW             | RPDO         | 4000            | rpm         | Stop activate   |

| Index             | Sub-index                                                                                                                                                                                                | Name                                                                                                                           | Description        | Data type | Data range   | Access-ability | Mapp-ability | Factory setting | Unit                     | Activate method |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------|-----------|--------------|----------------|--------------|-----------------|--------------------------|-----------------|
| 6081 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Profile velocity                                                                                                               |                    | uint32    | 0~500000     | RW             | RPDO         | 500000          | User unit/s              | Stop activate   |
|                   |                                                                                                                                                                                                          | Description: set the uniform speed in this position command section of the Profile position mode,                              |                    |           |              |                |              |                 |                          |                 |
| 6082 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | End velocity                                                                                                                   |                    | uint32    | 0~500000     | RW             | RPDO         | 0               | User unit/s              | Stop activate   |
| 6083 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Profile acceleration                                                                                                           |                    | uint32    | 0~4294967295 | RW             | RPDO         | 409600          | User unit/s <sup>2</sup> | Stop activate   |
| 6084 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Profile deceleration                                                                                                           |                    | uint32    | 0~4294967295 | RW             | RPDO         | 409600          | User unit/s <sup>2</sup> | Stop activate   |
| 6085 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Quick Stop deceleration                                                                                                        |                    | uint32    | 0~4294967295 | RW             | RPDO         | 500000          | User unit/s <sup>2</sup> | Stop activate   |
| 6086 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Motion profile type                                                                                                            |                    | int16     | 0~3          | RW             | RPDO         | 3               | 1                        | Stop activate   |
|                   |                                                                                                                                                                                                          | Description: set the curve type of motor position command or speed command.<br>0 ~ linear, 3 ~ s curve                         |                    |           |              |                |              |                 |                          |                 |
| 6087 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Torque slope                                                                                                                   |                    | uint32    | 0~4294967295 | RW             | RPDO         | 10              | 0.10%                    | Stop activate   |
|                   |                                                                                                                                                                                                          | Description: set the torque command acceleration under position torque mode, which means: torque command increments per second |                    |           |              |                |              |                 |                          |                 |
| 6088 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                                          | Torque profile type                                                                                                            |                    | int16     | 0~2          | RW             | RPDO         | 0               | 1                        | Stop activate   |
|                   |                                                                                                                                                                                                          | 具体描述: 0-斜坡, 2-无斜坡                                                                                                              |                    |           |              |                |              |                 |                          |                 |
| 608F <sub>h</sub> | 01 <sub>h</sub>                                                                                                                                                                                          | Encoder increments                                                                                                             |                    | uint32    | 0~4294967295 | RW             | NO           | 10000           | 1                        | Stop activate   |
|                   | 02 <sub>h</sub>                                                                                                                                                                                          | Motor revolutions                                                                                                              |                    | uint32    | 0~4294967295 | RW             | NO           | 1               | 1                        | Stop activate   |
| 608F <sub>h</sub> | Description: used to set the turns of the motor corresponding to the encoder increment    Resolution of position encoder= $\frac{\text{increment of encoder}(608Fh:01h)}{\text{motor turns}(608Fh:02h)}$ |                                                                                                                                |                    |           |              |                |              |                 |                          |                 |
| 6091 <sub>h</sub> | 01 <sub>h</sub>                                                                                                                                                                                          | Motor revolutions                                                                                                              | Transmission ratio | uint32    | 0~4294967295 | RW             | NO           | 1               | 1                        | Stop activate   |
|                   | 02 <sub>h</sub>                                                                                                                                                                                          | S <sub>h</sub> aft revolutions                                                                                                 |                    | uint32    | 0~4294967295 | RW             | NO           | 1               | 1                        | Stop activate   |

| Index             | Sub-index                                                                                                                                                                                | Name                                                                                                                                                                   | Description                                                                                                                           | Data type | Data range             | Access-ability | Mapp-ability | Factory setting | Unit                     | Activate method |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------|------------------------|----------------|--------------|-----------------|--------------------------|-----------------|
|                   | Description: it is used to establish the proportional relationship between the load axis displacement and the motor axis displacement specified by the user. See Section 5.2 for details |                                                                                                                                                                        |                                                                                                                                       |           |                        |                |              |                 |                          |                 |
| 6098 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                          | Homing method                                                                                                                                                          | See section 6.7.4 for details                                                                                                         | int8      | 17~30                  | RW             | RPDO         | 20              | 1                        | Stop activate   |
| 6099 <sub>h</sub> | 01 <sub>h</sub>                                                                                                                                                                          | Speed during search for switch <sub>h</sub>                                                                                                                            | (high speed)                                                                                                                          | uint32    | 0~4294967295           | RW             | RPDO         | 10000           | User unit/s              | Stop activate   |
|                   | 02 <sub>h</sub>                                                                                                                                                                          | Speed during search for zero                                                                                                                                           | (low speed)                                                                                                                           | int32     | -2147483648~2147483647 | RW             | RPDO         | 2730            | User unit/s              | Stop activate   |
| 609A <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                          | Homing acceleration                                                                                                                                                    |                                                                                                                                       | uint32    | 0~4294967295           | RW             | RPDO         | 409600          | User unit/s              | Stop activate   |
| 60A3 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                          | Profile jerk use                                                                                                                                                       | Number of position jerk applications, This device only uses 60A4 <sub>h</sub> :01 <sub>h</sub> and 60A4 <sub>h</sub> :02 <sub>h</sub> | Usint8    | 2                      | RW             | RPDO         | 2               | 1                        | Stop activate   |
| 60A4 <sub>h</sub> | 01 <sub>h</sub>                                                                                                                                                                          | Profile jerk 1                                                                                                                                                         |                                                                                                                                       | uint32    | 0~4294967295           | RW             | NO           | 50000           | User unit/s <sup>2</sup> | Stop activate   |
|                   | 02 <sub>h</sub>                                                                                                                                                                          | Profile jerk 2                                                                                                                                                         |                                                                                                                                       | uint32    | 0~4294967295           | RW             | NO           | 50000           | User unit/s <sup>2</sup> | Stop activate   |
| 60B0 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                          | Position offset                                                                                                                                                        |                                                                                                                                       | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit                | Stop activate   |
|                   |                                                                                                                                                                                          | Description: set the servo position command offset in the Cyclic sync position mode, after the offset:<br>Servo target velocity = 607A <sub>h</sub> +60B0 <sub>h</sub> |                                                                                                                                       |           |                        |                |              |                 |                          |                 |
| 60B1 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                          | Velocity offset                                                                                                                                                        |                                                                                                                                       | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit                | Stop activate   |
|                   |                                                                                                                                                                                          | Description: set the servo velocity command offset in the Cyclic sync velocity mode, after the offset:<br>Servo target velocity = 60FF <sub>h</sub> +60B1 <sub>h</sub> |                                                                                                                                       |           |                        |                |              |                 |                          |                 |
| 60B2 <sub>h</sub> | 00 <sub>h</sub>                                                                                                                                                                          | Torque offset                                                                                                                                                          |                                                                                                                                       | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit                | Stop activate   |

| Index             | Sub-index                                                     | Name                                                                                                                                                                                                                                                                                                                                                                                                                                             | Description           | Data type | Data range             | Access-ability | Mapp-ability | Factory setting | Unit              | Activate method |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|-------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|------------------------|----------------|--------------|-----------------|-------------------|-----------------|------|------|-------------------------------------------------------------------------------|---|---|------------------------------------------------------------------------------|---|---|-------------------------------------------------------------------------------|---|---|-------------------------------------------------------------------------------|
|                   |                                                               | Description: set the servo torque command offset in the Cyclic sync torque mode, after the offset:<br>Servo target torque = 6071 <sub>h</sub> + 60B2 <sub>h</sub>                                                                                                                                                                                                                                                                                |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60C1 <sub>h</sub> | 01 <sub>h</sub>                                               | Interpolation data record                                                                                                                                                                                                                                                                                                                                                                                                                        |                       | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit         | Stop activate   |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60C2 <sub>h</sub> | 01 <sub>h</sub>                                               | Interpolation time period value                                                                                                                                                                                                                                                                                                                                                                                                                  |                       | uint8     | 0~255                  | RW             | NO           | 20              | s                 | Stop activate   |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   | 02 <sub>h</sub>                                               | Interpolation time index                                                                                                                                                                                                                                                                                                                                                                                                                         |                       | Int8      | -128~127               | RW             | NO           | -1              | 1                 | Stop activate   |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   | Description: interpolation period = t×10 <sup>n</sup> seconds |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60C5 <sub>h</sub> | 00 <sub>h</sub>                                               | Max acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       | uint32    | 0~4294967295           | RW             | RPDO         | 500000          | User unit/s2      | Stop activate   |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60C6 <sub>h</sub> | 00 <sub>h</sub>                                               | Max deceleration                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       | uint32    | 0~4294967295           | RW             | RPDO         | 500000          | User unit/s²      | Stop activate   |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60F2 <sub>h</sub> | 00 <sub>h</sub>                                               | Positioning option code                                                                                                                                                                                                                                                                                                                                                                                                                          |                       | uint16    | 0~2                    | RW             | RPDO         | 0               | 1                 | Stop activate   |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               | Description as follow: <table><tr><td>Bit1</td><td>Bit0</td><td>Description:</td></tr><tr><td>0</td><td>0</td><td>Relative position shift, relative to the target position（607A<sub>h</sub>）</td></tr><tr><td>0</td><td>1</td><td>Relative position shift, relative to the position command（60FC<sub>h</sub>）</td></tr><tr><td>1</td><td>0</td><td>Relative position shift, relative to the position command（6064<sub>h</sub>）</td></tr></table> |                       |           |                        |                |              |                 |                   |                 | Bit1 | Bit0 | Description:                                                                  | 0 | 0 | Relative position shift, relative to the target position（607A <sub>h</sub> ） | 0 | 1 | Relative position shift, relative to the position command（60FC <sub>h</sub> ） | 1 | 0 | Relative position shift, relative to the position command（6064 <sub>h</sub> ） |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 | Bit1 | Bit0 | Description:                                                                  |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 | 0    | 0    | Relative position shift, relative to the target position（607A <sub>h</sub> ）  |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 | 0    | 1    | Relative position shift, relative to the position command（60FC <sub>h</sub> ） |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 | 1    | 0    | Relative position shift, relative to the position command（6064 <sub>h</sub> ） |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60F4 <sub>h</sub> | 00 <sub>h</sub>                                               | Following error actual value                                                                                                                                                                                                                                                                                                                                                                                                                     |                       | int32     | -2147483648~2147483647 | RO             | TPDO         | 0               | User unit         | -               |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60FA <sub>h</sub> | 00 <sub>h</sub>                                               | Control effort                                                                                                                                                                                                                                                                                                                                                                                                                                   | Output from regulator | int32     | -2147483648~2147483647 | RO             | TPDO         | 0               | Instructi on unit | -               |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
| 60FC <sub>h</sub> | 00 <sub>h</sub>                                               | Position demand internal value                                                                                                                                                                                                                                                                                                                                                                                                                   |                       | int32     | -2147483648~2147483647 | RO             | TPDO         | 0               | User unit         | -               |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |
|                   |                                                               | Description:Position command (60FC <sub>h</sub> )= Position command( 6062 <sub>h</sub> )x Electronic gear ratio(6091 <sub>h</sub> )                                                                                                                                                                                                                                                                                                              |                       |           |                        |                |              |                 |                   |                 |      |      |                                                                               |   |   |                                                                              |   |   |                                                                               |   |   |                                                                               |

| Index                   | Sub-index       | Name                                                                                                                                                                                                                                    | Description                         | Data type | Data range             | Access-ability | Mapp-ability | Factory setting | Unit        | Activate method |
|-------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-----------|------------------------|----------------|--------------|-----------------|-------------|-----------------|
| <b>60FD<sub>h</sub></b> | 00 <sub>h</sub> | Input signal (DI signal) monitoring                                                                                                                                                                                                     | Input signal (DI signal) monitoring | uint32    | 0~4294967295           | RO             | TPDO         | 0               | 1           | -               |
| <b>60FE<sub>h</sub></b> | 01 <sub>h</sub> | Physical output                                                                                                                                                                                                                         | Physical output                     | uint32    | 0~4294967295           | RO             | TPDO         | 0               | 1           | -               |
|                         | 02 <sub>h</sub> | Physical output enable                                                                                                                                                                                                                  | Physical output enable              | uint32    | 0~4294967295           | RO             | TPDO         | 0               | 1           | -               |
| <b>60FF<sub>h</sub></b> | 00 <sub>h</sub> | Target velocity                                                                                                                                                                                                                         |                                     | int32     | -2147483648~2147483647 | RW             | RPDO         | 0               | User unit/s | Stop activate   |
|                         |                 | Description: set the speed command in the the Profile velocity mode and Cyclic sync velocity mode                                                                                                                                       |                                     |           |                        |                |              |                 |             |                 |
| <b>6502<sub>h</sub></b> | 00 <sub>h</sub> | Supported drive modes                                                                                                                                                                                                                   | Supported drive modes               | uint32    | 0~4294967295           | RO             | RPDO         | 1023            | 1           |                 |
|                         |                 | <div> <div>15109876543210</div> <div> <div>reserved</div> <div>CST</div> <div>CSV</div> <div>CSP</div> <div>IP</div> <div>HM</div> <div>r</div> <div>PT</div> <div>PV</div> <div>VM</div> <div>PP</div> </div> <div>MSBLSB</div> </div> |                                     |           |                        |                |              |                 |             |                 |
|                         |                 | Description: CST, CSV, CSP, IP, HM, Pt, PV, VM, and PP bits: 1 = supported; 0 = not supported                                                                                                                                           |                                     |           |                        |                |              |                 |             |                 |

## 11 Version Information

| Manual version | Date       | Revision History                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A              | 2019/8/20  | Establishing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| B              | 2019/12/16 | <ol style="list-style-type: none"> <li>1. Added 8.2.4- Gain switching adjustment description</li> <li>2. The contents of the object dictionary were modified in 2008, and some of the object attributes in 6000 were changed to mappable, and an object 6502h was added.</li> <li>3. Add two fault codes</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| C              | 2020/2/6   | <ol style="list-style-type: none"> <li>1. Add the object of voltage calculation coefficient 2001h: 04h</li> <li>2. Add multi-segment position parameter group 2011h, and add 6.16 multi-segment position mode</li> <li>3. Added multi-stage speed parameter group 2012h, added chapter 6.17 multi-stage speed mode</li> <li>4. Added chapter 8.2 offline parameter identification, increase the objects 2001h: 0Dh and 2009h: 06h, increase the alarm code by 0XFF01</li> <li>5. Added Section 7.1.1 Function Number Multi-Segment Instructions and Incremental Encoder Input</li> <li>6. Modify the manufacturer mode to NiMotion mode</li> <li>7. Added the alarm codes in Chapter 9.1, such as encoder warning, Flash without user parameters and communication warning, etc.</li> <li>8. Added Chapter 9.2 Fault Action Settings</li> </ol> |
| D              | 2020/5/9   | <ol style="list-style-type: none"> <li>1. Add section 8.4.2 Low frequency vibration suppression, add objects 2009h: 05h, 2009h: 1Dh, 2009h: 1Dh and 2009h: 23h</li> <li>2. Return to origin mode 6.7.4-Function description Add description of return to origin from locked rotor detection, add objects 2007h: 13h and 2007h: 15h</li> <li>3. Multi-segment speed content correction, function number 28 changed to multi-segment enable, 2012h parameter group modification</li> <li>4. Multi-segment position content correction, function number 28 changed to multi-segment enable</li> </ol>                                                                                                                                                                                                                                              |
| E              | 2025/8/9   | <ol style="list-style-type: none"> <li>1. Add section 7.8 and 7.9.</li> <li>2. Modify some descriptions.</li> <li>3. Improve object dictionary</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| E01            | 2026/1/26  | 1. Modify description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| E02            | 2026/6/10  | 1. Modify description of some default                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

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