



一体化无刷电机

Integrated brushless motor

Modbus 通信（闭环）用户手册

Modbus communication (closed loop) user manual

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北京立迈胜控制技术有限责任公司

Beijing NiMotion Control Technology Co., Ltd

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1 关于手册 About the manual

1.1 简介 Introduction

本手册用以说明北京立迈胜控制技术有限责任公司所生产的一体化无刷电机的编程和操作方法。

This manual is used to explain the programming and operation method of the integrated brushless motor produced by Beijing NiMotion Control Technology Co., Ltd.

1.2 适用范围 Scope of application

适用于 Modbus 通信协议 485 总线一体化无刷电机。

Suitable for Modbus communication protocol 485 bus integrated brushless motor.

1.3 数字值含义 The meaning of numerical values

本手册中，数值一般是以十进制格式表示。如果必须使用十六进制表示的，以在数字末尾下标 "h" 来进行表示，例如：1003_h。

In this manual, values are generally expressed in decimal format. If it must be expressed in hexadecimal, it is indicated by the subscript "h" at the end of the number, for example: 1003_h.

对象的对象目录索引和子索引，表示为：<索引>: <子索引>

The object directory index and sub-index of the object, expressed as: <index>: <sub-index>

例如：对象 1003_h 的子索引 02 表示为 1003_h: 02_h。

For example, the sub-index 02 of the object 1003_h is represented as 1003_h:02_h.

1.4 位定义 Bit definition

对象的各个位总是在 LSB 编号从 0 开始的。

Each bit of the object always starts at 0 in the LSB number.

	MSB								LSB
Bit Nummer	7	6	5	4	3	2	1	0	
Bits	0	1	0	1	0	1	0	1	55 _{hex} =85 _{dec}

1.5 版本信息 Version Information

手册版本 Manual version	日期 Date	修改记录 Modify record
A	2020/6/2	创建 Establish
A01	2020/6/19	增加文档准确性 Increase document accuracy

2 通信网络 Communication network

2.1 Modbus 概述 Overview of Modbus

北京立迈胜控制技术有限责任公司一体化步进电机使用 RS-485 总线通信控制，协议上支持标准的 Modbus-RTU 协议。

Beijing NiMotion Control Technology Co., Ltd. integrated stepper motor uses RS-485 bus communication control, and the protocol supports the standard Modbus-RTU protocol.

Modbus 协议的通信方式为单主站/多从站方式。只有主站可以发出查询(询问)。从站执行查询要求的处理，回复应答信息。

The communication method of Modbus protocol is single master station/multiple slave stations. Only the master station can issue inquiries (inquiries). The slave station performs the processing required by the query and replies to the response message.

2.2 Modbus-RTU 传输模式 Modbus-RTU transmission mode

当设备使用 RTU(Remote Terminal Unit) 模式在 Modbus 串行链路通信，报文中每个 8 位字节含有两个 4 位十六进制字符。这种模式的主要优点是较高的数据密度，在相同的波特率下比 ASCII 模式有更高的吞吐率。每个报文必须是以连续的字符流传送。

When the device uses RTU (Remote Terminal Unit) mode to communicate on the Modbus serial link, each 8-bit byte in the message contains two 4-bit hexadecimal characters. The main advantage of this mode is higher data density and higher throughput than ASCII mode at the same baud rate. Each message must be transmitted in a continuous stream of characters.

帧描述： Frame description:

子节点地址 Child node address	功能代码 Function code	数据 Data	CRC
1 字节 1 byte	1 字节 1 byte	0 到 252 字节 0 to 252 bytes	2 字节 2 bytes CRC 低 Low CRC CRC 高 High CRC

报文帧由时长至少 3.5 个字符时间的空闲间隔区分，称为 t3.5，本模块采用标准 t3.5 作为空闲间隔区分。RTU 帧传输空闲间隔区分示意图见图 1。

The message frame is distinguished by an idle interval of at least 3.5 character times, called t3.5. This module uses the standard t3.5 as the idle interval. The schematic diagram of RTU frame transmission idle interval is shown in Figure 1.

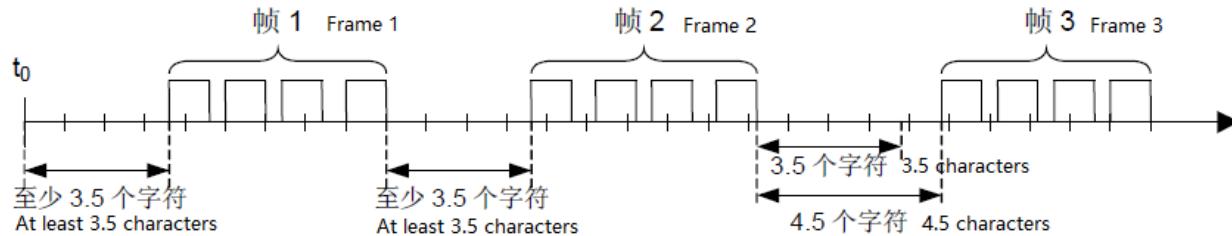


图 1 RTU 帧传输空闲间隔区分示意图

Figure 1 RTU frame transmission idle interval distinction diagram

2.3 数据类型 Data type

Modbus 以一系列具有不同特征表格上的数据模型为基础。两个基本表格为：

Modbus is based on a series of data models on tables with different characteristics. The two basic forms are:

基本表格 Basic form	对象类型 Object type	访问类型 Access type	内容 Content
输入寄存器 Input register	16 位 16 bits	只读 Read only	I/O 系统提供这种类型数据 I/O systems provide this type of data
保持寄存器 Holding register	16 位 16 bits	读写 Read and write	通过应用程序改变这种类型数据 Change this type of data through the application

2.4 Modbus-RTU 功能码 Modbus-RTU function code

	功能码名称 Function code name	功能码 Function code	子功能码 Sub-function code	广播报文 Broadcast message
16 比特访问 16-bit access	读输入寄存器 Read input register	0x04	—	不支持 Not support
	读保持寄存器 Read holding register	0x03	—	不支持 Not support
	写单个寄存器 Write a single register	0x06	—	支持 Support
	写多个寄存器 Write multiple registers	0x10	—	支持 Support

2.4.1 读保持寄存器(0x03) Read holding register (0x03)

读波特率 200C_h: 03_h (对应 modbus 保持寄存器地址 0x0231) 当前的值。

Read the current value of baud rate 200C_h: 03_h (corresponding to modbus holding register address 0x0231).

请求报文 Request message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	CRC 校验值 CRC check value
01	0x03	02 31	00 01	略 Skip

响应报文 Response message

从机地址 Slave address	功能码 Function code	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
01	0x03	02	00 00	略 Skip

当前波特率值为 0 (9.6kbps)。

The current baud rate value is 0 (9.6kbps).

2.4.2 读输入寄存器 (0x04) Read input register (0x04)

读输入电压 $200B_h: 15_h$ (对应 modbus 输入寄存器地址 0x01F7) 的值。

Read the value of the input voltage $200B_h: 15h$ (corresponding to the modbus input register address 0x01F7).

请求报文 Request message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	CRC 校验值 CRC check value
01	0x04	01 F7	00 01	略 Skip

响应报文 Response message

从机地址 Slave address	功能码 Function code	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
01	0x04	02	00 E7	略 Skip

当前的输入电压值为 $0x00E7(23.1V)$ 。

The current input voltage value is $0x00E7$ (23.1V).

2.4.3 写单个保持寄存器(0x06) Write a single holding register (0x06)

设置从机地址 0x01 的波特率 $200C_h: 03_h$ (对应 modbus 保持寄存器地址 0x0231) 为 0x01(9.6kbps)。

Set the baud rate of the slave address 0x01 $200C_h: 03h$ (corresponding to the modbus holding register address 0x0231) to 0x01 (9.6kbps).

请求报文 Request message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	CRC 校验值 CRC check value
01	0x06	02 31	00 01	略 Skip

响应报文 Response message

从机地址 Slave address	功能码 Function code	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
01	0x06	02 31	00 01	略 Skip

2.4.4 写多个保持寄存器(0x10) Write multiple holding registers (0x10)

设置从机地址 0x01 的从设备地址 200Ch: 02h (对应 modbus 保持寄存器地址 0x0230) 为 0x02 和波特率 200Ch: 03h (对应 modbus 保持寄存器地址 0x0231) 为 0x01(9.6kbps)。

Set the slave address 200Ch: 02h (corresponding to the modbus holding register address 0x0230) of the slave address 0x01 to 0x02 and the baud rate 200Ch: 03h (corresponding to the modbus holding register address 0x0231) to 0x01 (9.6kbps).

请求报文 Request message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验 值 CRC check value
01	0x10	02 30	00 02	04	00 02 00 01	略 Skip

响应报文 Response message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	CRC 校验值 CRC check value
01	0x10	02 30	00 02	略 Skip

2.5 通信异常响应 Communication abnormal response

当主站设备向从站设备发送请求时，主站希望得到一个正常的响应。主站的询问可能导致下列四种事件之一：

When the master station device sends a request to the slave station device, the master station expects a normal response. The inquiry from the master station may cause one of the following four events:

- 如果从站设备接收到无通信错误的请求，并且可以正常地处理询问，那么从站设备将返回一个正常响应。
-----If the slave device receives the request without communication error and can process the inquiry normally, then the slave device will return a normal response.
- 如果由于通信错误，从站没有接收到请求，那么不能返回响应。主站程序将按超时处理。
-----If the slave station does not receive the request due to a communication error, it cannot return a response. The master program will be processed according to the timeout.
- 如果从站接收到请求，但是检测到通信错误(奇偶校验、CRC...)，那么不能返回响应。主站程序将按超时处理。
-----If the slave station receives the request, but detects a communication error (parity, CRC...), then the response cannot be returned. The master program will be processed according to the timeout.
- 如果从站设备接收到无通信错误的请求，但不能处理这个请求(例如，如果请求读一个不存在的输入寄存器)，那么从站将返回一个异常响应，通知客户机出错的原因。
-----If the slave device receives a request without communication error, but cannot process

the request (for example, if the request reads a non-existing input register), then the slave will return an abnormal response to notify The cause of the error on the client.

异常响应报文有两个与正常响应报文不同的字段：

The abnormal response message has two different fields from the normal response message:

功能码字段：在正常响应中，从站在响应的功能码字段赋值原始请求的功能码。所有的功能码的 MSB 都为 0(他们的值都低于十六进制 80)。在异常响应中，从站设置功能码的 MSB 为 1。这使得异常响应中的功能码值比正常响应中的功能码值高十六进制 80。

Function code field: In the normal response, the slave station assigns the function code of the original request to the function code field of the response. The MSB of all function codes is 0 (their values are all lower than 80 hex). In the abnormal response, the slave station sets the MSB of the function code to 1. This makes the function code value in the abnormal response higher than the function code value in the normal response by 80 hexadecimal.

通过设置功能码 MSB，主站的应用程序能够识别异常响应，并且能够检测异常码的数据字段。

By setting the function code MSB, the application of the master station can recognize the abnormal response, and can detect the data field of the abnormal code.

数据字段：在正常的响应中，从站可以在数据字段中返回数据或统计值(请求中要求的任何信息)。

Data field: In a normal response, the slave can return data or statistics (any information requested in the request) in the data field.

在异常响应中，从站在数据字段中返回异常码。这说明了产生异常的原因。

In the exception response, the slave returns the exception code in the data field. This explains the cause of the exception.

所有支持的功能码的异常响应报文为功能码加上 0x80。

The exception response message of all supported function codes is the function code plus 0x80.

所有异常功能码为 0x83、0x84、0x86、0x90。

All abnormal function codes are 0x83, 0x84, 0x86, 0x90.

功能码 0x06 对应的异常响应报文如下：

The exception response message corresponding to function code 0x06 is as follows:

从机地址 Slave address	功能码 Function code	异常码 Exception code	CRC 校验值 CRC check value
01	0x86	01	略 Skip

异常码 Exception code	异常名称 Exception name	描述 Description
01	非法功能码 Illegal function code	功能码无法识别，不在 0x00~0x0F 以内 The function code cannot be recognized and is not within 0x00~0x0F
02	非法数据地址 Illegal data address	数据地址超出定义 Data address exceeds definition
03	非法数据值 Illegal data value	寄存器存储之外的值 Values other than register storage
04	从设备故障	产生不可重新获得的错误

	Slave failure	Produces an unrecoverable error
05	确认 Confirm	从机处理时间较长，需要主机经常询问 The processing time of the slave is long, and the master often ask
06	从设备忙 Slave busy	等待从机设备空闲时主机发送请求 The master sends a request when the slave device is idle
12	从设备报警 Slave alarm	当前电机状态存在报警 There is an alarm for the current motor status

2.6 通信参数配置 Communication parameter configuration

2.6.1 波特率设置 Baud rate setting

通过设置 RS-485 通信接口的通信波特率寄存器可以改变设备的通信速率，但设置波特率后需要保存参数，在设备下次开机或者重启之后生效。

The communication rate of the device can be changed by setting the communication baud rate register of the RS-485 communication interface, but the parameter needs to be saved after setting the baud rate, which will take effect after the device is turned on or restarted next time.

波特率参数对应的索引是 200C_h: 03_h（对应 modbus 保持寄存器地址 0x0231），可操作保持寄存器的功能码为 0x03、0x06、0x10。出厂波特率默认值为 115.2Kbps。

The corresponding index of the baud rate parameter is 200C_h: 03_h (corresponding to the modbus holding register address 0x0231), and the function codes of the operable holding register are 0x03, 0x06, 0x10. The factory default baud rate is 115.2Kbps.

设置从机地址的通信波特率为 115.2 Kbps 举例

Example of setting the communication baud rate of the slave address to 115.2 Kbps

发送的请求报文 Request message sent

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器值 Register value	CRC 校验值 CRC check value
01	0x06	02 31	00 05	略 Skip

响应报文 Response message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器值 Register value	CRC 校验值 CRC check value
01	0x06	02 31	00 05	略 Skip

保存设置的通信波特率参数 Save the set communication baud rate parameters

发送的请求报文 Request message sent

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value

01	0x10	00 26	00 02	04	65 76 61 73	略 Skip
----	------	-------	-------	----	-------------	--------

响应报文 Response message

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	CRC 校验值 CRC check value
01	0x10	00 26	00 02	略 Skip

设置值及与波特率的对应表： Set value and corresponding table with baud rate:

十六进制 Hex	波特率 Baud rate
0	9.6Kbps
1	9.6Kbps
2	19.2Kbps
3	38.4Kbps
4	57.6Kbps
5	115.2Kbps
6	256Kbps
7	500Kbps
8	1Mbps
9	1.5Mbps

2.6.2 节点ID Node ID

设备的地址的通过设置从设备地址 200Ch: 02h (对应 modbus 保持寄存器地址 0x0230) , 能够设置的范围 1~247。出厂默认从机地址为 0x01。从机地址的设置成功后需要进行保存参数设置，在设备下次开机或者重启之后生效。具体操作参照波特率设置。

The address of the device can be set from the device address 200Ch: 02h (corresponding to the modbus holding register address 0x0230), and the range can be set from 1 to 247. The factory default slave address is 0x01. After setting the slave address successfully, you need to save the parameter settings, which will take effect after the device is turned on or restarted next time. Refer to the baud rate setting for specific operations.

2.6.3 网络数据格式 Network data format

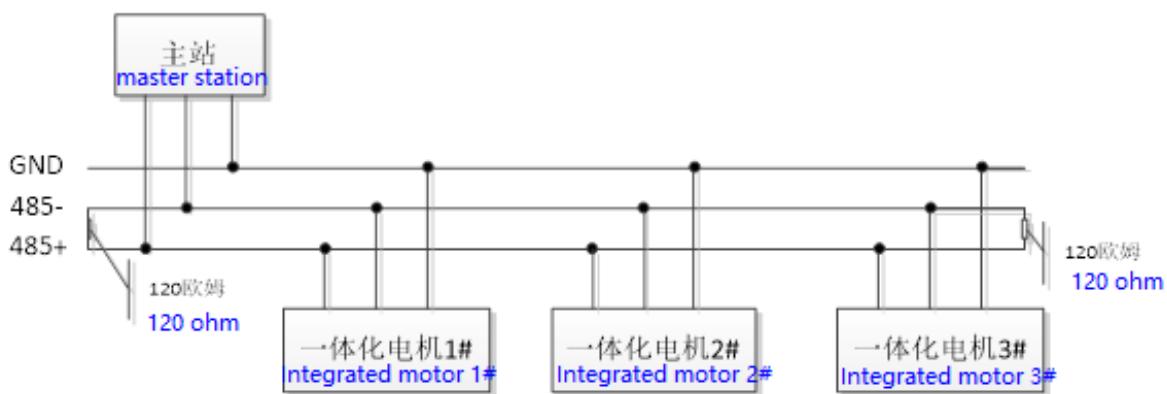
设备通信的网络数据格式通过设置网络数据格式 200Ch: 04h (对应 modbus 保持寄存器地址 0x0232) 来改变。设置值对应表如下表

The network data format of the device communication is changed by setting the network data format 200Ch: 04h (corresponding to the modbus holding register address 0x0232). The setting value correspondence table is as follows

十六进制 Hex	描述 Description
-------------	-------------------

0	8 数据位、偶校验、1 停止位 8 data bits, even parity, 1 stop bit
1	8 数据位、奇校验、1 停止位 8 data bits, odd parity, 1 stop bit
2	8 数据位、无奇偶校验、1 停止位 8 data bits, no parity, 1 stop bit
3	8 数据位、无奇偶校验、2 停止位 8 data bits, no parity, 2 stop bits

2.6.4 通讯线的连接 Communication line connection



2.6.5 广播抢占 Broadcast preemption

在电机的通信参数不确定忘记时，可通过广播报文抢占后断电重启。广播抢占请求报文需在电机上电前 1 秒内发送，抢占成功后 RUN 指示灯闪烁。抢占成功后电机的通信参数恢复为默认参数，即通信参数恢复出厂设置，从站地址等于 1，波特率等于 112500，奇偶校验位为无，8 个数据位，1 个停止位。电机序列号采用十六进制高字节在前的字节序。

When the communication parameters of the motor are uncertain and forgotten, the power can be restarted after being seized through broadcast messages. The broadcast preemption request message needs to be sent within 1 second before the motor is powered on. After the preemption is successful, the RUN indicator flashes. After the preemption is successful, the communication parameters of the motor are restored to the default parameters, that is, the communication parameters are restored to the factory settings, the slave address is equal to 1, the baud rate is equal to 112500, the parity bit is none, 8 data bits, and 1 stop bit. The serial number of the motor adopts the byte order of hexadecimal high byte first.

广播抢占请求报文

Broadcast preemption request message

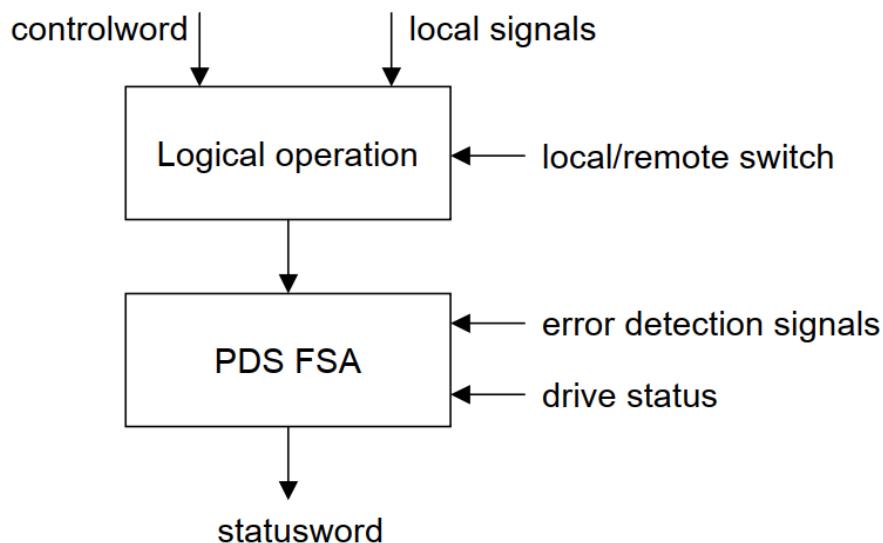
从机地址 Slave address (1B)	功能码 Function code (1B)	电机序列号 Motor serial number (4B)	CRC 校验值 CRC check value (2B)
0x00	0xD2	0x00 00 00 00	略 Skip

3 设备控制 Device control

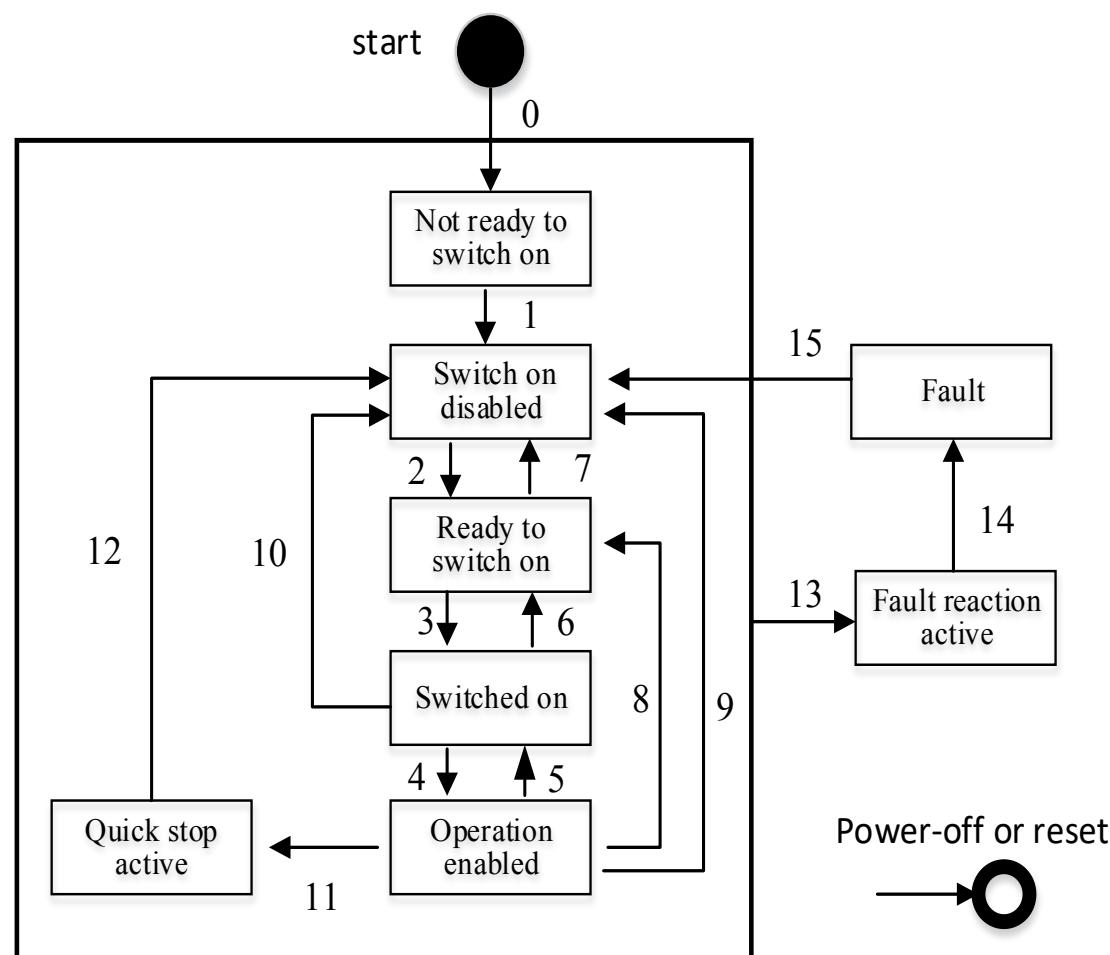
3.1 CiA402 状态机 CiA402 state machine

通过运行一个状态机，来控制切换一体化低压无刷电机的运行状态，这是在标准 CiA402 中定义的。通过控制字 6040h 来控制电机驱动器，而设备的实际状态可以从状态字对象 6041h 里回读。

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



3.1.1 状态转换图 State transition diagram



各状态对应电机情况如下表所示：

The corresponding motor conditions in each state are shown in the following table:

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	No	No	No	No	Yes	Yes	Yes	No

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
enabled								
Configuration allowed	Yes	Yes	Yes	Yes	Yes/No	Yes/No	Yes/No	Yes

控制字与状态机状态切换如下表：

The control word and state machine state switching is as follows:

Command	Bits of the controlword					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 SWITCHED ON state functionality

各状态下状态字如下表：

The status words in each status are as follows:

Statusword	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
----------------------	-------

注: x 表示该 bit 位不关心, bit8 到 bit15 在不同模式下有不同含义, 具体的各位状态请查看各运行模式。

Note: x means that the bit does not care, bit8 to bit15 have different meanings in different modes, please refer to each operating mode for the specific status of everyone.

3.1.2 控制字 Control word

控制字的位, 定义如下:

The bits of the control word are defined as follows:

15	10	9	8	7	6		3	2	1	0
11					4					
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

- 注意 Note

控制字的每一个 bit 位单独赋值无意义, 必须与其他控制位组合构成某一控制指令。bit0~bit3 和 bit7 在各运动模式下意义相同, 必须按顺序发送命令, 才可将电机驱动器按照 CiA402 状态机切换流程引导入预计的状态, 每一命令对应一确定的状态。bit4~bit6 与各运动模式相关(请查看不同模式下的控制指令)

It is meaningless to assign each bit of the control word individually, and it must be combined with other control bits to form a certain control instruction. Bit0~bit3 and bit7 have the same meaning in each motion mode. The commands must be sent in order before the motor driver can be guided into the expected state according to the CiA402 state machine switching process. Each command corresponds to a certain state. bit4~bit6 are related to each sport mode (please check the control commands in different modes)

3.1.3 状态字 Status word

状态字的位, 定义如下:

The status word bits are defined as follows:

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

MSB
LSB

位 Bit	描述 Description
0	ready to switch on
1	switched on
2	operation enabled
3	fault
4	voltage enabled

位 Bit	描述 Description
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

● 注意 Note

状态字的每一个 bit 位单独赋值无意义，必须与其他控制位组合构成反馈电机当前的状态。

It is meaningless to assign each bit of the status word individually, and it must be combined with other control bits to form the current status of the feedback motor.

bit0~bit9 在各模式下意义相同，控制字 6040h 按顺序发送命令后，电机反馈确定的状态。

Bit0~bit9 have the same meaning in each mode. After the control word 6040h sends commands in sequence, the motor feedbacks the determined status.

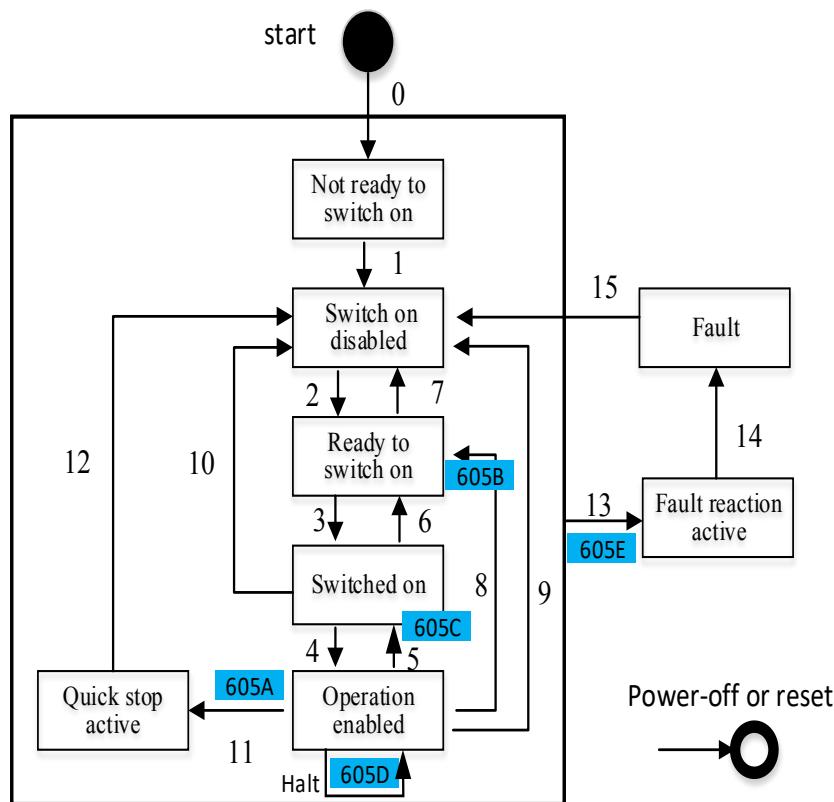
bit10, bit11, bit15 在各运动模式下意义相同，反馈电机执行某运动模式后的状态。

Bit10, bit11, and bit15 have the same meaning in each sport mode, and feedback the state of the motor after executing a certain sport mode.

3.1.4 停机方式 Stop mode

停机方式为状态机离开“运行”状态时的动作，相应的设置对象如下图所示：

The stop mode is the action when the state machine leaves the "running" state. The corresponding setting objects are shown in the following figure:



● 故障停机 Fault shutdown

发生故障和警告时，自动进入故障停机状态，故障停机方式与 $605E_h$ (Fault reaction option code) 有关。当 $605E_h = -1$ 时，停机方式和故障码中的反应码有关，为可配置参数； $605E_h > 0$ 时，停机方式通过对象字典 $605E_h$ 选择， $605E_h$ 设定值与停机方式关系如下表：

When a fault or warning occurs, it automatically enters the fault shutdown state. The fault shutdown mode is related to $605E_h$ (Fault reaction option code). When $605E_h = -1$, the stop mode is related to the reaction code in the fault code, which is a configurable parameter; when $605E_h > 0$, the stop mode is selected through the object dictionary $605E_h$, and the relationship between the set value of $605E_h$ and the stop mode is as follows:

设定值 Set value	停机方式 Stop mode
-1	停机方式和故障码中的反应码有关，详见“9.1 报警码” The stop mode is related to the reaction code in the fault code, see "9.1 Alarm Code" for details
0x00	自由停机，保持自由运行状态。 Free stop, keep free running state.
0x01	以 6084_h 设定的减速度斜坡慢速停机 Slowly stop with the deceleration ramp set at 6084_h
0x02	以 6085_h 设定的减速度斜坡快速停机 Quick stop with the deceleration ramp set at 6085_h

● 快速停机 Quick stop

非故障状态下，控制字 $6040_h = 0x02$ 时，执行快速停机。

In the non-fault state, when the control word $6040h = 0x02$, a quick stop is executed.

快速停机方式通过对象字典 605Ah (Quick stop option code) 选择, 605Ah 的设定值含义见下表:
The quick stop mode is selected through the object dictionary 605Ah (Quick stop option code). The meaning of the set value of 605Ah is shown in the table below:

设定值 Set value	停机方式 Stop mode
0x00	自由停机, 保持自由运行状态。 Free stop, keep free running state.
0x01	以 6084h 设定的减速度斜坡停机, 停机完成后保持自由运行状态。 Stop at the deceleration ramp set at 6084h, and keep free running state after the stop.
0x02	以 6085h 设定的减速度斜坡停机, 停机完成后保持自由运行状态。 Stop at the ramp with the deceleration set at 6085h, and keep free running state after the stop.

● 暂停停机 Suspend to stop

控制字 6040h 的 bit8 为暂停功能位, bit8 发生 0→1 变化时执行暂停停机。

Bit 8 of the control word 6040h is a pause function bit, and a pause is performed when bit 8 changes from 0→1.

暂停停机方式通过对象字典 605Dh (Halt option code) 选择, 605Dh 的设定值含义见下表:

The stop mode is selected through the object dictionary 605Dh (Halt option code). The meaning of the setting value of 605Dh is shown in the table below:

设定值 Set value	停机方式 Stop mode
0x00	保留 Keep
0x01	以 6084h 设定的减速度斜坡慢速停机, 停机完成后保持抱机状态。 Slowly stop at the deceleration ramp set at 6084h, and keep the machine in hold after the stop.
0x02	以 6085h 设定的减速度斜坡快速停机, 停机完成后保持抱机状态。 Quickly stop with the deceleration ramp set at 6085h, and keep the machine in hold after the stop.

● 失能运行停机 Disabled operation and shutdown

失能运行停机方式通过对象字典 605Ch (Disable operation option code) 选择, 605Ch 的设定值与含义见下表:

The disabled operation mode is selected through the object dictionary 605Ch (Disable operation option code). The set value and meaning of 605Ch are shown in the table below:

设定值 Set value	停机方式 Stop mode
0x00	自由停机，保持自由运行状态。 Free stop, keep free running state.
0x01	以 6084 _h 设定的减速度斜坡停机，停机完成后保持自由运行状态。 Stop at the deceleration ramp set at 6084h, and keep free running state after the stop.

● 停机 **Shutdown**

停机通过对象字典 605Bh (Shutdown option code) 选择，605Bh 的设定值含义见下表：

Shutdown is selected through the object dictionary 605Bh (Shutdown option code). The meaning of the set value of 605Bh is shown in the table below:

设定值 Set value	停机方式 Stop mode
0x00	自由停机，保持自由运行状态。 Free stop, keep free running state.
0x01	以 6084 _h 设定的减速度斜坡停机，停机完成后保持自由运行状态。 Stop at the deceleration ramp set at 6084h, and keep free running state after the stop.

4 单位转换 Unit conversion

为了适应各行各业的应用，方便用户定义各自的命令单位，此设备的内部单位转换单元可以将任意用户单位 (User Unit: 简称 UU) 转换成驱动器内部的运行单位 (Encoder Increment: 简称 Inc)

In order to adapt to the application of all walks of life, it is convenient for users to define their own command units. The internal unit conversion unit of this device can convert any user unit (User Unit: UU) into the internal operating unit of the drive (Encoder Increment: Inc.)

4.1 608F_h: 位置编码器分辨率 608F_h: position encoder resolution

此对象应指示配置的编码器增量和电机转动圈数。位置编码器分辨率的计算公式如下：

This object should indicate the configured encoder increment and the number of motor revolutions.
The calculation formula of position encoder resolution is as follows:

$$\text{位置编码器分辨率} = \frac{\text{编码器增量 (608Fh: 01h)}}{\text{电机转数 (608Fh: 02h)}}$$

$$\text{Position encoder resolution} = \frac{\text{Encoder increment (608Fh: 01h)}}{\text{Motor revolution (608Fh: 02h)}}$$

下表为对象的描述：

The following table describes the objects:

属性 Attributes	描述
索引 Index	608F _h
名称 Name	编码器分辨率 (Position encoder resolution)
数据结构 Data structure	Array
数据类型 Type of data	Unsigned32

下表为子索引的描述：

The following table describes the sub-index:

属性 Attributes	描述
子索引 Subindex	01 _h
描述 Description	编码器增量 (Encoder increments)
可访问性 Accessibility	rw
能否映射 Can it be mapped	否 No

数据类型 Type of data	Unsigned32
默认值 Defaults	4000
子索引 Subindex	02 _h
描述 Description	电机转数 (Motor revolutions)
可访问性 Accessibility	rw
能否映射 Can it be mapped	否 No
数据范围 Data range	Unsigned32
默认值 Defaults	1

4.2 6091_h: 传动比 26091_h: transmission ratio

该对象应指示电机轴转数和驱动轴转数。传动比的计算公式如下:

The object should indicate the number of motor shaft revolutions and drive shaft revolutions. The calculation formula of the transmission ratio is as follows:

$$\text{传动比} = \frac{\text{电机轴转数 (6091h: 01h)}}{\text{驱动轴转数 (6091h: 02h)}}$$

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

下表为对象的描述:

The following table describes the objects:

属性 Attributes	描述 Description
索引 Index	6091 _h
名称 Name	传动比(Gear ratio)
数据结构 Data structure	Array
数据类型 Type of data	Unsigned32

下表为子索引的描述:

The following table describes the sub-index:

属性 Attributes	描述 Description
子索引 Subindex	01 _h
描述 Description	电机轴转数 (Motor revolutions)
可访问性 Accessibility	rw
能否映射 Can it be mapped	否 No
数据范围 Data range	Unsigned32
默认值 Defaults	1
子索引 Subindex	02 _h
描述 Description	驱动轴转数 (Shaft revolutions)
可访问性 Accessibility	rw
能否映射 Can it be mapped	否 No
数据范围 Data range	Unsigned32
默认值 Defaults	1

传动比用于用户指定的驱动轴位移和电机轴位移的比例关系。

The transmission ratio is used for the proportional relationship between the drive shaft displacement and the motor shaft displacement specified by the user.

- 电机轴位置反馈(编码器单位)与驱动轴位置反馈(用户单位)的关系:

Relationship between motor shaft position feedback (encoder unit) and drive shaft position feedback (user unit):

$$\text{电机轴位置反馈} = \text{驱动轴位置反馈} \times \text{传动比}$$

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

- 电机轴转速(rpm)与驱动轴转速(指令单位/s) 的关系:

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

$$\text{电机轴转速(rpm)} = \frac{\text{驱动轴转速} \times \text{传动比 } 6091\text{h}}{\text{编码器分辨率}} \times 60$$

$$\text{Motor shaft speed (rpm)} = \frac{\text{Drive shaft speed} * \text{transmiss ion ratio } 6091\text{h} * 60}{\text{Encoder resolution}}$$

- 电机轴加速度(rpm/s)与驱动轴加速度(指令单位/s²) 的关系:

Relationship between motor shaft acceleration (rpm/s) and drive shaft acceleration (command unit/s²):

$$\text{电机轴加速度} = \frac{\text{驱动轴加速度} \times \text{传动比 } 6091\text{h}}{\text{编码器分辨率}} \times 60$$

$$\text{Motor shaft acceleration} = \frac{\text{Drive shaft acceleration} * \text{transmiss ion ratio } 6091\text{h}}{\text{Encoder resolution}} * 60$$

4.3 607E_h: 极性 607E_h: Polarity

该对象字典用来设定位置指令和速度指令是乘 1 或-1。位置极性只在轮廓位置模式和循环同步位置模式内部使用，对原点回归模式无影响。速度极性只在轮廓速度模式和循环同步速度模式使用。具体定义如下表所示：

The object dictionary is used to set whether the position command and speed command are multiplied by 1 or -1. The position polarity is only used inside the profile position mode and the cycle synchronized position mode, and has no effect on the homing mode. The speed polarity is only used in profile Velocity mode and cyclic Velocity mode. The specific definition is shown in the following table:

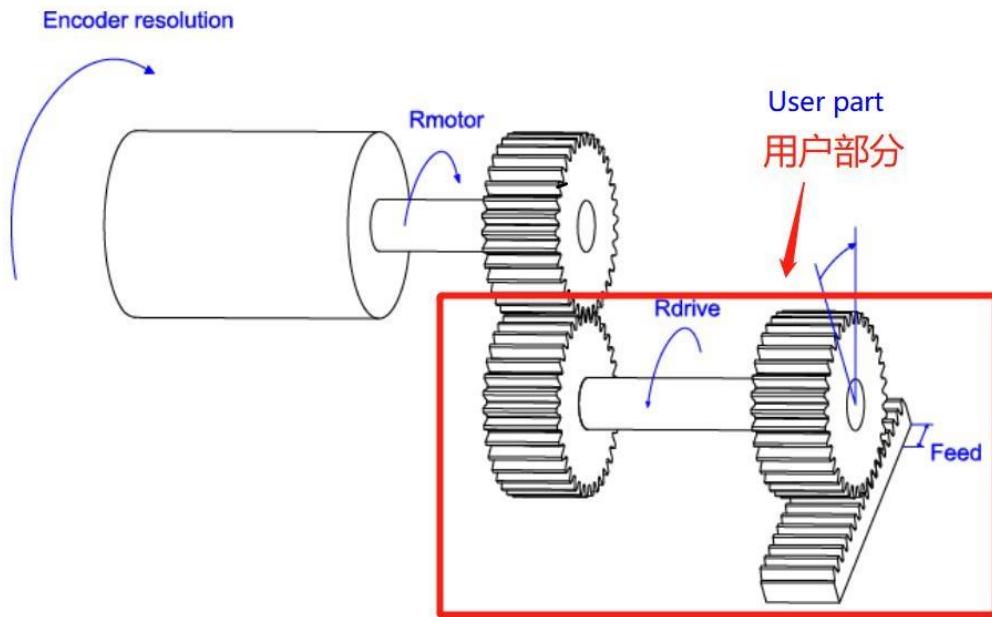
位-值含义 Bit-value meaning		
7	6	5~0
Position polarity	Velocity polarity	reserved (0)

上表中的位值表示为：0 表示乘以 1, 1 表示乘以-1。例如位置极性 Position Polarity = 0, 表示 Position demand value 的值将被乘上 1。下表为对象的描述：

The bit values in the table above are expressed as: 0 means multiply by 1, and 1 means multiply by -1. For example, Position Polarity = 0, which means that the Position demand value will be multiplied by 1. The following table describes the objects:

属性 Attributes	描述
索引 Index	607E _h
名称 Name	极性(Polarity)
数据结构 Data structure	Variable
可访问性 Accessibility	rw
数据类型 Type of data	Unsigned8
默认值 Defaults	0

4.4 举例 Examples



如上图所示，Rmotor 为电机轴，Rdrive 为驱动轴。假设：电机轴旋转一圈，编码器增量 Encoder resolution = 10000；当 Rdrive 旋转 1 圈时候，Rmotor 旋转 3 圈；从以上条件可知，驱动轴转 1 圈，需要电机走 3×10000 个编码器码，即电机转动 3 圈。设定的参数可根据以下公式计算：

As shown in the figure above, Rmotor is the motor shaft and Rdrive is the drive shaft. Assumption: Encoder resolution = 10000 when the motor shaft rotates one revolution; when Rdrive rotates one revolution, Rmotor rotates three revolutions; from the above conditions, it can be seen that if the drive shaft turns one revolution, the motor needs to take 3×10000 encoder codes , That is, the motor rotates 3 times. The set parameters can be calculated according to the following formula:

位置编码器分辨率 (position encoder resolution) 608F_h:

$$\text{位置编码器分辨率} = \frac{\text{编码器增量 (608Fh: 01h)}}{\text{电机转数 (608Fh: 02h)}} = \frac{10000}{1} = 10000$$

$$\text{Encoder resolution} = \frac{\text{Encoder increment (608Fh:01h)}}{\text{Motor revolution (608Fh:02h)}} = \frac{10000}{1} = 10000$$

传动比 (gear ratio) 6091_h:

$$\text{传动比} = \frac{\text{电机轴转数 (6091h: 01h)}}{\text{驱动轴转数 (6091h: 02h)}} = \frac{3}{1} = 3$$

$$\text{Transmission ratio} = \frac{\text{Motor shaft rotation (6091h:01h)}}{\text{Drive shaft revolution (6091h:02h)}} = \frac{3}{1} = 3$$

5 运行模式 Operating mode

5.1 控制模式概述 Overview of control modes

一体化电机的控制模式分为 CiA402 模式和 NiMotion 模式， 2002_{h} : 01_{h} （控制模式选择）用于确定电机处于 CiA402 模式还是 NiMotion 模式，对象描述如下：

The control mode of the integrated motor is divided into CiA402 mode and NiMotion mode. 2002_{h} : 01_{h} (control mode selection) is used to determine whether the motor is in CiA402 mode or NiMotion mode. The objects are described as follows:

属性 Attributes	描述 Description
索引 Index	2002_{h}
名称 Name	基础控制参数(Basic control parameter)
数据结构 Data structure	Record
数据类型 Type of data	-

子索引 01_{h} 来确定模式：

Sub-index 01_{h} to determine the mode:

子索引 Subindex	01_{h}
描述 Description	控制模式选择 (Contrl Mode Select)
可访问性 Accessibility	rw
能否映射 Can it be mapped	否 No
数据范围 Data range	Unsigned8
默认值 Defaults	0
值含义 Value meaning	0x00: CiA402 模式 0x00: CiA402 mode 0x01: NiMotion 位置模式 0x01: NiMotion position mode 0x02: NiMotion 速度模式 0x02: NiMotion Velocity mode 0x03: NiMotion 转矩模式 0x03: NiMotion torque mode 0x04: NiMotion 开环模式 0x04: NiMotion open loop mode

选择 CiA402 模式后，需要设置 6060_h 来选择具体运动模式（控制模式选择，运行状态设置无效），对象描述如下：

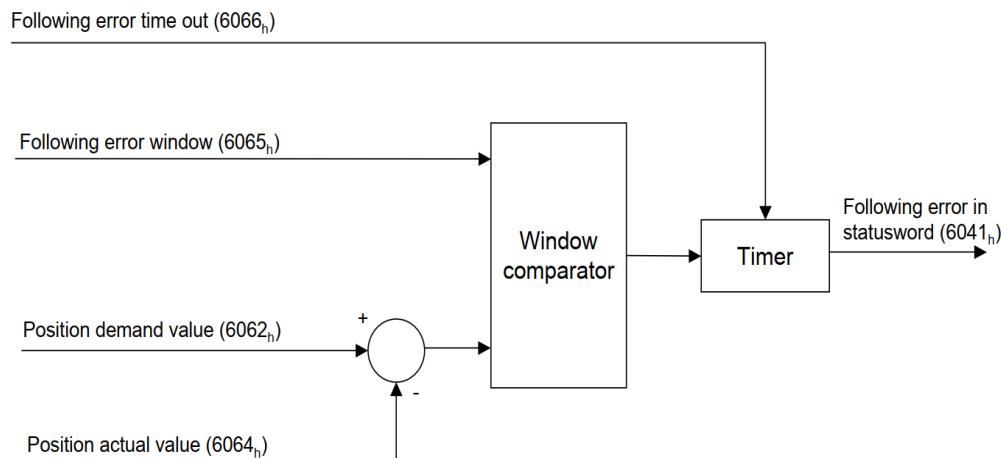
After selecting CiA402 mode, you need to set $6060h$ to select the specific sport mode (control mode selection, invalid running state setting), the object description is as follows:

子索引 Subindex	6060_h
描述 Description	模式选择 (Mode Operation)
可访问性 Accessibility	Variable
能否映射 Can it be mapped	rw
数据范围 Data range	否 No
默认值 Defaults	Unsigned8
子索引 Subindex	0x01
值含义 Value meaning	0x00: 无定义 0x00: no definition 0x01: 轮廓位置模式(PP) 0x01: profile position mode (PP) 0x02: 速度模式(VM) 0x02: velocity mode (VM) 0x03: 轮廓速度模式(PV) 0x03: profile velocity mode (PV) 0x04: 轮廓转矩模式(PT) 0x04: profile torque mode (PT) 0x05: 无定义 0x05: no definition 0x06: 原点回归模式(HM) 0x06: home mode (HM) 0x07: 插补模式(IP) 0x07: interpolation mode (IP) 0x08: 循环同步位置模式(CSP) 0x08: cyclic synchronous position mode (CSP) 0x09: 循环同步速度模式(CSV) 0x09: cycle synchronous Velocity mode (CSV) 0x0A: 循环同步转矩模式(CST) 0x0a: cyclic synchronous torque mode (CST)

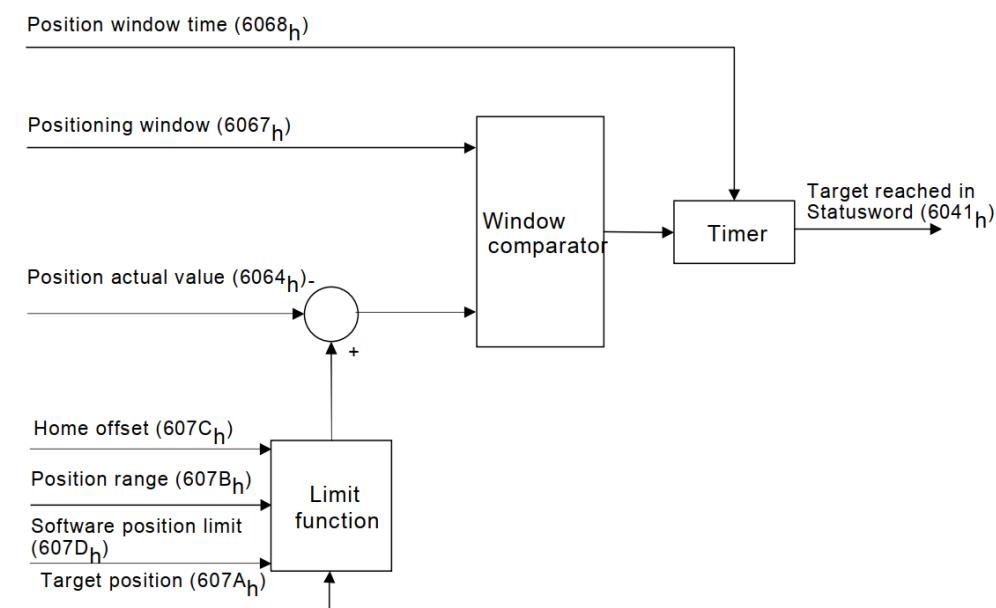
5.2 位置控制功能 Position control function

5.2.1 结构图 Structure diagram

位置跟随误差 Position following error



位置到达 Location reached



5.2.2 相关对象 Related objects

跟随误差 Following error

对象索引 Object index	描述 Description
6041 _h (Status word)	状态字 Status word
6062 _h (Position demand value)	驱动器内部当前目标位置指令值（用户单位） Command value of current target position inside the drive (user unit)
6064 _h (Position actual value)	电机当前的用户绝对位置反馈（用户单位）

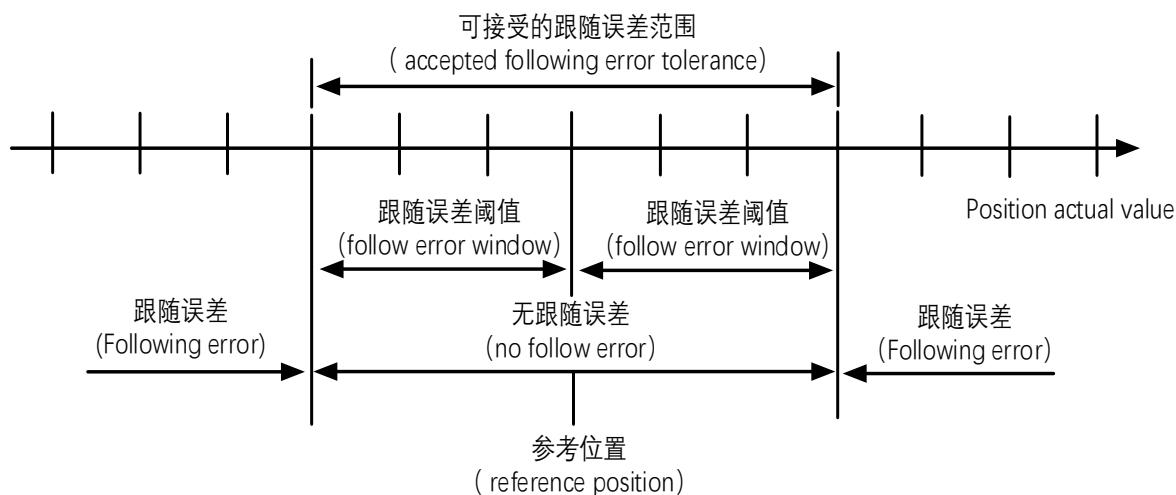
	Motor current user absolute position feedback (user unit)
6065 _h (Following Error Window)	跟随偏差阈值窗口 (用户单位) Following deviation threshold window (user unit)
6066 _h (Following Error Time Out)	跟随偏差超时时间阈值 (单位: ms) Threshold for following deviation timeout time (unit: ms)

位置到达 Location reached

对象索引 Object index	描述 Description
6041 _h (Status word)	状态字 Status word
6064 _h (Position actual value)	电机当前的用户绝对位置反馈 (用户单位) Motor current user absolute position feedback (user unit)
6067 _h (Position window)	位置到达窗口 (用户单位) Location arrival window (user unit)
6068 _h (Position window time)	位置到达窗口时间 (单位: ms) Position arrival window time (unit: ms)
607A _h (Target position)	预设的目标位置 (用户单位) Preset target location (user unit)
607B _h (Position range limit)	位置范围限制 (用户单位) Location range limitation (user unit)
607C _h (Home offset)	原点偏移值 (用户单位) Origin offset value (user unit) 具体描述: 设置原点回归下电机原点偏离机械零点的物理位置 Specific description: Set the physical position where the motor origin deviates from the mechanical zero point under the origin return 设置位置类控制模式(轮廓位置模式、插补模式、原点回零)下机械零点偏离电机原点的物理位置 Set the physical position where the mechanical zero point deviates from the motor origin in the position control mode (profile position mode, interpolation mode, zero point return) 原点偏置生效条件: 本次上电运行, 已完成原点回零操作, 状态字 6041h 的 bit15=1。 Origin offset effective condition: this time after power-on operation, the origin zero return operation has been completed, bit 15 of status word 6041h=1.
607D _h (Software position limit)	目标位置的限值 (用户单位) Target position limit (user units)

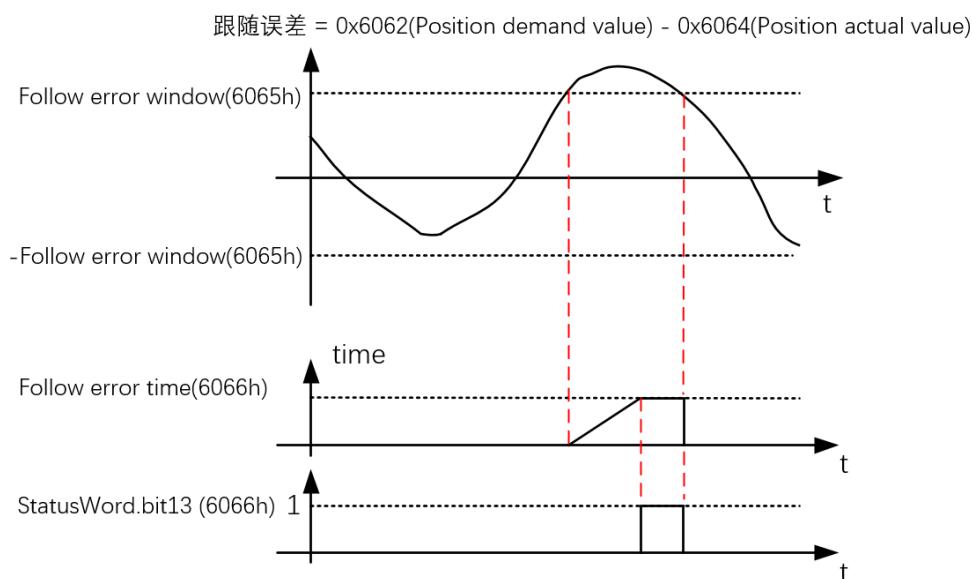
5.2.3 功能描述 Functional description

位置跟随误差 Position following error



跟随误差指的是参考位置 6062h (Position demand value) 和实际位置 6064h (Position actual value) 的偏差。在 6066h (Following error timeout) 设定的时间内，如果跟随误差值一直大于跟随误差窗口 6065h (Following error windows) 的值（如图 6.2 所示，跟随误差超出可接受的跟随误差范围），那么状态字 (6041h Statusword) 的 bit13 (following error) 将被置 1，时序图如下图所示：

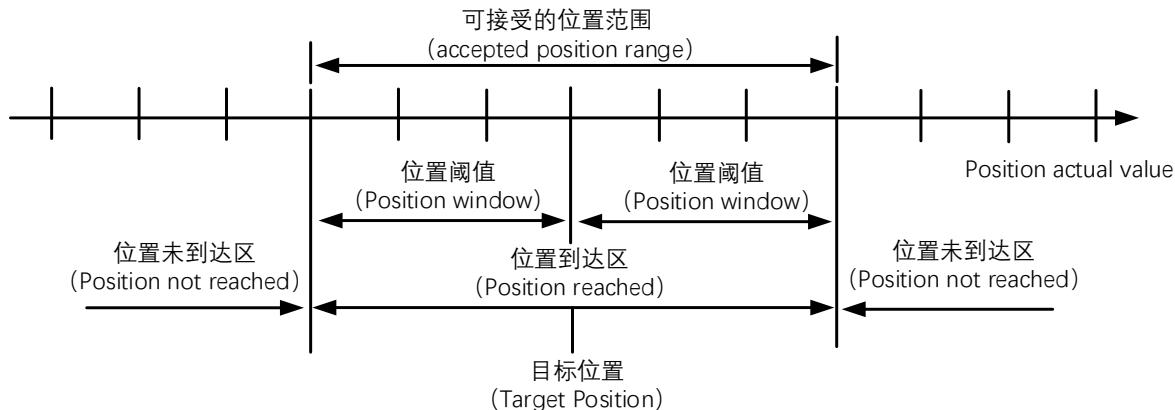
The following error refers to the deviation between the reference position 6062_h (Position demand value) and the actual position 6064_h (Position actual value). Within the time set by 6066_h (Following error timeout), if the following error value is always greater than the value of the following error window 6065_h (Following error windows) (as shown in Figure 6.2, the following error exceeds the acceptable following error range), then the status The bit 13 (following error) of the word (6041_h Statusword) will be set to 1. The timing diagram is shown in the figure below:



位置到达 Location reached

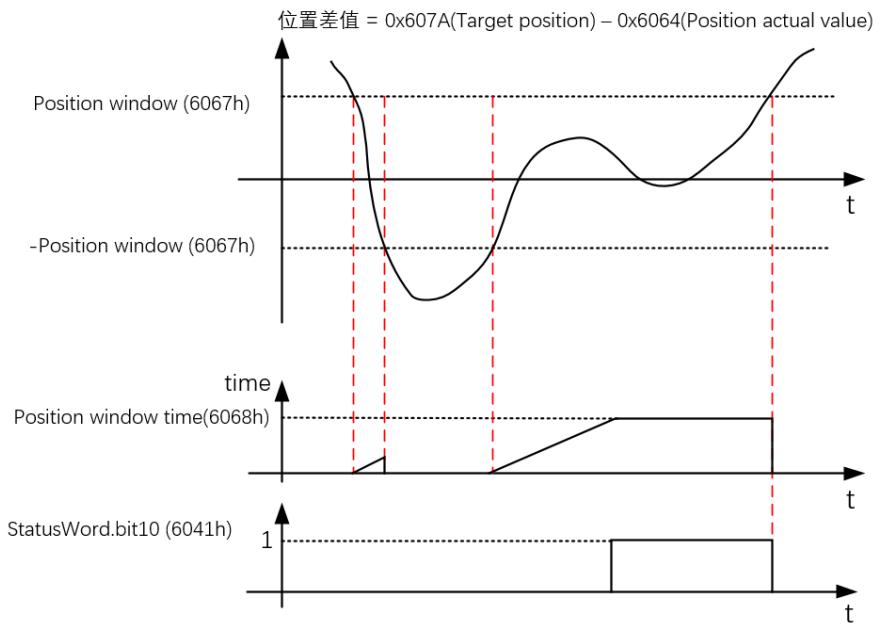
误差可接受范围示意图：

Schematic diagram of the acceptable range of error:



位置差值为目标位置 607Ah (Target position) 和实际位置 6064h (Position actual value) 的差值。如果该差值稳定在可接受的位置范围（如上图所示）并达到设定时间 6068h (position windows time)，那么状态字 (Statusword) 的 bit10 (target reached) 将被置 1，即表示目标位置到达。时序图如下图所示：

The position difference is the difference between the target position 607Ah (Target position) and the actual position 6064h (Position actual value). If the difference is stable within the acceptable position range (as shown in the above figure) and reaches the set time 6068h (position windows time), then bit10 (target reached) of the status word (Statusword) will be set to 1, indicating the target position Arrivals. The timing diagram is shown below:

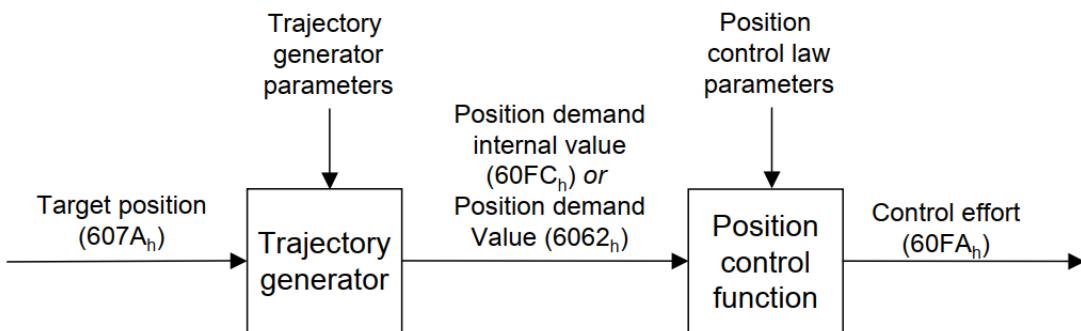


5.3 轮廓位置模式 (PP) Profile position mode (PP)

此模式主要用于点对点定位应用。此模式下，上位机给目标位置(绝对或者相对)、位置曲线的速度、加减速及减速度，内部的轨迹发生器将根据设置生成目标位置曲线指令，驱动器内部完成位置控制，速度控制，转矩控制。总体结构如下图：

This mode is mainly used for point-to-point positioning applications. In this mode, the upper computer gives the target position (absolute or relative), the speed of the position curve,

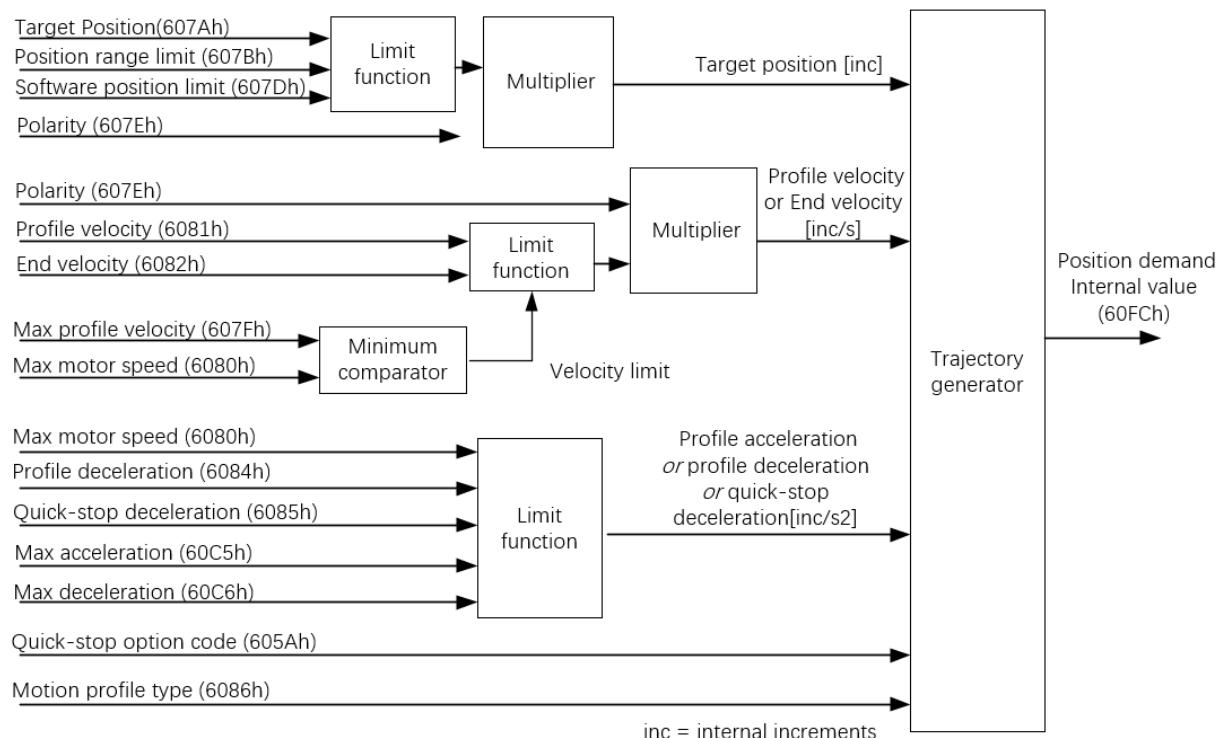
acceleration, deceleration and deceleration, the internal track generator will generate the command of the target position curve according to the settings, and the internal driver will complete the position control, speed control and torque control. The overall structure is as follows:



5.3.1 结构图 Structure diagram

下图定义了轨迹发生器的详细结构:

The following figure defines the detailed structure of the trajectory generator:



5.3.2 相关对象 Related objects

在该模式下需要注意下述对象:

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

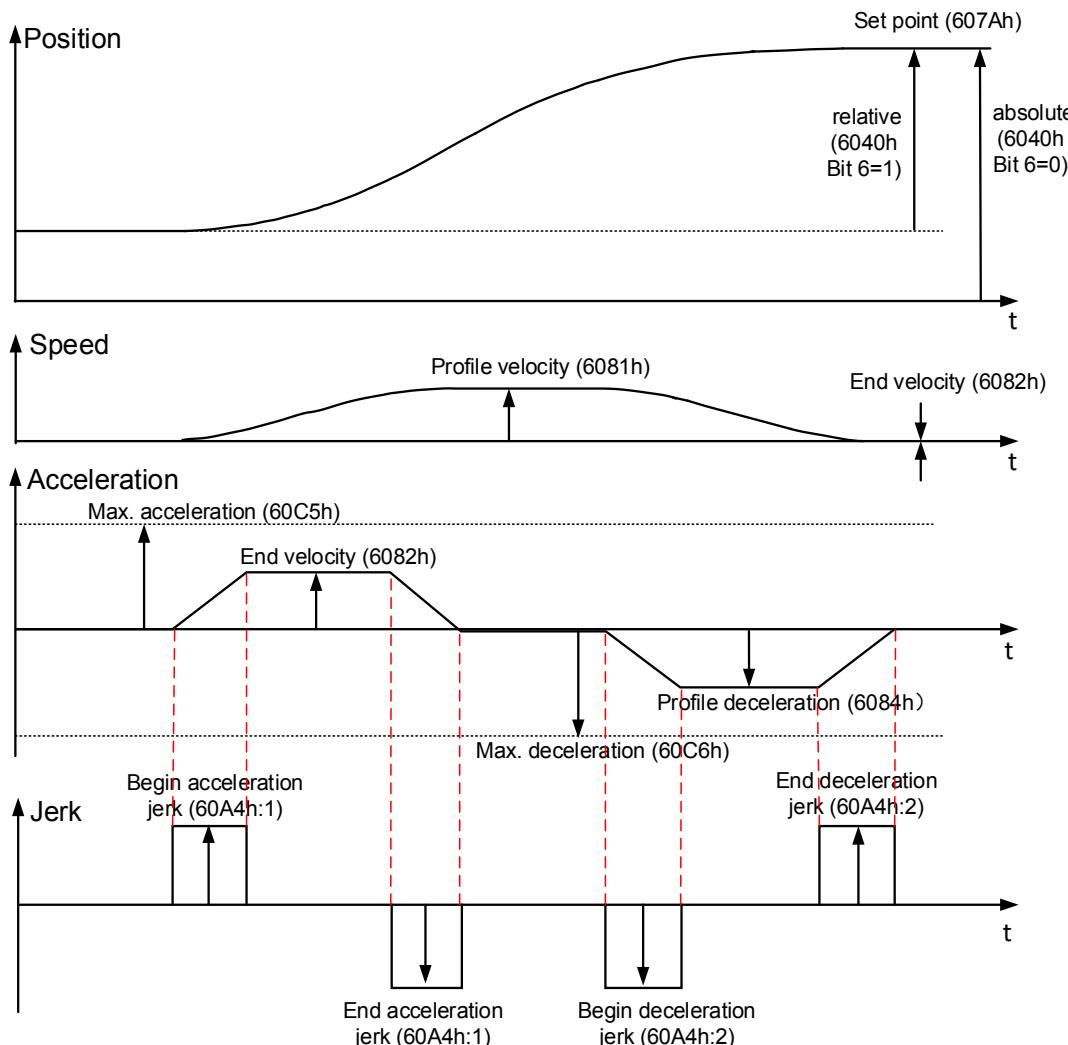
对象索引 Object index	描述 Description
605D _h (Halt option code)	暂停方式选择 Pause mode selection

对象索引 Object index	描述 Description
605Ah (Quick stop option code)	快速停机方式选择 Quick stop mode selection
6062h (Position Demand Value)	驱动器内部当前目标位置指令值（用户单位） Command value of current target position inside the drive (user unit)
6063h (Position Actual Enc Value)	电机当前的绝对位置反馈（编码器单位） Motor current absolute position feedback (encoder unit)
6064h (Position Actual User Value)	电机的当前位置（用户单位） The current position of the motor (user unit)
607Ah (Target Position)	预设的目标位置（用户单位） Preset target location (user unit)
607Bh (Position Range Limit)	位置范围限制（用户单位） Location range limitation (user unit)
607Dh (Software Position Limit)	目标位置的限制（用户单位） Limitation of target location (user unit)
607Eh (Polarity)	旋转方向(极性), 详见“5.1.4 607Eh: 极性” Direction of rotation (polarity), see "5.1.4 607Eh: Polarity" for details
607Fh (Max Profile Velocity)	运行过程中的最大轮廓速度（用户单位/s），起限制速度的作用。 The maximum profile speed (user units/s) during operation plays a role in limiting the speed.
6080h (Max motor speed)	电机最大速度（rpm） Maximum speed of motor (rpm)
6081h (Profile Velocity)	该段位移指令运行过程中的匀速阶段轮廓速度（用户单位/s），即定位期间到达加速度斜坡末端的速度。大小受 607Fh 限制。 The profile speed (user unit/s) of the constant speed stage during the operation of this segment of displacement command, that is, the speed to reach the end of the acceleration ramp during positioning. The size is limited by 607Fh.
6082h (End Velocity)	轮廓终点速度，到达目标位置时的速度（用户单位/s），斜坡末端的速度，通常将该对象设置为零，这样在到达目标位置时速度正好减为0。大小受 607Fh 限制。 The profile end speed, the speed when reaching the target position (user units/s), and the speed at the end of the slope, usually set the object to zero, so that the speed just decreases to 0 when reaching the target position. The size is limited by 607Fh.
6083h (Profile Acceleration)	运行过程中的轮廓加速度（用户单位/s ² ），大小受 60C5h 限制。 The profile acceleration (user units/s ²) during operation is limited by 60C5h.
6084h (Profile Deceleration)	运行过程中的轮廓减速度（用户单位/s ² ），大小受 60C6h 限制。 The profile deceleration (user units/s ²) during operation is limited by 60C6h.
6085h (Quick Stop Deceleration)	执行"快速停机"时的停机减速度（用户单位/s ² ） Stop deceleration when executing "fast stop" (user unit/s ²)

对象索引 Object index	描述 Description
6086 _h (Motion Profile Type)	<p>选择规划器曲线即斜坡的类型, Select the type of planner curve that is the slope,</p> <p>若值为"0", 则不会对冲击(加速度)进行限制, 即梯型曲线; If the value is "0", the impact (acceleration) will not be limited, that is, the trapezoid curve;</p> <p>若值为"3", 则将用 60A4_h: 01_h-02_h 中的值来限制冲击(加速度), 即 S 型曲线, 本设备只使用了 01_h 和 02_h 索引。 If the value is "3", the value in 60A4h: 01h-02h will be used to limit the impact (acceleration), that is, the S-curve, the device only uses the 01h and 02h indexes.</p>
60C5 _h (Max Acceleration)	最大加速度限值 (用户单位/s ²) Maximum acceleration limit (user units/s ²)
60C6 _h (Max Deceleration)	最大减速度限值 (用户单位/s ²) Maximum deceleration limit (user units/s ²)
60F2 _h (Positioning option code)	定位选项 Targeting options
60FC _h (Position Demand internal value)	轨迹发生器的输出, 即内部规划的实时位置指令 (编码器单位) The output of the trajectory generator is the internally planned real-time position command (encoder unit)

下图为速度、加速度、冲击参数对运行过程的作用示意:

The following figure shows the effect of speed, acceleration and impact parameters on the running process:



5.3.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须在对象 2002h: 01h 中设定值为"0"和对象 6060h(Modes Of Operation)中设定值为"1"。

To enable this mode, the value must be set to "0" in object 2002h: 01h and "1" in object 6060h (Modes Of Operation).

控制字 Control word

15	10	9	8	7	6	5	4	3	0
(see 4.1.2)	Change on set-point	Halt	(see4.1.2)	abs/rel	Change set immediately	New set- point	(see4.1.2)		
MSB					LSB				

在轮廓位置模式下，对象 **6040_h** (Controlword) 中的下述位具有特别的功能

In profile position mode, the following bits in object 6040h (Controlword) have special functions

位 5	位 4	含义
Bit 5	Bit 4	Meaning

0	0->1	非立刻更新，将先完成正在执行的运行任务，然后才启动下个运行任务 For non-immediate updates, the running task being executed will be completed before the next running task is started
1	0-> 1	立刻更新，将立即执行由位 4 触发的运行任务 Update immediately, the running task triggered by bit 4 will be executed immediately

位 Bit	值 Value	含义 Meaning
6	0	目标位置为绝对位置指令 Target position is absolute position command
	1	目标位置为相对位置指令，目标位置是基于当前位置的相对位置，基准位置取决于 $60F2_h$ 的位 0 和 1 The target position is a relative position command. The target position is a relative position based on the current position. The reference position depends on bits 0 and 1 of $60F2_h$
8	0	应执行或继续定位 Should perform or continue positioning
	1	电机将减速并停止运动，减速度取决于对象 $605D_h$ The motor will slow down and stop moving, the deceleration depends on the object $605D_h$

状态字 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

在轮廓位置模式下，对象 6041_h (Statusword)中的下述位具有特别的功能：

In profile position mode, the following bits in object $6041h$ (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
10	0	非暂停状态下(6040_h 的 bit8 = 0): 目标未到达 In non-paused state (bit8 = $6040h$): The target has not been reached 暂停状态下(6040_h 的 bit8 = 1): 电机减速 In the pause state (bit8 = 1 at $6040h$): the motor decelerates
	1	非暂停状态下(6040_h 的 bit8 = 0): 目标到达 In non-paused state (bit8 = $6040h$ = 0): target arrived 暂停状态下(6040_h 的 bit8 = 1): 电机转速为 0 In the pause state (bit8 = 1 in $6040h$): the motor speed is 0
12	0	之前的定位点定位完成，等待新设定点 The previous positioning point is completed, waiting for the new set point

	1	之前的定位点仍在处理，新的定位点将会覆盖旧的定位点 The previous anchor point is still being processed, the new anchor point will overwrite the old anchor point
13	0	无跟随误差 No following error
	1	有跟随误差 Follow error

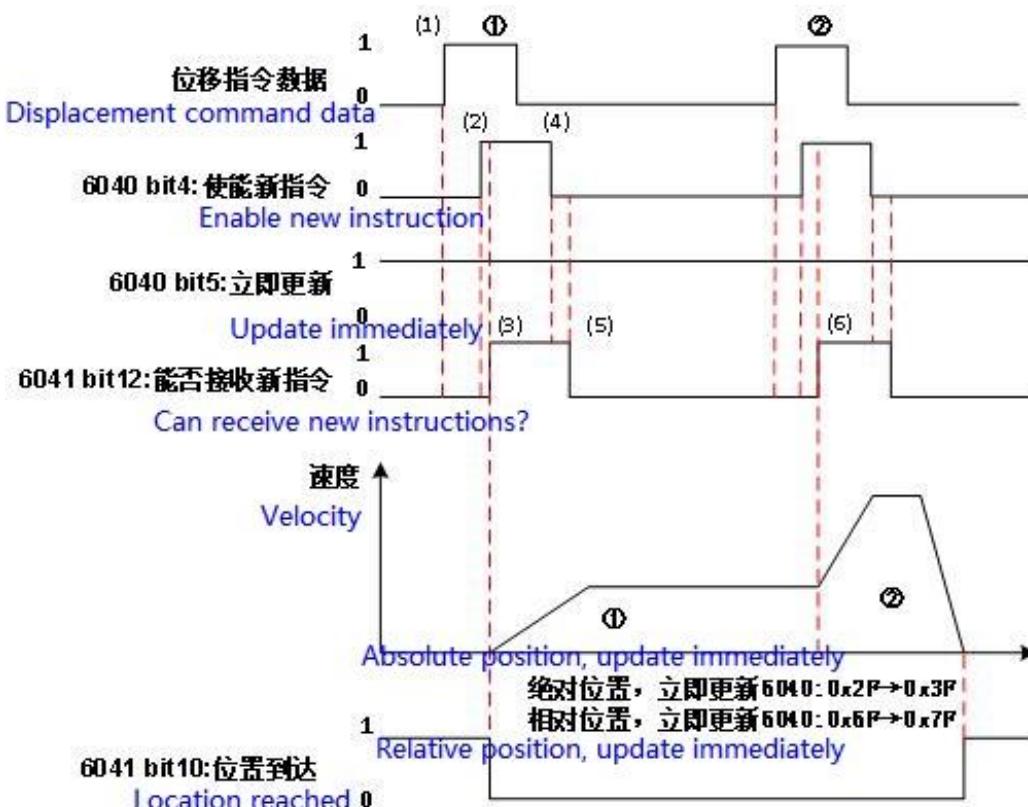
5.3.4 功能描述 Functional description

下面分立即更新和非立即更新解释控制指令时序：

The following is an explanation of the timing of the control commands with immediate update and non-immediate update:

1) 控制指令时序-立刻更新

Control instruction timing-update immediately

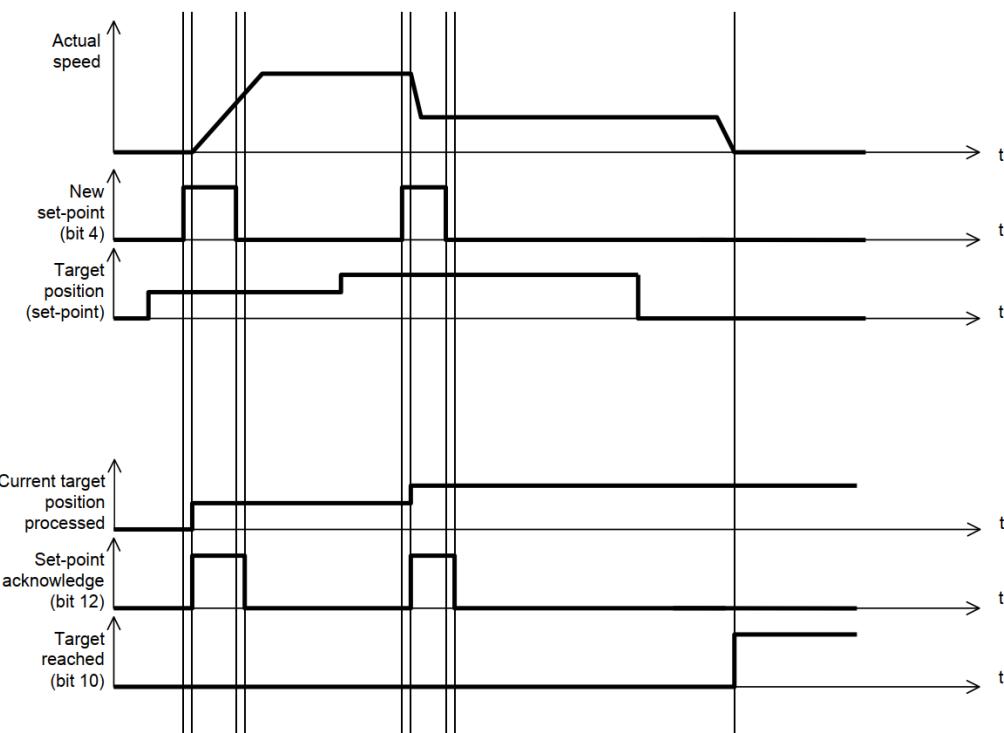


下表是对上图过程中标注的一些释义：

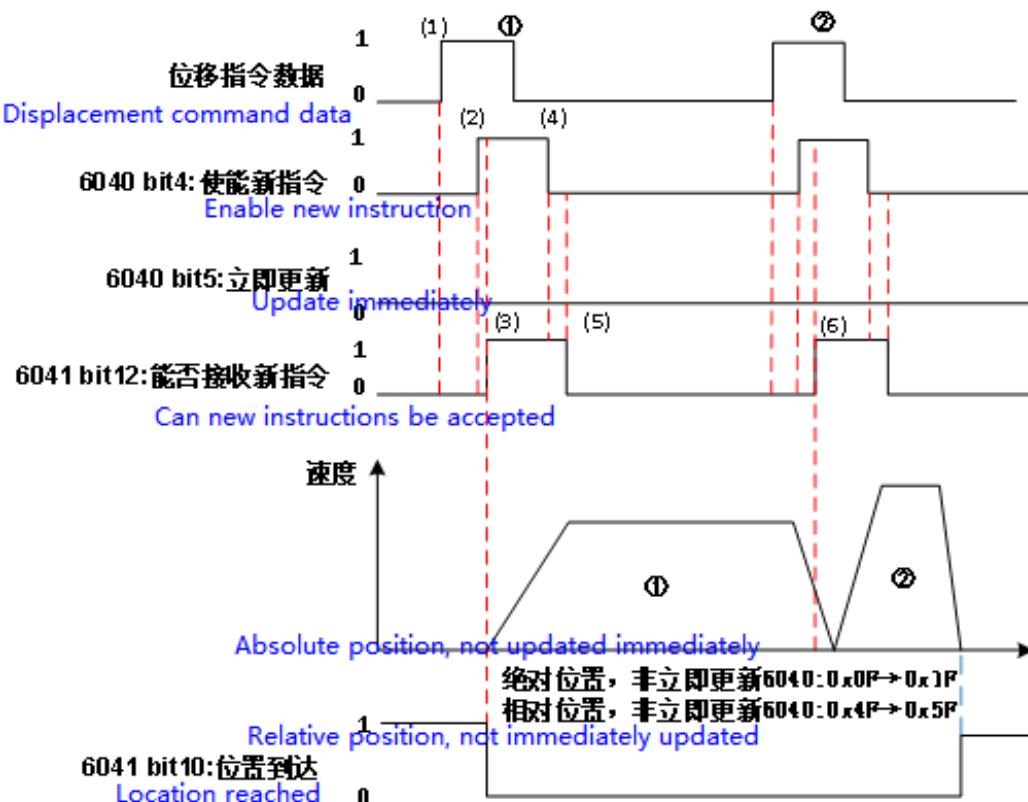
The following table explains some explanations in the process of the above picture:

(1)	上位机更新位移指令(包括目标位移 607Ah, 加速时间 6083h, 减速时间 6084h, 轮廓速度 6081h 等) The host computer updates the displacement command (including target displacement 607Ah, acceleration time 6083h, deceleration time 6084h, profile speed 6081h, etc.)
-----	--

(2)	将 6040h 的 bit4 由 0 置 1，提示从站有新的位移指令（立即更新时 6040h 的 bit5 设为 1） Set bit 4 of 6040h from 0 to 1, indicating that the slave has a new displacement command (bit 5 of 6040h is set to 1 when updating immediately)
(3)	从站在接收到 6040h 的 bit4 的上升沿后，对是否可接收该新的位移指令做出判断：若此时 6041h 的 bit12 为 0，表明从站可接收新的位移指令①；从站接收新的位移指令后，将 6041 的 bit12 由 0 置 1，表明新的位移指令①已接收，且当前从站处于不能继续接收新的位移指令状态。 After receiving the rising edge of bit4 at 6040h, the slave makes a judgment on whether the new displacement command can be received: if bit12 at 6041h is 0 at this time, it indicates that the slave can receive the new displacement command ①; the slave receives the new After the displacement command, set bit 12 of 6041 from 0 to 1, indicating that the new displacement command ① has been received and the current slave station is in a state where it cannot continue to receive the new displacement command. 立即更新模式下，新的位移指令一旦被接收(6041 的 bit12 由 0 变为 1)，电机立刻执行该位移指令 In the immediate update mode, once a new displacement command is received (bit 12 of 6041 changes from 0 to 1), the motor immediately executes the displacement command
(4)	上位机接收到从站的状态字 6041h 的 bit12 变为 1 后，才可以释放位移指令数据，并将控制字 6040h 的 bit4 由 1 置 0，表明当前无新的位置指令 After the host computer receives the slave station status word 6041h bit12 becomes 1, it can release the displacement command data, and set the control word 6040h bit4 from 1 to 0, indicating that there is no new position command
(5)	从站检测到控制字 6040h 的 bit4 由 1 变为 0 时，可以将状态字 6041h 的 bit12 由 1 置 0，表明从站已准备好可以接收新的位移指令。 When the slave detects that bit 4 of control word 6040h changes from 1 to 0, it can set bit 12 of status word 6041h from 1 to 0, indicating that the slave is ready to receive a new displacement command.



2) 控制指令时序-非立刻更新 Control command timing-not immediately updated



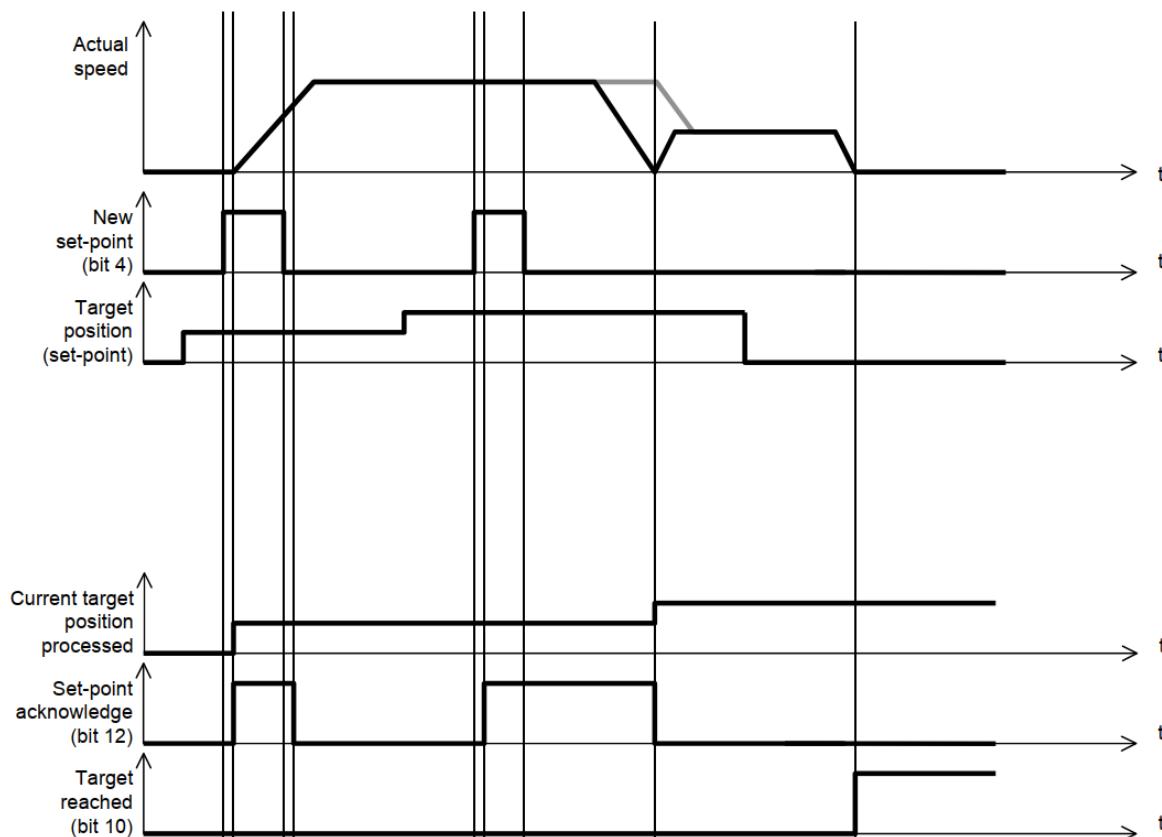
非立即更新情况下图中标注(1)-(5)与立即更新情况下释义类似，可以在图中位置(6)对比看出，区别在于：非立即更新情况下，虽然已经接受了新的目标位置②，但是需要先到达位置①，减速停机，再行进至位置②。

In the case of non-immediate update, the annotations (1)-(5) in the figure are similar to the

interpretation in the case of immediate update. You can see from the position (6) in the figure. The difference is: in the case of non-immediate update, although the new Target position ②, but need to reach position ① first, decelerate to stop, and then move to position ②.

非立即更新情况下，本电机设计了5个缓存，即能同时有5个目标位置在序列中，电机将依次行进至这些位置。如果缓存满了将不能接受新的位置，等到有缓存为空时才能接收新的位置。电机停机时会清除这些缓存。

In the case of non-immediate update, the motor has designed 5 buffers, that is, there can be 5 target positions in the sequence at the same time, and the motor will travel to these positions in sequence. If the cache is full, the new location cannot be accepted, and the new location cannot be received until the cache is empty. These caches are cleared when the motor is stopped.



5.3.5 冲击受限和不受限模式 Shock restricted and unrestricted modes

原则上，模式按照冲击可分为“冲击受限”和“冲击不受限”两种

In principle, the modes can be divided into "impact limited" and "impact unrestricted" according to impact

- **冲击受限模式 Shock restricted mode**

将对象 6086_h 设为“3”，可执行冲击受限定位运行。此时，对象 60A4_h: 01_h-04_h 中与冲击有关的项生效

Set object 6086_h to "3" to perform impact limited positioning operation. At this time, subject 60A4h: 01h~04h items related to impact take effect

- **冲击不受限模式 Unlimited shock mode**

此模式下，特征曲线各个位置上没有冲击限制。运行“冲击不受限”斜坡的方法：将对象 6086_h 中的项设为“0”。

In this mode, there is no impact limit on each position of the characteristic curve. To run the "shock unrestricted" ramp: Set the item in object 6086_h to "0".

5.3.6 配置举例 Configuration examples

- 配置模式: Configuration mode:

2002_h: 01_h=0、运行模式 6060_h=0x01, 使设备工作在轮廓位置模式;

2002h: 01h=0, running mode 6060h=0x01, make the device work in profile position mode;

- 参数配置: Parameter configuration:

写目标位置 607A_h (用户单位) ;

Write target location 607Ah (user unit);

写当前段位移指令匀速运行速度 6081_h(用户单位/s);

Write the current displacement command at a constant speed of 6081_h (user unit/s);

设置位移的加速度 6083_h(用户单位/s²) 和减速度 6084_h(用户单位/s²);

Set the acceleration of displacement 6083h (user unit/s²) and deceleration 6084h (user unit/s²);

- 写控制字 Write control word

6040_h = 0x06→0x07→0x(n)F → 0x(n+1)F, 电机运行,

6040h = 0x06→0x07→ 0x(n)F → 0x(n+1)F, the motor is running,

不同的指令类型如下表所示:

The different instruction types are shown in the table below:

6040 _h -bit6	6040 _h -bit5	6040 _h 变化	描述 Description
0	0	0x0F → 0x1F	绝对位置, 非立刻更新 Absolute position, not immediately updated
0	1	0x2F → 0x3F	绝对位置, 立刻更新 Absolute position, update immediately
1	0	0x4F → 0x5F	相对位置, 非立刻更新 Relative position, not updated immediately
1	1	0x6F → 0x7F	相对位置, 立刻更新 Relative position, update immediately

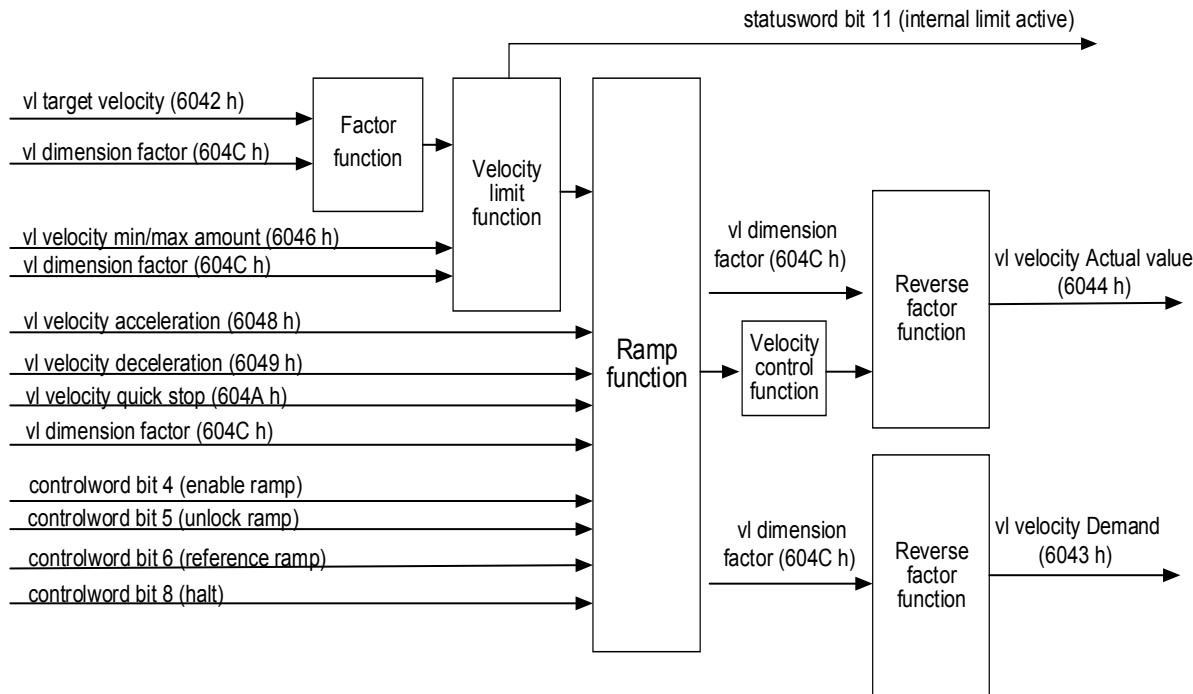
监控参数: Monitoring parameters:

- 实际位置反馈: 6063_h(编码器单位), 6064_h(用户单位)

Actual position feedback: 6063h (encoder unit), 6064h (user unit)

5.4 速度模式 (VM) Velocity mode (VM)

5.4.1 结构图 Structure diagram



5.4.2 相关对象 Related objects

在该模式下需要注意下述对象:

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

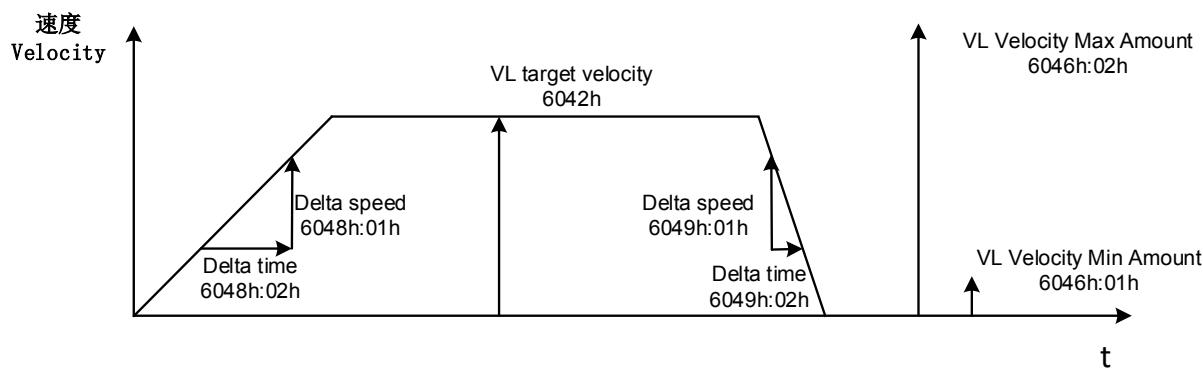
对象索引 Object index	描述 Description
6042 _h (VI target velocity)	VM 模式的目标速度, (默认单位: rpm, 与 604C _h 有关) Target speed in VM mode, (default unit: rpm, related to 604Ch)
6043 _h (VI velocity demand)	VM 模式生效的目标速度指令 (单位同 6042 _h , 默认: rpm) Target speed command in VM mode (unit: 6042h, default: rpm)
6044 _h (VI velocity actual value)	当前的实际速度反馈值 (rpm) Current actual speed feedback value (rpm)
604C _h (VL dimension factor)	VM 模式速度单位的缩放系数, 默认速度单位为 rpm (转/分)。 Scaling factor for the speed unit of the VM mode. The default speed unit is rpm (rev/min). 子索引 1 包含用于计算速度的分子(乘数), 子索引 2 包含分母(除数)。速度单位: rpm * 子索引 1 / 子索引 2, 比如子索引 1 设置 2, 子索引 2 设置 1, 则速度单位: 2rpm。 Sub-index 1 contains the numerator (multiplier) used to calculate the speed, and sub-index 2 contains the

对象索引 Object index	描述 Description
	<p>denominator (divisor). Speed unit: rpm * $\frac{\text{Subindex1}}{\text{Subindex2}}$, For example, if sub-index 1 is set to 2 and sub-index 2 is set to 1, the speed unit is 2 rpm. 如果子索引 1 和 2 任意一个为 0, 速度单位为 rpm。 If either of sub-indexes 1 and 2 is 0, the speed unit is rpm.</p>
6048 _h (Velocity acceleration)	<p>VM 模式的加速度。子索引 1 包含速度变化（单位 rpm），子索引 2 包含对应的时间（单位秒）。</p> <p>Acceleration in VM mode. Sub-index 1 contains the speed change (in rpm), and sub-index 2 contains the corresponding time (in seconds).</p> <p>二者共同计算出加速度，具体公式如下：</p> <p>The two together calculate the acceleration, the specific formula is as follows:</p> <p>VI velocity acceleration = Delta speed (6048_h: 01_h) / Delta time (6048_h: 02_h)</p> <p>例如：需要让电机在 3.5s 内加速到 300rpm，则配置 6048_h: 01_h=3000, 6048_h: 02_h=35。</p> <p>For example, if you need to accelerate the motor to 300rpm in 3.5s, configure 6048_h: 01h=3000, 6048h: 02h=35.</p>
6049 _h (Velocity deceleration)	<p>VM 模式的减速度。子索引 1 包含速度变化（单位: rpm），子索引 2 包含对应的时间（单位: s (秒)）</p> <p>The deceleration of VM mode. Sub-index 1 contains the speed change (unit: rpm), and sub-index 2 contains the corresponding time (unit: s (second)).</p> <p>二者共同计算出加速度，具体公式如下：</p> <p>The two together calculate the acceleration, the specific formula is as follows:</p> <p>VI velocity deceleration = Delta speed (6049_h: 01_h) / Delta time (6049_h: 02_h)</p>
604A _h (Quick stop deceleration)	<p>VM 模式的快速停机时的减速度。子索引 1 包含速度变化（单位: rpm），子索引 2 包含对应的时间（单位: s (秒)）。</p> <p>The deceleration of VM mode during rapid shutdown. Sub-index 1 contains the speed change (unit: rpm), and sub-index 2 contains the corresponding time (unit: s (second)).</p> <p>二者共同计算出加速度，具体公式如下：</p> <p>The two together calculate the acceleration, the specific formula is as follows:</p> <p>VI Quick stop deceleration = Delta speed (604A_h: 01_h) / Delta time (604A_h: 02_h)</p>
6046 _h (Velocity min max amount)	<p>VM 模式下速度的限值（默认单位: rpm, 与 604C_h 有关），具体描述如下：</p> <p>Speed limit in VM mode (default unit: rpm, related to 604Ch),</p>

对象索引 Object index	描述 Description
	<p>The specific description is as follows:</p> <p>6046_h: 01_h 设置最低速度。若目标速度(6042_h)低于最低速度，其值将被设为最低速度 6046_h: 01_h。</p> <p>6046_h: 01_h sets the minimum speed. If the target speed (6042_h) is lower than the minimum speed, its value will be set to the minimum speed of 6046_h: 01_h.</p> <p>6046_h: 02_h 设置最高速度。若目标速度(6042_h)高于最高速度，其值将被设为最高速度 6046_h: 02_h。</p> <p>6046_h: 02_h sets the maximum speed. If the target speed (6042_h) is higher than the maximum speed, the value will be set to the maximum speed of 6046_h: 02_h.</p>

下图为加速度，减速度对运行过程的作用示意：

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



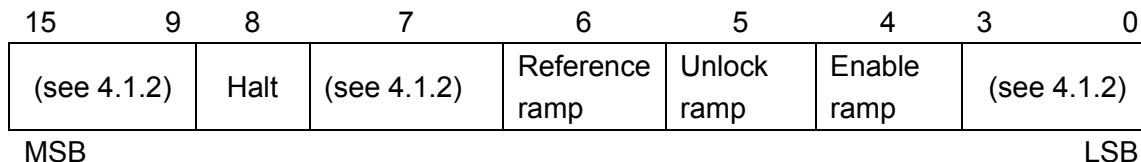
5.4.3 控制指令与状态信息 Control commands and status information

启用 Enable

启用该模式，必须在对象 2002_h: 01_h 中设定值为"0"和对象 6060_h (Modes Of Operation)中 设定值为"2"。

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

控制字 Control word

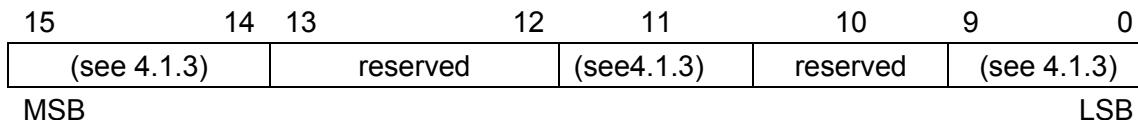


在速度模式下，对象 6040_h (Controlword)中的下述位具有特别的功能

In Velocity mode, the following bits in object 6040h (Controlword) have special functions

位 Bit	值 Value	描述 Description
2	0	触发快速停机，电机将按照对象 604Ah 中所设置的快速停机减速度执行快速制动。随后，控制器切换至"Switch on disabled"状态 When a quick stop is triggered, the motor will perform rapid braking at the rapid stop deceleration set in object 604Ah. Subsequently, the controller switches to the "Switch on disabled" state
	1	无动作 No action
4	0	无加减速过程，输出立即变化到给定速度 Without acceleration and deceleration, the output changes to the given speed immediately
	1	根据加减速的设置进行调速 Adjust the speed according to the acceleration and deceleration settings
5	0	不再跟随规划器的输出进行调速，速度输出值应锁定为当前速度值 No longer follow the output of the planner for speed regulation, the speed output value should be locked to the current speed value
	1	根据规划器的速度输出进行调速 Adjust the speed according to the speed output of the planner
6	0	速度曲线规划器输入为 0 Speed curve planner input is 0
	1	速度曲线规划器输入为给定的目标速度 The speed curve planner input is the given target speed
8	0	无动作 No action
	1	电机暂停 Motor pause

状态字 Status word



在速度模式下，对象 **6041h** (Controlword)中的位无特别功能，通用位的定义参见 4.1.3 状态子章节。

In the Velocity mode, the bits in the object 6041h (Controlword) have no special functions. For the definition of the general bits, see section 4.1.3 Status Subword.

5.4.4 功能描述 Functional description

在该模式下，电机按照目标速度预设值运行，与变频器类似。不同于轮廓速度模式，该模式不允许选择冲击受限的斜坡。

In this mode, the motor runs at the preset value of the target speed, similar to the inverter. Unlike profile Velocity mode, this mode does not allow the selection of ramps with limited impact.

5.4.5 配置举例 Configuration Examples

- 配置模式: Configuration mode:

写 2002_h : $01_h=0$ 、 $6060_h=0x02$, 配置为速度模式(VM)

Write 2002_h : $01_h=0$, $6060_h=0x02$, configured as Velocity mode (VM)

- 参数配置: Parameter configuration:

写目标速度: $6042_h=1000$;

Write target speed: $6042_h=1000$;

写加减速度:

Write acceleration and deceleration:

6048_h : $01_h=500$, 6048_h : $02_h=1$;

6049_h : $01_h=500$, 6049_h : $02_h=1$ 。

- 写控制字: Write control word:

$6040_h = 0x06 \rightarrow 0x07 \rightarrow 0x7F$, 电机运行;

$6040_h = 0x06 \rightarrow 0x07 \rightarrow 0x7F$, the motor is running;

参数监控: Parameter monitoring:

- 当前的实际速度 $606C_h$ (单位 rpm)

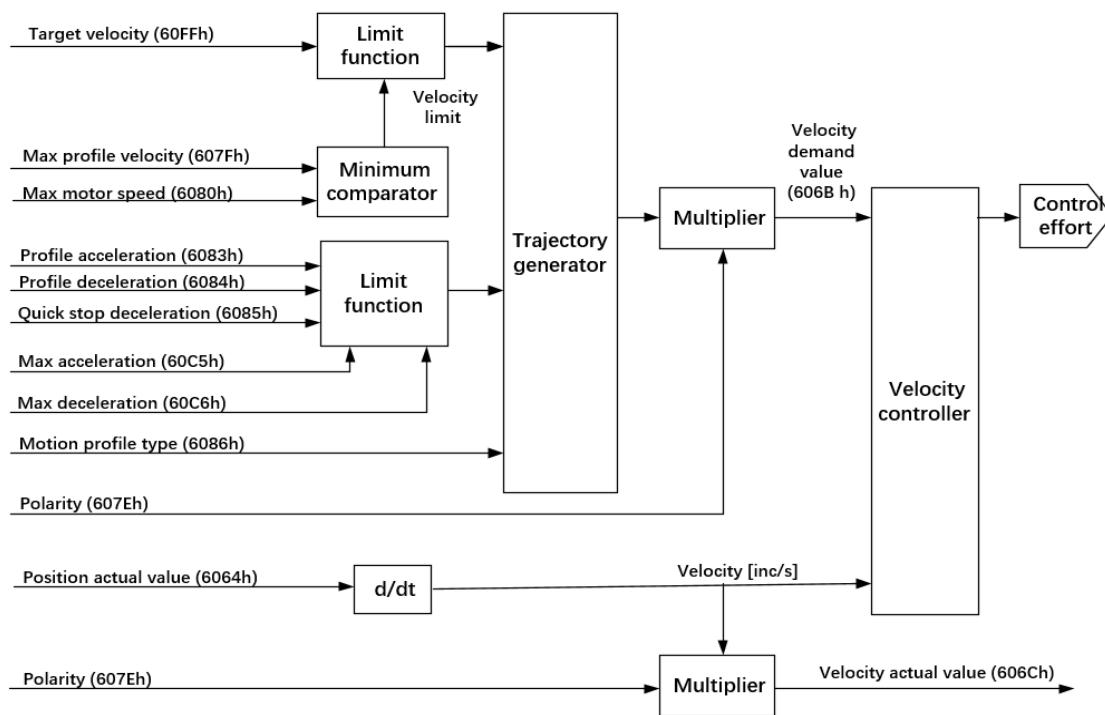
Current actual speed $606C_h$ (unit rpm)

5.5 轮廓速度模式 (PV) Profile velocity mode (PV)

此模式下，上位控制器将目标速度、加速度、减速度发送给驱动器，速度、转矩调节由内部执行。

In this mode, the host controller sends the target speed, acceleration, and deceleration to the drive, and the speed and torque adjustments are performed internally.

5.5.1 结构图 Structure diagram



5.5.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
6063 _h (Position Actual Enc Value)	电机当前的绝对位置反馈（编码器单位） Motor current absolute position feedback (encoder unit)
6064 _h (Position actual user value)	电机当前的用户绝对位置反馈（用户单位） Motor current user absolute position feedback (user unit)
606B _h (Velocity demand value)	控制器内部生效的速度指令值 Speed command value valid inside the controller
606C _h (Velocity actual value)	当前的实际速度反馈值 (rpm) Current actual speed feedback value (rpm)
607E _h (Polarity)	旋转方向(极性), 详见“5.1.4 607E _h : 极性” Direction of rotation (polarity), see "5.1.4 607E _h : Polarity" for details
607F _h (Max profile velocity)	运行过程中的最大轮廓速度 (用户单位/s), 起限制速度的作用。 The maximum profile speed (user units/s) during operation plays a role in limiting the speed.
6080 _h (Max motor speed)	电机的最大转速 (rpm) Maximum speed of motor (rpm)
6083 _h (Profile acceleration)	运行过程中的轮廓加速度 (用户单位/s ²), 大小受 60C5 _h 限制。

对象索引 Object index	描述 Description
	The profile acceleration (user units/s ²) during operation is limited by 60C5h.
6084 _h (Profile deceleration)	运行过程中的轮廓减速度 (用户单位/s ²)，大小受 60C6 _h 限制。 The profile deceleration (user units/s ²) during operation is limited by 60C6h.
6085 _h (Quick stop deceleration)	执行"快速停机"时的停机减速度 (用户单位/s ²) Stop deceleration when executing "fast stop" (user unit/s ²)
6086 _h (Motion profile type)	选择曲线即斜坡的类型， Select the type of curve or slope, 若值为"0"，则不会对冲击(加加速度)进行限制，即梯型曲线； If the value is "0", the impact (acceleration) will not be limited, that is, the trapezoid curve; 若值为"3"，则将用 60A4 _h : 01 _h -02 _h 中的值来限制冲击(加加速度)，即 S 型曲线，本设备只使用了 01 _h 和 02 _h 索引。 If the value is "3", the value in 60A4h: 01h-02h will be used to limit the impact (acceleration), that is, the S-curve, the device only uses the 01h and 02h indexes.
60C5 _h (Max acceleration)	最大加速度限值 (用户单位/s ²) Maximum acceleration limit (user units/s ²)
60C6 _h (Max deceleration)	最大减速度限值 (用户单位/s ²) Maximum deceleration limit (user units/s ²)
60FF _h (Target velocity)	目标速度 (用户单位/s) Target speed (user units/s)

5.5.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须在对象 2002_h: 01_h 中设定值为"0"和对象 6060_h (Modes Of Operation)中设定值为"3"。

To enable this mode, you must set the value to "0" in object 2002h: 01h and the value to "3" in object 6060h (Modes Of Operation).

控制字 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

在轮廓速度模式下，对象 6040_h (Controlword)中的下述位具有特别的功能

In profile Velocity mode, the following bits in object 6040h (Controlword) have special functions

位 Bit	值 Value	含义 Meaning
8	0	电机继续运行 The motor continues to run

	1	暂停 suspend
--	---	------------

状态字 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

在轮廓速度模式下，对象 **6041h** (Statusword)中的下述位具有特别的功能：

In profile Velocity mode, the following bits in object 6041h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
10	0	非暂停状态下(6040h 的 bit8 = 0): 目标速度未到达 In non-paused state (bit8 = 6040h): The target speed has not been reached 暂停状态下(6040h 的 bit8 = 1): 电机减速 In the pause state (bit8 = 1 at 6040h): the motor decelerates
	1	非暂停状态下(6040h 的 bit8 = 0): 目标速度到达 In non-pause state (bit8 = 6040h): target speed reached 暂停状态下(6040h 的 bit8 = 1): 电机转速为 0 In the pause state (bit8 = 1 in 6040h): the motor speed is 0
12	0	速度不为 0 Speed is not 0
	1	速度为 0 Speed is 0

5.5.4 功能描述 Functional description

此模式下，上位控制器将目标速度、加速度、减速度发送给驱动器，速度、转矩调节由内部执行。

In this mode, the host controller sends the target speed, acceleration, and deceleration to the drive, and the speed and torque adjustments are performed internally.

5.5.5 配置举例 Configuration examples

- 配置模式 Configuration mode

写 $2002h$: $01h=0$ 、运行模式 $6060h=0x03$, 使其工作在轮廓速度模式;

Write $2002h$: $01h=0$, running mode $6060h=0x03$, make it work in profile Velocity mode;

- 配置参数: Configuration parameters:

写目标速度: $60FFh= 4000$;

Write target speed: $60FFh = 4000$;

写轮廓加速度: $6083h= 40000$;

Write profile acceleration: $6083h= 40000$;

写轮廓减速度: $6084h= 40000$;

Write profile deceleration: 6084_h= 40000;

- 写控制字: Write control word:

6040_h=0x06→0x07→0x0F, 电机运行;

6040h=0x06→0x07→0x0F, the motor is running;

参数监控:

Parameter monitoring:

- 当前的实际速度 606C_h (单位: rpm)

Current actual speed 606Ch (unit: rpm)

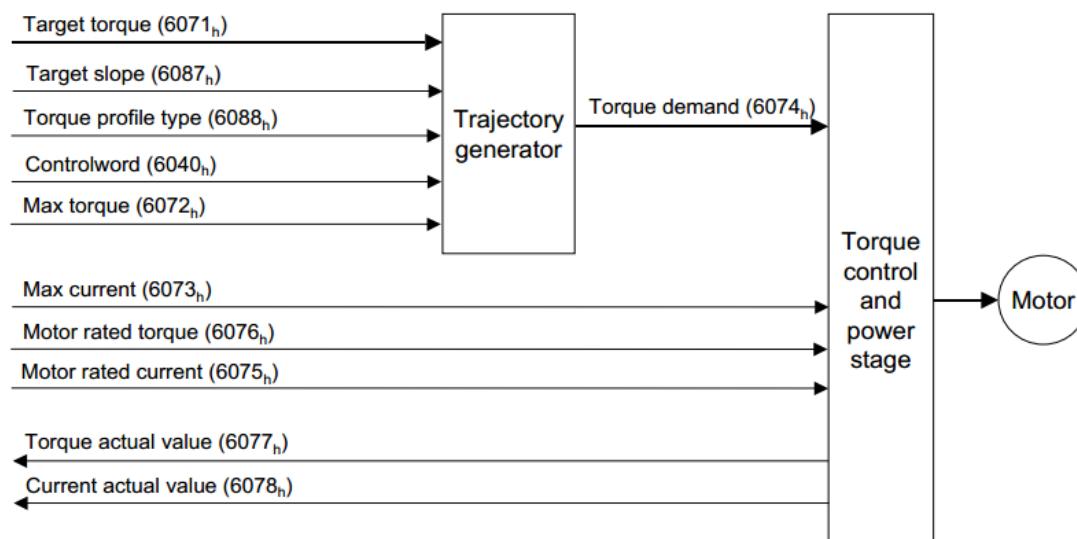
5.6 轮廓转矩模式 (PT) profile torque mode (PT)

此模式下, 上位控制器将目标转矩 6071_h、转矩斜坡常数 6087_h 发送给驱动器, 转矩调节由内部执行, 当速度达到限幅值将进入调速阶段。

In this mode, the host controller sends the target torque 6071_h and the torque ramp constant 6087_h to the drive. The torque adjustment is performed internally. When the speed reaches the limit value, it will enter the speed regulation phase.

5.6.1 结构图 Structure diagram

控制框图 Control block diagram



5.6.2 相关对象 Related objects

在该模式下需要注意下述对象:

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

对象索引 Object index	描述 Description
605D _h (Halt option code)	暂停方式选择 Pause mode selection
605A _h (Quick stop option code)	快速停机方式选择

对象索引 Object index	描述 Description
	Quick stop mode selection
6071 _h (Target torque)	设置目标转矩 (单位: 0.1%) Set target torque (unit: 0.1%)
6072 _h (Max torque)	整个斜坡(加速、保存转矩、制动)上的最大转矩 (单位: 0.1%) Maximum torque (unit: 0.1%) on the entire ramp (acceleration, saved torque, braking)
2007 _h : 10 _h (TorqCtrlFwrSpeedLimit)	转矩控制正向速度限制值(rpm) Torque control forward speed limit (rpm)
2007 _h : 11 _h (TorqCtrlBwrSpeedLimit)	转矩控制反向速度限制值(rpm) Torque control reverse speed limit (rpm)
6087 _h (Torque slope)	每秒钟的转矩最大变化 (单位: 0.1%) Maximum torque change per second (unit: 0.1%)
6088 _h (Torque profile type)	转矩斜坡类型 (0-斜坡, 2-无) Torque ramp type (0-ramp, 2-none)
6077 _h (Torque actual value)	力矩实际值 (单位: 0.1%) Actual torque value (unit: 0.1%)

5.6.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须在对象 2002_h: 01_h 中设定值为"0"和对象 6060_h (Modes Of Operation)中设定值为"4"。

To enable this mode, you must set the value to "0" in object 2002h: 01h and the value to "4" in object 6060h (Modes Of Operation).

控制字 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

在轮廓转矩模式下，对象 6040_h (Controlword)中的下述位具有特别的功能

In profile torque mode, the following bits in object 6040h (Controlword) have special functions

位 Bit	值 Value	含义 Meaning
8	0	电机继续运行 The motor continues to run
	1	暂停 suspend

状态字 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	

在轮廓转矩模式下，对象 **6041h** (Statusword) 中的下述位具有特别的功能：

In profile torque mode, the following bits in object 6041h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
10	0	非暂停状态下(6040h 的 bit8 = 0): 目标转矩未到达 In non-pause state (bit8 = 6040h): target torque is not reached 暂停状态下(6040h 的 bit8 = 1): 电机减速 In the pause state (bit8 = 1 at 6040h): the motor decelerates
	1	非暂停状态下(6040h 的 bit8 = 0): 目标转矩到达 In non-pause state (bit8 = 6040h): target torque reached 暂停状态下(6040h 的 bit8 = 1): 电机转速为 0 In the pause state (bit8 = 1 in 6040h): the motor speed is 0

5.6.4 功能描述 Functional description

速度限幅功能 Speed limit function

在轮廓转矩模式下运行一体化低压无刷电机，当电机的运行速度超过速度限幅（正向速度限制值 **2007h: 10h** 和反向速度限制值 **2007h: 11h**）设定的值时，自动转为速度模式控制并控制当前速度在速度限幅之内。当检测到给定的目标转矩小于当前速度的平均力矩时，电机退出速度控制恢复成转矩模式控制。

When running the integrated low-voltage brushless motor in profile torque mode, when the motor's operating speed exceeds the value set by the speed limit (forward speed limit value 2007h: 10h and reverse speed limit value 2007h: 11h), it automatically turns Control the Velocity mode and control the current speed within the speed limit. When it is detected that the given target torque is less than the average torque of the current speed, the motor exits the speed control and returns to the torque mode control.

5.6.5 配置举例 Configuration examples

- 配置模式 Configuration mode

写 **2002h: 01h=0**、运行模式 **6060h=0x04**，使其工作在轮廓转矩模式；

Write **2002h: 01h=0**, running mode **6060h=0x04**, make it work in profile torque mode;

- 配置参数： Configuration parameters:

写目标转矩：**6071h= 500**（单位：0.1%）；

Write target torque: **6071h = 500** (unit: 0.1%);

写转矩斜坡类型 **6088h=2**；

Write torque ramp type **6088h=2**;

写转矩斜坡 **6087h=10**；

Write torque ramp **6087h=10**;

- 写控制字: Write control word:

$6040_{\text{h}}=0x06 \rightarrow 0x07 \rightarrow 0x0F$, 电机运行;

$6040_{\text{h}}=0x06 \rightarrow 0x07 \rightarrow 0x0F$, the motor is running;

参数监控: Parameter monitoring:

- 实际转矩 6077_{h} (单位 0.1%)

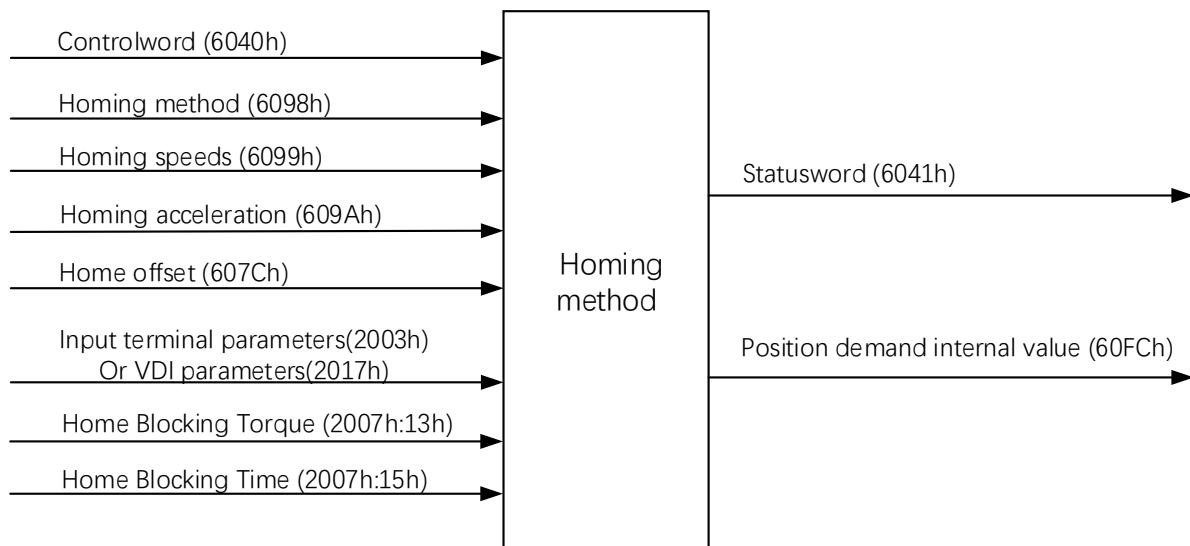
Actual torque 6077_{h} (unit 0.1%)

5.7 原点回归模式 (HM) Home mode (HM)

原点回归模式是用于从目前的位置移动到设备的原点位置。在运动过程中，最大加速度，最小减速度，最大速度，最小速度等都考虑在内。

The home mode is used to move from the current position to the origin position of the device. During the movement, the maximum acceleration, minimum deceleration, maximum speed, minimum speed, etc. are taken into account.

5.7.1 结构图 Structure diagram



5.7.2 相关对象 Related objects

在该模式下需要注意下述对象:

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

对象索引 Object index	描述 Description
6062_{h} (Position demand value)	驱动器内部当前生效的目标位置指令值（用户单位） The currently valid target position command value in the drive (user unit)
$607C_{\text{h}}$ (Home Offset)	具体描述: 设置在原点回归模式下机械零点偏离电机原点的物理位置; 在完成原点回归操作时, 状态字 6041_{h} 的 bit15=1 时生效

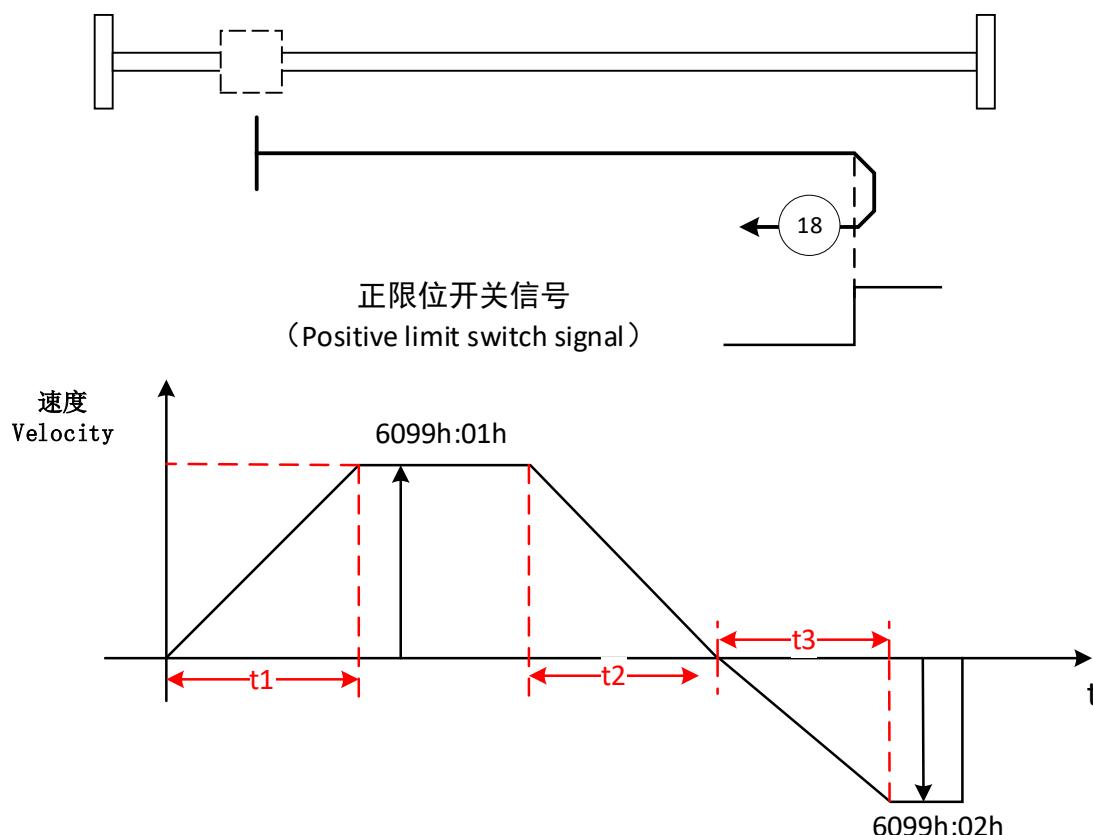
对象索引 Object index	描述 Description
	Specific description: Set the physical position where the mechanical zero point deviates from the motor origin in the homing mode; when the homing operation is completed, bit 15 of status word 6041h becomes effective
6098 _h (Homing Method)	原点回归方式(参见"6.7.4 功能描述") Origin return method (see "6.7.4 Function description")
6099 _h (Speed)	运行速度 (用户单位/s) Operating speed (user units/s) 子索引: 6099 _h : 01 _h : 寻找开关的速度; Sub-index: 6099h: 01h: Find the speed of the switch; 6099 _h : 02 _h : 寻找原点的速度 6099h: 02h: the speed of finding the origin
609Ah (Homing Acceleration)	原点回归运行的加速度 (用户单位/s ²) Acceleration of homing operation (user unit/s ²)
60FC _h (Position demand internal value)	轨迹发生器的输出, 即内部规划的实时位置指令 (编码器单位) The output of the trajectory generator is the internally planned real-time position command (encoder unit)
6063h (Position actual enc value)	电机当前的绝对位置反馈 (编码器单位) Motor current absolute position feedback (encoder unit)
2003 _h (Input terminal parameters)	实体输入端子功能配置 (详见“7.1.1 数字量输入”) Physical input terminal function configuration (see "7.1.1 Digital input" for details) 需要注意的是: 不能同时有多路输入端子配置为同一种开关, 否则会报端子设置故障 It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting fault will be reported
2017 _h (VDI/VDO parameters)	虚拟端子输入功能配置 (详见: “7.1.1 数字量输入”) Virtual terminal input function configuration (see: "7.1.1 Digital Input" for details)
2007h:13h (ReachedTorqValidVal)	堵转找寻原点时的检测转矩 The detected torque when the locked position is found
2007h:15h (TorqCtrlSpdLmtWinTime)	堵转找寻原点时的检测时间

对象索引 Object index	描述 Description
	Detection time when blocking to find the origin

速度含义举例 Examples of speed meaning

下图为使用原点回归方式 18 时的速度变化：

The following figure shows the speed change when using the homing method 18:



$$\text{其中 among: } t_1 = \frac{6099_{\text{h}}:01_{\text{h}}}{609A_{\text{h}}}; \quad t_2 = \frac{6099_{\text{h}}:01_{\text{h}}}{609A_{\text{h}}}; \quad t_3 = \frac{6099_{\text{h}}:02_{\text{h}}}{609A_{\text{h}}}$$

5.7.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须在对象 $2002_{\text{h}}:01_{\text{h}}$ 中设定值为"0"和对象 6060_{h} (Modes Of Operation)设定值为"6"，且多功能端子需配置原点开关或限位开关的功能。多功能端子配置详见 7.1 章节。

To enable this mode, you must set the value to "0" in object $2002_{\text{h}}:01_{\text{h}}$ and the value to "6" in object 6060_{h} (Modes Of Operation), and configure the function of the origin switch or limit switch for the multi-function terminals. For multi-function terminal configuration, please refer to Chapter 7.1.

控制字 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

在原点回归模式下，对象 **6040h** (Controlword) 中的下述位具有特别的功能

In the homing mode, the following bits in object 6040h (Controlword) have special functions

位 Bit	值 Value	含义 Meaning
4	0	未启动原点回归模式 The homing mode is not activated
	1	启动或继续原点回归模式 Start or continue homing mode
8	0	电机按 bit4 设置决定启动原点回归与否 The motor decides whether to start homing according to bit4 setting
	1	电机按 605Dh 的设置暂停运行 The motor is suspended according to the setting of 605Dh

状态字 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

在原点回归模式下，对象 **6041h** (Statusword) 中的下述位具有特别的功能：

In the homing mode, the following bits in object 6041h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
10	0	目标位置未到达 Target position not reached
	1	目标位置到达 Target position reached
12	0	原点回归未完成 Return to origin is not complete
	1	原点回归完成 Return to origin completed

5.7.4 功能描述 Functional description

5.7.4.1 开关找寻原点方式 Switch find origin method

利用开关进行原点回归的方式，目前支持 CiA402 中的 17~30。对于原点回零之后往往我们需要从零点开始运行工作，一般来说原点回零之后需要再进行运行到零点位置指令。为了方便用户使用，本系列一体化电机在原点回归之后会自动回到零点位置。

The way of using the switch to return to the origin, currently supports 17~30 in CiA402. After returning 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.

与 HM 模式相关的输入端子 DI 功能号配置:

DI function number configuration of input terminal related to HM mode:

功能号 Function number	功能定义 Function definition
14	正限位开关 Positive limit switch
15	负限位开关 Negative limit switch
31	原点开关 Home switch

需要原点回归的方向和开关状态如下表所示:

The directions and switch states that require homing are shown in the table below:

原点回归方式 6098h Home method 6098h	使用的开关 Switch used
17	负限位开关 Negative limit switch
18	正限位开关 Positive limit switch
19	原点开关 Home switch
20	原点开关 Home switch
21	原点开关 Home switch
22	原点开关 Home switch
23	原点开关, 正限位开关 Home switch, positive limit switch
24	原点开关, 正限位开关 Home switch, positive limit switch
25	原点开关, 正限位开关 Home switch, positive limit switch
26	原点开关, 正限位开关 Home switch, positive limit switch
27	原点开关, 负限位开关 Home switch, negative limit switch
28	原点开关, 负限位开关 Home switch, negative limit switch

29	原点开关, 负限位开关 Home switch, negative limit switch
30	原点开关, 负限位开关 Home switch, negative limit switch

● 原点回归方式 17: Home method 17:

机械原点: 负限位开关

Mechanical origin: negative limit switch

负限位开关为无效时, 以反向高速开始回零, 遇到负限位开关为有效时(沿变化), 减速, 反向, 正向低速运行, 遇到负限位开关无效时(沿变化)停止。

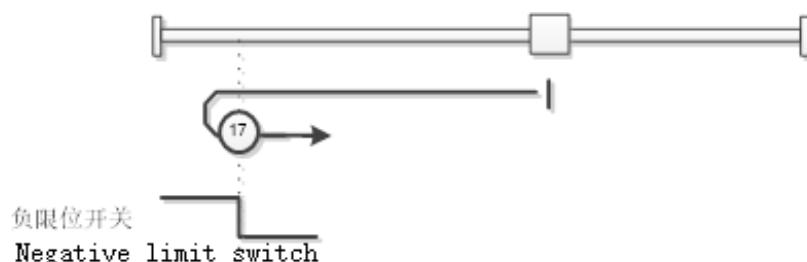
When the negative limit switch is invalid, it starts to return to zero at the high speed in the reverse direction. When the negative limit switch is valid (changes along the edge), it decelerates, reverses, and runs at a low speed in the positive direction. When the negative limit switch is invalid (edge) Change) to stop.

负限位开关为有效时, 直接正向低速开始回零, 遇到负限位开关为无效时(沿变化)停止。

When the negative limit switch is valid, it starts to return to zero at low speed directly, and stops when the negative limit switch is invalid (edge change).

运动轨迹如下图:

The motion trajectory is as follows:



● 原点回归方式 18: Home method 18:

机械原点: 正限位开关

Mechanical origin: positive limit switch

正限位开关为无效时, 以正向高速开始回零, 遇到正限位开关为有效时(沿变化), 减速, 反向, 反向低速运行, 遇到正限位开关无效时(沿变化)停止。

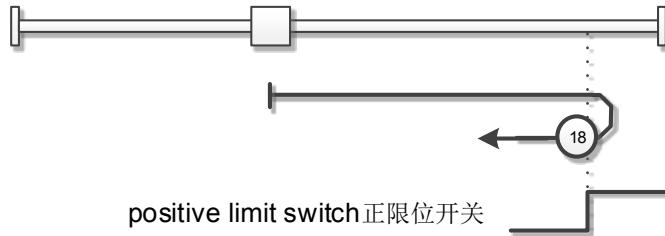
When the positive limit switch is invalid, it starts to return to zero at the high speed of the positive direction. When the positive limit switch is valid (changes along the edge), it decelerates, reverses, and runs at a low speed in the reverse direction. When the positive limit switch is invalid (edge) Change) to stop.

正限位开关为有效时, 直接反向低速开始回零, 遇到正限位开关为无效时(沿变化)停止。

When the positive limit switch is valid, it starts to return to zero at low speed directly, and stops when the positive limit switch is invalid (edge change).

运动轨迹如下图:

The motion trajectory is as follows:



- 原点回归方式 19 和 20: Home method 19 and 20:

机械原点: 原点开关

Mechanical origin: origin switch

回归方式 19: 原点开关为无效时, 以正向高速开始回零, 遇到原点开关为有效时(沿变化), 减速, 反向, 反向低速运行, 遇到原点开关无效时(沿变化)停止; 原点开关为有效时, 直接反向低速开始回零, 遇到原点开关为无效时(沿变化)停止。

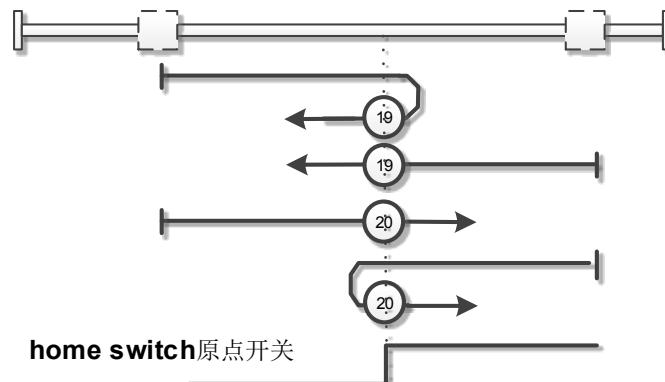
Home method 19: When the home switch is invalid, it starts to return to zero at the high speed in the forward direction. When the home switch is encountered when it is valid (change along the edge), it decelerates, reverses, and runs at a low speed in the reverse direction, when the home switch is invalid (change along the edge) Stop; when the home switch is valid, it will directly return to zero at low speed, and stop when the home switch is invalid (edge change).

回归方式 20: 原点开关为无效时, 直接正向低速开始回零, 遇到原点开关为有效时(沿变化)停止; 原点开关为有效时, 以反向高速开始回零, 遇到原点开关为无效时(沿变化), 减速, 反向, 正向低速运行, 遇到原点开关有效时(沿变化)停止。

Home method 20: When the origin switch is invalid, it starts to return to zero at the positive low speed directly, and stops when the origin switch is valid (along the change); when the origin switch is valid, it returns to zero at a high speed in the reverse direction, and the origin switch is encountered as When it is invalid (change along the edge), it decelerates, reverses, and runs at a low speed in the forward direction. It stops when it encounters the origin switch is effective (change along the edge).

运动轨迹如下图:

The motion trajectory is as follows:



- 原点回归方式 21 和 22: Home method 21 and 22:

机械原点: 原点开关

Mechanical origin: origin switch

回归方式 21: 原点开关为无效时, 以反向高速开始回零, 遇到原点开关为有效时(沿变化), 减速, 反向, 正向低速运行, 遇到原点开关无效时(沿变化)停止; 原点开关为有效时, 直接正向低

速开始回零，遇到原点开关为无效时（沿变化）停止。

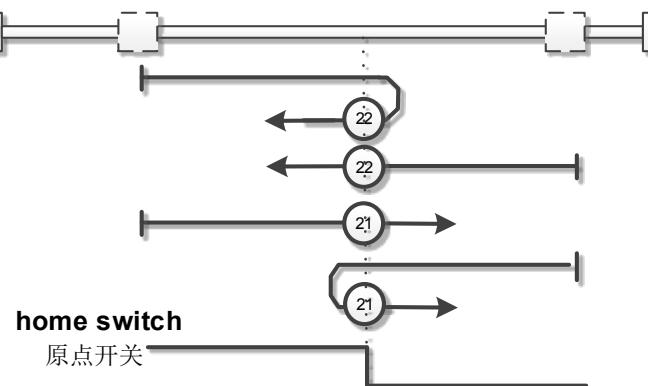
Home method 21: When the home switch is invalid, it starts to return to zero at a high speed in the reverse direction. When the home switch is encountered, it is valid (change along the edge), deceleration, reverse, forward low speed operation, when the home switch is invalid (change along the edge) Stop; when the home switch is valid, it will directly return to zero at low speed in the positive direction, and stop when the home switch is invalid (edge change).

回归方式 22: 原点开关为无效时，直接反向低速开始回零，遇到原点开关为有效时（沿变化）停止；原点开关为有效时，以正向高速开始回零，遇到原点开关为无效时（沿变化），减速，反向，反向低速运行，遇到原点开关有效时（沿变化）停止。

Home method 22: When the origin switch is invalid, it starts to return to zero at low speed directly, and stops when the origin switch is valid (along the change); when the origin switch is valid, it starts to return to zero at a high speed in the forward direction, and the origin switch is encountered as When it is invalid (change along the edge), it decelerates, reverses, and runs at a low speed in the reverse direction, and stops when it encounters the origin switch is effective (change along the edge).

运动轨迹如下图：

The motion trajectory is as follows:



● 原点回归方式 23~26: Home method 23 - 26:

机械原点：原点开关

Mechanical origin: origin switch

这几种方式实际上是电机先一个方向运动去扫描原点开关。只有在原点开关处于有效状态下是比较短的寻找轨迹。

In these ways, the motor is first moved in one direction to scan the origin switch. Only when the origin switch is in the active state is the search trajectory shorter.

回归方式 23: Home method 23:

a. 原点开关为无效时，未遇到正限位开关时，以正向高速开始回零，遇到原点开关为有效时（沿变化），减速，反向，反向低速运行，遇到原点开关无效时（沿变化）停止；

a. When the origin switch is invalid, when the positive limit switch is not encountered, return to zero at the high speed in the forward direction, when the origin switch is valid (change along the edge), decelerate, reverse, reverse low speed operation, encounter the origin Stop when the switch is invalid (change along the edge);

b. 原点开关为无效时，以正向高速开始回零，遇到正限位开关，反向，反向高速运行，遇到原点开关有效时（沿变化），减速，继续反向低速运行，遇到原点开关无效时（沿变化）停止；

b. When the origin switch is invalid, it starts to return to zero at a high speed in the forward direction. When it encounters a positive limit switch, it runs in reverse and reverse directions. Stop when the origin switch is invalid (change along the edge);

c. 原点开关为有效时，直接反向低速开始回零，遇到原点开关为无效时（沿变化）停止。

c. When the origin switch is valid, it will directly return to zero at low speed, and stop when it is invalid (edge change).

回归方式 24: Home method 24:

a. 原点开关为无效时，未遇到正限位开关时，以正向高速开始回零，遇到原点开关为有效时（沿变化），减速，反向，反向低速运行，遇到原点开关无效时（沿变化），反向，正向低速运行，遇到原点开关有效时（沿变化）停止；

a. When the origin switch is invalid, when the positive limit switch is not encountered, return to zero at the high speed in the forward direction, when the origin switch is valid (change along the edge), decelerate, reverse, reverse low speed operation, encounter the origin When the switch is invalid (change along the edge), reverse, forward low-speed operation, stop when the origin switch is valid (edge change);

b. 原点开关为无效时，以正向高速开始回零，遇到正限位开关，反向，反向高速运行，遇到原点开关有效时（沿变化），减速，反向低速运行，遇到原点开关无效时（沿变化），反向，正向低速运行，遇到原点开关有效时（沿变化）停止；

b. When the origin switch is invalid, it starts to return to zero at a high speed in the forward direction. When it encounters the positive limit switch, it runs in reverse and reverse high speeds. When the origin switch is valid (changes along the edge), it decelerates and runs in reverse low speed. When the origin switch is invalid (change along the edge), it runs in reverse and forward low speed, and stops when the origin switch is valid (change along the edge);

c. 原点开关为有效时，直接反向低速开始回零，遇到原点开关为无效时（沿变化），反向，正向低速运行，遇到原点开关为有效时（沿变化）停止。

c. When the home switch is valid, the reverse low speed starts to return to zero directly. When the home switch is invalid (edge change), the reverse and forward low speed run, when the home switch is valid (edge change), stop.

回归方式 25: Home method 25:

a. 原点开关为无效时，未遇到正限位开关时，以正向高速开始回零，遇到原点开关为有效时（沿变化），减速，正向低速运行，遇到原点开关无效时（沿变化），反向，反向低速运行，遇到原点开关有效时（沿变化）停止；

a. When the origin switch is invalid, when the positive limit switch is not encountered, return to zero at the high speed in the positive direction, when the origin switch is valid (changes along the edge), decelerate, run at low speed in the forward direction, when the origin switch is invalid (Edge change), reverse, reverse low speed operation, stop when the origin switch is valid (edge change);

b. 原点开关为无效时，以正向高速开始回零，遇到正限位开关，反向，反向高速运行，遇到原点开关有效时（沿变化），减速，正向低速运行，遇到原点开关无效时（沿变化），反向，反向低速运行，遇到原点开关有效时（沿变化）停止；

b. When the origin switch is invalid, it starts to return to zero at a high speed in the forward direction. When the positive limit switch is encountered, it runs in reverse and reverse directions. When the origin switch is valid (changes along the edge), it decelerates. When the origin switch is invalid (change along the edge), it runs in reverse and reverse low speed, and stops when the origin switch is valid (change along the edge);

c. 原点开关为有效时，直接正向低速开始回零，遇到原点开关为无效时（沿变化），反向，反向低速运行，遇到原点开关为有效时（沿变化）停止。

c. When the origin switch is valid, it will directly return to zero at the low speed in the forward direction. When the origin switch is invalid (change along the edge), it runs in reverse and reverse speed, and stops when the origin switch is valid (change along the edge).

回归方式 26: Home method 26:

a. 原点开关为无效时，未遇到正限位开关时，以正向高速开始回零，遇到原点开关为有效时（沿变化），减速，正向低速运行，遇到原点开关无效时（沿变化）停止；

a. When the origin switch is invalid, when the positive limit switch is not encountered, return to zero at the high speed in the positive direction, when the origin switch is valid (changes along the edge), decelerate, run at low speed in the forward direction, when the origin switch is invalid (Change along) stop;

b. 原点开关为无效时，以正向高速开始回零，遇到正限位开关，反向，反向高速运行，遇到原点开关有效时（沿变化），减速，正向低速运行，遇到原点开关无效时（沿变化）停止；

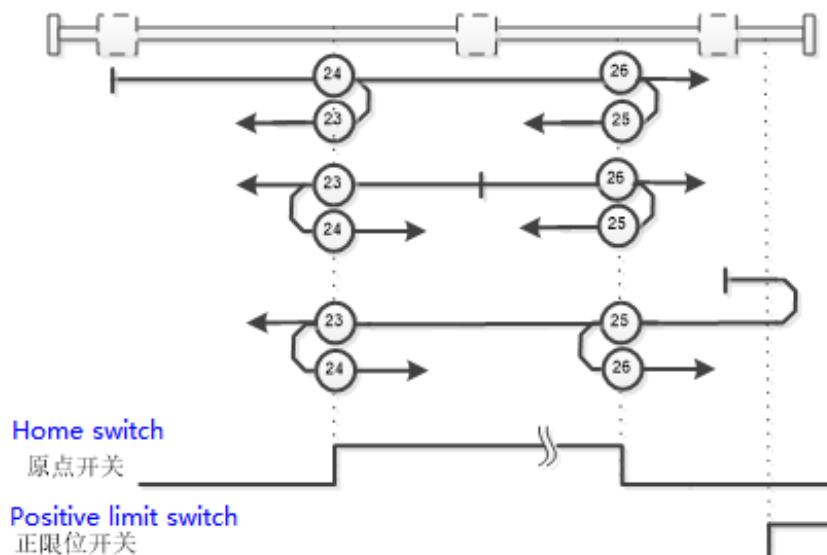
b. When the origin switch is invalid, it starts to return to zero at a high speed in the forward direction. When the positive limit switch is encountered, it runs in reverse and reverse directions. When the origin switch is valid (changes along the edge), it decelerates and runs at low speed in the forward direction. Stop when the origin switch is invalid (change along the edge);

c. 原点开关为有效时，直接正向低速开始回零，遇到原点开关为无效时（沿变化）停止。

c. When the home switch is valid, it will directly return to zero at low speed in the positive direction, and stop when the home switch is invalid (edge change).

运动轨迹如下图：

The motion trajectory is as follows:



● 原点回归方式 27~30: Home method 27 - 30:

机械原点：原点开关

Mechanical origin: origin switch

这几种方式实际上是电机先一个方向运动去扫描原点开关。只有在原点开关处于有效状态下是比较短的寻找轨迹。

In these methods, the motor is first moved in one direction to scan the origin switch. Only when the origin switch is in the active state is the search trajectory shorter.

回归方式 27: Home method 27:

a. 原点开关为无效时, 未遇到负限位开关时, 以反向高速开始回零, 遇到原点开关为有效时(沿变化), 减速, 反向, 正向低速运行, 遇到原点开关无效时(沿变化)停止;

a. When the origin switch is invalid, when the negative limit switch is not encountered, return to zero at high speed in the reverse direction, when the origin switch is valid (change along the edge), decelerate, reverse, run at low speed in the forward direction, encounter the origin Stop when the switch is invalid (change along the edge);

b. 原点开关为无效时, 以反向高速开始回零, 遇到负限位开关, 反向, 正向高速运行, 遇到原点开关有效时(沿变化), 减速, 继续正向低速运行, 遇到原点开关无效时(沿变化)停止;

b. When the origin switch is invalid, it starts to return to zero at the reverse high speed. When it encounters the negative limit switch, it runs in the reverse direction and the forward direction. When the origin switch is valid (changes along the edge), it decelerates and continues the forward low speed operation. Stop when the origin switch is invalid (change along the edge);

c. 原点开关为有效时, 直接正向低速开始回零, 遇到原点开关为无效时(沿变化)停止。

c. When the home switch is valid, it will directly return to zero at low speed in the positive direction, and stop when the home switch is invalid (edge change).

回归方式 28: Home method 28:

a. 原点开关为无效时, 未遇到负限位开关时, 以反向高速开始回零, 遇到原点开关为有效时(沿变化), 减速, 反向, 正向低速运行, 遇到原点开关无效时(沿变化), 反向, 反向低速运行, 遇到原点开关有效时(沿变化)停止;

a. When the origin switch is invalid, when the negative limit switch is not encountered, return to zero at high speed in the reverse direction, when the origin switch is valid (change along the edge), decelerate, reverse, run at low speed in the forward direction, encounter the origin When the switch is invalid (change along the edge), reverse, reverse low speed operation, stop when the origin switch is valid (change along the edge);

b. 原点开关为无效时, 以反向高速开始回零, 遇到正限位开关, 反向, 正向高速运行, 遇到原点开关有效时(沿变化), 减速, 正向低速运行, 遇到原点开关无效时(沿变化), 反向, 反向低速运行, 遇到原点开关有效时(沿变化)停止;

b. When the origin switch is invalid, it starts to return to zero at a high speed in the reverse direction. When the positive limit switch is encountered, it runs in the reverse direction and the forward direction. When the origin switch is valid (changes along the edge), it decelerates and the low speed in the forward direction. When the origin switch is invalid (change along the edge), it runs in reverse and reverse low speed, and stops when the origin switch is valid (change along the edge);

c. 原点开关为有效时, 直接正向低速开始回零, 遇到原点开关为无效时(沿变化), 反向, 反向低速运行, 遇到原点开关为有效时(沿变化)停止。

c. When the origin switch is valid, it will directly return to zero at the low speed in the forward direction. When the origin switch is invalid (change along the edge), it runs in reverse and reverse speed, and stops when the origin switch is valid (change along the edge).

回归方式 29: Home method 29:

a. 原点开关为无效时, 未遇到负限位开关时, 以反向高速开始回零, 遇到原点开关为有效时(沿变化), 减速, 反向低速运行, 遇到原点开关无效时(沿变化), 反向, 正向低速运行, 遇到原点开关有效时(沿变化)停止;

a. When the origin switch is invalid, when the negative limit switch is not encountered, return

to zero at a high speed in the reverse direction, when the origin switch is valid (changes along the edge), deceleration, reverse low speed operation, when the origin switch is invalid (Change along the edge), reverse, forward low speed operation, stop when the origin switch is valid (change along the edge);

b. 原点开关为无效时，以反向高速开始回零，遇到负限位开关，反向，正向高速运行，遇到原点开关有效时（沿变化），减速，反向低速运行，遇到原点开关无效时（沿变化），反向，正向低速运行，遇到原点开关有效时（沿变化）停止；

b. When the origin switch is invalid, it starts to return to zero at the reverse high speed. When it encounters the negative limit switch, it runs in the reverse direction and the forward direction. When the origin switch is valid (changes along the edge), it decelerates and runs in the reverse low speed. When the origin switch is invalid (change along the edge), it runs in reverse and forward low speed, and stops when the origin switch is effective (change along the edge);

c. 原点开关为有效时，直接反向低速开始回零，遇到原点开关为无效时（沿变化），反向，正向低速运行，遇到原点开关为有效时（沿变化）停止。

c. When the home switch is valid, the reverse low speed starts to return to zero directly. When the home switch is invalid (edge change), the reverse and forward low speed run, when the home switch is valid (edge change), stop.

回归方式 30: Home method 30:

a. 原点开关为无效时，未遇到负限位开关时，以反向高速开始回零，遇到原点开关为有效时（沿变化），减速，反向低速运行，遇到原点开关无效时（沿变化）停止；

a. When the origin switch is invalid, when the negative limit switch is not encountered, return to zero at a high speed in the reverse direction, when the origin switch is valid (changes along the edge), deceleration, reverse low speed operation, when the origin switch is invalid (Change along the edge);

b. 原点开关为无效时，以反向高速开始回零，遇到负限位开关，反向，正向高速运行，遇到原点开关有效时（沿变化），减速，反向低速运行，遇到原点开关无效时（沿变化）停止；

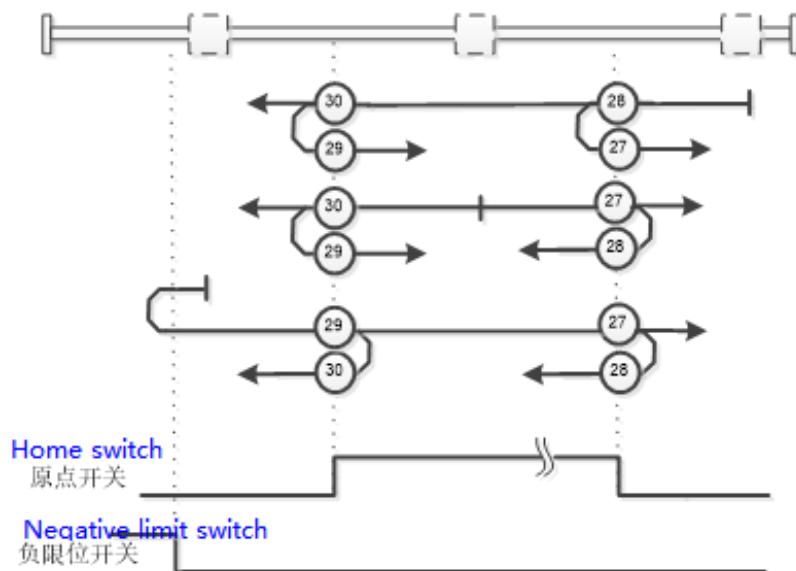
b. When the origin switch is invalid, it starts to return to zero at the reverse high speed. When it encounters the negative limit switch, it runs in the reverse direction and the forward direction. Stop when the origin switch is invalid (change along the edge);

c. 原点开关为有效时，直接反向低速开始回零，遇到原点开关为无效时（沿变化）停止。

c. When the origin switch is valid, it will directly return to zero at low speed, and stop when it is invalid (edge change).

运动轨迹如下图：

The motion trajectory is as follows:



5.7.4.2 堵转找寻原点方式 Finding the origin by blocking rotation

堵转原点回归方式目前只支持闭环控制模式。堵转原点回归方式和前面利用开关找寻原点方式类似，所不同之处在于利用堵转检测转矩值代替了限位开关。

The locked-rotation origin return 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 limit torque is replaced by the value of the detected torque of the locked rotor.

其原点回归的方式和运行方向如下表所示：

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

原点回归方式 6098h Home method 6098h	运行方向 Running direction
37	按 6099-s2 速度正向运行 Run forward at 6099-s2 speed
38	按 6099-s2 速度反向运行 Reverse running at 6099-s2 speed

另外该方式需要设置如下两个参数：

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

1、堵转找寻原点时的检测转矩 (2007h:13h)

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

该堵转转矩阈值应大于找寻原点过程中的实际运行转矩，且一般应小于最大转矩，以避免触发堵转故障保护。

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、堵转找寻原点时的检测时间 (2007h:15h)

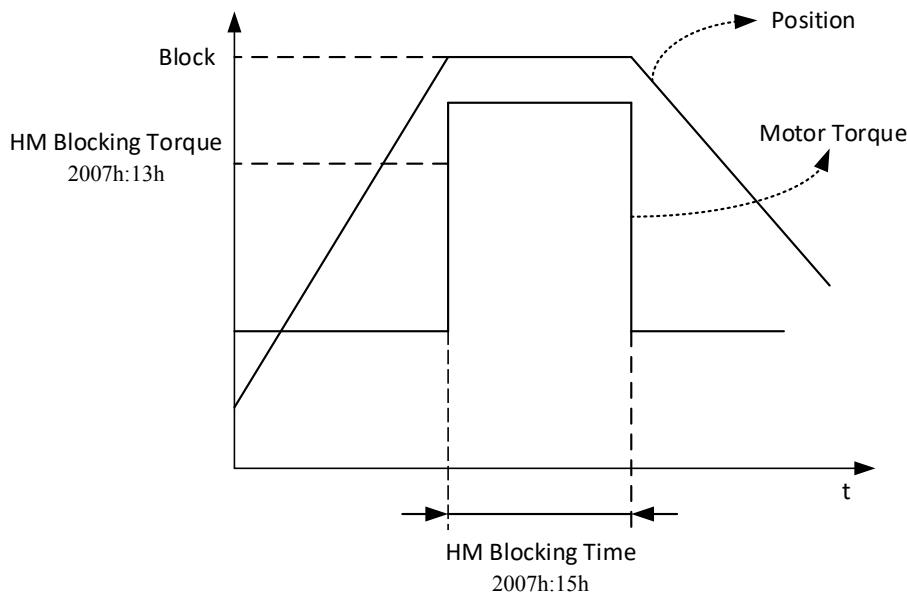
2. Detection time when finding the origin by blocking rotation (2007h:15h)

该时间为电机堵转找寻原点过程维持堵转的时间。

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

具体堵转原点回归方式过程示意图如下：

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



5.7.5 配置举例 Configuration examples

1. 负限位开关找寻原点方式 Negative limit switch to find the origin

- 设置模式 Setting mode

写 2002_h: 01_h=0、运行模式 6060_h=0x06，使其工作在原点回归模式；

Write 2002_h: 01_h=0, running mode 6060_h=0x06, make it work in the homing mode;

- 设置端子 Set terminal

2003_h: 03_h=15(负限位开关), 2003_h: 04_h=0(低电平有效);

2003_h: 03_h=15 (negative limit switch), 2003_h: 04_h=0 (active low level);

- 设置原点回归方式 Set the home method

6098_h=17;

- 写寻找限位开关速度和寻找原点信号速度

Write the speed of searching for limit switch and the speed of searching for origin signal

6099_h: 01_h=10000 6099_h: 02_h=1000;

- 设置回零加速度 Set back to zero acceleration

609A_h=200000;

- 写控制字 Write control word

6040_h=0x06→0x07→0x0F→0x1F，电机运行。

6040_h=0x06→0x07→0x0F→0x1F, the motor is running.

2. 堵转找寻原点方式 Method to find the origin

- 设置模式 Setting mode

写 2002_h: 01_h=0、运行模式 6060_h=0x06，使其工作在原点回归模式；

Write 2002_h: 01_h=0, running mode 6060_h=0x06, make it work in the homing mode;

- 设置端子 Set terminal

2003_h: 03_h=15(负限位开关), 2003_h: 04_h=0(低电平有效);
 2003_h: 03_h=15 (negative limit switch), 2003_h: 04_h=0 (active low level);

- 设置原点回归方式 Set the origin return method

6098_h =37;

- 设置寻找原点信号速度 Set the speed of finding the origin signal

6099_h: 02_h=1000;

- 设置回零加速度 Set back to zero acceleration

609Ah=200000;

- 写控制字 Write control word

6040_h= 0x06→0x07→0x0F→0x1F, 电机运行

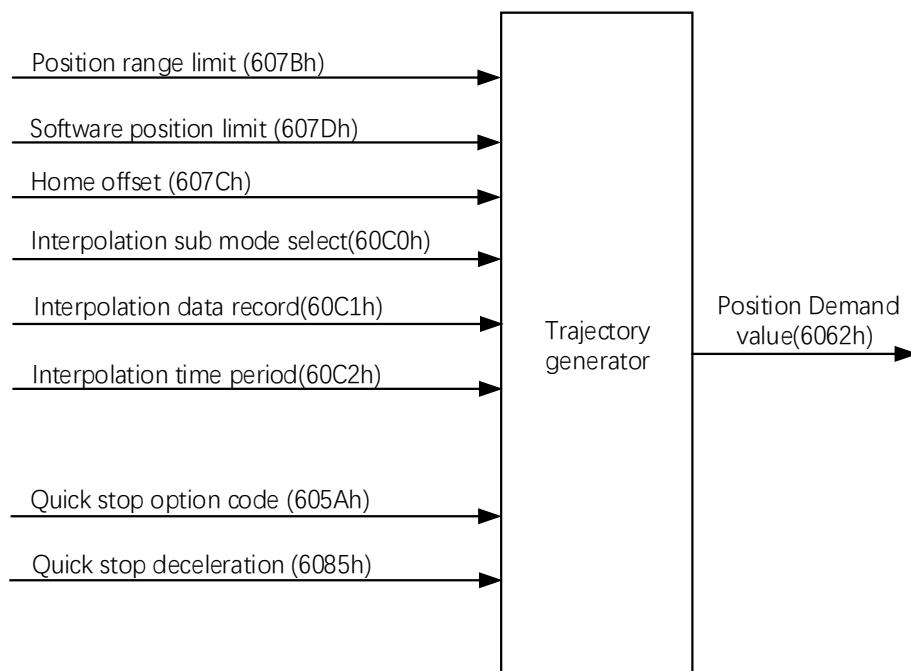
6040_h= 0x06→0x07→0x0F→0x1F, the motor is running

5.8 插补模式 (IP) Interpolation mode (IP)

插值位置模式用于同步多个轴。为此，高级控制器执行斜坡和路径计算，并将轴在特定时间所处的相应需求位置传递给控制器。控制器在这些中间位置点之间插入。

Interpolated position mode is used to synchronize multiple axes. To this end, the advanced controller performs ramp and path calculations and transfers the corresponding demand position of the axis at a specific time to the controller. The controller is inserted between these intermediate positions.

5.8.1 结构图 Structure diagram



5.8.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
607Bh (Position Range Limit)	位置范围限值（用户单位）。

对象索引 Object index	描述 Description
	Position range limit (user units).
607Dh (Software Position Limit)	目标位置的限值（用户单位）。 The limit of the target position (user units).
60C0h(Interpolation sub mode select)	插补类型选择，本设备只支持线性插补，默认值为 0 Selection of interpolation type, the device only supports linear interpolation, the default value is 0
60C1h(Interpolation data record)	设置插补目标位置（用户单位） Set the interpolation target position (user unit)
60C2h (Interpolation time period)	插补时间 (建议 1-20ms) Interpolation time (recommended 1-20ms) 由子索引 01h 和 02h 共同定义，插补周期= $t \cdot 10^n$ 秒 Defined by sub-indexes 01h and 02h, interpolation period = $t \cdot 10^n$ seconds 子索引： Sub-index: 60C2h: 01h(Interpolation time period value): 插补时间常数 t. 60C2h: 01h (Interpolation time period value): Interpolation time constant t. 60C2h: 02h(Interpolation time index): 插补时间指数 n 60C2h: 02h (Interpolation time index): Interpolation time index n Quick stop mode selection
605Ah (Quick stop option code)	快速停机方式选择 Quick stop mode selection
605Dh (Halt option code)	暂停方式选择 Pause mode selection
6085h (Quick stop deceleration)	执行"快速停机"时的停机减速度（用户单位/ s^2 ） Stop deceleration when executing "fast stop" (user unit/ s^2)
6062h (Position Demand Value)	驱动器内部当前生效的目标位置指令值（用户单位） The currently valid target position command value in the drive (user unit)
6063h (Position actual enc Value)	电机当前的绝对位置反馈（编码器单位） Motor current absolute position feedback (encoder unit)

5.8.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须设置对象 2002h: 01h 值为"0"和对象 6060h(Modes Of Operation)中设定值为"7"。

To enable this mode, you must set object 2002h: 01h to "0" and object 6060h (Modes Of Operation) to "7".

控制字 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

在插补模式下，对象 **6040_h** (Controlword) 中的下述位具有特别的功能：

In interpolation mode, the following bits in object 6040_h (Controlword) have special functions:

位 Bit	值 Value	含义 Meaning
4	0	失能插补 Disability interpolation
	1	使能插补 Enable interpolation
8	0	执行位 4 的指令 Execute bit 4 instruction
	1	根据对象 605D _h 的配置暂停 Pause according to the configuration of object 605D _h

状态字 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

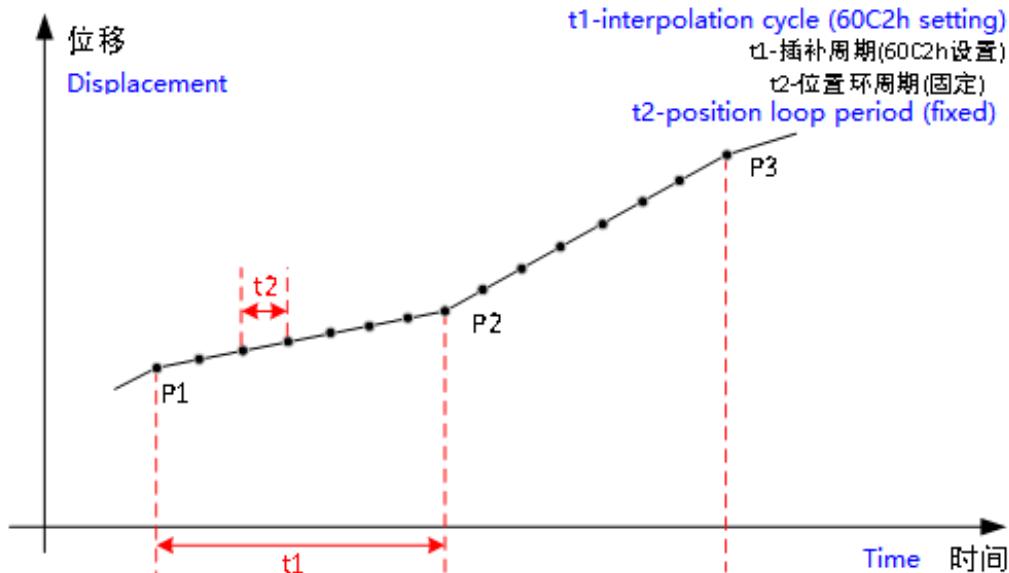
在插补模式下，对象 **6041_h** (Statusword) 中的下述位具有特别的功能：

In interpolation mode, the following bits in object 6041_h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
10	0	未到达目标位置 Did not reach the target position
	1	到达目标位置 Reach the target position
12	0	插补未激活 Interpolation is not activated
	1	插补激活 Interpolation activation
13	0	无跟随误差 No following error
	1	有跟随误差 Follow error

5.8.4 功能描述 Functional description

插补示意图 Interpolation diagram



注: t1: 插补周期, 可通过对象字典 60C2h 设定 (建议 1-20ms)。

Note: t1: Interpolation cycle can be set through the object dictionary 60C2h (recommended 1-20ms).

t2: 位置环控制周期, 由驱动器内部决定。

t2: Position loop control period, determined internally by the drive.

P1/P2/P3: 绝对位置, 绝对位置指令通过对象字典 60C1h: 01h 发送, 插补模式只支持绝对位置指令。

P1/P2/P3: Absolute position. Absolute position commands are sent through the object dictionary 60C1h: 01h. Interpolation mode only supports absolute position commands.

5.8.5 配置举例 Configuration examples

- 配置工作在插补模式:

The configuration works in interpolation mode:

写 2002h: 01h=0、运行模式 6060h=0x07;

Write 2002h: 01h=0, operation mode 6060h=0x07;

- 配置插补时间:

Configure interpolation time:

时间常数 60C2h: 01h=20 与时间指数 60C2h: 02h = -3, 时间则为 20ms;

Time constant 60C2h: 01h = 20 and time index 60C2h: 02h = -3, the time is 20ms;

- 电机运行: Motor operation:

写控制字 6040h= 0x06→0x07→0x0F→0x1F

Write control word 6040h = 0x06→0x07→0x0F→0x1F

- 上位机按照插补周期写插补位置 60C1h: 01h(只支持绝对位置指令)

The upper computer writes the interpolation position 60C1h according to the interpolation cycle: 01h (only supports absolute position commands)

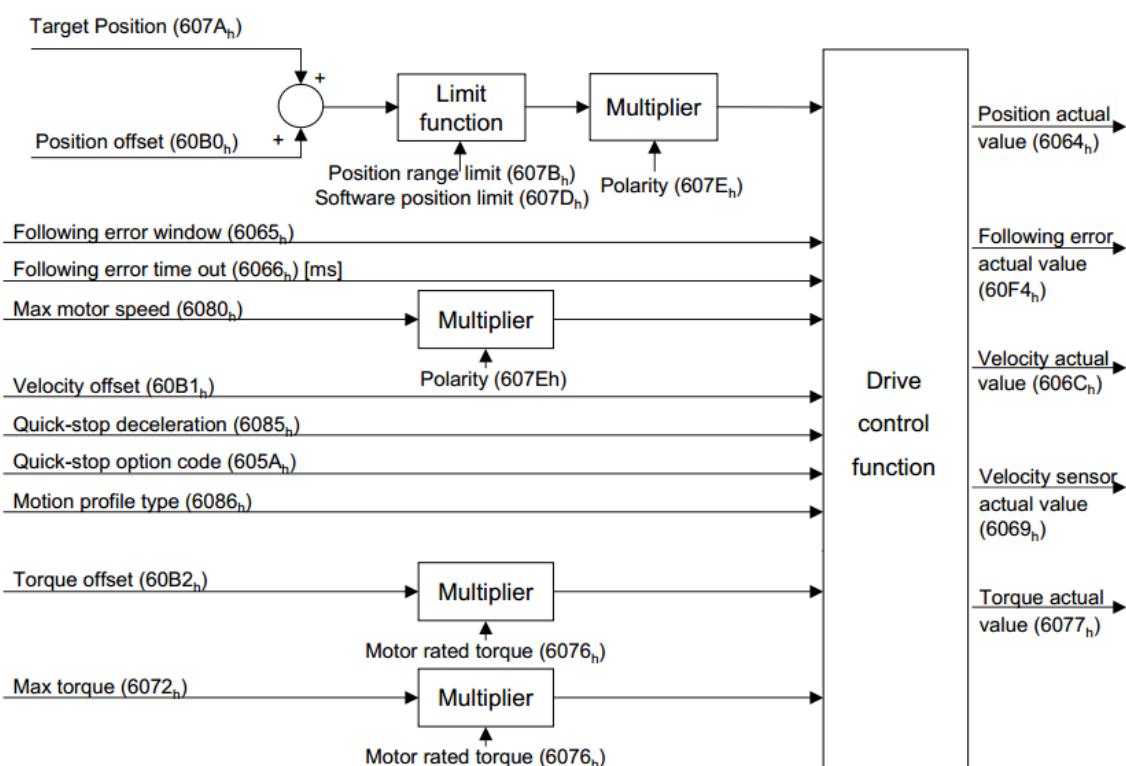
5.9 循环同步位置模式 (CSP) Cyclic synchronized position mode (CSP)

在该模式下, 将以固定的时间间隔(以下称为"循环")通过现场总线向控制器发送绝对的位置预设

值。此时，控制器不再计算斜坡，它仅遵循预设值。目标位置通过 PDO 进行传输，控制器会立即对其进行反应。Controlword 中的位 4 无需设定（不同于轮廓位置模式）。目标预设值是绝对值，因此与每个循环被发送的次数无关。

In this mode, absolute position presets will be sent to the controller via the fieldbus at fixed time intervals (hereinafter referred to as "cycles"). At this time, the controller no longer calculates the slope, it only follows the preset value. The target position is transmitted via PDO and the controller will react to it immediately. Bit 4 in Controlword does not need to be set (unlike profile position mode). The target preset value is an absolute value, so it has nothing to do with the number of times each cycle is sent.

5.9.1 结构图 Structure diagram



5.9.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
607Ah (Target position)	预设的目标位置（用户单位） Preset target location (user unit)
607Bh (Position Range Limit)	位置范围限制（用户单位） Location range limitation (user unit)
607Dh (Software Position Limit)	目标位置的限值（用户单位） Target position limit (user units)
607Eh (Polarity)	旋转方向(极性)，详见“5.3 607Eh：极性”

	Direction of rotation (polarity), see "5.3 607Eh: Polarity" for details
6065 _h (Following Error Window)	跟随偏差阈值窗口（用户单位） Following deviation threshold window (user unit)
6066 _h (Following Error Time Out):	跟随误差的时间范围，单位：毫秒。若实际位置超出误差范围 (6065 _h) 的时间长于规定时间 (6066 _h)，将触发跟随误差，控制字的 bit13 将置 1 Time range of following error, unit: millisecond. If the actual position exceeds the error range (6065h) longer than the specified time (6066h), the following error will be triggered and bit 13 of the control word will be set to 1.
6080 _h (Max motor speed)	电机的最大转速 (rpm) Maximum speed of motor (rpm)
6085 _h (Quick-Stop Deceleration)	执行"快速停机"时的停机减速度 (用户单位/s ²) Stop deceleration when executing "fast stop" (user unit/s ²)
605A _h (Quick-Stop Option Code)	快速停机方式选择 Quick stop mode selection
605D _h (Halt Option Code)	暂停方式选择 Pause mode selection
6086 _h (Motion Profile Type)	要行进斜坡的类型，若值为"0"，则不会对冲击进行限制，若值为"3"，则将用 60A4 _h : 01 _h - 04 _h 中的值限制冲击，本设备只用了 01 _h -02 _h 。 The type of slope to be traveled. If the value is "0", the impact will not be limited. If the value is "3", the value in 60A4h: 01h-04h will be used to limit the impact. This device only uses 01 _h -02 _h .
60B0 _h (Position offset)	位置偏置（用户单位） Position offset (user unit)
60B1 _h (Velocity offset)	速度偏置（用户单位） Speed offset (user unit)
6064 _h (Position Actual Value)	电机当前的用户绝对位置反馈（用户单位） Motor current user absolute position feedback (user unit)
606C _h (Velocity Actual Value)	当前的实际速度反馈值 (rpm) Current actual speed feedback value (rpm)
60F4h (Following Error Actual Value)	实时跟随偏差（用户单位） Real-time following deviation (user unit)

5.9.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须在对象 2002_h: 01_h 中设定值为"0"和对象 6060_h (Modes Of Operation) 中 设定值为"8"。

To enable this mode, the value must be set to "0" in object 2002_h: 01_h and "8" in object 6060_h (Modes Of Operation).

控制字 Control word

在循环同步位置模式下，对象 6040_h (Controlword) 中的位无特别功能，通用位的定义参见 4.1.2 控制字章节。

In the cyclic synchronous position mode, the bits in the object 6040_h (Controlword) have no special functions. For the definition of general bits, see section 4.1.2 Control Word.

注：CSP 模式仅支持绝对位置指令

Note: CSP mode only supports absolute position commands

状态字 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

在循环同步位置模式下，对象 6041_h (Statusword) 中的下述位具有特别的功能：

In cyclic synchronized position mode, the following bits in object 6041_h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
12	0	控制器不遵循目标预设值，607Ah (Target position) 的预设值将被忽视 The controller does not follow the target preset value, the preset value of 607Ah (Target position) will be ignored
	1	控制器遵循目标预设值，对象 607Ah (Target position) 被用作位置控制输入 The controller follows the target preset value and the object 607Ah (Target position) is used as the position control input
13	0	无跟随误差 No following error
	1	有跟随误差 Follow error

5.9.4 功能描述 Functional description

在该模式下，将以固定的时间间隔(以下称为"循环")通过现场总线向控制器发送绝对的位置预设值。
In this mode, absolute position presets will be sent to the controller via the fieldbus at fixed time intervals (hereinafter referred to as "cycles").

5.9.5 配置举例 Configuration Examples

- 配置模式： Configuration mode:

工作在循环同步位置模式：写 2002_h: 01_h = 0、运行模式 6060_h = 0x08;

Working in cyclic synchronized position mode: write 2002_h: 01_h = 0, running mode 6060_h = 0x08;

- 电机运行： Motor operation:

写控制字 6040_h = 0x06→0x07→0x0F;

Write control word $6040_h = 0x06 \rightarrow 0x07 \rightarrow 0x0F$;

- 上位机按照同步周期发送目标位置 $607A$ (只支持绝对位置指令)

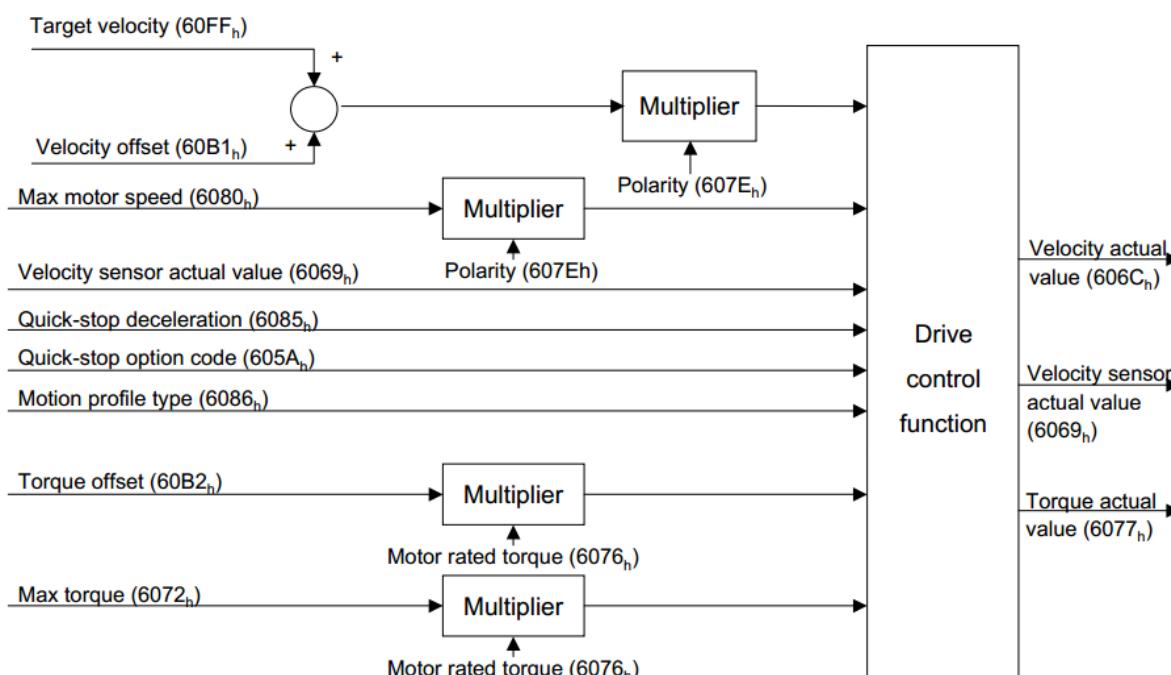
The host computer sends the target position $607A$ according to the synchronization cycle (only supports absolute position commands)

5.10 循环同步速度模式 (CSV) Cyclic Synchronous Velocity mode (CSV)

周期同步速度模式下,上位控制器将计算好的目标速度 $60FF_h$ 周期性同步的发送给驱动器,速度、转矩调节由内部执行。

In the periodic synchronous Velocity mode, the host controller sends the calculated target speed $60FF_h$ to the drive periodically and synchronously, and the speed and torque adjustment are performed internally.

5.10.1 结构图 Structure drawing



5.10.2 相关对象 Related objects

在该模式下需要注意下述对象:

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

对象索引 Object index	描述 Description
$605A_h$ (Quick-Stop Option Code)	快速停机方式选择 Quick stop mode selection
$605D_h$ (Halt Option Code)	暂停方式选择 Pause mode selection
$606C_h$ (Velocity actual value)	当前的实际速度反馈值 (单位: rpm) Current actual speed feedback value (unit: rpm)

对象索引 Object index	描述 Description
607E _h (Polarity)	旋转方向(极性), 详见“5.1.4 607Eh: 极性” Direction of rotation (polarity), see "5.1.4 607Eh: Polarity" for details
60FF _h (Target velocity)	设置目标速度(用户单位/s) Set the target speed (user units/s)
6080 _h (Max motor speed)	电机的最大转速 (rpm) Maximum speed of motor (rpm)
6085 _h (Quick-stop deceleration)	执行"快速停机"时的停机减速度 (用户单位/s ²) Stop deceleration when executing "fast stop" (user unit/s ²)
6086 _h (Motion profile type)	选择曲线即斜坡的类型, Select the type of curve or slope, 若值为"0", 则不会对冲击(加加速度)进行限制, 即梯型曲线; If the value is "0", the impact (acceleration) will not be limited, that is, the trapezoid curve; 若值为"3", 则将用 60A4 _h : 01 _h -02 _h 中的值来限制冲击(加加速度), 即 S 型曲线, 本设备只使用了 01 _h 和 02 _h 索引。 If the value is "3", the value in 60A4h: 01h-02h will be used to limit the impact (acceleration), that is, the S-curve, the device only uses the 01h and 02h indexes.
60B1 _h (Velocity offset)	位置偏置 (用户单位) Position offset (user unit)
60B2 _h (Torque offset)	转矩偏置 (0.1%) Torque bias (0.1%)
6072 _h (Max torque)	整个斜坡(加速、保存转矩、制动)上的最大转矩 (0.1%) Maximum torque (0.1%) on the entire ramp (acceleration, torque saving, braking)

5.10.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式, 必须在对象 2002_h: 01_h 中设定值为"0"和对象 6060_h (Modes Of Operation)中设定值为"8"。

To enable this mode, the value must be set to "0" in object 2002h: 01h and "8" in object 6060h (Modes Of Operation).

控制字 Control word

在循环同步速度模式下, 对象 6040_h (Controlword)中的位无特别功能, 通用位的定义参见 4.1.2 控制字章节。

In the cyclic synchronous Velocity mode, the bits in the object 6040_h (Controlword) have no special functions. For the definition of general bits, refer to chapter 4.1.2 Control Word.

状态字 Status word

15	14	13	12	11	10	9	0
----	----	----	----	----	----	---	---

(see 4.1.3)	reserved	Target velocity ignored	(see 4.1.3)	reserved	(see 4.1.3)
MSB			LSB		

在循环同步速度模式下，对象 **6041h** (Statusword) 中的下述位具有特别的功能：

In cyclic synchronous Velocity mode, the following bits in object 6041h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
12	0	目标速度将被舍弃 Target speed will be discarded
	1	目标速度当作规划器输入 Target speed as planner input

5.10.4 功能描述 Functional description

周期同步速度模式下，上位控制器将计算好的目标速度 **60FFh** 周期性同步的发送给电机驱动器，速度调节由电机内部执行。

In the periodic synchronous Velocity mode, the host controller sends the calculated target speed **60FFh** to the motor driver periodically and synchronously, and the speed adjustment is performed internally by the motor.

5.10.5 配置举例 Configuration examples

- 设置模式： Setting mode:

写 **2002h**: **01h=0**、运行模式 **6060h=0x09**，使其工作在循环同步速度模式；

Write **2002h**: **01h=0**, running mode **6060h=0x09**, make it work in cyclic Velocity mode;

- 写控制字 Write control word

6040h=0x06→0x07→0x0F，电机运行，上位机需要按照同步周期写速度对象 **60FFh**

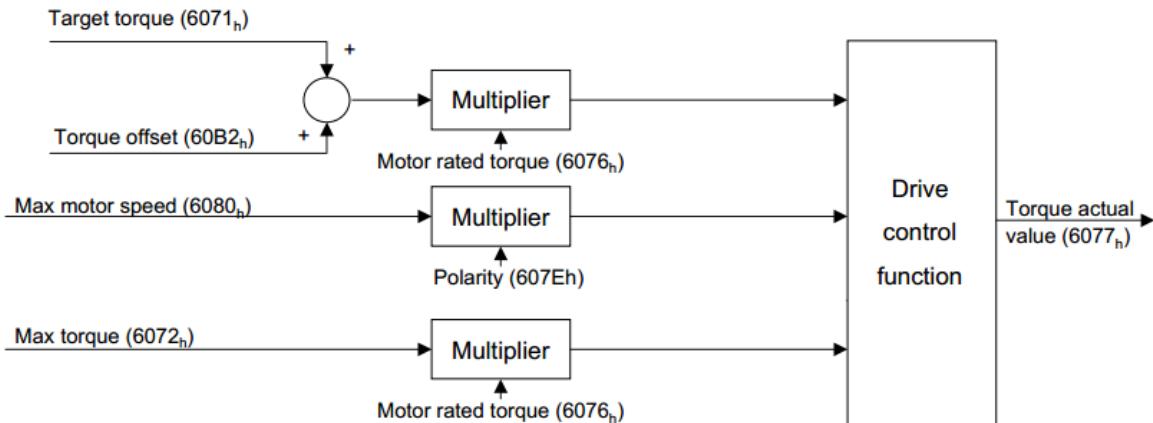
6040h=0x06→0x07→0x0F, the motor is running, the host computer needs to write the speed object **60FFh** according to the synchronization cycle

5.11 循环同步转矩模式 (CST) Cyclic synchronous torque mode (CST)

此模式下，上位控制器将计算好的目标转矩 **6071h** 周期性同步的发送给驱动器，转矩调节由内部执行。当速度达到限幅值后将进入调速阶段。

In this mode, the host controller sends the calculated target torque **6071h** to the drive periodically and synchronously. The torque adjustment is performed internally. When the speed reaches the limit value, it will enter the speed regulation stage.

5.11.1 结构图 Structure diagram



5.11.2 相关对象 Related objects

在该模式下需要注意下项对象：

In this mode, you need to pay attention to the following items:

对象索引 Object index	描述 Description
605A _h (Quick stop option code)	快速停机方式选择 Quick stop mode selection
605D _h (Halt option code)	暂停方式选择 Pause mode selection
6071 _h (Target torque)	设置目标转矩 (0.1%) Set target torque (0.1%)
6072 _h (Max torque)	整个斜坡(加速、保存转矩、制动)上的最大转矩 (0.1%) Maximum torque (0.1%) on the entire ramp (acceleration, torque saving, braking)
6073 _h (Max current)	最大允许电流 (0.01A) Maximum allowable current (0.01A)
6080 _h (Max motor speed)	电机的最大转速 (rpm) Maximum speed of motor (rpm)
60B2 _h (Torque offset)	转矩偏置 (0.1%) Torque bias (0.1%)
6088 _h (Torque profile type)	转矩斜坡类型 (0-斜坡, 2-无) Torque ramp type (0-ramp, 2-none)
6077 _h (Torque actual value)	转矩矩实际值 (0.1%) Actual torque value (0.1%)

5.11.3 控制指令与状态信息 Control instructions and status information

启用 Enable

启用该模式，必须在对象 2002_h: 01_h 中设定值为"0"和对象 6060_h (Modes Of Operation) 中设

值为"8"。

To enable this mode, the value must be set to "0" in object 2002_h: 01_h and "8" in object 6060_h (Modes Of Operation).

控制字 Control word

在循环同步转矩模式下，对象 **6040_h** (Controlword) 中的位无特别功能，通用位的定义参见 4.1.2 控制字章节。

In the cyclic synchronous torque mode, the bits in the object 6040h (Controlword) have no special functions. For the definition of general bits, see section 4.1.2 Control Word.

状态字 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			

在循环同步转矩模式下，对象 **6041_h** (Statusword) 中的下述位具有特别的功能：

In cyclic synchronous torque mode, the following bits in object 6041h (Statusword) have special functions:

位 Bit	值 Value	含义 Meaning
12	0	目标转矩将被舍弃 The target torque will be discarded
	1	目标转矩当作规划器输入 Target torque as planner input

5.11.4 功能描述 Functional description

此模式下，上位控制器将计算好的目标转矩 6071_h 周期性同步的发送给驱动器。

In this mode, the host controller sends the calculated target torque 6071h to the drive periodically and synchronously.

5.11.5 配置举例 Configuration examples

- 设置模式: Setting mode:

写 2002_h : $01_h=0$ 、运行模式 $6060_h=0x0A$, 使其工作在循环同步转矩模式;

Write 2002_h : $01_{h=0}$, running mode $6060_h=0x0A$, make it work in cyclic synchronous torque mode;

- ### ● 写控制字 Write control word

写控制字 $6040_{\text{h}} = 0x06 \rightarrow 0x07 \rightarrow 0x0F$, 电机运行, 上位机需要写目标转矩 6071_{h}

Write control word $6040_h = 0x06 \rightarrow 0x07 \rightarrow 0x0F$, the motor is running, the host computer needs to write the target torque 6071_h

5.12 NiMotion 模式 NiMotion mode

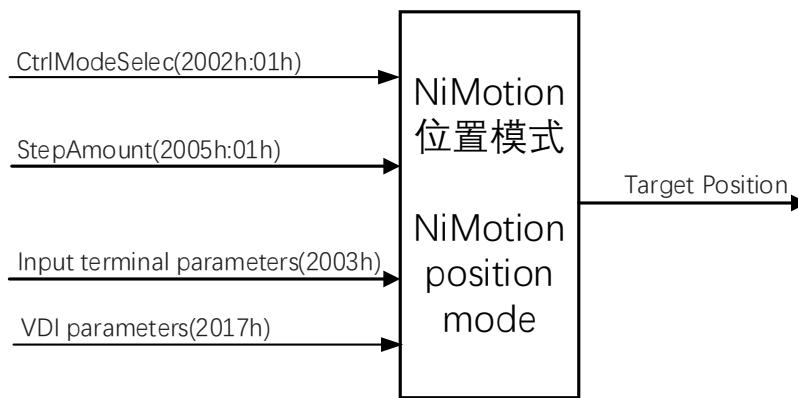
5.12.1 概述 Overview

NiMotion 模式区别于 CIA402 模式，没有状态机管理，通过多功能端子配置的参数进行位置、速度、转矩控制，包括 NiMotion 位置模式，NiMotion 速度模式和 NiMotion 转矩模式。2002_h: 01_h（控制模式选择）用于确定处于哪种工作模式，具体对应关系见 6.1 控制模式概述

The NiMotion mode is different from the CIA402 mode. There is no state machine management, and the position, speed, and torque control are carried out through the parameters configured by the multi-function terminals, including NiMotion position mode, NiMotion Velocity mode, and NiMotion torque mode. 2002_h: 01_h (control mode selection) is used to determine which working mode is in, the specific correspondence is shown in 6.1 Control Mode Overview

5.13 NiMotion 位置模式 NiMotion position mode

5.13.1 结构图 Structure diagram



5.13.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
2002 _h : 01 _h (CtrlModeSelec)	运行模式选择 Operating mode selection
2005 _h : 05 _h (StepAmount)	步进量设置（编码器单位） Step setting (encoder unit)
2017 _h (VDI parameters)	虚拟输入端子功能配置（详见：“7.1.1 数字量输入”） Virtual input terminal function configuration (see: "7.1.1 Digital Input" for details)
2003 _h (Input terminal parameters)	实体输入端子功能配置（详见：“7.1.1 数字量输入”） Entity input terminal function configuration (see: "7.1.1 Digital Input" for details)

对象索引 Object index	描述 Description
	<p>Physical input terminal function configuration (see: "7.1.1 Digital Input" for details)</p> <p>需要注意的是：不能同时有多路输入端子配置为同一种开关，否则会报端子设置故障</p> <p>It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting fault will be reported</p>

5.13.3 控制指令与状态信息 Control commands and status information

该模式下没有状态机管理，电机通过端子使能。

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

启用 Enable

该模式运行前提：一体化低压无刷电机切换至 NiMotion 位置模式（2002_h: 01_h 写 1）。

The operation premise of this mode: the integrated low-voltage brushless motor is switched to NiMotion position mode (2002_h: 01_h write 1).

① 位置来源选择： Location source selection:

对象(2005h: 01h)为位置指令来源，含义：0-脉冲，1-步进量；

The object (2005_h: 01_h) is the source of the position command, meaning: 0-pulse, 1-step;

② 设置多功能端子(实体端子和虚拟端子都适用，端子设置详见“7.1 数字输入和输出”)

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

若设置的位置指令来源为 1，配置一路输入端子为电机使能，并根据实际配置其有效的逻辑电平，默认低电平有效；设置另一路输入端子为步进量使能，根据实际配置其有效的逻辑电平，默认低电平有效；

If the set position command source is 1, 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; set the other input terminal as the step enable, according to the actual configuration Its effective logic level, the default low level is effective;

若设置的位置指令来源为 0（外部脉冲给定），除设置电机使能的端子，还需要设置输入端子 DI1 和 DI2 为相应的脉冲输入功能。

If the set position command source is 0 (external pulse given), in addition to setting the motor enable terminal, it is also necessary to set the input terminals DI1 and DI2 as the corresponding pulse input function.

③ 位置设置 Location setting

若选择位置指令来源为 1，则需要设置步进量给定值，写入到对象 2005h: 05h；

If the source of the position command is 1, you need to set the given value of the step amount and write it to the object 2005_h: 05_h;

若选择位置指令来源为 0，则需要从输入端子 DI1 和 DI2 输入脉冲信号。

If the source of the position command is 0, you need to input pulse signals from the input terminals DI1 and DI2.

④ 运行 Run

若选择位置指令来源为 1，通过端子使能电机，再通过端子使能步进量信号，则电机行进(2005h:

05h) 设置的距离 (单位: 编码器单位), 每使能一次步进量, 电机行进一次;

If the source of the position command is 1, the motor is enabled through the terminal, and the step signal is enabled through the terminal, the distance (unit: encoder unit) set by the motor travel (2005h:05h), each step is enabled, The motor travels once;

若选择位置指令来源为 0, 根据设置的电机使能端子, 使能电机, 电机按照输入端子的脉冲信号运行。

If the source of the position command is 0, the motor is enabled according to the set motor enable terminal, and the motor runs according to the pulse signal of the input terminal.

5.13.4 功能描述 Functional description

该模式下, 电机将根据端子的输入信号行进一段可控制的距离。

In this mode, the motor will travel a controllable distance according to the input signal of the terminal.

5.13.5 举例 Examples

步进量给定位置控制 Step position control

参数设置: parameter settings:

- 设置为 NiMotion 位置模式 2002h: 01h=1
Set to NiMotion position mode 2002h: 01h=1
- 设置位置指令来源为步进量: 2005h: 01h=1
Set the position command source as step amount: 2005h: 01h=1
- 设置步进量: 2005h: 05h = 50
Set step size: 2005h: 05h = 50
- 设置电机使能: 2003h: 01h=1、逻辑为低电平有效: 2003h: 02h=0
Set the motor enable: 2003h: 01h=1, the logic is low level effective: 2003h: 02h=0
- 设置步进量使能: 2003h: 03h=20、逻辑为下降沿有效: 2003h: 04h=3
Set step enable: 2003h: 03h=20, logic is valid for falling edge: 2003h: 04h=3

运行: run:

- 电机使能: DI1 输入低电平
Motor enable: DI1 input low level
- 步进量使能: DI2 输入一个下降沿, 步进一段距离; 每输入一个下降沿都会步进一段距离
Step amount enable: DI2 input a falling edge, step a distance; each input a falling edge will step a distance

正交脉冲给定位置控制 Quadrature pulse given position control

参数设置: parameter settings:

- 设置为 NiMotion 位置模式 2002h: 01h=1
Set to NiMotion position mode 2002h: 01h=1
- 设置位置指令来源为脉冲: 2005h: 01h=0
Set the position command source as pulse: 2005h: 01h=0
- 设置输入端子:
Set input terminal:
 - DI1 正交脉冲输入 A: 2003h: 01h=40
DI1 orthogonal pulse input A: 2003h: 01h=40
 - DI2 正交脉冲输入 B: 2003h: 03h=41
DI2 orthogonal pulse input B: 2003h: 03h=41

DI2 orthogonal pulse input B: 2003_h: 03_h=41

DI3 功能号设置为电机使能:

DI3 function number is set to motor enable:

功能选择为步进使能: 2003_h: 05_h =1

The function selection is stepping enable: 2003_h: 05_h =1

逻辑选择低电平有效: 2003_h: 06_h =0

Logic selection low level effective: 2003_h: 06_h =0

运行: run:

- 电机使能: DI3 输入低电平

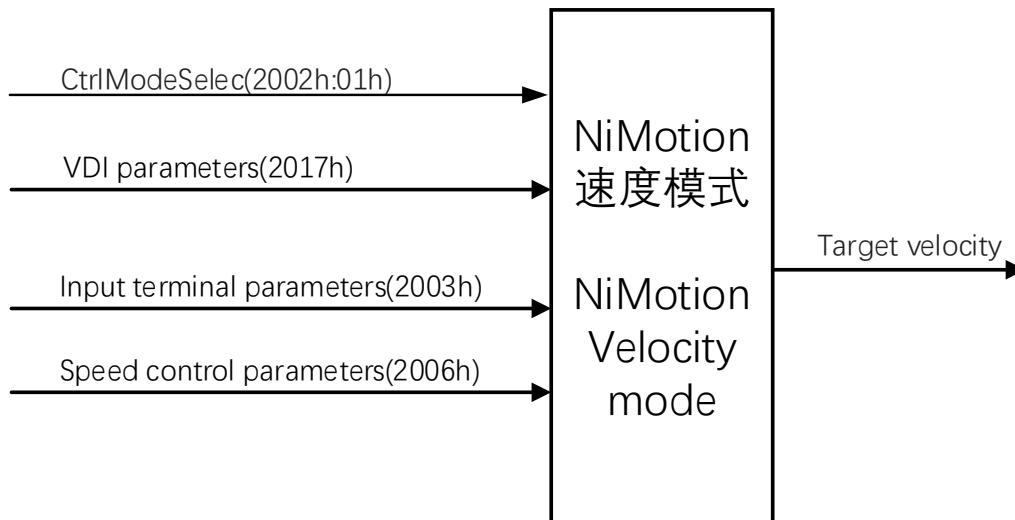
Motor enable: DI3 input low level

- 脉冲输入控制: 端子 DI1 和 DI2 输入正交脉冲, 电机按照输入的脉冲进行位置控制

Pulse input control: The terminals DI1 and DI2 input orthogonal pulses, and the motor performs position control according to the input pulses

5.14 NiMotion 速度模式 NiMotion Velocity mode

5.14.1 结构图 Structure diagram



5.14.2 相关对象 Related objects

在该模式下需要注意下述对象:

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

对象索引 Object index	描述 Description
2000 _h : 0F _h	最大转速, rpm Maximum speed, rpm
2002 _h : 01 _h (CtrlModeSelec)	运行模式选择 Operating mode selection

	NiMotion 速度模式参数 NiMotion Velocity mode parameters 子索引: Sub-index: 2006 _h : 01 _h : NiMotion 速度模式速度给定来源, 0-数字给定, 3-占空比给定 (20Hz-20kHz, 推荐 1kHz) 2006 _h : 01 _h : NiMotion Velocity mode speed reference source, 0-digital reference, 3-duty cycle reference (20Hz-20kHz, 1kHz recommended) 2006 _h : 04 _h : 速度指令数字给定值, 单位 rpm 2006 _h : 04 _h : Speed command digital setting value, unit rpm 2006 _h : 07 _h : 速度指令加速斜坡时间常数, 单位 ms, 表示从 0rpm 加速到 1000rpm 所用的时间。 2006 _h : 07 _h : Speed command acceleration ramp time constant, unit ms, indicating the time it takes to accelerate from 0rpm to 1000rpm. 2006 _h : 08 _h : 速度指令减速斜坡时间常数, 单位 ms 2006 _h : 08 _h : Speed command deceleration ramp time constant, unit ms
2006 _h (Speed control parameters)	虚拟输入端子功能配置 (详见: "7.1.1 数字量输入") Virtual input terminal function configuration (see: "7.1.1 Digital Input" for details)
2003 _h (Input terminal parameters)	实体输入端子功能配置 (详见: "7.1.1 数字量输入") Physical input terminal function configuration (see: "7.1.1 Digital Input" for details) 需要注意的是: 不能同时有多路输入端子配置为同一种开关, 否则会报端子设置故障 It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting fault will be reported

5.14.3 控制指令与状态信息 Control commands and status information

该模式下没有状态机管理, 电机通过端子使能。

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

启用 Enable

该模式运行前提: 一体化低压无刷电机切换至 NiMotion 速度模式 (2002_h: 01_h 设置为 2)。

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

①速度来源选择: Speed source selection:

对象为速度指令来源(2006_h: 01_h), 含义: 0-数字给定, 3-占空比给定;

The object is the source of the speed command (2006h: 01h), meaning: 0-number given, 3-duty ratio given;

②设置多功能端子(实体端子和虚拟端子都适用, 端子设置详见“7.1 数字输入和输出”):

Set multi-function terminals (both physical terminals and virtual terminals are applicable, please

refer to "7.1 Digital Input and Output" for terminal setting details):

配置一路输入端子为电机使能，并根据实际配置其有效的逻辑电平，默认低电平有效。若上一步设置的速度指令来源为 3（占空比给定），则需要设置相应的输入端子 DI1 和 DI2 为占空比输入功能

Configure one input terminal to enable the motor, and configure its effective logic level according to the actual situation, the default low level is effective. If the speed command source set in the previous step is 3 (duty cycle given), you need to set the corresponding input terminals DI1 and DI2 as the duty cycle input function

③速度、加速度和最大速度设置 Speed, acceleration and maximum speed settings

若选择速度指令来源为 0-数字给定，则需要设置速度给定值，写入到对象 2006_h: 04_h;

If the source of the speed command is 0-digital reference, you need to set the speed reference value and write it to the object 2006_h: 04_h;

若选择速度指令来源为 3-占空比给定，则需要从 DI1（占空比）和 DI2（方向）输入脉冲信号，

If the source of the speed command is 3-duty cycle given, you need to input pulse signals from DI1 (duty cycle) and DI2 (direction),

配置加减速速度 2006_h: 07_h 和 2006_h: 08_h

Configure acceleration and deceleration 2006h: 07h and 2006h: 08h

配置最大速度 2000_h: 0F_h，占空比调速为 100% 对应最大转速

Configure the maximum speed 2000h: 0Fh, the duty cycle speed is 100% corresponding to the maximum speed

④运行 Run

根据设置的电机使能端子，使能电机，电机按照设置的速度运行。

According to the set motor enable terminal, the motor is enabled, and the motor runs at the set speed.

5.14.4 功能描述 Functional description

该模式下，电机将根据端子的输入或者数字量给定运行至相应的速度。

In this mode, the motor will run to the corresponding speed according to the terminal input or digital setting.

5.14.5 举例 Examples

实现数字给定调速： Realize digital given speed regulation:

① 参数设置： Parameter setting:

- 设置速度模式为 2（NiMotion 速度模式）： 2002_h: 01_h=2

Set the Velocity mode to 2 (NiMotion Velocity mode): 2002_h: 01_h=2

- 设置主速度指令来源为 0（数字给定）： 2006_h: 01_h=0;

Set the source of the main speed command to 0 (number given): 2006_h: 01_h=0;

- 设置辅助速度指令来源为 0（数字给定）： 2006_h: 02_h=0;

Set the source of the auxiliary speed command to 0 (number given): 2006_h: 02_h=0;

- 设置加速斜坡时间常数为 100ms: 2006_h: 07_h=100

Set the acceleration ramp time constant to 100ms: 2006_h: 07_h=100

设置减速斜坡时间常数为 100ms: 2006_h: 08_h=100

Set the deceleration ramp time constant to 100ms: 2006h: 08h=100

- 设置数字给定为 60rpm, 2006_h: 04_h=60

Set the digital setting to 60rpm, 2006_h: 04_h=60

● 端子设置 Terminal settings

设置 DI1 端子: Set DI1 terminal:

功能选择为步进使能: 2003_h: 01_h =1

The function selection is step enable: 2003_h: 01_h =1

逻辑选择低电平有效: 2003_h: 02_h =0

Logic selection low level effective: 2003_h: 02_h =0

② 运行: Running:

● DI1 输入低电平, 电机按照数字给定 (2006h: 02h) 调速

DI1 input low level, the motor speed regulation according to the digital setting (2006h: 02h)

实现占空比输入调速: To achieve duty cycle input speed regulation:

① 参数设置: Parameter setting:

● 设置速度模式为 2 (NiMotion 速度): 2002_h: 01_h=2

Set the Velocity mode to 2 (NiMotion speed): 2002_h: 01_h=2

● 设置速度指令来源为 3 (占空比): 2006_h: 01_h=3

Set the speed command source to 3 (duty cycle): 2006_h: 01_h=3

● 设置加速斜坡时间常数为 100ms: 2006_h: 03_h=100

Set the acceleration ramp time constant to 100ms: 2006h: 03h=100

设置减速斜坡时间常数为 100ms: 2006_h: 04_h=100

Set the deceleration ramp time constant to 100ms: 2006h: 04h=100

设置最大速度为 3000rpm: 2000_h: 0F_h=3000

Set the maximum speed to 3000rpm: 2000_h: 0F_h=3000

● 端子设置 Terminal settings

DI1 占空比输入: 2003_h: 01_h=44

DI1 duty ratio input: 2003_h: 01_h=44

DI2 占空比方向输入: 2003_h: 03_h=45

DI2 duty direction input: 2003_h: 03_h=45

DI3 功能号设置为步进使能:

DI3 function number is set to step enable:

功能选择为步进使能: 2003_h: 05_h =1

The function selection is stepping enable: 2003h: 05h =1

逻辑选择低电平有效: 2003_h: 06_h =0

Logic selection is active low: 2003_h: 06_h =0

② 运行: Running:

● DI1 输入一定占空比的方波, DI3 输入低电平使能电机, 电机按照输入的占空比调速

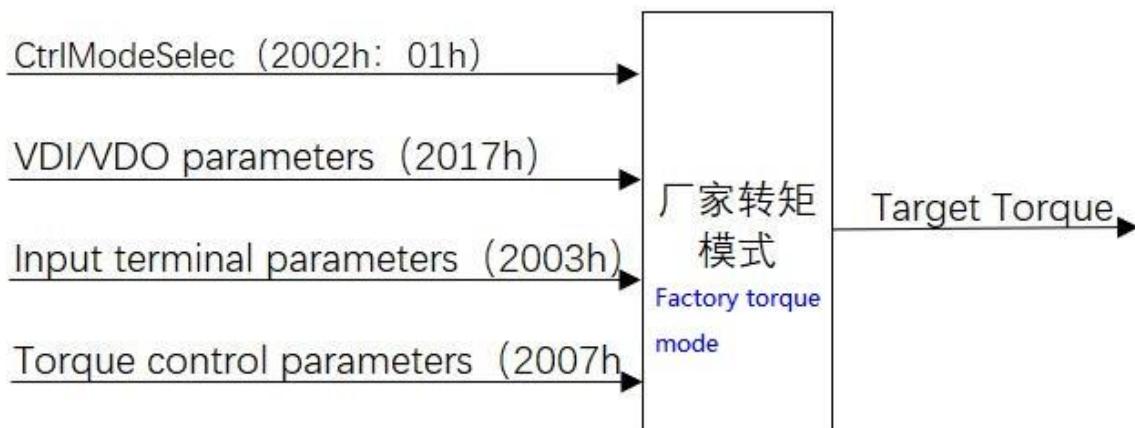
DI1 input square wave with certain duty ratio, DI3 input low level to enable the motor, the motor speed regulation according to the input duty ratio

监控参数: 200B_h: 07_h 显示为实时输入占空比

Monitoring parameters: 200B_h: 07_h is displayed as real-time input duty cycle

5.15 NiMotion 转矩模式 NiMotion torque mode

5.15.1 结构图 Structure diagram



5.15.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
2002 _h : 01 _h (CtrlModeSelec)	运行模式选择 Operating mode selection
2007 _h (Speed control parameters)	NiMotion 转矩模式参数 NiMotion torque mode parameters 子索引： Sub-index: 2007 _h : 01 _h : NiMotion 转矩模式转矩给定来源, 0-数字给定 2007 _h : 01 _h : Source of torque reference in NiMotion torque mode, 0-number reference 2007 _h : 04 _h : 转矩指令数字给定值(0.1%) 2007 _h : 04 _h : Digital setting value of torque command (0.1%) 2007 _h : 0A _h : 正内部转矩限制 (0.1%) 2007 _h : 0A _h : positive internal torque limit (0.1%) 2007 _h : 0B _h : 反内部转矩限制 (0.1%) 2007 _h : 0B _h : anti-internal torque limit (0.1%) 2007 _h : 10 _h : 转矩控制正向速度限制值 (rpm) 2007 _h : 10 _h : Torque control forward speed limit value (rpm) 2007 _h : 11 _h : 转矩控制反向速度限制值 (rpm) 2007 _h : 11 _h : Reverse speed limit value of torque control (rpm)
2017 _h (VDI parameters)	虚拟输入端子功能配置 (详见：“7.1.1 数字量输入”) Virtual input terminal function configuration (see: "7.1.1 Digital Input" for details)

2003 _h (Input terminal parameters)	<p>实体输入端子功能配置（详见“7.1.1 数字量输入”） Physical input terminal function configuration (see "7.1.1 Digital input" for details) 需要注意的是：不能同时有多路输入端子配置为同一种开关，否则会报端子设置故障 It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting fault will be reported</p>
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5.15.3 控制指令与状态信息 Control instructions and status information

该模式下没有状态机管理，电机通过端子使能。

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

启用 Enable

该模式运行前提：一体化低压无刷电机切换至 NiMotion 转矩模式（2002_h: 01_h 设置为 3）。

The premise of this mode of operation: the integrated low-voltage brushless motor is switched to the NiMotion torque mode (2002_h: 01_h is set to 3).

① 转矩来源选择： Torque source selection:

对象(2007_h: 01_h)为转矩指令来源，含义：0-数字给定；

The object (2007_h: 01_h) is the source of torque command, meaning: 0-number given;

② 设置多功能端子(实体端子和虚拟端子都适用，端子设置详见“7.1 数字输入和输出”):

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

配置一路输入端子为电机使能，并根据实际配置其有效的逻辑电平，默认低电平有效

Configure one input terminal to enable the motor, and configure its effective logic level according to the actual situation.

③ 转矩给定和转矩、速度限制设置 Torque setting and torque and speed limit settings

选择速度指令来源为数字给定，则需要设置转矩给定值，写入到对象 2007_h: 04_h;

If the source of the speed command is digital reference, you need to set the torque reference value and write it to the object 2007_h: 04_h;

配置正反内部转矩限制 2007_h: 0A_h 和 2007_h: 0B_h

Configure positive and negative internal torque limits 2007h:0Ah and 2007h:0Bh

配置正反向速度限制值 2007_h: 10_h 和 2007_h: 11_h

Configure forward and reverse speed limit values 2007_h: 10_h and 2007_h: 11_h

④ 运行 run

根据设置的电机使能端子，使能电机，电机按照设置的转矩运行。

According to the set motor enable terminal, the motor is enabled, and the motor runs at the set torque.

5.15.4 功能描述 Functional description

该模式下，电机将通过实体或者虚拟端子的使能控制和转矩数字量给定运行至相应的转矩。当电机的运行速度超过速度限幅（正向速度限制值 2007_h: 10_h 和 反向速度限制值 2007_h: 11_h）设定的值时，自动转为速度模式控制并控制当前速度在速度限幅之内。当检测到给定的目标转矩小于当前速度的平均力矩时，电机退出速度控制恢复成转矩模式控制。

In this mode, the motor will run to the corresponding torque through the enable control of the

physical or virtual terminals and the torque digital setting. When the running speed of the motor exceeds the speed limit (forward speed limit value 2007_h: 10_h and reverse speed limit value 2007_h: 11_h), it will automatically switch to Velocity mode control and control the current speed within the speed limit . When it is detected that the given target torque is less than the average torque of the current speed, the motor exits the speed control and returns to the torque mode control.

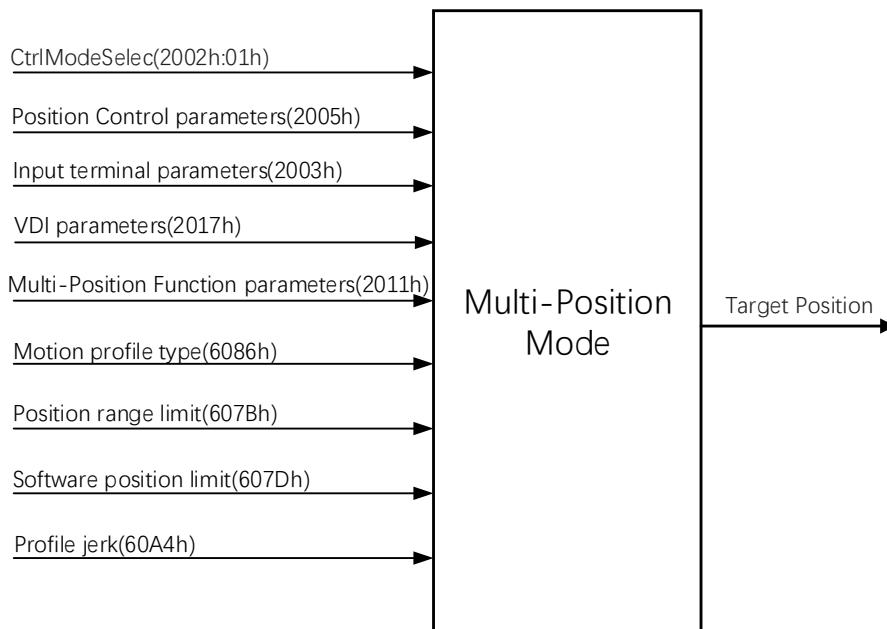
5.15.5 举例 Examples

①参数设置 Parameter setting:

- 设置速度模式为 3 (NiMotion 转矩模式) : 2002_h: 01_h=2;
Set the Velocity mode to 3 (NiMotion torque mode): 2002_h: 01_h=2;
 - 设置速度指令来源为 0 (数字给定) : 2007_h: 01_h=0
Set the speed command source to 0 (digital reference): 2007_h: 01_h=0
 - 设置正反内部转矩限制为 100%: 2007_h: 0A_h=1000 和 2007_h: 0B_h=1000
Set positive and negative internal torque limit to 100%: 2007_h: 0A_h=1000 and 2007_h: 0B_h=1000
设置正反向速度限制值为 3000rpm: 2007_h: 10_h=3000 和 2007_h: 11_h=3000
Set the forward and reverse speed limit value to 3000rpm: 2007_h: 10_h=3000 and 2007_h: 11_h=3000
 - 设置数字给定为 100%, 2007_h: 04_h=1000
Set the number given as 100%, 2007_h: 04_h=1000
 - 端子设置 Terminal settings
设置 DI1 端子: Set DI1 terminal:
功能选择为步进使能: 2003_h: 01_h =1
The function selection is stepping enable: 2003_h: 01_h =1
逻辑选择低电平有效: 2003_h: 02_h =0
Logic selection is active low: 2003_h: 02_h =0
- ②运行: Running:
- DI1 输入低电平, 电机按照数字给定 (2007_h: 04_h) 的转矩运行
DI1 input low level, the motor runs according to the torque of digital setting (2007_h:04_h)

5.16 多段位置模式 Multi-segment position mode

5.16.1 结构图 Structure diagram



5.16.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
2002 _h :01 _h (CtrlModeSelec)	运行模式选择 Operating mode selection
2005 _h (Position control parameters)	2005 _h :01 _h : 位置指令来源, 0-脉冲, 1-步进量, 2-多段位置 2005 _h :01 _h : source of position command, 0-pulse, 1-step, 2-multi-step position
2017 _h (VDI parameters)	虚拟输入端子功能配置 (详见: "7.1.1 数字量输入") Virtual input terminal function configuration (see: "7.1.1 Digital Input" for details)
2003 _h (Input terminal parameters)	实体输入端子功能配置 (详见: "7.1.1 数字量输入") Physical input terminal function configuration (see: "7.1.1 Digital Input" for details) 需要注意的是: 不能同时有多路输入端子配置为同一种开关, 否则会报端子设置故障 It should be noted that multiple input terminals cannot be configured as the same

	switch at the same time, otherwise the terminal setting fault will be reported
2011 _h (Multi-position function parameters)	多段位置功能参数组 Multi-section position function parameter group
6086 _h (Motion Profile Type)	选择规划器曲线即斜坡的类型, Select the type of planner curve that is the slope, 若值为"0", 则不会对冲击(加速度)进行限制, 即梯型曲线; If the value is "0", the impact (acceleration) will not be limited, that is, the trapezoid curve; 若值为"3", 则将用 60A4 _h : 01 _h -02 _h 中的值来限制冲击(加速度), 即 S 型曲线, 本设备只使用了 01 _h 和 02 _h 索引。 If the value is "3", the value in 60A4 _h : 01 _h -02 _h will be used to limit the impact (acceleration), that is, the S-curve, the device only uses the 01 _h and 02 _h indexes.
607B _h (Position range limit)	位置范围限制 (用户单位) Location range limitation (user unit)
607D _h (Software position limit)	目标位置的限值 (用户单位) Target position limit (user units)
60A4h (Profile jerk)	轮廓加加速度, 具体实现过程详见 6.3.2 profile acceleration, please refer to 6.3.2 for details

5.16.3 控制指令与状态信息 Control instructions and status information

该模式下没有状态机管理, 电机通过端子使能。

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

启用 Enable

该模式运行前提: 电机运行模式切换至 NiMotion 位置模式 (2002_h:01_h 写 1)。

The premise of this mode of operation: the motor operation mode is switched to NiMotion position mode (2002h:01h write 1).

①位置来源选择: Location source selection:

对象(2005h:01h)为位置指令来源(2005h:01h), 含义: 0-脉冲, 1-步进量, 2-多段位置;

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

②设置多功能端子(实体端子和虚拟端子都适用, 端子设置详见“7.1 数字输入和输出”)

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

设置位置指令来源为 2, 配置一路输入端子为电机使能, 并根据实际配置其有效的逻辑电平, 默认

认低电平有效;

Set the position command source to 2, configure one input terminal to enable the motor, and configure its effective logic level according to the actual situation, the default low level is effective;

设置另一路输入端子为多段位置/速度使能(功能号 28), 根据实际配置其有效的逻辑电平, 默认低电平有效;

Set the other input terminal to multi-position position/speed enable (function number 28), according to the actual configuration of its effective logic level, the default low level is effective;

③位置设置 Location setting

通过多段位置功能参数组(2011_h)设定相应的运行方式和各段的运行参数。

Through the multi-segment position function parameter group (2011_h), set the corresponding operation mode and operation parameters of each stage.

④运行 Run

先通过一路端子使能电机, 再通过另一路端子使能多段位置指令, 电机则按照多段位置功能参数组(2011_h)设定的运行方式和各段的运行参数运行。

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 operation mode and operation parameters set by the multi-segment position function parameter group (2011_h).

5.16.4 功能描述 Functional description

多段位置模式有 3 种运行方式, 分别是单次运行、循环运行和 DI 切换运行。使用多段位置功能时, 必须分别设置 DI 端口为使能(功能号 1)和多段位置/速度使能(功能号 28); 每段运行期间, 必须保证使能有效; 非 DI 切换运行模式下, 除了使能有效, 必须保证多段位置/速度使能有效, 如果关闭了多段位置/速度使能, 将放弃本段未发送的位移指令并停机。

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 enable (function number 1) and multi-segment position/speed enable (function number 28); during each segment operation, the enable must be valid; in non-DI switching operation mode, In addition to the enabling effect, it must be ensured that the multi-segment position/speed enable is effective. If the multi-segment position/speed enable is turned off, the displacement command not sent by this segment will be abandoned and the machine will be stopped.

各运行方式的具体描述如下表所示:

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

运行方式 Operation mode	说明 Explanation	运行曲线 Running curve
------------------------	-------------------	-----------------------

单次运行 $2011_{h}:01_{h} = 0$ Single run $2011_{h}:01_{h} = 0$	第 1 段到第 16 段运行 1 次; Run once from paragraph 1 to paragraph 16; 段号自动递增切换; The segment number is automatically incremented and switched; 段与段之间可设等待时间; Waiting time can be set between segments; 多段位置/速度使能为电平有效。 Multi-level position/speed enable is level effective.	
循环运行 $2011_{h}:01_{h} = 1$ cycle operation $2011_{h}:01_{h} = 1$	2011 _h :06 _h 设置的起点段到 2011 _h :02 _h 设置的终点段运行 2011 _h :04 _h 设置的次数; The number of times set from 2011 _h :06 _h to the end point set by 2011 _h :02= to the end point set by 2011 _h :04 _h ; 段号自动递增切换; The segment number is automatically incremented and switched; 段与段之间可设等待时间; Waiting time can be set between segments; 多段位置/速度使能为电平有效; Multi-level position/speed enable is level effective; 注: 如果终点段的设置值小于起点段, 则第 1 段至第 16 段循环一次。 Note: If the setting value of the end segment is less than the start segment, the first segment to the 16th segment will cycle once.	

DI 切换运行 $2011_{h}:01_{h} = 2$ DI switch operation $2011_{h}:01_{h} = 2$ 注：实体端子和虚拟端子可以组合使用，且其组合必须为4位；如：实体端子选择 DI1=6,DI2=7, 虚拟端子 VI1=8,VI2=9. Note: The physical terminal and the virtual terminal can be used in combination, and the combination must be 4 bits; for example: Physical terminal selection DI1=6, DI2=7, VI1=8, VI2=9.	位置段号切换由多功能号 6、7、8、9 组成的 4 位二进制数对应的十进制 0~15 决定； The position segment number switching is determined by the decimal 0~15 corresponding to the 4-bit binary number composed of the multi-function numbers 6, 7, 8, 9; 段与段之间设置的等待时间无效； The waiting time set between segments is invalid； 多段位置/速度使能为电平有效； Multi-level position/speed enable is level effective； 段号与多功能号关系对应如下： The relationship between the section number and the multi-function number is as follows: <table border="1"> <thead> <tr> <th>Fun 9</th><th>Fun 8</th><th>Fun 7</th><th>Fun 6</th><th>段号</th></tr> </thead> <tbody> <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> </tbody> </table>	Fun 9	Fun 8	Fun 7	Fun 6	段号	0	0	0	0	1	0	0	0	1	2					1	1	1	1	16	<p>The graph illustrates the velocity profile over time. It shows two trapezoidal sections, Section x and Section y, separated by two DI switching edge changes. The Y-axis is labeled 'Velocity V' and the X-axis is labeled 'Time t' (Time). The velocity starts at V1max, drops to V2max, and then rises back to V1max. Two vertical dashed red lines mark the 'DI 切换沿变化' (DI switching edge changes) points where the velocity profile changes. The sections are labeled '第x段 Section x' and '第y段 Section y'.</p>
Fun 9	Fun 8	Fun 7	Fun 6	段号																							
0	0	0	0	1																							
0	0	0	1	2																							
.....																											
1	1	1	1	16																							

5.16.5 配置举例 Configuration examples

多段位置-单次运行控制 Multi-section position-single operation control

● 参数设置 Parameter setting

设置为 NiMotion 位置模式: 2002_h:01_h=1;

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

设置位置指令来源为多段位置: 2005_h:01_h=2;

Set the source of the position command as a multi-segment position: 2005_h:01_h=2;

设置多段位置功能参数组:

Set multi-section position function parameter group:

段位置运行方式: 2011_h:01_h = 0(单次运行);

Section position operation mode: 2011_h:01_h = 0 (single operation);

位置指令类型选择: 2011_h:05_h = 0(相对位移);

Position command type selection: 2011_h:05_h = 0 (relative displacement);

第 1 段位移的运行参数:

Operating parameters of the first stage displacement:

移动位移 2011_h:07_h = 10000(用户单位), 最大允许速度 2011_h:08_h =500(单位 rpm),

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

加减速时间 2011_h:09_h = 500(单位 ms), 位移完成后等待时间 2011_h:0A_h =1000(单位 ms)

Acceleration and deceleration time 2011_h:09_h = 500 (unit ms), waiting time after displacement is completed 2011_h:0A_h =1000 (unit ms)

第 2 段至第 16 段参照第 1 段位移的运行参数设置;

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

设置电机使能: 2003_h:03_h=1、逻辑为低电平有效: 2003_h:04_h=0;

Set the motor enable: 2003_h:03_h=1, the logic is low level effective: 2003_h:04_h=0;

设置多段位置/速度使能: 2003_h:05_h=28、逻辑为低电平有效: 2003_h:06_h=0;

Set multi-stage position/speed enable: 2003_h:05_h=28, logic is low level effective: 2003_h:06_h=0;

● 运行 Run

电机使能: DI1 输入低电平;

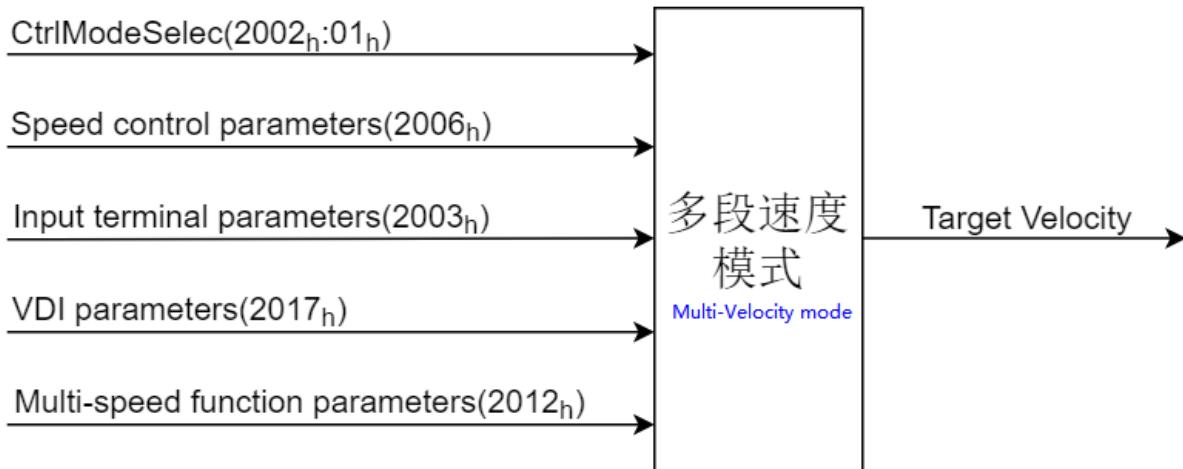
Motor enable: DI1 input low level;

多段位置/速度使能, DI2 输入低电平, 电机按照 2011_h 多段位置功能参数组设定的运行方式和运行参数运行。

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

5.17 多段速度模式 Multi-step Velocity mode

5.17.1 结构图 Structure diagram



5.17.2 相关对象 Related objects

在该模式下需要注意下述对象：

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

对象索引 Object index	描述 Description
2002 _h :01 _h (CtrlModeSelec)	运行模式选择 Operating mode selection
2006 _h (Speed control parameters)	2006 _h :01 _h : NiMotion 速度模式主速度给定来源, 0-数字给定, 3-占空比给定 (20Hz-20kHz, 推荐 1kHz) 2006 _h :01 _h : NiMotion Velocity mode main speed reference source, 0-digital reference, 3-duty cycle reference (20Hz-20kHz, 1kHz recommended) 2006 _h :02 _h : NiMotion 速度模式辅速度给定来源, 0-数字给定, 3-多段速度 2006 _h :02 _h : NiMotion Velocity mode auxiliary speed reference source, 0-number reference, 3-multi-step speed 2006 _h :03 _h : NiMotion 速度模式速度指令选择, 0-主速度给定, 1-辅速度给定, 2-主速度和辅速度给定 (默认 0) 2006 _h :03 _h : NiMotion Velocity mode speed command selection, 0-main speed reference, 1-auxiliary speed reference, 2-main speed and auxiliary speed reference (default 0) 2006 _h :04 _h : 速度指令数字给定值, 单位 rpm 2006 _h :04 _h : Speed command digital setting value, unit rpm

对象索引 Object index	描述 Description
	2006 _h :07 _h : 速度指令加速斜坡时间常数, 单位 ms, 表示从 0rpm 加速到 1000rpm 所用的时间。 2006 _h :07 _h : Speed command acceleration ramp time constant, unit ms, indicating the time it takes to accelerate from 0 rpm to 1000 rpm. 2006 _h :08 _h : 速度指令减速斜坡时间常数, 单位 ms 2006 _h :08 _h : Speed command deceleration ramp time constant, unit ms
2017 _h (VDI parameters)	虚拟输入端子功能配置 (详见: "7.1.1 数字量输入") Virtual input terminal function configuration (see: "7.1.1 Digital Input" for details)
2003 _h (Input terminal parameters)	实体输入端子功能配置 (详见: "7.1.1 数字量输入") Physical input terminal function configuration (see: "7.1.1 Digital Input" for details) 需要注意的是: 不能同时有多路输入端子配置为同一种开关, 否则会报端子设置故障 It should be noted that multiple input terminals cannot be configured as the same switch at the same time, otherwise the terminal setting fault will be reported
2012 _h (Multi-speed function parameters)	多段速度功能参数组 Multi-stage speed function parameter group

5.17.3 控制指令与状态信息 Control commands and status information

该模式下没有状态机管理, 电机通过端子使能。

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

启用 Enable

该模式运行前提: 电机运行模式切换至 NiMotion 速度模式 (2002_h:01_h 设置为 2)。

The premise of this mode of operation: the motor operation mode is switched to NiMotion Velocity mode (2002 h:01h is set to 2).

①速度来源选择: Velocity source selection:

对象为辅速度指令来源(2006_h:02_h), 含义: 0-数字给定, 3-多段速度, ;

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

通过速度指令选择(2006_h:03_h)实际生效的是主速度指令、辅速度指令或主辅速度指令。

The speed command selection (2006h:03h) is actually the main speed command, auxiliary speed command or main and auxiliary speed command.

②设置多功能端子(实体端子和虚拟端子都适用, 端子设置详见“7.1 数字输入和输出”):

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

配置一路输入端子为电机使能, 并根据实际配置其有效的逻辑电平, 默认低电平有效。

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

③速度设置 Velocity setting

通过多段速度功能参数组(2012h)设定相应的运行方式和各段的运行参数

Set the corresponding operation mode and operation parameters of each stage through the multi-stage speed function parameter group (2012h)

④运行 Run

通过一路端子使能电机，电机则按照多段速度功能参数组(2012h)设定的运行方式和各段的运行参数运行

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

5.17.4 功能描述 Functional description

多段速度模式有 3 种运行方式，分别是单次运行、循环运行和 DI 切换运行。使用多段位置/速度功能时，必须设置一个 DI 端口为电机使能(功能号 1)；每段速度指令运行期间，必须保证电机使能有效，如果关闭了电机使能，电机将按照失能方式停机。

There are three operation modes for multi-Velocity mode, which are single operation, cycle operation and DI switching operation. When using the multi-stage position/speed function, a DI port must be set as the motor enable (function number 1); during the operation of each speed command, the motor enable must be valid. If the motor enable is turned off, the motor will follow the disabled mode Downtime.

各运行方式的具体描述如下表所示：

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

运行方式 Operation mode	说明 Explanation	运行曲线 Running curve
单次运行 2012h:01h = 0 Single run 2012h:01h = 0	第 1 段到第 16 段运行 1 次； Run once from paragraph 1 to paragraph 16; 段号自动递增切换。 The segment number is automatically incremented and switched.	<p>速度 velocity V1max V2max 时间 time Section 1 第1段 Section 2 第2段 S1 S2 The first and second section speed V1max, V2max: 第1段、第2段指令速度 第1段运行时间为 t1+t2, 第2段运行时间为 t3+t4, 以此类推 The first run time is T1 + T2, the second run time is T3 + T4, and so on</p>

运行方式 Operation mode	说明 Explanation	运行曲线 Running curve
循环运行 $2012_{h}:01_{h} = 1$ cycle operation $2012_{h}:01_{h} = 1$	第 1 段到 $2012_{h}:02_{h}$ 设置的终点段; End segment set from paragraph 1 to $2012_{h}:02_{h}$; 运行 $2012_{h}:03_{h}$ 设置的次数; Run the number of times set in $2012_{h}:03_{h}$; 段号自动递增切换。 The segment number is automatically incremented and switched.	 V _{1max} , V _{2max} : 第 1 段、第 2 段指令速度 The first and second instruction speed 第1段运行时间为 t1+t2, 第2段运行时间为 t3+t4, 以此类推 The first segment runs for t1 + t2, the second segment runs for t3 + t4, and so on
DI 切换运行 $2012_{h}:01_{h} = 2$ DI switch operation $2012_{h}:01_{h} = 2$ 注: 实体端子和虚拟端子可以组合使用, 且其组合必须为 4 位; 如: 实体端子选择 DI1=6,DI2=7 ,虚拟端子 VI1=8,VI2=9 Note: The physical terminal and the virtual terminal can be used in combination,	速度段号切换由多功能号 6、7、8、9 组成的 4 位二进制数对应的十进制 0~15 决定; The speed segment number switching is determined by the decimal 0~15 corresponding to the 4-bit binary number composed of the multi-function numbers 6, 7, 8, 9; 使能有效即可持续运行; Enable effective and sustainable operation; 每段速度指令运行时间仅由速度段号切换间隔时间决定。 The running time of each speed command is only	 V _{xmax} , V _{ymax} , V _{zmax} : 第 x 段、第 y 段、第 z 段指令速度 Section x, y, z instruction speed

运行方式 Operation mode	说明 Explanation	运行曲线 Running curve																									
and the combination must be 4 bits; for example: Physical terminal selection DI1=6, DI2=7, virtual terminal VI1=8, VI2=9	determined by the interval time of speed segment number switching.																										
	段号与多功能号关系对应表 Correspondence table of the relationship between segment number and multi-function number	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Fun9</th> <th>Fun 8</th> <th>Fun7</th> <th>Fun6</th> <th>段号 Segment number</th> </tr> </thead> <tbody> <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 style="text-align: center;">.....</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>16</td> </tr> </tbody> </table>	Fun9	Fun 8	Fun7	Fun6	段号 Segment number	0	0	0	0	1	0	0	0	1	2					1	1	1	1	16
Fun9	Fun 8	Fun7	Fun6	段号 Segment number																							
0	0	0	0	1																							
0	0	0	1	2																							
.....																											
1	1	1	1	16																							

5.17.5 配置举例 Configuration examples

多段速度-单次运行控制

Multi-step speed-single operation control

- 参数设置: Parameter setting:

设置为 NiMotion 速度模式 2002_h:01_h=2;

Set to NiMotion Velocity mode 2002_h:01_h=2;

设置速度指令来源为多段速度: 2006_h:02_h=3, 2006_h:03_h=1;

Set the speed command source to multi-step speed: 2006h:02h=3, 2006h:03h=1;

设置多段速度功能参数组:

Set multi-step speed function parameter group:

多段速度运行方式 2012_h:01_h = 0(单次运行);

Multi-step speed running mode 2012_h:01_h = 0 (single run);

第 1 段速度的运行参数:

Operating parameters of the 1st stage speed:

速度指令 2012_h:0C_h = 500(单位 rpm), 指令运行时间 2012_h:0D_h = 2000(单位 ms),

Speed command 2012_h:0C_h = 500 (in rpm), command running time 2012_h:0D_h = 2000 (in ms),

加减速时间 2012_h:0E_h = 500(单位 ms);

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

第 2 段至第 16 段的运行参数参照第 1 段速度的运行参数设置;

The operating parameters of the 2nd to 16th segments refer to the operating parameter settings of the 1st speed;

设置电机使能: 2003_h:03_h=1、逻辑为低电平有效: 2003_h:04_h=0;

Set the motor enable: 2003_h:03_h=1, the logic is low level effective: 2003_h:04_h=0;

设置多段位置/速度使能: 2003_h:05_h=28、逻辑为低电平有效: 2003_h:06_h=0;

Set multi-stage position/speed enable: 2003_h:05_h=28, logic is low level effective: 2003_h:06_h=0;

● 运行 Run

电机使能: DI1 输入低电平;

Motor enable: DI1 input low level;

多段位置/速度使能, DI2 输入低电平, 电机按照 2012_h 多段速度功能参数组设定的运行方式和各段的运行参数运行。

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

6 特殊功能 Special functions

6.1 数字输入和输出 Digital input and output

一体化低压无刷电机具有输入与输出的接口。集成的数字量输入功能用于连接辅助运动控制的传感器，如限位微动开关，光电开关，霍尔传感器等。数字量输出功能可输出 8mA 电流，以驱动固态继电器或指示灯等。

The integrated low-voltage brushless motor has input and output interfaces. The integrated digital input function is used to connect sensors for auxiliary motion control, such as limit micro switches, photoelectric switches, Hall sensors, etc. The digital output function can output 8mA current to drive solid state relays or indicator lights.

6.1.1 数字量输入 Digital input

相关对象设置 Related object settings

对象索引 Object index	描述 Description
2003 _h (Input terminal parameters)	实体输入端子功能配置 Physical input terminal function configuration
2017 _h (VDI parameters)	虚拟输入端子功能配置 Virtual input terminal function configuration
200C: 07 _h (Communication\VDI)	虚拟数字输入使能, 0-禁用, 1-使能 Virtual digital input enable, 0-disable, 1-enable
2031 _h : 01h(VDI_VirtualLevelCommSet)	通信给定 VDI 虚拟电平 Communication given VDI virtual level
200Bh: 05h (MonitoredDiStates)	实体端子对应的实际电平状态 (bit0-DI1~bit3-DI4) The actual level status corresponding to the physical terminal (bit0-DI1~bit3-DI4)

控制指令 Control instruction

此设备数字量输入实体端子最多为 3 个：固定的输入 DI1~3；

There are at most 3 digital input physical terminals of this equipment: fixed input DI1~3;

通信虚拟输入端子，通过 2017_h 参数组设置使用。2031_h: 01_h 为通讯设置虚拟端子对应电平的状态 (bit0-VDI1~bit15-VDI16)。

Communication virtual input terminal, set and used by 2017_h parameter group. 2031_h: 01_h is the state of setting the corresponding level of the virtual terminal for communication (bit0-VDI1~bit15-VDI16).

6.1.1.1 实体端子 Physical terminals

特殊功能选择 Special function selection

具体取值如下表： The specific values are as follows:

功能号 Function number	功能定义 Function definition
0	无定义 Undefined
1	使能 Enable
2	报警复位 Alarm reset
6	多段运行指令切换 1 Multi-stage running command switching 1
7	多段运行指令切换 2 Multi-stage running command switching 2
8	多段运行指令切换 3 Multi-stage running command switching 3
9	多段运行指令切换 4 Multi-stage running command switching 4
12	暂停 Pause
14	正向超程开关 Forward Overtravel Switch
15	反向超程开关 Reverse overtravel switch
20	步进量使能 Step enable
21	Nimotion 速度模式下给定转速方向命令 Command of given speed direction in Nimotion Velocity mode
28	多段位置/速度使能 Multi-stage position/speed enable
31	原点开关 Home switch
33	设置原点 Set home
38	清除故障历史 Clear fault history
39	清除上电时间 Clear power-on time
40	正交脉冲输入 A (固定 DI1) Quadrature pulse input A (fixed DI1)
41	正交脉冲输入 B (固定 DI2) Quadrature pulse input B (fixed DI2)
42	脉冲输入 (固定 DI1) Pulse input (fixed DI1)
43	脉冲输入方向 (固定 DI2) Pulse input direction (fixed DI2)
44	占空比输入 (固定 DI1) Duty cycle input (fixed DI1)
45	占空比输入方向 (固定 DI2) Duty ratio input direction (fixed DI2)
46	外部增量式编码器信号 A (固定 DI1)

功能号 Function number	功能定义 Function definition
	External incremental encoder signal A (fixed DI1)
47	外部增量式编码器信号 B (固定 DI2) External incremental encoder signal B (fixed DI2)
48	外部增量式编码器信号 Z (固定 DI3) External incremental encoder signal Z (fixed DI3)

端子逻辑选择 Terminal logic selection

多功能端子逻辑选择通过 **2003h** (实体输入端子) 参数组设置使用。具体取值如下表:

The multi-function terminal logic selection is set and used by the parameter group 2003h (entity input terminal). The specific values are as follows:

设定值 Set value	逻辑定义 Logical definition
0	低电平有效 Active low
1	高电平有效 Active high
2	上升沿有效 Valid on rising edge
3	下降沿有效 Valid on falling edge
4	上升下降沿均有效 Both rising and falling edges are valid

注: Note:

1、“1-使能”只在 NiMotion 模式下有效，等效于 402 模式下对 6040h 写使能控制字。

“1-Enable” is only valid in NiMotion mode, which is equivalent to writing enable control word for 6040h in 402 mode.

2、不同端子不能设置相同的功能号，若设置有误则会报参数错误故障。

The same function number cannot be set for different terminals. If the setting is wrong, a parameter error fault will be reported.

3、若工作模式设置为 CiA402 的 HM 模式，没有设置 14、15 和 31 功能号也会报参数故障。

If the working mode is set to the HM mode of CiA402, the parameter failure will also be reported if the function numbers of 14, 15, and 31 are not set.

4、端子功能和逻辑选择设置为停机生效。

The terminal function and logic selection are set to be effective after shutdown.

5、数字输入端仅每毫秒探测一次。无法处理输入端处少于 1ms 的信号变化。

The digital input is only detected once every millisecond. Unable to handle signal changes of

less than 1ms at the input.

6、若检测实体端子功能号相对应功能号设置为 46、47 和 48 时，电机初始角 2000h:1Eh 会自动重置为 0，首次使能会使电机自动进入找电机初始角的状态（402 模式下状态机会退回到 Switch on disable 状态，需要重新通过控制字使状态字进入 Operation enabled 状态）；使用外部增量编码器时，电机首次上电都需要找电机初始角，否则电机无法正常运行。

If the corresponding function number of the detection physical terminal is set to 46, 47 and 48, the initial angle of the motor 2000h: 1Eh will be automatically reset to 0. The first enable will make the motor automatically enter the state of finding the initial angle of the motor (402 In the mode, the status machine will return to the Switch on disable state, and the status word needs to be entered into the Operation enabled state again through the control word; when an external incremental encoder is used, the initial angle of the motor needs to be found for the first time the motor is powered on, otherwise the motor cannot run normally).

举例 Examples

下面配置实体输入端子 DI1 为正限位开关

Next configure the physical input terminal DI1 as a positive limit switch

- 配置 DI1 为正限位开关, 2003h: 01h =14
Configure DI1 as a positive limit switch, 2003h: 01h = 14
- 逻辑选择为低电平有效, 2003h: 02h =0
Logic selection is low level effective, 2003h: 02h =0

6.1.1.2 虚拟端子 Virtual terminal

虚拟 VDI 端子特殊功能定义

Virtual VDI terminal special function definition

具体取值如下表：

The specific values are as follows:

功能号 Function number	功能定义 Function definition
0	无定义 Undefined
1	使能 Enable
2	报警复位 Alarm reset
6	多段运行指令切换 1 Multi-stage running command switching 1
7	多段运行指令切换 2 Multi-stage running command switching 2
8	多段运行指令切换 3 Multi-stage running command switching 3

9	多段运行指令切换 4 Multi-stage running command switching 2
12	暂停 Pause
14	正向超程开关 Forward Overtravel Switch
15	反向超程开关 Reverse overtravel switch
20	步进量使能 Step enable
21	Nimotion 速度模式下给定转速方向命令 Command of given speed direction in Nimotion Velocity mode
28	多段位置/速度使能 Multi-stage position/speed enable
31	原点开关 Home switch
33	设置零点 Set home
38	清除故障历史 Clear fault history
39	清除上电时间 Clear power-on time

虚拟 VDI 端子逻辑选择 Virtual VDI terminal logic selection

多功能端子逻辑选择通过 2017_h（虚拟输入端子）参数组设置使用。具体取值如下表：

Multi-function terminal logic selection is set and used by 2017h (virtual input terminal) parameter group. The specific values are as follows:

设定值 Set value	值的具体含义 The specific meaning of the value
0	高电平有效 Active high
1	上升沿有效 Valid on rising edge

启用 Enable

一体化低压无刷电机虚拟 VDI 端子在索引 200C_h: 07_h 为 1 时功能有效，200C_h: 07_h 值为 0 关闭虚拟 DI 端子功能。通过 2017_h 子索引输入端子功能号和逻辑选择来进行启用，当逻辑选择有效时，相应功能号的功能有效。索引 2031_h: 01_h 为虚拟输入端子对应的状态 (bit0-VDI1~bit15-VDI16)，只能通过通信方式给定，具体定义如下：

The virtual VDI terminal of the integrated low-voltage brushless motor is effective when the index 200C_h: 07_h is 1, and the value of 200C_h: 07_h is 0 to disable the virtual DI terminal function. It is enabled through the 2017_h sub-index input terminal function number and logic selection. When the logic selection is valid, the function of the corresponding function number is valid. Index

2031_h: 01_h is the corresponding state of the virtual input terminal (bit0-VDI1~bit15-VDI16), which can only be given through the communication method, the specific definition is as follows:

2031_h: 01_h

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

举例 Examples

下面配置虚拟输入端子 DI1 为步进使能

Next configure the virtual input terminal DI1 as step enable

- 配置 DI1 为正限位开关, 2017_h: 01_h=1
Configure DI1 as a positive limit switch, 2017_h: 01_h=1
- 逻辑选择为高电平有效, 2017_h: 02_h=0
Logic selection is high level effective, 2017_h: 02_h=0
- 启用, 2031_h: 01_h=1
Enable, 2031_h: 01_h=1

6.1.2 数字量输出 Digital output

相关对象设置 Related object settings

2004 _h (Output terminal parameters)	输出端子配置参数 Output terminal configuration parameters
2031 _h : 02h(VDoStateCommSet)	通信给定 VD0 输出状态 (bit0~Do) Communication given VD0 output status (bit0~Do)

控制指令 Control instruction

此设备数字量输出实体端子有 2 个, 需要配置对象 2004_h 选定输出端子功能和逻辑电平。也可以通过对对象 2031_h: 02_h 通信给定输出状态。

There are two digital output physical terminals of this device, and the configuration object 2004h needs to select the output terminal function and logic level. The output status can also be given through object 2031_h:02_h communication.

输出端子功能选择: Output terminal function selection:

功能号 Function number	功能定义 Function definition
0	无定义 Undefined
1	普通 DO 口 Ordinary DO port
2	电机运行停止 Motor stop
3	目标达到 Goal reached
4	报警输出 Alarm Output

输出端子逻辑选择: Logic selection of output terminal:

设定值 Set value	逻辑定义 Logical definition
0	低电平有效 Active low
1	高电平有效 Active high

举例 Examples

例 1: 配置 DO0 为用户控制并输出高电平:

Example 1: Configure DO0 as user control and output high level:

- 配置 DO0 为输出, 2004h: 01h =1;
Configure DO0 as output, 2004h: 01h =1;
- 配置 DO0 逻辑为高电平有效, 2004h: 02h =1;
Configure DO0 logic to be high level effective, 2004h: 02h =1;
- 通信给定 DO0 输出电平, 2031h: 02h = 0x01, 此时 DO0 输出高电平。
Communication given DO0 output level, 2031h: 02h = 0x01, at this time DO0 output high level.

6.2 I²t 电机过载保护 I²t motor overload protection

一体化低压无刷电机通电后, 由于电流的热效应将不断产生热量, 同时向周围环境释放热量。当电机产生的热量超过释放的热量时, 电机温度升高, 温度过高, 将导致电机烧毁。I²t 电机过载保护的目的是确保电机在温度限值下正常运行, 防止电机损坏。

After the integrated low-voltage brushless motor is energized, it will continue to generate heat due to the thermal effect of the current, and at the same time release heat to the surrounding environment. When the heat generated by the motor exceeds the released heat, the temperature of the motor rises, and the temperature is too high, which will cause the motor to burn out. The purpose of I²t motor overload protection is to ensure the normal operation of the motor within the temperature limit and prevent damage to the motor.

相关对象 Related objects

对象索引 Object index	描述 Description
2000h: 09h (RatedCurrent)	额定电流 (单位: 0.01A) Rated current (unit: 0.01A)
2000h: 0Ah (MaximumCurrent)	最大电流 (单位: 0.01A) Maximum current (unit: 0.01A)
2000h: 0Bh (MaxCurrentDurTime)	最大电流持续时间 (单位: ms) Maximum current duration (unit: ms)

触发机制 Trigger mechanism

要启用该保护功能, 必须要正确说明上述三个对象项。当电机运行在额定电流以上的时候, 驱动器检测并计算 I² 的时间积分, 当积分值大于设定的最大电流(2000h: 0Ah)和最大电流持续时间(2000h: 0Bh)的乘积时, 电机报过载警告并限制转矩输出为额定值。若这些条件未被满足, I²t 过载保护功能将不会被触发。

To enable this protection function, the above three object items must be explained correctly.

When the motor runs above the rated current, the drive detects and calculates the time integral of I_{2t}. 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 reports an overload Warning and limit torque output to rated value. If these conditions are not met, the I_{2t} overload protection function will not be triggered.

6.3 制动设置 Brake settings

一体化无刷电机无内置制动电阻和外置制动电阻，为防止当电机的转矩和转速方向相反时，能量从电机端传回电机的驱动器内使得母线电压值过高损坏电机的驱动器，驱动器内部会判断当母线电压超过泄放电压（2001h: 0F_h）后，通过控制电机来消耗多余的回馈能量。

The integrated brushless motor has no built-in braking resistor and external braking resistor, in order to prevent the energy from being transmitted back to the motor driver from the motor end when the torque and speed of the motor are opposite, so that the bus voltage is too high to damage the motor driver , The driver internally judges that when the bus voltage exceeds the bleed voltage (2001h: 0F_h), it consumes excess feedback energy by controlling the motor.

下表为一体化无刷电机型号所对应的转子惯量与可制动功率 P₀ 大小。

The following table shows the rotor inertia and braking power P₀ corresponding to the integrated brushless motor model.

一体化无刷电机型号 Integrated brushless motor model	转子惯量 J (10 ⁻⁴ kgm ²) Rotor inertia J (10⁻⁴kgm²)	制动功率 P ₀ (W) Braking power P₀ (W)
BLM4210A	0.14	5.4

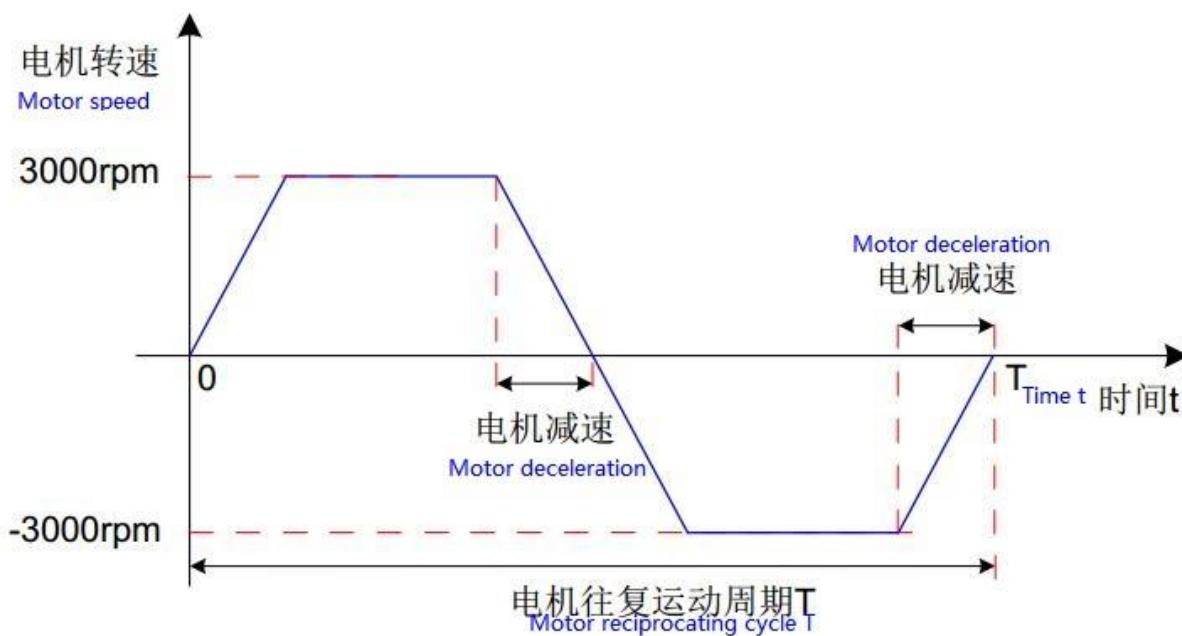
实际所需制动电阻功率 P 与往复运动的周期 T (s)、电机转速 n (rpm)、转子惯量 J (kgm²)、负载与电机的惯量比 N 有关，具体计算公式如下：

The actual required braking resistor power P is related to the period T (s) of the reciprocating motion, the motor speed n (rpm), the rotor inertia J (kgm²), and the load and motor inertia ratio N. The specific calculation formula is as follows:

$$P = \frac{2*(N+1)*J*n*n}{182*T}$$

以 BLM4210A 为例，假设往复运动周期 T=2s，最高转速 3000rpm，负载惯量为电机惯量的 5 倍，具体的速度曲线如下：

Taking BLM4210A as an example, assume that the reciprocating motion period T=2s, the maximum speed is 3000rpm, and the load inertia is 5 times the motor inertia. The specific speed curve is as follows:



则需制动电阻功率: The braking resistor power is required:

$$P_1 = \frac{2*(N+1)*J*n*n}{182*T} = \frac{2*(5+1)*0.14*0.0001*3000*3000}{182*2} = 4.15W$$

P_1 小于一体化无刷电机可处理的制动功率 P_0 (5.4W) , 此时一体化无刷电机可以满足此减速速度(或者负加速度)。

P_1 is less than the braking power P_0 (5.4W) that the integrated brushless motor can handle. At this time, the integrated brushless motor can meet this deceleration (or negative acceleration).

若将上述假设条件中的负载惯量由 5 倍改为 10 倍, 其他条件不变, 则需制动电阻功率 P_2 :

If the load inertia in the above assumptions is changed from 5 times to 10 times, and other conditions remain unchanged, the braking resistor power P_2 is required:

$$P_2 = \frac{2*(N+1)*J*n*n}{182*T} = \frac{2*(10+1)*0.14*0.0001*3000*3000}{182*2} = 7.62W$$

P_2 大于 P_0 (5.4W) , 此时一体化无刷电机为防止电压过充, 只能按照 P_0 (5.4W) 对应的减速度进行减速, 无法满足用户所需的减速速度要求, 建议用户调整减速速度大小。

P_2 is greater than P_0 (5.4W). At this time, the integrated brushless motor can only be decelerated according to the deceleration corresponding to P_0 (5.4W) to prevent voltage overcharge. It cannot meet the deceleration requirements of the user. It is recommended that the user adjust the deceleration size.

注: 除非直流侧电源允许能量回馈, 否则本产品不适合于用作发电机的场合。

Note: Unless the DC side power supply allows energy feedback, this product is not suitable for use as a generator.

6.4 参数保存和恢复 Parameter saving and restoration

参数管理按 CiA301 标准编写, 1010_h 为保存参数功能对象, 1011_h 为读取参数功能对象。

The parameter management is written according to CiA301 standard, 1010h is the function object for saving parameters, and 1011h is the function object for reading parameters.

6.4.1 65参数保存 Parameter saving

1010h 的子索引中，值为 1 表明支持对应的保存操作，0x65766173 为保存参数命令，往 1010h 对应子索引写保存参数命令字，返回 1 为保存参数成功，返回非 1 为不成功。

In the 1010h sub-index, a value of 1 indicates that the corresponding save operation is supported, 0x65766173 is the save parameter command, write the save parameter command word to the 1010h corresponding sub-index, return 1 to save the parameter success, and return a non-1 to unsuccessful.

例如：1010h: 01h 写 0x65766173 为保存用户参数。

For example: 1010h: 01h write 0x65766173 to save user parameters.

6.4.2 参数恢复 Parameter recovery

1011h 的子索引中，值为 1 表明支持对应的恢复操作，0x64616F6C 为恢复参数命令，往 1011h 对应子索引写恢复参数命令字，返回 1 为恢复参数成功，返回非 1 为不成功。

In the sub-index of 1011h, a value of 1 indicates that the corresponding recovery operation is supported, 0x64616F6C is the recovery parameter command, and the recovery parameter command word is written to the corresponding sub-index of 1011h, returning 1 is the recovery parameter success, and returning a non-1 is unsuccessful.

例如：1011h: 01h 写 0x64616F6C 为恢复 Nimotion 参数；

For example: 1011h: 01h write 0x64616F6C to restore Nimotion parameters;

6.5 参数保存和恢复 Parameter saving and restoration

参数管理按 CiA301 标准编写，1010h 为保存参数功能对象，1011h 为读取参数功能对象。

The parameter management is written according to CiA301 standard, 1010h is the function object for saving parameters, and 1011h is the function object for reading parameters.

7 调整 Adjustment

7.1 概述 Overview

为了最大限度的发挥一体化无刷电机的性能，使该设备能快速、准确的响应来自上位机或者内部设定的指令，必须根据驱动负载的特性对增益进行合理的调整。增益包括速度环增益、位置环增益，速度环积分时间，滤波等，他们之间相互影响，因此在调整增益参数时，必须考虑到各个参数之间的平衡。

In order to maximize the performance of the integrated brushless motor, so that the device can quickly and accurately respond to commands from the host computer or internal settings, the gain must be adjusted reasonably according to the characteristics of the driving load. The gain includes speed loop gain, position loop gain, speed loop integration time, filtering, etc., and they affect each other, so when adjusting the gain parameters, the balance between each parameter must be considered.

注：在进行增益调整之前，建议先进行点动试运行，确认电机可以正常动作；调整过程中可能伴随着马达的振动，请充分注意安全。

Note: Before performing gain adjustment, it is recommended to perform a jog test run to confirm that the motor can operate normally; during the adjustment process, vibration of the motor may be accompanied, so please pay full attention to safety.

7.2 参数离线识别 Offline parameter identification

电机电阻、电机电感、转动惯量、电机转矩系数、电机初始角等是电机的重要参数，正确的设置这些参数是保证电机正常运行的前提。这些参数可以根据实际手动设置，也可以通过电机的参数离线识别功能自动识别。

Motor resistance, motor inductance, moment of inertia, motor torque coefficient, motor initial angle, etc. are important parameters of the motor. Setting these parameters correctly is the prerequisite for ensuring the normal operation of the motor. These parameters can be set manually according to the actual situation, or can be automatically recognized by the offline parameter recognition function of the motor.

7.2.1 相关对象 Related objects

对象索引 Object index	描述 Description
2000h:06h (SerialEncoderType)	编码器类型 Encoder type
2000h:09h (RatedCurrent)	额定电流（单位 0.01A） Rated current (unit 0.01A)
2000h:0Eh (RatedMotorSpeed)	额定转速（单位 rpm） Rated speed (in rpm)
2000h:11h (PolePairsNum)	电机极对数 Motor pole pairs
2000h:1Eh (PhU_UpEdgeElecAngle)	电机初始角 Motor initial angle
2001h:0Dh (DeadZoneTime)	开关死区时间（单位 us），默认 100us Switch dead time (unit us), default 100us

2001h:1Dh (OpenLoopCurrent)	开环运行电流 (单位: 0.01A) Open-loop running current (unit: 0.01A)
2001h:01h (CtrlModeSelc)	控制模式选择 (5 为电机参数离线识别) Control mode selection (5 is offline identification of motor parameters)
2009h:06h (OffInertiaAutoTunMode)	参数离线识别状态显示 Parameter offline recognition status display

注：启用电机的参数离线识别功能必须正确设置以上相关对象

Note: The above related objects must be set correctly to enable the offline parameter recognition function of the motor

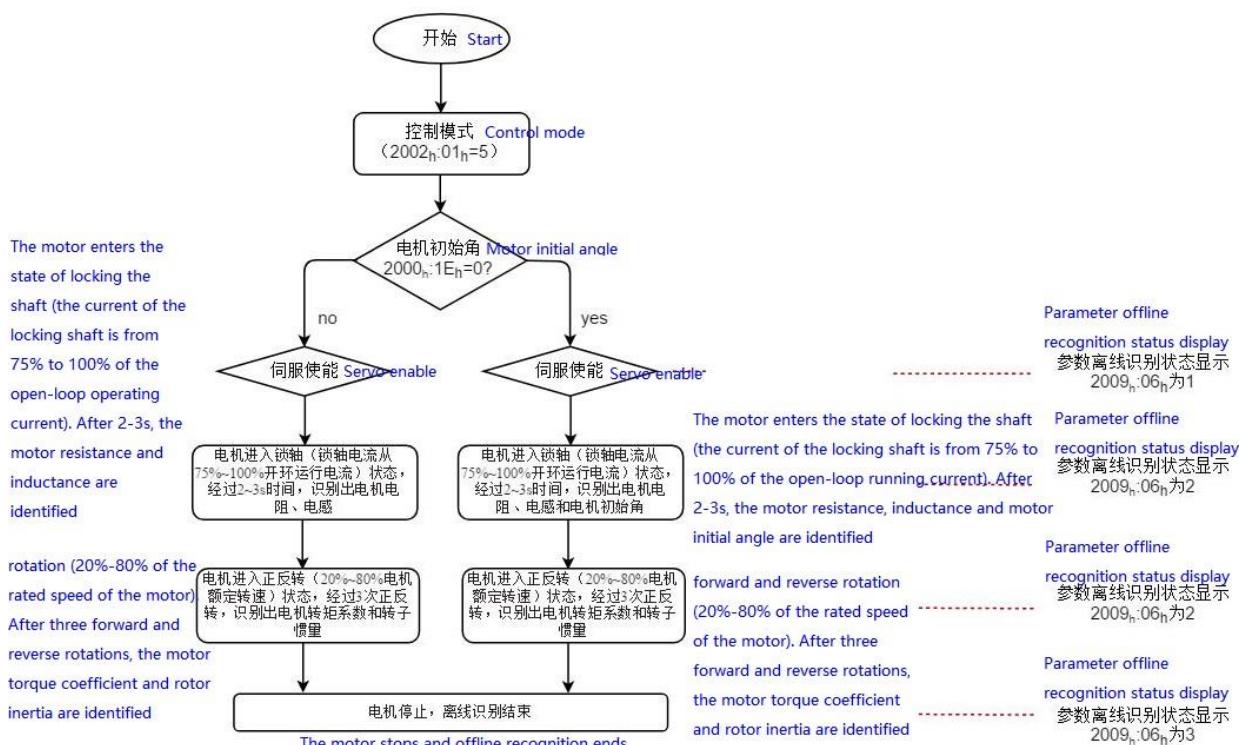
7.2.2 参数离线识别说明 Description of offline parameter identification

当使用电机的参数离线识别功能时，需注意下列事项：

When using the offline parameter identification function of the motor, the following items should be noted:

- 必须正确设置 8.2.1 章节的相关对象；
The relevant objects in chapter 8.2.1 must be set correctly;
- 设置的开环运行电流在额定电流之内；
The set open-loop running current is within the rated current;
- 转子负载比较稳定，无剧烈波动，负载惯量比（负载总惯量与转子惯量之比）在合适范围之内；
The rotor load is relatively stable without severe fluctuations, and the load inertia ratio (the ratio of the total load inertia to the rotor inertia) is within the appropriate range;
- 电机实际运行速度为 20%—80% 的额定速度
The actual running speed of the motor is 20%-80% of the rated speed

参数离线识别流程图 Parameter offline recognition flowchart



电机参数离线识别过程中会监视每个流程，若出现流程跳转和超时，则会报电机参数识别故障（故障码：0xFF01）。

During the process of offline identification of motor parameters, each process will be monitored. If a process jump or timeout occurs, a motor parameter identification fault (fault code: 0xFF01) will be reported.

7.3 手动增益调整 Manual gain adjustment

7.3.1 相关对象 Related objects

对象索引 Object index	描述 Description
2008 _h : 01 _h (SpeedLoopGain)	速度环增益（单位 0.1Hz），在不产生噪声、振动的情况下，增大此参数，可加快定位时间，带来更好的速度稳定性和跟随性；产生噪音，则降低参数设定值； Speed loop gain (unit 0.1Hz), increase this parameter without noise and vibration, can speed up the positioning time, bring better speed stability and followability; if noise occurs, reduce the parameter setting value ;
2008 _h : 02 _h (SpdLoopIntergrTime)	速度环积分时间常数(单位 0.01ms)，减小设定值可加强积分作用，加快定位时间，但设定值过小易引起机械振动。 Speed loop integral time constant (unit: 0.01ms). Decreasing the set value can strengthen the integral function and speed up the positioning time. However, if the set value is too small, it may cause mechanical vibration.
2008 _h : 03 _h (PosLoopGain)	位置环增益，加大此参数，可加快定位时间，并提高电机静止时抵抗外界扰动的能力。设定值过高可能导致系统不稳定，发生振荡 Position loop gain, increasing this parameter can speed up the positioning time and improve the ability of the motor to resist external disturbances when it is stationary. If the setting value is too high, the system may become unstable and oscillate.
2008 _h : 0F _h (SpdFdFwrFilterTime)	速度前馈滤波时间常数（单位 0.01ms） Speed feedforward filter time constant (unit: 0.01ms)
2008 _h : 10 _h (SpeedFdFwrGain)	速度前馈增益 Speed feedforward gain
2008 _h : 11 _h (TorqFdFwrFilterTime)	转矩前馈滤波时间常数（单位 0.01ms） Torque feedforward filter time constant (unit: 0.01ms)
2008 _h : 12 _h (TorqFdFwrGain)	转矩前馈增益 Torque feedforward gain
2007 _h : 06 _h (TorqRefFilterTime)	转矩指令滤波时间常数，消除高频噪声，抑制机械共振。增大 2008 _h : 01 _h 发生振动时，可通过调整 2007 _h : 06 _h 抑制振动。设定值过大，将导致电流环的响应降低

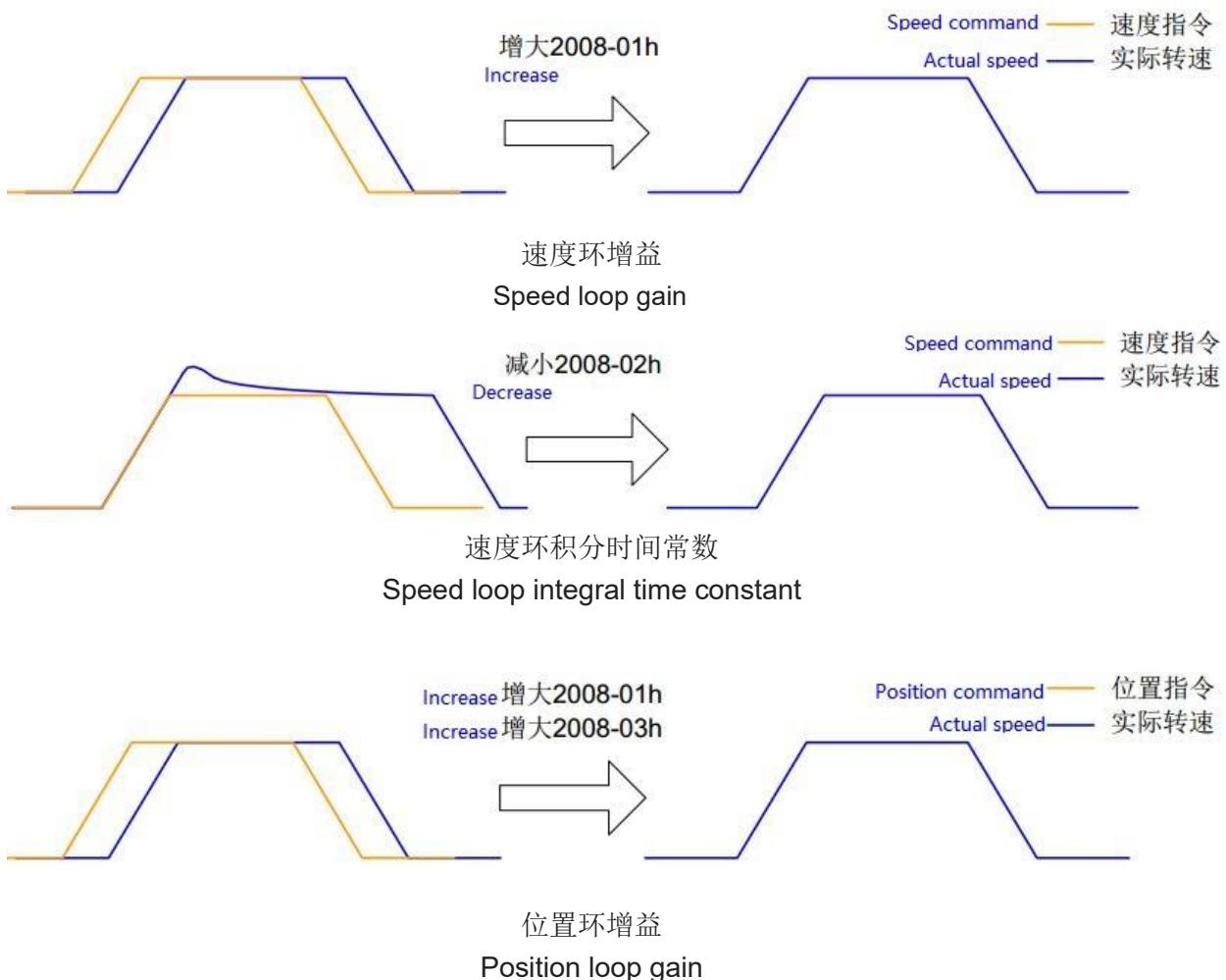
	The torque command filters the time constant, eliminates high-frequency noise, and suppresses mechanical resonance. Increase When vibration occurs in 2008h: 01h, the vibration can be suppressed by adjusting 2007h: 06h. If the setting value is too large, the response of the current loop will decrease
--	--

7.3.2 基本增益调整说明 Basic gain adjustment instructions

一体化无刷电机由三个控制环路构成，从内向外依次是电流环、速度环和位置环，电流环的响应频率最高。无刷电机出厂默认电流环增益参数已确保了充分的响应性，一般无需调整，因此需要调整的只有位置环增益、速度环增益及速度环积分时间常数。为保证系统稳定，提高位置环增益的同时，需提高速度环增益。

The integrated brushless motor is composed of three control loops, which are the current loop, the speed loop and the position loop in order from inside to outside. The response frequency of the current loop is the highest. The factory default current loop gain parameters of the brushless motor have ensured sufficient responsiveness, and generally no adjustment is required, so only the position loop gain, speed loop gain and speed loop integral time constant need to be adjusted. In order to ensure the stability of the system, while increasing the position loop gain, it is necessary to increase the speed loop gain.

基本增益调节如下： The basic gain adjustment is as follows:





7.3.3 前馈增益调整说明 Explanation of feedforward gain adjustment

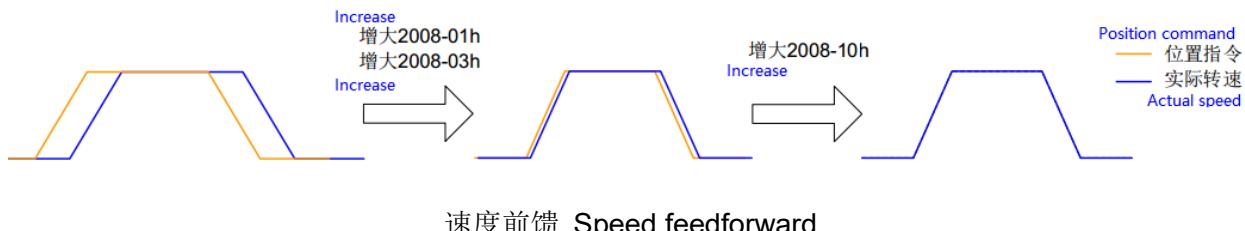
速度前馈 Speed feedforward

速度前馈可以提高速度指令响应，减小固定速度时的位置偏差，主要应用于全闭环位置控制模式。基本调节方法如下：

Speed feedforward can improve the speed command response and reduce the position deviation at a fixed speed. It is mainly used in the full closed-loop position control mode. The basic adjustment method is as follows:

设定 $2008_{\text{h}}: 0F_{\text{h}}$ 为一固定数值；然后，将 $2008_{\text{h}}: 10_{\text{h}}$ 设定值由 0 逐渐增大，直至某一设定值下，速度前馈取得效果。调整时，应反复调整 $2008_{\text{h}}: 0F_{\text{h}}$ 和 $2008_{\text{h}}: 10_{\text{h}}$ ，寻找平衡性好的设定

Set $2008_{\text{h}}: 0F_{\text{h}}$ as a fixed value; then, gradually increase the setting value of $2008_{\text{h}}: 10_{\text{h}}$ from 0 until a certain set value, speed feedforward to achieve the effect. When adjusting, you should repeatedly adjust $2008_{\text{h}}: 0F_{\text{h}}$ and $2008_{\text{h}}: 10_{\text{h}}$ to find a well-balanced setting



转矩前馈 Torque feedforward

位置控制模式，采用转矩前馈，可以提高转矩指令响应，减小固定加减速时的位置偏差；速度控制模式，采用转矩前馈，可以提高转矩指令响应，减小固定速度时的速度偏差。

The position control mode, using torque feedforward, can improve the torque command response and reduce the position deviation during fixed acceleration and deceleration; the speed control mode, using torque feedforward, can improve the torque command response and reduce the fixed speed Speed deviation.

基本调节方法如下： The basic adjustment method is as follows:

设定 $2008_{\text{h}}: 11_{\text{h}}$ 为一固定数值；然后，将 $2008_{\text{h}}: 12_{\text{h}}$ 设定值由 0 逐渐增大，直至某一设定值下，速度前馈取得效果。调整时，应反复调整 $2008_{\text{h}}: 11_{\text{h}}$ 和 $2008_{\text{h}}: 12_{\text{h}}$ ，寻找平衡性好的设定。

Set $2008_{\text{h}}: 11_{\text{h}}$ as a fixed value; then, gradually increase the setting value of $2008_{\text{h}}: 12_{\text{h}}$ from 0 until a certain set value, speed feedforward to obtain the effect. When adjusting, you should repeatedly adjust $2008_{\text{h}}: 11_{\text{h}}$ and $2008_{\text{h}}: 12_{\text{h}}$ to find a well-balanced setting.

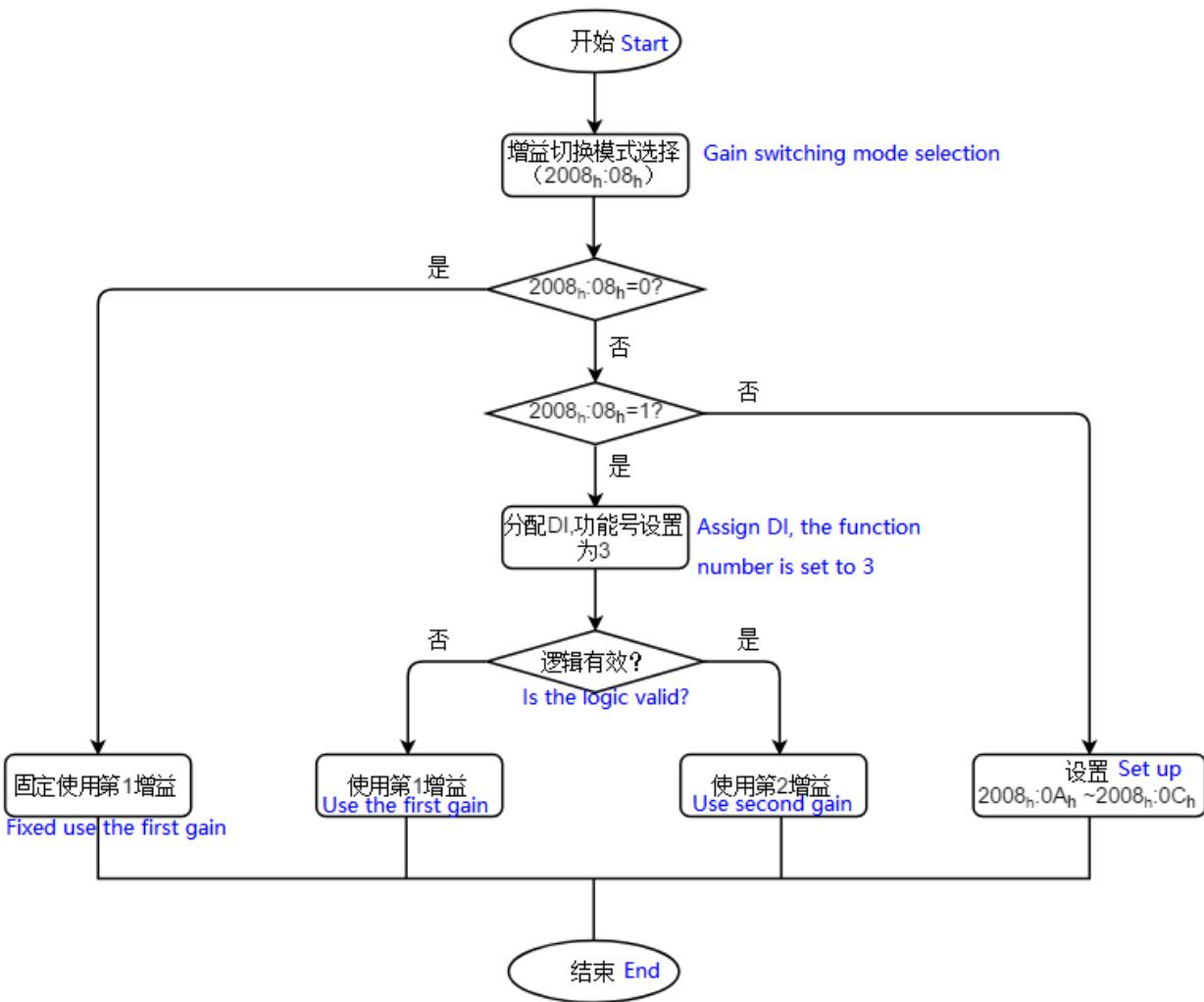
7.3.4 增益切换调整说明 Gain switching adjustment instructions

电机的增益切换功能由外部 DI 或内部状态触发，当切换条件满足时，电机根据相关参数设置的有效性切换至第 1 组或第 2 组增益，满足实际使用需求，具体作用如下：

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

- 电机运行状态切换到较高增益，以获得更好的指令跟踪性能；
Switch the motor running state to a higher gain to get better command tracking performance;
- 电机静止状态切换到较高增益，以缩短定位时间；
Switch to a higher gain when the motor is at a standstill to shorten the positioning time;
- 电机静止(使能)状态切换到较低增益，以抑制振动；
Switch to lower gain when the motor is at rest (enable) to suppress vibration;
- 根据负载设备情况等通过外部信号切换不同的增益设置；
Switch different gain settings through external signals according to the load equipment conditions;

增益切换流程图 Gain switching flowchart



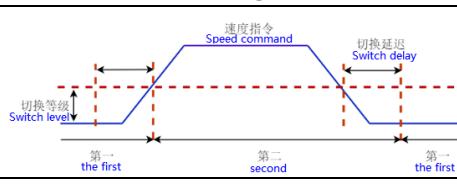
增益切换条件 Gain switching conditions

第一增益 (2008_h:01_h~2008_h:03_h) 与第二增益 (2008_h:04_h~2008_h:06_h) 的切换共有 10 种模式，不同模式的示意图和关联参数如下表所示：

There are 10 modes for switching between the first gain (2008_h:01_h~2008_h:03_h) and the second gain (2008_h:04_h~2008_h:06_h). The schematic diagrams and related parameters of different modes are shown in the following table:

增益切换模式 Gain switching mode			关联参数 Related parameters		
模式名 Pattern name	示意图 Schematic diagram		延迟时间 Delay time (2008 _h :0Ah)	切换等级 Switching level (2008 _h :0B _h)	切换时滞 Switching time lag (2008 _h :0C _h)
2008 _h :08 _h	-	-	无效 Invalid	无效 Invalid	无效 Invalid
0 固定使用第 1 增益 Fixed the 1st gain	-	-	无效 Invalid	无效 Invalid	无效 Invalid
1 使用外部 DI 切换	-	-	无效 Invalid	无效 Invalid	无效 Invalid

增益切换模式 Gain switching mode			关联参数 Related parameters		
	Use external DI switch				
2	转矩指令 Torque command		有效 valid (ms)	有效 valid (%)	有效 valid (%)
3	速度指令 Speed command	内部生效的速度指令值(606B _h) 25ms 维持不变固定使用第 1 增益，变化使用第 2 增益 The internally effective speed command value (606B _h) remains unchanged for 25ms. The first gain is used fixedly, and the second gain is used for changes.	有效 valid (ms)	无效 valid Invalid	无效 valid Invalid
4	速度指令变化率 Speed command rate of change		有效 valid (ms)	有效 valid (rpm/ms)	有效 valid (rpm/ms)
5	速度指令 Speed command		有效 valid (ms)	有效 valid (rpm)	有效 valid (rpm)
6	位置偏差 Position deviation		有效 valid (ms)	有效 (编码器单位)	有效 (编码器单位)
7	位置指令 Position command		有效 valid (ms)	无效 Invalid	无效 Invalid
8	定位完成 Positioning complete		有效 valid (ms)	无效 Invalid	无效 Invalid

增益切换模式 Gain switching mode			关联参数 Related parameters		
9	实际速度 Actual speed		有效 valid (ms)	有效 valid (rpm)	有效 valid (rpm)

7.4 共振抑制 Resonance suppression

无刷电机在实际使用过程中由于机械系统固有的共振特性，在基本增益提高的同时，可能会在机械共振频率附近产生共振，影响无刷电机性能的发挥。陷波器通过降低特定频率处的增益，可达到抑制共振的目的。

In the actual use process of the brushless motor, due to the inherent resonance characteristics of the mechanical system, while the basic gain is increased, resonance may occur near the mechanical resonance frequency, affecting the performance of the brushless motor. The trap can suppress resonance by reducing the gain at a specific frequency.

一体化无刷电机有 4 组手动陷波器，每组陷波器有 3 个参数，分别为陷波器频率，陷波宽度和深度，各参数由用户手动设置，具体如下表所示：

The integrated brushless motor has 4 sets of manual wave traps. Each set of wave traps has 3 parameters, which are the wave trap frequency, the width and depth of the wave trap. Each parameter is manually set by the user, as shown in the following table:

名称 Name	手动陷波器 Manual trap			
	1	2	3	4
频率(Hz) Frequency (Hz)	2009h: 0Dh	2009h: 10h	2009h: 13h	2009h: 16h
陷波宽度(Hz) Notch width (Hz)	2009h: 0Eh	2009h: 11h	2009h: 14h	2009h: 17h
深度(%) Depth(%)	2009h: 0Fh	2009h: 12h	2009h: 15h	2009h: 18h

注：当深度等级为 0，陷波器无效。

Note: When the depth level is 0, the trap is invalid.

使用手动陷波器时，需要将陷波器的频率设置为实际发生的中心共振频率，同时输入该组陷波器的宽度等级（中心共振频率范围）和深度等级，若共振得到抑制，说明陷波器取得效果。

When using a manual notch filter, you need to set the frequency of the notch filter to the actual center resonance frequency, and enter the width level (central resonance frequency range) and depth level of the group of traps. If the resonance is suppressed, it means that the trap The wave device achieves the effect.

陷波器深度 Trap depth

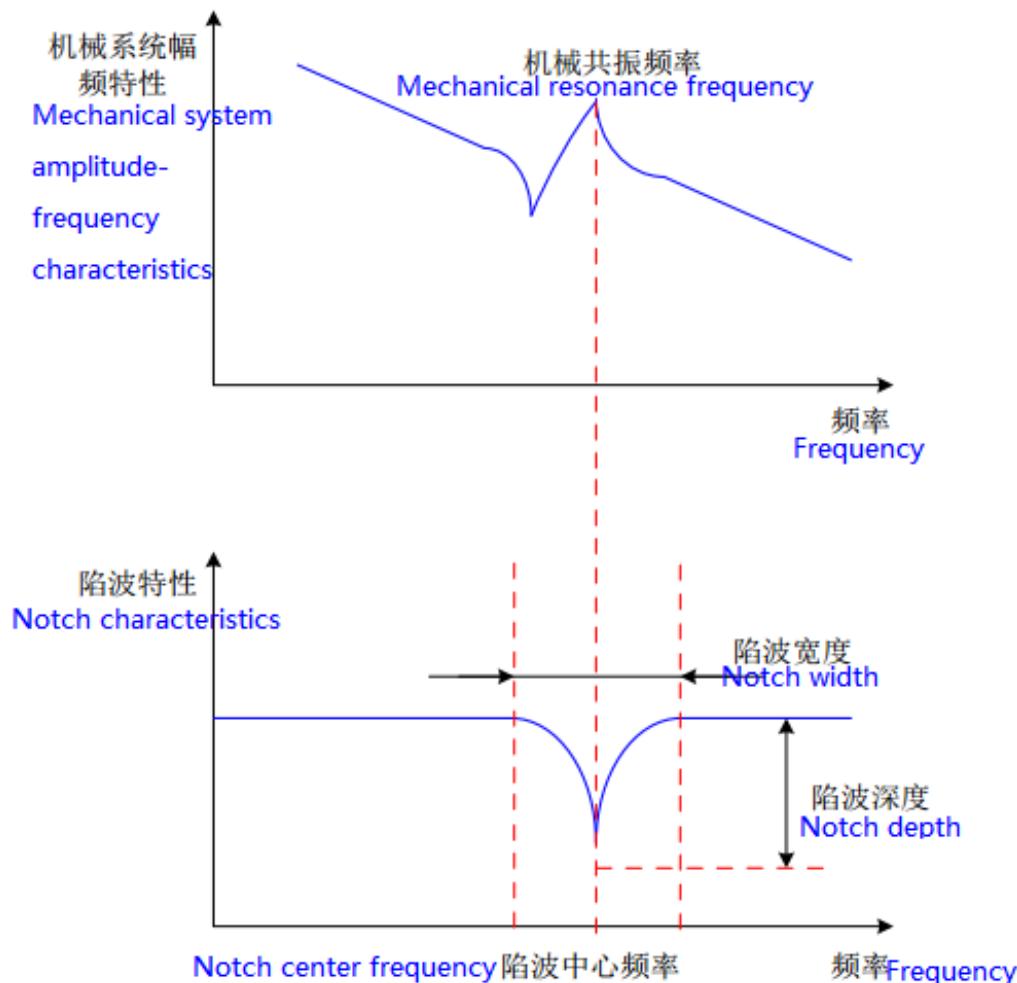
陷波器深度等级 100 时，在中心频率处，输入完全被抑制；陷波器深度等级为 0 时，陷波器无效。因此，陷波器深度等级设置越大，陷波深度越深，对机械共振的抑制也越强，但可能导致系统

不稳定，使用时应注意。

When the notch filter depth level is 100, the input is completely suppressed at the center frequency; when the notch filter depth level is 0, the notch filter is invalid. Therefore, the greater the setting of the notch depth level, the deeper the notch depth, the stronger the suppression of mechanical resonance, but it may cause the system to be unstable, so please pay attention when using it.

陷波器抑制原理如下图所示：

The principle of trap suppression is shown in the following figure:



8 故障管理 Fault management

8.1 报警代码 Alarm code

当一体化无刷电机出现警告或者故障时，电机会主动报警（指示灯-黄灯闪烁，0.5s 闪烁频率表示为警告、0.25s 闪烁频率表示为故障；指示灯-绿色 0.5s 闪烁代表通讯报警，常亮代表通讯正常），并执行相应的动作。相应的报警代码会存储在对象 1003_h: 02_h~1003_h: 11_h 中，对象 1003_h: 01_h 为当前的故障数目。

When the integrated brushless motor has a warning or a fault, the motor will actively alarm (indicator-yellow light flashes, 0.5s flashing frequency indicates a warning, 0.25s flashing frequency indicates a fault; indicator-green 0.5s flashing indicates communication alarm , Steady light means normal communication), and perform the corresponding action. The corresponding alarm code will be stored in the object 1003_h: 02_h~1003_h: 11_h, and the object 1003_h: 01_h is the current number of faults.

对象 1003_h 中有 16 个报警队列，采用堆栈方式存储，遵循先进先出规则。在历史报警存储都被占用的情况下，产生新的报警，会删除最早出现的错误，之前的错误依次向下移动。具体报警代码如下表所示：

There are 16 alarm queues in object 1003_h, which are stored in a stack and follow the first-in first-out rules. In the case where the historical alarm storage is occupied, a new alarm is generated and the earliest error is deleted, and the previous errors are moved down in turn. The specific alarm codes are shown in the following table:

报警代码一览表

List of alarm codes

报警代码 Alarm code	报警内容 Alarm content	默认报警类型 Default alarm type	默认故障反 应码 Default fault response code	是否自复位 Whether to reset	603F _h (错误码) (error code)
0x2300	电机过流 Motor overcurrent	故障 Fault	0	否 No	0x2301
0x4012311	电机过载 Motor overload	警告 Warning	4	是 Yes	0x2311
0x3002312	电机堵转 Motor blocked	暂停并锁轴 Pause and lock the shaft	3	否 No	0x2312
0x13210	电源过电压 Power supply overvoltage	故障 Fault	0	是 Yes	0x3210
0x1013220	电源欠电压 Power supply undervoltage	故障 Fault	1	是 Yes	0x3220
0x14210	温度过高报警	故障 Fault	0	是 Yes	0x4210

报警代码 Alarm code	报警内容 Alarm content	默认报警类型 Default alarm type	默认故障反应码 Default fault response code	是否自复位 Whether to reset	603Fh(错误码) (error code)
	High temperature alarm				
0x14220	温度过低报警 Low temperature alarm	故障 Fault	0	是 Yes	0x4220
0x5080	驱动器故障* Drive failure*	故障 Fault	0	否 No	0x5080
0x5540	Flash 操作故障* Flash operation failure*	故障 Fault	0	否 No	0x5540
0x5541	Flash 初始化故障* Flash initialization failure*	故障 Fault	0	否 No	0x5541
0x4005542	Flash 校验错误警告* Flash check error warning*	警告 Warning	4	否 No	0x5542
0x5543	Flash 用户区无参数* No parameters in Flash user area*	故障 Fault	0	否 No	0x5543
0x6000	硬件初始化故障* Hardware initialization failure*	故障 Fault	0	否 No	0x6000
0x16320	参数设置错误 Parameter setting error	故障 Fault	0	是 Yes	0x6320
0x6321	注册故障* Registration failure*	故障 Fault	0	否 No	0x6321
0x7305	Z 脉冲故障* Z pulse failure*	故障 Fault	0	否 No	0x7305
0x7306	编码器故障* Encoder failure*	故障 Fault	0	否 No	0x7306
0x4017307	编码器警告* Encoder warning*	警告 Warning	4	是 Yes	0x7307
0x17310	超速 Overspeed	故障 Fault	0	是 Yes	0x7310
0x4017501	Modbus 通信中的非法功能码 Illegal function code	警告 Warning	4	是 Yes	0x7501

报警代码 Alarm code	报警内容 Alarm content	默认报警类型 Default alarm type	默认故障反应码 Default fault response code	是否自复位 Whether to reset	603Fh(错误码) (error code)
	in Modbus communication				
0x4017502	Modbus 通信中的非法地址 Illegal address in Modbus communication	警告 Warning	4	是 Yes	0x7502
0x4017503	Modbus 通信中的非法数据值 Illegal data value in Modbus communication	警告 Warning	4	是 Yes	0x7503
0x4017505	Modbus 通信中的确认 Confirmation in Modbus communication	警告 Warning	4	是 Yes	0x7505
0x4017506	Modbus 通信中的从设备忙 Slave device busy in Modbus communication	警告 Warning	4	是 Yes	0x7506
0x401750C	Modbus 通信中的同步报文请求数据数据大于映射总数据 Synchronous message request data data in Modbus communication is greater than total mapped data	警告 Warning	4	是 Yes	0x750C
0x401750D	Modbus 通信中的同步报文请求数据个数对应映射数据不相等 The number of synchronous message request data in Modbus	警告 Warning	4	是 Yes	0x750D

报警代码 Alarm code	报警内容 Alarm content	默认报警类型 Default alarm type	默认故障反应码 Default fault response code	是否自复位 Whether to reset	603Fh(错误码) (error code)
	communication corresponds to the unequal mapping data				
0x401750E	Modbus 通信中的同步功能下单播报文节点地址错误 The node address of the unicast message is incorrect under the synchronous function in Modbus communication	警告 Warning	4	是 Yes	0x750E
0x8610	原点回归超时 Origin return timeout	故障 Fault	0	否 No	0x8610
0x8611	位置超差 Location out of tolerance	故障 Fault	0	否 No	0x8611
0x3018613	软件限位错误 Software limit error	暂停并锁轴 Pause and lock the shaft	3	否 No	0x8613
0x3018614	限位开关错误 Limit switch error	暂停并锁轴 Pause and lock the shaft	3	否 No	0x8614
0x4018615	曲线规划计算错误 Curve planning calculation error	警告 Warning	4	是	0x8615
0x18616	目标位置溢出 Target position overflow	故障 Fault	0	否 No	0x8616
0x5018617	曲线规划参数过小 Curve planning parameters are too small	忽略 Ignore	5	是 Yes	0x8617
0xFF01	电机参数识别故障* Motor parameter identification failure*	故障 Fault	0	否 No	0xFF01

报警代码相应位的定义 Definition of corresponding bit of alarm code

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
故障反应码 Fault response code[8]								自复位允许 Self reset allowed[8]							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
故障码 Error code[16]															

● 故障反应码定义 Definition of fault response code

- 0- 状态机切换到故障状态（参照“4.1 CiA402 状态机”），如果 $605E \geq 0$ ，则按照 $605E$ 选择的故障停机方式；否则：功率管全关，自由停机。
 0-state machine switches to the fault state (refer to "4.1 CiA402 state machine"). If $605E \geq 0$, the fault shutdown mode selected by $605E$ will be followed; otherwise: the power tube is fully closed and free shutdown.
- 1- 状态机切换到故障状态（参照“4.1 CiA402 状态机”），如果 $605E \geq 0$ ，则按照 $605E$ 选择的故障停机方式；否则：按慢速曲线停车关闭输出。
 1- The state machine switches to the fault state (refer to "4.1 CiA402 state machine"), if $605E \geq 0$, the fault shutdown mode selected by $605E$ is followed; otherwise: the output is shut down according to the slow curve.
- 2- 状态机切换到故障状态（参照“4.1 CiA402 状态机”），如果 $605E \geq 0$ ，则按照 $605E$ 选择的故障停机方式；否则：按快速曲线停车关闭输出。
 2- The state machine switches to the fault state (refer to "4.1 CiA402 state machine"), if $605E \geq 0$, the fault shutdown mode selected by $605E$ is followed; otherwise: the output is shut down according to the fast curve stop.
- 3- 按快速曲线暂停锁轴，不切换到故障状态并不受对象 $605E_h$ 影响。
 3- Press the quick curve to suspend the axis lock without switching to the fault state and not affected by the object $605E_h$.
- 4- 警告且不改变当前运行状态，不切换到故障状态并不受对象 $605E_h$ 影响。
 4- Warning and do not change the current operating state, do not switch to the fault state and are not affected by the object $605E_h$.
- 5- 忽略并记录在 $1003h$ 中，不切换到故障状态并不受对象 $605E_h$ 影响。
 5- Ignore and record in $1003h$, do not switch to the fault state and not be affected by the object $605E_h$.
- 6- 忽略但不记录在 $1003h$ 中，不切换到故障状态并不受对象 $605E_h$ 影响。
 6- Ignore but do not record in $1003h$, do not switch to the fault state and are not affected by object $605E_h$.

● 自复位允许 Self-reset allowed

- 0- 不允许 0-not allowed

- 1- 允许（当警告或者故障消除时，自动复位）

- 1- Allowed (automatically reset when the warning or fault is eliminated)

注： Note:

- 上表（报警代码一览表）报警代码中默认报警类型为“故障”的，表示在产生此报警后，电机进入故障状态（状态字值为 $0x228$ ）

The above table (alarm code list) The default alarm type in the alarm code is "fault", which means that after this alarm is generated, the motor enters the fault state (status word value is 0x228)

- 报警代码的默认报警类型、默认故障反应码和是否自复位可以通过对象 200E_h 进行配置

The default alarm type, default fault response code and whether self-reset of the alarm code can be configured through the object 200E_h

- 报警内容带*符号的无法通过对象 200E_h 进行配置。驱动器及硬件初始化故障后需要重新启动后一体化电机才能正常运行。

Alarm content with * symbol cannot be configured through the object 200E_h. After the driver and hardware initialization failure, the integrated motor needs to be restarted to operate normally.

- 603F_h 包含一体化电机最后出现的错误，对应报警代码中低 16 位的故障码。

603F_h contains the last error of the integrated motor, corresponding to the lower 16 fault codes in the alarm code.

8.2 故障动作设置 Fault action settings

报警代码由故障码(16 位)、故障反应码(8 位)和自复位允许(8 位)共 32 位组成。故障码表示电机在非正常状态下的故障现象，通过故障码判断电机的当前状态，一般和对象 603F_h(错误码)相对应，0 表示电机当前无故障；故障反应码表示电机故障后相应的动作方式和对状态字故障位的处理，如自由停机-故障状态、按一定减速度停机-故障状态、暂停锁轴-非故障状态等；自复位允许表示电机的故障消除后，是否允许电机自动复位当前状态字的故障位，1-允许、0-不允许。相应位的顺序如下：

The alarm code consists of a total of 32 bits including a fault code (16 bits), a fault response code (8 bits), and a self-reset permission (8 bits). The fault code indicates the fault phenomenon of the motor in an abnormal state. The fault code is used to determine the current state of the motor. It generally corresponds to the object 603F_h (error code). 0 indicates that the motor is currently fault-free; the fault response code indicates the corresponding action after the motor fault. Method and treatment of the status word fault bit, such as free stop-fault state, stop at a certain deceleration-fault state, pause shaft lock-non-fault state, etc.; self-reset permission indicates whether the motor is allowed to automatically reset after the fault of the motor is eliminated. The fault bit of the current status word, 1-allow, 0-disallow. 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
故障反应码 Fault response code[8]								自复位允许 Self reset allowed[8]							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
故障码 Error code[16]															

故障反应码的具体定义 Specific definition of fault response code

0- 状态机切换到故障状态（参照“4.1 CiA402 状态机”），如果 605E>=0，则按照 605E 选择的故障停机方式；否则：功率管全关，自由停机。

0-state machine switches to the fault state (refer to "4.1 CiA402 state machine"). If 605E>=0, the fault shutdown mode selected by 605E will be followed; otherwise: the power tube is fully closed and free shutdown.

1- 状态机切换到故障状态（参照“4.1 CiA402 状态机”），如果 605E>=0，则按照 605E 选择的故障停机方式；否则：按慢速曲线停车关闭输出。

1- The state machine switches to the fault state (refer to "4.1 CiA402 state machine"), if

605E>=0, the fault shutdown mode selected by 605E is followed; otherwise: the output is shut down according to the slow curve.

2- 状态机切换到故障状态（参照“4.1 CiA402 状态机”），如果 605E>=0，则按照 605E 选择的故障停机方式；否则：按快速曲线停车关闭输出。

2- The state machine switches to the fault state (refer to "4.1 CiA402 state machine"), if 605E>=0, the fault shutdown mode selected by 605E is followed; otherwise: the output is shut down according to the fast curve stop.

3- 按快速曲线暂停锁轴，不切换到故障状态并不受对象 605E_h 影响。

3- Press the quick curve to suspend the axis lock without switching to the fault state and not affected by the object 605E_h.

4- 警告且不改变当前运行状态，不切换到故障状态并不受对象 605E_h 影响。

4- Warning and do not change the current operating state, do not switch to the fault state and are not affected by the object 605E_h.

5- 忽略并记录在 1003_h 中，不切换到故障状态并不受对象 605E_h 影响。

5- Ignore and record in 1003_h, do not switch to the fault state and not be affected by the object 605E_h.

6- 忽略但不记录在 1003_h 中，不切换到故障状态并不受对象 605E_h 影响。

6- Ignore but do not record in 1003_h, do not switch to the fault state and are not affected by object 605E_h.

报警代码配置 Alarm code configuration

故障代码组 200E_h 里例举了可由用户自由配置的报警代码，具体如下：

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

故障代码组 200E _h Fault code group 200E _h	含义 Meaning	默认故障动作 Default fault action
0x4012311	电机过载 Motor overload	否 No
0x3002312	电机堵转 Motor blocked	否 No
0x13210	电源过电压 Power supply overvoltage	是 Yes
0x1013220	电源欠电压 Power supply undervoltage	是 Yes
0x14210	温度过高报警 High temperature alarm	是 Yes
0x14220	温度过低报警 Low temperature alarm	是 Yes
0x16320	参数设置错误 Parameter setting error	是 Yes
0x17310	超速 Overspeed	是 Yes
0x17501	Modbus 通信中的非法功能码 Illegal function code in Modbus communication	否 No
0x17502	Modbus 通信中的非法地址 Illegal address in Modbus communication	否 No
0x17503	Modbus 通信中的非法数据值 Illegal data value in Modbus communication	否 No

故障代码组 200E_h Fault code group 200E_h	含义 Meaning	默认故障动作 Default fault action
0x17505	Modbus 通信中的确认 Confirmation in Modbus communication	否 No
0x17506	Modbus 通信中的从设备忙 Slave device busy in Modbus communication	否 No
0x1750C	Modbus 通信中的同步报文请求数据数据 大于映射总数据 Synchronous message request data data in Modbus communication is greater than total mapped data	否 No
0x1750D	Modbus 通信中的同步报文请求数据个数 对应映射数据不相等 The number of synchronous message request data in Modbus communication corresponds to the unequal mapping data	否 No
0x1750E	Modbus 通信中的同步功能下单播报文节 点地址错误 The node address of the unicast message is incorrect under the synchronous function in Modbus communication	否 No
0x8610	原点回归超时 Origin return timeout	是 Yes
0x8611	位置超差 Location out of tolerance	是 Yes
0x3018613	软件限位错误 Software limit error	否 No
0x3018614	限位开关错误 Limit switch error	否 No
0x3285	输出相故障 Output phase failure	是 Yes
0x4018615	曲线规划计算错误 Curve planning calculation error	否 No
0x18616	目标位置溢出 Target position overflow	是 Yes
0x5018617	曲线规划参数过小 Curve planning parameters are too small	否 No

注：上述列表中故障动作的“是（否）”是表示在产生此故障后，电机是否进入故障状态。

Note: The “Yes (No)” of the fault action in the above list indicates whether the motor has entered a fault state after this fault occurs.

报警代码配置举例说明 Example of alarm code configuration

电源欠压设置 Power supply undervoltage setting

$200E_h:04_h$ (电源欠电压)设置为 $0x1003220$, 当电机运行时, 供电电源电压低于检测阈值(默认 24V), 电机按 $605E$ 设置的停机方式停机(参照相应位的顺序, 该故障反应码对应为 1); 当供电电源电压恢复正常时, 需通过手动复位操作, 电机才能进行正常的运行操作(参照相应位的顺序, 自复位允许对应为 0)。

$200E_h:04_h$ (power supply undervoltage) is set to $0x1003220$. When the motor is running, the power supply voltage is lower than the detection threshold (default 24V), the motor stops according to the shutdown mode set by $605E$ (refer to the order of corresponding bits, the fault response code corresponds to 1); When the power supply voltage returns to normal, the manual reset operation is required for the motor to perform normal operation (refer to the order of the corresponding bits, self-reset is allowed to correspond to 0).

8.3 故障复位 Fault reset

一体化故障恢复后, 自复位不允许的故障码需通过手动复位操作, 电机才能进行正常的运行操作。手动复位操作有 3 中方式, 具体如下:

After the integrated fault is restored, the fault codes that are not allowed by self-reset need to be manually reset, so that the motor can be operated normally. There are 3 ways of manual reset operation, as follows:

- 通过发送控制 $0x80$ 来清除故障状态 (控制字 bit7 上升沿有效)

Clear the fault status by sending control $0x80$ (control word bit7 rising edge is valid)

- 通过实体输入端子 (2003_h) 其中一个功能配置为 2 号功能码 (报警复位), 并设置相应的逻辑选择, 按照其设置端子的逻辑选择使其有效即可复位

One of the functions is configured as No. 2 function code (alarm reset) through the physical input terminal (2003_h), and the corresponding logic selection is set, and it can be reset according to the logic selection of the setting terminal to make it effective

- 通过虚拟输入端子 (2017_h) 其中一个功能配置为 2 号功能码 (报警复位), 并设置相应的逻辑选择, 按照其设置端子的逻辑选择使其有效即可复位

Through virtual input terminal (2017_h), one of the functions is configured as No. 2 function code (alarm reset), and set the corresponding logic selection, according to the logic selection of the setting terminal to make it effective to reset

8.4 故障检测说明 Fault detection instructions

- 驱动器故障检测 Drive failure detection

该故障由驱动芯片故障信号中断响应触发, 触发则报驱动器故障。

This fault is triggered by the interruption response of the driver chip fault signal, and the driver will be reported as triggered.

- I^2T 过载检测 I^2T overload detection

当电机运行在额定电流以上的时候, 故障检测将计算 I^2 的时间积分, 当积分值大于设定的最大电流($2000_h: 0A_h$)和最大电流持续时间($2000_h: 0B_h$)的乘积时则报过载警告, 并限制转矩输出为额定值, 30s 之后解除限制。

When the motor runs above the rated current, the fault detection will calculate the time integral of I^2 . When the integral value is greater than the product of the set maximum current ($2000_h: 0A_h$) and the maximum current duration ($2000_h: 0B_h$), an overload warning will be reported. , And limit the torque output to the rated value, and lift the limit after 30s.

- 堵转故障检测 Locked rotor fault detection

当电机运行在转速低于 5 转且处于额定电流以上的时候，故障检测将计算 I₂ 的时间积分，当积分值大于设定的最大电流(2000h: 0Ah)和最大电流持续时间(2000h: 0Bh)的乘积时则报堵转故障，并停止输出。

When the motor is running below 5 rpm and above the rated current, the fault detection will calculate the time integral of I₂. When the integral value is greater than the set maximum current (2000h: 0Ah) and maximum current duration (2000h: 0Bh). When the product of is, a locked fault is reported and the output is stopped.

- 高温低温故障检测 High temperature and low temperature fault detection

当驱动器温度大于 105°C 时报高温故障，低于 70°C 时则解除故障；当驱动器温度低于 -25°C 时则报温度过低故障，高于 -20°C 时则解除故障。

When the temperature of the driver is higher than 105°C, a high temperature fault is reported, and when the temperature is lower than 70°C, the fault is removed; when the temperature of the driver is lower than -25°C, the fault is reported to be too low, and when the temperature is higher than -20°C, the fault is removed.

- 过压欠压故障检测 Overvoltage and undervoltage fault detection

当电机的电源电压高于(2001h: 11h)设置的电压时，报过压故障；当电机的电源电压低于(2001h: 10h)设置的电压时，报欠压故障。

When the power supply voltage of the motor is higher than the voltage set in (2001h: 11h), an overvoltage fault is reported; when the power supply voltage of the motor is lower than the voltage set in (2001h: 10h), an undervoltage fault is reported.

- 参数设置故障检测 Parameter setting fault detection

参数设置故障检测多功能端子的设置错误，包括不同端子（实体端子和虚拟端子）设置了相同的功能号或 CiA402 原点回归模式下没有设置 14、15 和 31 功能号。

Parameter setting fault detection The setting of multi-function terminals is wrong, including different terminals (physical terminals and virtual terminals) are set with the same function number or CiA402 zero return mode does not set 14, 15 and 31 function numbers.

- 超速故障检测 Overspeed fault detection

当电机的转速高于(200Ah: 06h)设置的转速并维持 10ms 时，报超速故障，低于则解除故障状态。

When the speed of the motor is higher than the set speed of (200Ah: 06h) and maintained for 10ms, an overspeed fault is reported, and if it is lower, the fault status is released.

- Modbus 通信中的非法地址故障检测

Illegal address fault detection in Modbus communication

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的非法数据值故障检测

Malfunction detection of illegal data values in Modbus communication

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的非法功能码故障检测

Malfunction detection of illegal function codes in Modbus communication

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的同步功能下单播报文节点地址错误故障检测

The fault detection of the unicast message node address error under the synchronization function in Modbus communication

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的从设备忙故障检测

Slave device busy fault detection in Modbus communication

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的同步报文请求数据数据大于映射总数据故障检测

In the Modbus communication, the synchronization request data data is greater than the total data mapping fault detection

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的同步报文请求数据个数对应映射数据不相等故障检测

In the Modbus communication, the synchronization request data data is greater than the total data mapping fault detection

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- Modbus 通信中的同步功能下单播报文节点地址错误故障检测

The number of synchronous message request data in Modbus communication corresponds to the unequal mapping data fault detection

该错误在 Modbus 通讯下，由从站协议错误标志位标识。

This error is identified by the slave protocol error flag under Modbus communication.

- 硬件初始化故障检测 Hardware initialization failure detection

电机上电时，硬件(驱动器，编码器)没有初始化成功则报硬件初始化故障。

When the motor is powered on, if the hardware (driver, encoder) is not initialized successfully, it will report a hardware initialization failure.

- Flash 故障检测 Flash fault detection

对电机的 Flash 进行操作的时候，当保存参数或上电读取存储参数没通过检测时则报 Flash 故障。

When operating the Flash of the motor, when the saved parameters or the power-on reading storage parameters fail to pass the test, a Flash fault is reported.

- 原点回归超时故障检测

Origin return overtime fault detection

当电机在 CiA402 原点回归模式使能的情况下，若在限定的时间(2005_h : $1C_h$)内没有能完成原点回归的动作，则报原点回归超时故障。

When the motor is enabled in the CiA402 homing mode, if there is no homing operation within the limited time (2005_h : $1Ch$), a homing homing fault will be reported.

- 跟踪故障检测 Tracking fault detection

电机在位置模式控制下，位置偏差超过 $\pm 6065_h$ 时，且时间到达 6066_h (ms)时，报跟踪故障。

When the motor is under position mode control, when the position deviation exceeds $\pm 6065h$, and the time reaches $6066h$ (ms), a tracking failure is reported.

- 软件超限故障检测 Software overrun fault detection

电机在位置控制模式下，根据 $607B_h$ 和 $607D_h$ 设置的软件限位值（用户单位）来判断，实际位置超出设定值则报软件超限故障。

In the position control mode, the motor is judged according to the software limit value (user unit) set by $607B_h$ and $607D_h$. If the actual position exceeds the set value, it will report a software overrun fault.

- 超限开关故障检测 Over-limit switch fault detection

根据多功能端子设置的 14 和 15 功能号，检测正反限位开关是否触发，触发则报超限开关故障。

According to the 14 and 15 function numbers set by the multi-function terminal, it is detected whether the positive and negative limit switches are triggered, and if the trigger is triggered, the fault of the limit switch is reported.

- 目标位置溢出故障检测

Overflow fault detection of target position

电机在位置控制模式下，给定的位置($607A_h$)经过齿轮比(6091_h)后超过数据类型 int32 的数据范围(-2147483648~+2147483647)则报目标位置溢出故障。

When the motor is in position control mode, if the given position ($607A_h$) exceeds the data range of the data type int32 (-2147483648~+2147483647) after the gear ratio (6091_h), it will report the target position overflow fault.

- 曲线规划参数过小故障检测

Curve planning parameter too small fault detection

电机在位置控制模式下，给定的冲击量或加速度不能在给定的位移区间实现 S 型曲线则报曲线规划参数过小故障。

In the position control mode of the motor, if the given impact or acceleration cannot achieve the S-shaped curve within the given displacement interval, the curve planning parameter will be reported to be too small.

- Flash 初始化故障 (0x5541)

Flash initialization failure (0x5541)

控制器未保存 Nimotion 区参数，联系厂家人员。

The controller does not save the parameters in the Nimotion area.

9 NiMotion 协议 NiMotion Agreement

NiMotion 协议优化了 Modbus 协议，在 Modbus 基础上新建了两种报文格式（过程数据报文和同步报文）。通过这两种报文可以达到多指令控制，大大减少数据处理时间，提高了多电机控制的协调性，进一步使电机达到两两同步的功能。过程数据报文用于多个参数自由组合为一帧报文同时收发处理，同步报文用于控制指令生效时机。

The NiMotion protocol optimizes the Modbus protocol and creates two new message formats (process data message and synchronization message) based on Modbus. Through these two messages, multi-command control can be achieved, which greatly reduces the data processing time, improves the coordination of multi-motor control, and further enables the motor to achieve the function of two-to-one synchronization. Process data messages are used to freely combine multiple parameters into a frame of messages and send and receive at the same time. Synchronous messages are used to control when the command takes effect.

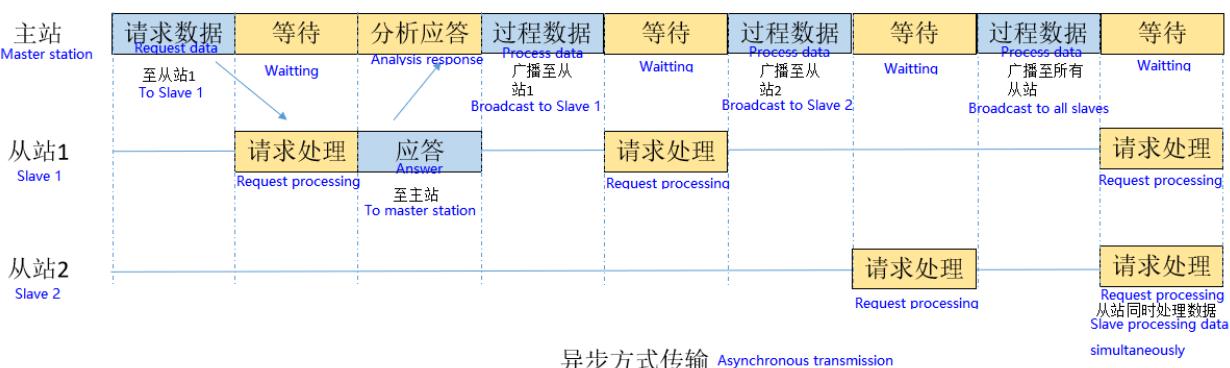
R_PDO: 接收过程数据;

R_PDO: Receive process data;

T_PDO: 发送过程数据。

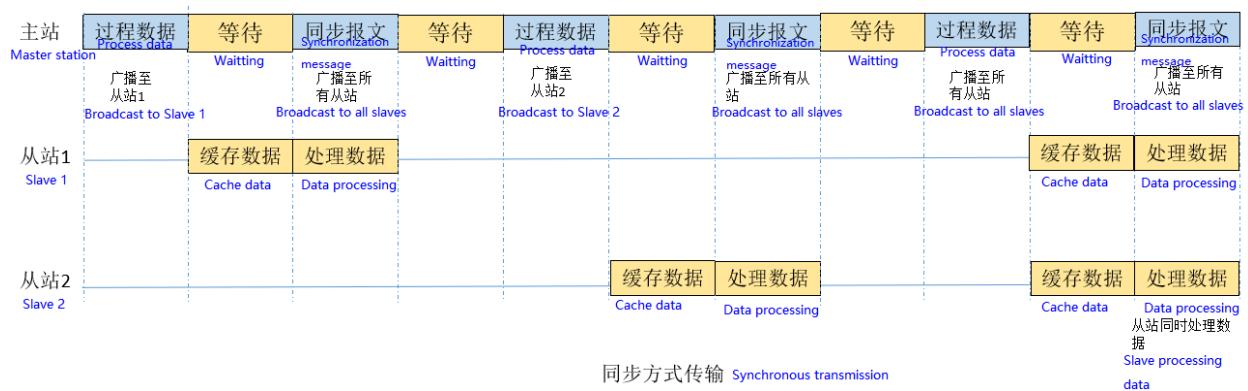
T_PDO: send process data.

9.1 主站从站时序图 Timing chart of master and slave



在异步方式传输过程中，针对从站 1 的单播过程数据在经过从站 1 处理后向主站发送应答，主站收到无误的应答之后发送针对从站 1 的广播过程数据，此时只有从站 1 处理，但无应答；主站发送针对从站 2 的广播过程数据，此时只有从站 2 处理，但无应答；主站发送针对所有从站的广播过程数据，所有从站都处理，但都无应答。

In the asynchronous transmission process, the unicast process data for the slave station 1 is sent to the master station after processing by the slave station 1, and the master station sends the broadcast process data for the slave station 1 after receiving the error-free response. Slave 1 processing, but no response; master station sends broadcast process data for slave station 2, only slave station 2 processes, but no response; master station sends broadcast process data for all slave stations, all slave stations process , But no response.



在同步方式传输过程中，主站发送针对从站 1 的广播过程数据，从站 1 收到报文后只是缓存数据并不处理，主站再次广播发送同步报文，从站 1 开始处理数据；主站发送针对从站 2 的广播过程数据，从站 2 收到报文后只是缓存数据并不处理，主站再次广播发送同步报文，从站 2 开始处理数据；主站发送针对所有从站的广播过程数据，从站 1 和从站 2 收到报文后都是缓存数据并不处理，主站再次广播发送同步报文，从站 1 和从站 2 同时开始处理数据。

In the synchronous transmission mode, the master station sends the broadcast process data for the slave station 1. After the slave station 1 receives the message, it only buffers the data and does not process it. The master station broadcasts the synchronization message again, and the slave station 1 starts processing the data; The master station sends the broadcast process data for the slave station 2. After the slave station 2 receives the message, it only buffers the data and does not process it. The master station broadcasts the synchronization message again, and the slave station 2 starts processing the data; the master station sends the data for all slave stations. The broadcast process data of slave station 1 and slave station 2 are both buffered data and not processed after receiving the message. The master station broadcasts and sends the synchronization message again, and slave station 1 and slave station 2 start processing data at the same time.

9.2 报文格式 Message format

9.2.1 同步报文 Synchronization message

同步报文是一种通过对寄存器地址含义重新定义，用于在同步模式下决定过程数据更新到寄存器时间的广播报文。

Synchronization message is a broadcast message that is used to determine the process data update time to register time in synchronization mode by redefining the meaning of the register address.

同步报文的作用是在同步模式下，将缓存区存储的数据更新到寄存器中，进而控制从站变化。

The function of the synchronization message is to update the data stored in the buffer area to the register in the synchronization mode, thereby controlling the change of the slave station.

同步广播报文具体说明如下：

The detailed description of the synchronous broadcast message is as follows:

表 1 主站同步请求报文

Table 1 Master station synchronization request message

序号 Serial number	字段名称 Field Name	字节长度(字 节) Byte length (bytes)	内容 Content	备注 Remarks
1	地址域 Address field	1	0x00	广播模式 Broadcast mode
2	功能码 function code	1	0x10	写多个寄存器 Write multiple registers
3	寄存器地址高字 节 Register address high byte	1	0x80	同步报文标识 0x8000 Synchronization message identifier 0x8000
4	寄存器地址低字 节 Register address low byte	1	0x00	
5	寄存器数量高字 节 Number of registers high byte	1	0x00	1 个寄存器 1 register
6	寄存器数量低字 节 Register low byte	1	0x01	
7	字节数 Bytes	1	0x02	数据部分 2 个字节 Data part 2 bytes
8	寄存器值高字节 Register value high byte	1	0x66	同步报文数据值标 志 Sync message data value flag
9	寄存器值低字节 Register value low byte	1	0x88	固定为 0x6688 Fixed at 0x6688
10	CRC16 低位 CRC16 low order	1	计算 CRC 低字节 Calculate CRC low byte	16 位 CRC 校验 16-bit CRC check
11	CRC16 高位 CRC16 high order	1	计算 CRC 高字节 Calculate CRC high byte	

同步报文是向从站写数据，考虑到过程数据报文是写多个寄存器，所以为了减少现有程序的改动，所以统一选用 0x10 功能码。

The synchronous message is to write data to the slave station, considering that the process data message is to write multiple registers, so in order to reduce the changes of the existing program, the 0x10 function code is selected uniformly.

为了制定特定的同步报文，将寄存器地址改为同步报文的标识，考虑到需要与现有的寄存器地址区分开，所以最高位设置为 1，即 0x8000。

In order to formulate a specific synchronization message, the register address is changed to the identifier of the synchronization message. Considering that it needs to be distinguished from the existing register address, the highest bit is set to 1, which is 0x8000.

寄存器值作为一个同步的标志，所以固定数据为 0x6688。

The register value serves as a synchronization flag, so the fixed data is 0x6688.

9.2.2 过程数据写操作 Process data write operation

9.2.2.1 请求报文 Request message

支持 modbus 协议报文格式

Support modbus protocol message format

读取内容、长度，根据寄存器（0x6000~0x6021）设置。

Read the content and length, set according to the register (0x6000~0x6021).

表 2 过程数据请求

Table 2 Process data request

序号 Serial number	字段名称 Field Name	字节长度(字 节) Byte length (bytes)	内容 Content	备注 Remarks
1	地址域 Address field	1	0x00	广播/单播模式
2	功能码 Function code	1	0x10	写多个寄存器
3	寄存器地址高位 Register address high	1	0x83	消息模式
4	寄存器地址低位 Register address low	1	0x00	
5	寄存器数量高字 节 Number of registers high	1	0x00	寄存器数量 (1~33)

序号 Serial number	字段名称 Field Name	字节长度(字 节) Byte length (bytes)	内容 Content	备注 Remarks
	byte			
6	寄存器数量低字 节 Number of registers low byte	1	0x05	
7	字节数	1	0x0A	寄存器数量*2 (2~66) Number of registers*2 (2~66)
8	寄存器值高字节 Register value high byte	1	0x00	电机地址 (0~247) 0 为向 所有电机发送 Motor address (0~247) 0 is sent to all motors
9	寄存器值低字节 Register value low byte	1	0x01	
10	寄存器值高字节 Register value high byte	1	0x00	
11	寄存器值低字节 Register value low byte	1	0x07	
12	寄存器值高字节 Register value high byte	1	0x00	
13	寄存器值低字节 Register value low byte	1	0x01	寄存器的值 (根据实际需求设 置) Register value (Set according to actual needs)
14	寄存器值高字节 Register value high byte	1	0x00	
15	寄存器值低字节 Register value low byte	1	0x00	
16	寄存器值高字节 Register value high byte	1	0x03	
17	寄存器值低字节	1	0x84	

序号 Serial number	字段名称 Field Name	字节长度(字 节) Byte length (bytes)	内容 Content	备注 Remarks
	Register value high byte			
18	CRC16 低位 CRC16 low order	1	计算 CRC 低字节 Calculate CRC low byte	16 位 CRC 校验 16-bit CRC check
19	CRC16 高位 CRC16 high order	1	计算 CRC 高字节 Calculate CRC high byte	

过程数据是向从站写多个寄存器的数据，所以采用 0x10 功能码。

Process data is data from writing multiple registers to the slave station, so the 0x10 function code is used.

为了制定特定的过程数据报文，将寄存器地址改为过程数据报文的标识，考虑到需要与现有的寄存器地址区分开，所以最高位设置为 1，参考 CAN 自定义的过程数据格式，过程数据标识+0x300，即 0x8300。

In order to formulate a specific process data message, the register address is changed to the identification of the process data message, considering that it needs to be distinguished from the existing register address, so the highest bit is set to 1, refer to the CAN custom process data format, process The data identifier is +0x300, which is 0x8300.

映射最大有 16 条，每条最多有两个寄存器，所以映射最多有 32 个寄存器，再加上一个电机地址占一个寄存器，故寄存器数量范围是 1~33。

There are a maximum of 16 maps, each with a maximum of two registers, so the map has a maximum of 32 registers, plus a motor address to occupy a register, so the number of registers ranges from 1 to 33.

每个寄存器占用两个字节数，故字节数范围是 2~66。

Each register occupies two bytes, so the number of bytes ranges from 2 to 66.

节点地址占用一个寄存器，modbus 总线上最多只能有 247 个从站。所以范围是 1~247。如果是 0，表示向所有从站发送。

The node address occupies a register, and there can be at most 247 slave stations on the modbus bus. So the range is 1~247. If it is 0, it means to send to all slaves.

9.2.2.2 应答报文 Reply message

请参考 modbus 协议 0x10 功能码响应报文。

Please refer to modbus protocol 0x10 function code response message.

9.2.3 过程数据读操作 Process data read operation

9.2.3.1 请求报文 Request message

过程数据读操作仅可在异步模式下使用，支持 modbus 协议报文格式。

The process data read operation can only be used in asynchronous mode and supports the modbus protocol message format.

读取内容、长度，根据寄存器（0x6000~0x6021）设置。

Read the content and length, set according to the register (0x6000~0x6021).

表 6 过程数据读请求报文

Table 6 Process data read request message

序号 Serial number	字段名称 Field Name	字节长度(字节) Byte length (bytes)	内容 Content	备注 Remarks
1	地址域 Address field	1	0x01	节点地址 Node address
2	功能码 Function code	1	0x04	读多个寄存器 Read multiple registers
3	寄存器地址高位 Register address high	1	0x83	寄存器地址 (缓存区地址) Register address (buffer address)
4	寄存器地址低位 Register address low	1	0x80	
5	寄存器数量高字节 Number of registers high byte	1	0x00	寄存器数量 (1~32) Number of registers (1~32)
6	寄存器数量低字节 Number of registers low byte	1	0x02	
13	CRC16 低位 CRC16 low order	1	计算 CRC 低字节 Calculate CRC low byte	16 位 CRC 校验 16-bit CRC check
14	CRC16 高位 CRC16 high order	1	计算 CRC 高字节 Calculate CRC high byte	

功能码 0X10 是写寄存器，此处是读寄存器的值，故 0x10 功能码不再合适，选用 0x04 功能码
 Function code 0X10 is to write register, here is to read the value of register, so 0x10 function code is no longer suitable, choose 0x04 function code

过程数据读取的是缓存区的数据，故地址也是缓存区的地址

Process data reads the data in the cache area, so the address is also the address of the cache area

缓存区最多有 16 个映射条目，每个条目最多只有两个寄存器，故寄存器数量范围是 1~32。

The cache area has a maximum of 16 mapping entries, and each entry has a maximum of two registers, so the number of registers ranges from 1 to 32.

9.2.3.2 应答报文 Reply message

请参考 modbus 协议 0x04 功能码响应报文。

Please refer to modbus protocol 0x04 function code response message.

9.3 异常处理 Exception handling

请参考第 8 章故障管理。

Please refer to Chapter 8 Fault Management.

9.4 举例 Examples

1. 设置从站缓存区映射条目数寄存器（0x5000），根据需求确定条目数。

Set the number of mapping entries register (0x5000) in the buffer area of the slave station, and determine the number of entries according to requirements.

2. 根据条目数，从 R_PDO 映射 1 寄存器开始设置，最大可设置到映射 12 寄存器，寄存器高字节确定映射到的寄存器起始地址，寄存器低字节确定映射寄存器的数量。

According to the number of entries, set from the R_PDO map 1 register, the maximum can be set to the map 12 registers, the register high byte determines the starting address of the mapped register, and the register low byte determines the number of mapped registers.

3. 设置从站缓存区映射条目数寄存器（0x6000），根据需求确定条目数。

Set the number of entries mapping register (0x6000) in the buffer area of the slave station, and determine the number of entries according to the requirements.

4. 根据条目数，从 T_PDO 映射 1 寄存器开始设置，最大可设置到映射 12 寄存器，寄存器高字节确定映射到的寄存器起始地址，寄存器低字节确定映射寄存器的数量。

According to the number of entries, set from the T_PDO map 1 register, the maximum can be set to the map 12 registers, the register high byte determines the starting address of the mapped register, and the register low byte determines the number of mapped registers.

5. 设置同步模式使能 200Ch: 18h（对应 Modbus 保持寄存器地址 0x0246）为使能(0x01)。

Set the synchronization mode to enable 200Ch: 18h (corresponding to Modbus holding register address 0x0246) as enable (0x01).

6. 主站发送寄存器地址为 0x8300 的过程数据报文，从站按照功能码执行函数。

The master station sends the process data message with register address 0x8300, and the slave station executes the function according to the function code.

7. 主站发送寄存器地址为 0x8000、数据值为 0x6688 的同步报文，从站执行功能码函数。触发数据更新，电机状态做出相应改变。

The master station sends a synchronization message with a register address of 0x8000 and a data value of 0x6688, and the slave station executes a function code function. The data update is triggered and the motor status changes accordingly.

实现流程： Implementation process:

① 1号电机 RPDO 映射条目数为 2 条。

The number of RPDO mapping entries for motor 1 is two.

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
01	0x10	50 00	00 02	04	00 00 00 02	略 Skip

② 1号电机 RPDO 映射控制字 6040_h: 0_h (对应 Modbus 保持寄存器地址 0x0380)、目标位置 607A_h: 0_h (对应 Modbus 保持寄存器地址 0x03E7)。

The RPDO mapping control word of motor No. 1 is 6040h: 0h (corresponding to Modbus holding register address 0x0380), target position 607Ah: 0h (corresponding to Modbus holding register address 0x03E7).

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
01	0x10	50 02	00 04	08	03 80 00 01 03 E7 00 02	略 Skip

③ 1号电机开启同步模式 200C_h: 18_h (对应 Modbus 保持寄存器地址 0x0246)。

Motor No. 1 starts synchronous mode 200Ch: 18h (corresponding to Modbus holding register address 0x0246).

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器值 Register value	CRC 校验值 CRC check value
01	0x06	02 46	00 01	略 Skip

④ 1号电机保存参数后断电重启。

After saving the parameters, the No. 1 motor restarts after power off.

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
01	0x10	00 26	00 02	04	65 76 61 73	略 Skip

⑤ 主站广播发送过程数据（控制字为 6，目标位置为 1000）至 1 号电机。

The master station broadcasts the process data (the control word is 6, the target position is 1000) to the No. 1 motor.

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
00	0x10	83 00	00 04	08	00 01 00 06 00 00 03 84	略 Skip

⑥ 主站广播发送同步报文更新参数。

The master station broadcasts the synchronization message update parameters.

从机地址 Slave address	功能码 Function code	寄存器地址 Register address	寄存器数量 Number of registers	字节数 Bytes	寄存器值 Register value	CRC 校验值 CRC check value
00	0x10	80 00	00 02	04	66 66 88 88	略 Skip

9.5 映射参数设置 Mapping parameter settings

此映射是为过程数据多指令控制所做，每条映射占用两个寄存器，高寄存器用于存储用户想要映射的参数的寄存器首地址，低寄存器用于存储该参数在参数表里占用的寄存器数量。地址 0x5000 和 0x6000 分别代表的是 R_PDO 和 T_PDO 启用的映射条目数，最大可映射条目为 12 条。

This mapping is done for multi-instruction control of process data. Each mapping occupies two registers. The high register is used to store the first address of the register of the parameter that the user wants to map, and the low register is used to store the register occupied by the parameter in the parameter table. Quantity. Addresses 0x5000 and 0x6000 represent the number of mapping entries enabled by R_PDO and T_PDO, respectively. The maximum number of mapping entries is 12.

例：R_PDO 映射 1 的值为 0x02310001

Example: The value of R_PDO mapping 1 is 0x02310001

高 16 位 0x0231 指映射到寄存器地址为 0x0231 的参数：通信波特率。

The upper 16 bits 0x0231 refer to the parameter mapped to register address 0x0231: communication baud rate.

低 16 位 0x0001 指此映射的参数占用了一个寄存器。

The lower 16 bits of 0x0001 indicate that the parameters of this map occupy a register.

Modbus 地址 Modbus address	名称 Name	描述 Description	寄存器数量 Number of registers	数据范围 Data range
5000	R_PDO 映射条目数 R_PDO map entries	过程数据报文映射寄存器的条目数 Number of entries in the process data message mapping register	2	0~0x0C
5002	R_PDO 映射参数 1 R_PDO mapping parameter 1	低寄存器：映射的寄存器起始地址 高寄存器：寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~4294967295
5004	R_PDO 映射参数 2 R_PDO mapping parameter 2	低寄存器：映射的寄存器起始地址 高寄存器：寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~4294967295
5006	R_PDO 映射参数 3 R_PDO mapping parameter 3	低寄存器：映射的寄存器起始地址 高寄存器：寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~4294967295

Modbus 地址 Modbus address	名称 Name	描述 Description	寄存器数量 Number of registers	数据范围 Data range
5008	R_PDO 映射参数 4 R_PDO mapping parameter 4	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
500A	R_PDO 映射参数 5 R_PDO mapping parameter 5	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
5006C	R_PDO 映射参数 6 R_PDO mapping parameter 6	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
500E	R_PDO 映射参数 7 R_PDO mapping parameter 7	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
5010	R_PDO 映射参数 8 R_PDO mapping parameter 8	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
5012	R_PDO 映射参数 9 R_PDO mapping parameter 9	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
5014	R_PDO 映射参数 10 R_PDO mapping parameter 10	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
5016	R_PDO 映射参数 11 R_PDO mapping parameter 11	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数	2	0~429496729 5

Modbus 地址 Modbus address	名称 Name	描述 Description	寄存器数量 Number of registers	数据范围 Data range
		Low register: the starting address of the mapped register High register: the number of registers		
5018	R_PDO 映射参数 12 R_PDO mapping parameter 12	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6000	T_PDO 映射条目数 Number of T_PDO mapping entries	过程数据报文映射寄存器的条目数 Number of entries in the process data message mapping register	2	0~0x0C
6002	T_PDO 映射参数 1 T_PDO mapping parameter 1	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6004	T_PDO 映射参数 2 T_PDO mapping parameter 2	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6006	T_PDO 映射参数 3 T_PDO mapping parameter 3	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6008	T_PDO 映射参数 4 T_PDO mapping parameter 4	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
600A	T_PDO 映射参数 5 T_PDO mapping parameter 5	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5

Modbus 地址 Modbus address	名称 Name	描述 Description	寄存器数量 Number of registers	数据范围 Data range
600C	T_PDO 映射参数 6 T_PDO mapping parameter 6	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
600E	T_PDO 映射参数 7 T_PDO mapping parameter 7	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6010	T_PDO 映射参数 8 T_PDO mapping parameter 8	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6012	T_PDO 映射参数 9 T_PDO mapping parameter 9	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6014	T_PDO 映射参数 10 T_PDO mapping parameter 10	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6016	T_PDO 映射参数 11 T_PDO mapping parameter 11	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5
6018	T_PDO 映射参数 12 T_PDO mapping parameter 12	低寄存器: 映射的寄存器起始地址 高寄存器: 寄存器个数 Low register: the starting address of the mapped register High register: the number of registers	2	0~429496729 5

10 对象字典 Object Dictionary

对象字典是设备规范中重要的部分，它是一组参数和变量的有序集合，包含了设备描述及设备网络状态的所有参数。每个对象包含索引、子索引、名称、描述、数据类型、数据范围、可访问性、能否映射、出厂设定、单位、生效方式。

The object dictionary is an important part of the device specification. It is an ordered set of parameters and variables that contains all the parameters of the device description and the network status of the device. Each object contains an index, sub-index, name, description, data type, data range, accessibility, ability to map, factory settings, units, and effective mode.

名词解释 Glossary

"索引": 指定同一类对象在对象字典中的位置，以十六进制表示

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

"子索引": 同一个索引下面，包含多个对象，各对象在该类下的偏置

"Sub-index": Under the same index, contains multiple objects, and the offset of each object under this category

"数据类型及范围": 具体请参见下表

"Data Type and Range": Please refer to the table below for details

数据类型 Type of data	数据范围 Data range	数据长度 Data length
Int8	-128~127	1 字节 1 byte
Int16	-32768~32767	2 字节 2 bytes
Int32	-2147483648~2147483647	4 字节 4 bytes
Uint8	0~255	1 字节 1 byte
Uint16	0~65535	2 字节 2 bytes
Uint32	0~4294967295	4 字节 4 bytes
String	ASCII	~

"可访问性": 具体请参见下表 "Accessibility": see the table below for details

可访问性 Accessibility	说明 Explanation
RW	可读写 Can read and write
WO	只写 Write only
RO	只读 Read only

“能否映射”: 具体请参见下表

"Can be mapped": see the table below for details

能否映射 Can it be mapped	说明 Explanation
NO	不可映射在 PDO 中 Not mapped in PDO
RPDO	可以作为 RPDO Can be used as RPDO
TPDO	可以作为 TPDO Can be used as TPDO

“生效方式”: 具体请参见下表

"Effective Mode": Please refer to the table below for details

生效方式 Effective method	说明 Explanation
立即生效 Effective immediately	参数设置完成后, 设定值立即生效 After the parameter setting is completed, the set value takes effect immediately
停机生效 Effective downtime	参数设置完成后, 等到驱动器不处于运行状态, 设定值生效 After the parameter setting is completed, wait until the drive is not in the



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	running state, the set value takes effect
再次通电 Power on again	参数设置完成后, 重新接通驱动器电源, 设定值生效 After the parameter setting is completed, turn on the drive power again, the set value takes effect

10.1 通信参数 1000h 组 Communication parameter 1000h group

1000h 对象组包含 Modbus 通讯所需的参数。

The 1000h object group contains the parameters required for Modbus communication.

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
1001h	-	00h	Error Register	错误寄存器 Error register	Uint8	-	RO	NO	0	VAR	-
1003h	00h	01h	NumberErrors Number of alarms present in the device	当前设备中存在的报警 数量 Number of alarms present in the device	uint8	-	RO	NO	-	VAR	-
	01h	02h			uint32	-	RO	NO	-	VAR	-
	02h	04h			uint32	-	RO	NO	-	VAR	-
	03h	06h			uint32	-	RO	NO	-	VAR	-
	04h	08h			uint32	-	RO	NO	-	VAR	-
	05h	0Ah			uint32	-	RO	NO	-	VAR	-
	06h	0Ch			uint32	-	RO	NO	-	VAR	-
	07h	0Eh			uint32	-	RO	NO	-	VAR	-
	08h	10h			uint32	-	RO	NO	-	VAR	-
	09h	12h			uint32	-	RO	NO	-	VAR	-
	0Ah	14h			uint32	-	RO	NO	-	VAR	-
	0Bh	16h			uint32	-	RO	NO	-	VAR	-

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
1010h	0Ch	18h	ErrorField_C		uint32	-	RO	NO	-	VAR	-
	0Dh	1Ah	ErrorField_D		uint32	-	RO	NO	-	VAR	-
	0Eh	1Ch	ErrorField_E		uint32	-	RO	NO	-	VAR	-
	0Fh	1Eh	ErrorField_F		uint32	-	RO	NO	-	VAR	-
	10h	20h	ErrorField_10		uint32	-	RO	NO	-	VAR	-
1011h	01h	26h	SaveAllParam	保存当前所有参数 Save all current parameters	uint32	-	RW	NO	1	VAR	-
1017h	01h	3Ch	RestAllParam	读取所有参数 Read all parameters	uint32	-	RW	NO	1	VAR -	-
1018h	-	52h	Producer heartbeat time	生产者心跳时间 Producer heartbeat time	Uint16	-	RW	NO	0	ms	-
1018h	03h	53h	APP Version	软件版本号 Software version number	uint32	-	RO	NO	-	-	-
	04h	55h	Serial number	产品序列号 Product Serial Number	uint32	-	RO	NO	-	-	-



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10.2 制造商定义参数 2000h 组说明 Description of manufacturer-defined parameters 2000h group

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2000h (电 机参 数) (Moto r para meter s)	06h	62h	SerialEncoderType	总线编码器类型 Bus encoder type	uint16	0~1	RW	NO	1	-	停机生效 Shutdown effective
	07h	63h	RatedVoltage	额定电压 Rated voltage	uint16	24~48	RW	NO	48	1V	停机生效 Shutdown effective
	08h	64h	RatedPower	额定功率 Rated power	uint16	-	RW	NO	40	0.01K W	停机生效 Shutdown effective
	09h	65h	RatedCurrent	额定电流 Rated current	uint16	-	RW	NO	1250	0.01A	停机生效 Shutdown effective
	0Ah	66h	MaximumCurrent	最大电流 Maximum current	uint16	-	RW	NO	2250	0.01A	停机生效 Shutdown effective
	0Bh	67h	MaxCurrentDurTime	最大电流持续时间 Maximum current duration	uint16	-	RW	NO	3000	0.1s	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2000h (电 机参 数) (Mot o r pa ramete rs)	0Ch	68h	RatedTorque	额定转矩 Rated torque	uint16	-	RW	NO	127	0.01N m	停机生效 Shutdown effective
	0Dh	69h	MaxTorque	最大转矩 Max Torque	uint16	-	RW	NO	2000	0.01N m	停机生效 Shutdown effective
	0Eh	6Ah	RatedMotorSpeed	额定转速 Rated speed	uint16	-	RW	NO	3000	1rpm	停机生效 Shutdown effective
	0Fh	6Bh	MaxMotorSpeed	最大转速 Maximum speed	uint16	-	RW	NO	6000	1rpm	停机生效 Shutdown effective
	10h	6Ch	RotorInertiaJm	转动惯量 Jm Moment of inertia Jm	uint16	-	RW	NO	30	0.01k gcm ²	停机生效 Shutdown effective
	11h	6Dh	PolePairsNum	永磁同步电机极对数 Number of pole pairs of permanent magnet synchronous motor	uint16	-	RW	NO	4	1	停机生效 Shutdown effective
	12h	6Eh	StatorResistance	定子电阻 Stator resistance	uint16	-	RW	NO	115	0.001 Ω	停机生效 Shutdown

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
											effective
	13h	6Fh	StatorInductanceLq	定子电感 Lq Stator inductance Lq	uint16	-	RW	NO	25	0.01m H	停机生效 Shutdown effective
	14h	70h	StatorInductanceLd	定子电感 Ld Stator inductance Ld	uint16	-	RW	NO	25	0.01m H	停机生效 Shutdown effective
	16h	72h	TorqueCoeffKt	转矩系数 Kt Torque coefficient Kt	uint16	-	RW	NO	11	0.01N m/Arm s	停机生效 Shutdown effective
	19h	75h	EncoderBitPR	编码器绝对位数 Encoder absolute digits	uint32	-	RW	NO	14	1bit	停机生效 Shutdown effective
	1Ah	77h	EncoderPoleNum	编码器极数 Number of encoder poles	uint16	-	RW	NO	1	1	停机生效 Shutdown effective
	1Ch	7Ah	SensorSelect	位置传感器选择 Position sensor selection	uint16	-	RW	NO	2	-	停机生效 Shutdown effective
	1Dh	7Bh	SignalZ_ElecAngle	Z 信号对应电角度 Z signal corresponds to	uint16	-	RW	NO	0	1/409 6	停机生效 Shutdown

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				electrical angle							effective
	1E _h	7C _h	P _h U_UpEdgeElecAngle	U 相上升沿对对应角度 U-phase rising edge corresponds to the corresponding angle	int16	-	RW	NO	0	1	停机生效 Shutdown effective
2001 _h (驱动器参数) (Driver parameters)	07 _h	8B _h	RatedOutputCurrent	额定输出电流 Rated output current	Uint16	0~65535	RO	NO	1200	0.01A	停机生效 Shutdown effective
	08 _h	8C _h	MaxOutputCurrent	最大输出电流 Maximum output current	uint16	0~65535	RO	NO	1500	0.01A	停机生效 Shutdown effective
	0D _h	91 _h	DeadZoneTime	开关死区时间 Switch dead time	uint16	0~65535	RW	NO	100	us	停机生效 Shutdown effective
	0E _h	92 _h	BusOverVoltVal	直流母线过压保护点 DC bus overvoltage protection point	uint16	0~65535	RW	NO	100	1V	停机生效 Shutdown effective
	0F _h	93 _h	BusDischargeVoltVal	直流母线电压泄放点 DC bus voltage relief point	uint16	0~65535	RW	NO	55	1V	停机生效 Shutdown effective
	10 _h	94 _h	BusLowVoltVal	直流母线电压欠压点	uint16	0~65535	RW	NO	24	1V	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				DC bus voltage undervoltage point							Shutdown effective
11h	95h	OverCurrentVal	驱动器过流保护点 Drive overcurrent protection point	uint16	0~65535	RW	NO	10	1A		停机生效 Shutdown effective
18h	9Ch	CurrentFilterCoeff	电流采样滤波器参数 Current sampling filter parameters	uint16	0~65535	RW	NO	100	0.01		停机生效 Shutdown effective
1Ch	A0h	CurLoopCutOffFrq	电流环截至频率 Current loop cutoff frequency	uint16	0~65535	RW	NO	800	1Hz		停机生效 Shutdown effective
1Dh	A1h	OpenLoopCurrent	开环运行电流 Open-loop operating current	uint16	0~65535	RW	NO	625	0.01A		停机生效 Shutdown effective
01h	B1h	CtrlModeSelect	控制模式选择 Control mode selection	uint16	0~4	RW	NO	4	-		停机设定立即生效 Shutdown and setting effective immediately
具体描述: 0-CIA402 模式, 1-NiMotion 位置模式, 2-NiMotion 速度模式, 3-NiMotion 力矩模式											

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method		
2002h (基本 控制 参数) (Basic control parameters)			Specific description: 0~CIA402 mode, 1~NiMotion position mode, 2~NiMotion Velocity mode, 3~NiMotion torque mode										
	04h	B4h	OutputPulsePhase	输出脉冲的占空比 Duty cycle of output pulse	uint16	0~100	RW	NO	50	1%	运行设定停机 生效 Operation setting shutdown takes effect		
	13h	C3h	BreakResistorType	内外部抑制电阻选择, 详见 7.4 章节 Selection of internal and external suppression resistors, see chapter 7.4	uint16	0~2	RW	NO	0	1	再次通电 Power on again		
	1Dh	CDh	MCUId0	MCU 识别码 0 MCU identification code 0	uint32	-	RO	NO	0	-	-		
	1Eh	CFh	MCUId1	MCU 识别码 1 MCU identification code 1	uint32	-	RO	NO	0	-	-		
	1Fh	D1h	MCUId2	MCU 识别码 2	uint32	-	RO	NO	0	-	-		

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				MCU identification code 2							
2003h (实 体 端 子 输 入 参 数)	03h	D5h	DI1FunSelec	DI1 端子功能选择 DI1 terminal function selection	uint16	0~45	RW	NO	1	1	停机生效 Shutdown effective
			具体描述: 详见 7.1 章节 Specific description: see chapter 7.1								
	04h	D6h	DI1LogicSelec	DI1 端子逻辑选择 DI1 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 详见 7.1 章节 Specific description: see chapter 7.1								
	05h	D7h	DI2FunSelec	DI2 端子功能选择 DI2 terminal function selection	uint16	0~45	RW	NO	2	1	停机生效 Shutdown effective
	06h	D8h	DI2LogicSelec	DI2 端子逻辑选择 DI2 terminal logic selection	uint16	0~4	RW	NO	2	1	停机生效 Shutdown effective
	07h	D9h	DI3FunSelec	DI3 端子功能选择	uint16	0~45	RW	NO	12	1	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				DI3 端子功能选择 DI3 terminal function selection							Shutdown effective
08h	DAh	DI3LogicSelec		DI3 端子逻辑选择 DI3 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
09h	DBh	DI4FunSelec		DI4 端子功能选择 DI4 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
0Ah	DCh	DI4LogicSelec		DI4 端子逻辑选择 DI4 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
0Bh	DDh	DI5FunSelec		DI5 端子功能选择 DI5 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
0Ch	DEh	DI5LogicSelec		DI5 端子逻辑选择 DI5 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
0Dh	DFh	DI6FunSelec		DI6 端子功能选择 DI6 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
0Eh	E0h	DI6LogicSelec		DI6 端子逻辑选择	uint16	0~4	RW	NO	0	1	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				DI6 端子逻辑选择 DI6 terminal logic selection							停机生效 Shutdown effective
0F _h	E1 _h	DI7FunSelec		DI7 端子功能选择 DI7 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
10 _h	E2 _h	DI7LogicSelec		DI7 端子逻辑选择 DI7 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
11 _h	E3 _h	DI8FunSelec		DI8 端子功能选择 DI8 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
12 _h	E4 _h	DI8LogicSelec		DI8 端子逻辑选择 DI8 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
13 _h	E5 _h	DI9FunSelec		DI9 端子功能选择 DI9 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
14 _h	E6 _h	DI9LogicSelec		DI9 端子逻辑选择 DI9 terminal logic selection	uint16	0~4	RW	NO	0	1	停机生效 Shutdown effective
15 _h	E7 _h	DinFunAllocation3		上电有效功能分配	uint16	0~65535	RW	NO	0	1	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method	
				Effective power distribution							Shutdown effective	
				具体描述: bit0-DI1, bit1-DI2, bit2-DI3; 相应位为 1 表示相应的 DI 端口为高电平 3.0V								
				Specific description: bit0-DI1, bit1-DI2, bit2-DI3; the corresponding bit is 1 means the corresponding DI port is high level 3.0V								
2004h (端子输出参数) (Terminal output parameter)	01h	F8h	DO1FunSel	DO1 端子功能选择 DO1 terminal function selection	uint16	0~30	RW	NO	0	1	停机生效 Shutdown effective	
				具体描述: 详见 7.1 章节 Specific description: see chapter 7.1								
	02h	F9h	DO1LogicSel	DO1 端子逻辑选择 DO1 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective	
				具体描述: 详见 7.1 章节 Specific description: see chapter 7.1								
	03h	FAh	DO2FunSel	DO2 端子功能选择 DO2 terminal function selection	uint16	0~30	RW	NO	0	1	停机生效 Shutdown effective	
	04h	FBh	DO2LogicSel	DO2 端子逻辑选择 DO2 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective	
	05h	FCh	DO3FunSel	DO3 端子功能选择 DO3 terminal function selection	uint16	0~30	RW	NO	0	1	停机生效 Shutdown effective	

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	06h	FDh	DO3LogicSelec	DO3 端子逻辑选择 DO3 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	07h	FEh	DO4FunSelec	DO4 端子功能选择 DO4 terminal function selection	uint16	0~30	RW	NO	0	1	停机生效 Shutdown effective
	08h	FFh	DO4LogicSelec	DO4 端子逻辑选择 DO4 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	09h	100h	DO5FunSelec	DO5 端子功能选择 DO5 terminal function selection	uint16	0~30	RW	NO	0	1	停机生效 Shutdown effective
	0Ah	101h	DO5LogicSelec	DO5 端子逻辑选择 DO5 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
2005h (位 置控 制参 数)	01h	10Dh	PosRefSource	位置指令来源 Source of position command	uint16	0~65535	RW	NO	1	1	停机生效 Shutdown effective
			具体描述: 0-脉冲, 1-步进量 Specific description: 0-pulse, 1-step								

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	05h	112h	StepAmount	步进量 Step	int16	-32768~32767	RW	NO	100	inc	停机生效 Shutdown effective
	1Ch	12Eh	HomingDurationLimit	原点回归时间限制 Origin return time limit	uint16	0~65535	RW	NO	10000	ms	停机生效 Shutdown effective
(速度控制参数) (Speed control parameters)	2006h 01h	148h	MainSpeedRefSourceA	主速度指令 A 来源 Source of main speed command A	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 0~数字给定(2006h: 04h 的设定值), 3~占空比给定 Specific description: 0~digital setting (2006h: 04h setting value), 3~duty ratio setting								
	02h	149h	AuxSpeedRefSourceB	辅助速度指令 B 来源 Source of auxiliary speed command B	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
meters)	03h	14Ah	具体描述: 0-数字给定(2006h: 04h 的设定值) Specific description: 0-number setting (2006h: 04h setting value)								
			SpeedRefSourceSelect	速度指令选择 Speed command selection	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
	具体描述: 0-A (只有 2006h: 01h 生效), 1-B (只有 2006h: 02h 生效), 2-A+B(2006h: 01h 和 2006h: 02h 同时生效) Specific description: 0-A (only effective at 2006h: 01h), 1-B (only effective at 2006h: 02h), 2-A+B (effective at both 2006h: 01h and 2006h: 02h)										

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2006h (速 度 控 制 参 数) (Spee d contr ol para)	04h	14Bh	KeypadSpeedRef	速度指令键盘设定值 Speed command keyboard setting	int16	-32768~32767	RW	NO	10	1rpm	立即生效 Effective immediately
	06h	14Dh	ValidSpeedRef	生效的速度设定值 Effective speed setting	int16	-32768~32767	RW	NO	0	1rpm	立即生效 Effective immediately
	07h	14Eh	SpeedRefAccelRampT ime	速度指令加速斜坡时间 常数 Speed command acceleration ramp time constant	uint16	0~65535	RW	NO	10	1ms	立即生效 Effective immediately
	08h	14Fh	SpeedRefDecelRampT ime	速度指令减速斜坡时间 常数 Speed command deceleration ramp time constant	uint16	0~65535	RW	NO	10	1ms	立即生效 Effective immediately
	09h	150h	MaxSpeedLimit	最大转速阈值 Maximum speed threshold	uint16	0~65535	RW	NO	6000	1rpm	立即生效 Effective immediately
	0Ah	151h	FwrSpeedLimit	正向速度阈值	uint16	0~65535	RW	NO	4000	1rpm	立即生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
meter s)				Forward speed threshold							Effective immediately
	0B _h	152 _h	BwrSpeedLimit	反向速度阈值 Reverse speed threshold	uint16	0~65535	RW	NO	4000	1rpm	立即生效 Effective immediately
2007 _h (转矩 控制 参数) (Torque control parameters)	01 _h	15E _h	MainTorqRefSourceA	主转矩指令 A 来源 Source of main torque command A	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 0~数字给定(2007 _h : 04 _h 的设定值) Specific description: 0-digit setting (setting value of 2007 _h : 04 _h)								
	02 _h	15F _h	AuxTorqRefSourceB	辅助转矩指令 B 来源 Source of auxiliary torque command B	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 0-数字给定(2007 _h : 04 _h 的设定值) Specific description: 0-digit setting (2007 _h : 04 _h setting value)								
contr ol para meter)	03 _h	160 _h	TorqRefSource	转矩指令选择 Torque command selection	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 0-A (只有 2007 _h : 01 _h 生效), 1-B (只有 2007 _h : 02 _h 生效), 2-A+B(2007 _h : 01 _h 和 2007 _h : 02 _h 同时生效) Specific description: 0-A (only effective at 2007 _h : 01 _h), 1-B (only effective at 2007 _h : 02 _h), 2-A+B (effective at both 2007 _h : 01 _h and 2007 _h : 02 _h)								

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2007h (转矩 控制 参数) (Torq ue contr ol para meter)	04h	161h	KeypadTorqRef	转矩指令键盘设定值 Torque command keyboard setting	int16	-32768~32767	RW	NO	10	0.1%	停机生效 Shutdown effective
	05h	162h	ValidTorqRef	生效的转矩指令设定值 Effective torque command setting	int16	-32768~32767	RW	NO	10	0.1%	停机生效 Shutdown effective
	06h	163h	TorqRefFilterTime	转矩指令滤波时间常数 Torque command filter time constant	uint16	0~65535	RW	NO	0	0.01m s	立即生效 Effective immediately
			设定值过大，将降低响应性。 If the setting value is too large, the response will be reduced.								
	0Ah	167h	FwrTorqInterLimit	正内部转矩限制 Positive internal torque limit	uint16	0~65535	RW	NO	1000	0.1%	立即生效 Effective immediately
	0Bh	168h	BwrTorqInterLimit	反内部转矩限制 Inverse internal torque limit	uint16	0~65535	RW	NO	1000	0.1%	立即生效 Effective immediately
	10h	16Dh	TorqCtrlFwrSpeedLimit	转矩控制正向速度限制 值 Torque control forward speed limit value	uint16	0~65535	RW	NO	3000	1rpm	立即生效 Effective immediately

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	11h	16Eh	TorqCtrlBwrSpeedLimit	转矩控制反向速度限制值 Torque control reverse speed limit	uint16	0~65535	RW	NO	3000	1rpm	立即生效 Effective immediately
	13h	170h	ReachedTorqValidVal	堵转找寻原点时的检测转矩 Detecting torque when finding the origin in locked rotation (HM Blocking Torque)	uint16	0~65535	RW	NO	500	0.1%	
	15h	172h	TorqCtrlSpdLmtWinTime	堵转找寻原点时的检测时间 Detection time when blocking to find the origin (HM Blocking Time)	uint16	0~65535	RW	NO	500	ms	
2008h (增益类参数)	01h	178h	SpeedLoopGain	速度环增益 Speed loop gain	uint16	1~20000	RW	NO	500	0.1Hz	运行设定立即生效 Run settings take effect immediately

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method	
(Gain para meter s)				具体描述：设置速度环的比例增益。此参数决定速度环的响应，越大则速度环响应越快，但是设置的太大可能引起振动。位置模式下，若要加大位置环增益，需同时加大速度环增益。 Description: Set the proportional gain of the speed loop. This parameter determines the response of the speed loop. The larger the speed loop, the faster the response, but too large a setting may cause vibration. In position mode, if you want to increase the position loop gain, you need to increase the speed loop gain at the same time.	SpdLoopIntegrTime	速度环积分时间常数 Speed loop integral time constant	uint16	0~51200	RW	NO	800	0.01m s
	02h	179h		具体描述：设置速度环的积分时间常数。设置的值越小，积分效果越强，停止时的偏差值更快接近于0。当此参数设置为51200，无积分效果。 Description: Set the integral time constant of the speed loop. The smaller the set value, the stronger the integration effect, and the deviation value at the time of stopping is closer to 0 faster. When this parameter is set to 51200, there is no integral effect.								
2008h (增益 类参数) (Gain para meter s)	03h	17Ah	PosLoopGain	位置环增益 Position loop gain	uint16	0~20000	RW	NO	1500	1	运行设定立即 生效 Run settings take effect immediately	
具体描述：设置位置环的比例增益。此参数决定位置环的响应性，设置较大的位置环增益，可以缩短定位时间，但设置过大可能引起振动。 Description: Set the proportional gain of the position loop. This parameter determines the responsiveness of the position loop. Setting a larger position loop gain can shorten the positioning time, but setting it too large may cause vibration.												

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	04h	17Bh	SpeedLoop2ndGain	第二速度环增益 Second speed loop gain	uint16	1~20000	RW	NO	1	0.1Hz	立即生效 Effective immediately
	05h	17Ch	SpdLoop2ndIntegrTime	第二速度环积分时间常数 Integral time constant of the second speed loop	uint16	0~51200	RW	NO	15	0.01ms	立即生效 Effective immediately
	06h	17Dh	PosLoop2ndGain	第二位置环增益 Second position loop gain	uint16	0~20000	RW	NO	0	1	立即生效 Effective immediately
	17Fh	GainSwitchModeSet	第二增益模式设置 Second gain mode setting	uint16	0~1	RW	NO	0	1		立即生效 Effective immediately
08h			9~实际速度，实际速度的绝对值超过(等级+时滞)[rpm]的状态在延迟时间期间内持续]时，切换到第二增益，实际速度的绝对值不到(等级-时滞) [rpm] 的状态在延迟时间期间内持续时，返回到第一增益。 9~Actual speed, when the absolute value of the actual speed exceeds (level + time lag) [rpm] status continues during the delay time, switch to the second gain, the absolute value of the actual speed is less than (level-time lag) When the state of [rpm] continues during the delay time, it returns to the first gain.								
	09h	180h	GainSwitchCondition	增益切换条件选择	uint16	0~10	RW	NO	0	1	立即生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				Gain switching condition selection							Effective immediately
				具体描述：0~第 1 组增益，1~第 2 组增益 Specific description: 0~group 1 gain, 1~group 2 gain							
	0Ah	181h	GainSwitchDelay	增益切换延迟时间 Gain switching delay time	uint16	0~10000	RW	NO	0	0.1ms	立即生效 Effective immediately
	0Bh	182h	GainSwitchLevel	增益切换等级 Gain switching level	uint16	0~20000	RW	NO	0	1	立即生效 Effective immediately
				实际切换动作的产生受等级和时滞两个条件的共同影响，具体影响方式见 2008h:08h 的说明。根据增益切换模式的不同，切换等级的单位会随之变化。 The actual switching action is affected by both the level and the time lag. For the specific impact mode, see the description at 2008h:08h. Depending on the gain switching mode, the unit of the switching level will change accordingly.							
	0Ch	183h	GainSwitchHyst	增益切换时滞 Gain switching lag	uint16	0~20000	RW	NO	0	1	立即生效 Effective immediately
				实际切换动作的产生受等级和时滞两个条件的共同影响，具体影响方式见 2008h:08h 的说明。根据增益切换模式的不同，切换等级的单位会随之变化。 The actual switching action is affected by both the level and the time lag. For the specific impact mode, see the description at 2008h:08h. Depending on the gain switching mode, the unit of the switching level will change accordingly.							

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	0F _h	186 _h	SpdFdFwrFilterTime	速度前馈滤波时间常数 Speed feedforward filter time constant	uint16	0~65535	RW	NO	0	0.01ms	立即生效 Effective immediately
	10 _h	187 _h	SpeedFdFwrGain	速度前馈增益 Speed feedforward gain	uint16	0~65535	RW	NO	0	0.1%	立即生效 Effective immediately
调整时, 应反复调整 2008h: 0F _h 和 2008h: 10 _h , 寻找平衡性好的设定 When adjusting, you should repeatedly adjust 2008h: 0F _h and 2008h: 10 _h to find a well-balanced setting											
	11 _h	188 _h	TorqFdFwrFilterTime	转矩前馈滤波时间常数 Torque feedforward filter time constant	uint16	0~65535	RW	NO	0	0.01ms	立即生效 Effective immediately
	12 _h	189 _h	TorqFdFwrGain	转矩前馈增益 Torque feedforward gain	uint16	0~65535	RW	NO	0	0.001	立即生效 Effective immediately
调整时, 应反复调整 2008h: 11 _h 和 2008h: 12 _h , 寻找平衡性好的设定。 When adjusting, you should repeatedly adjust 2008h: 11 _h and 2008h: 12 _h to find a well-balanced setting.											
	14 _h	18B _h	SpdFdBckFilterCutOffF req	速度反馈低通滤波截止 频率 Speed feedback low-pass filter cutoff frequency	uint16	0~4000	RW	NO	900	1Hz	立即生效 Effective immediately

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method		
			具体描述：设置的越小，速度反馈波动越小，但反馈延迟也越大，一般保持默认参数即可。 Specific description: The smaller the setting, the smaller the speed feedback fluctuation, but the larger the feedback delay, generally keep the default parameters.										
2009h (增 益 参 数) (Gain para meter)	06h	197h	参数离线识别状态显示 Parameter offline recognition status display	OffInertiaAutoTunMode	uint16	0~65535	RO	NO	0	1	-		
			具体描述：详见 8.2.2 章节 Specific description: see chapter 8.2.2 for details										
	0Dh	19Eh	Notch1Freq	第 1 组陷波器频率 Group 1 notch frequency	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately		
			具体描述：设置陷波器的中心频率，即机械共振频率。 Description: Set the center frequency of the trap, that is, the mechanical resonance frequency.										
	0Eh	19Fh	Notch1Width 调整 Level Notch1Width adjust Level	第 1 组陷波器陷波宽度 Notch width of the first group of traps	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately		
			具体描述：设置机械共振中心频率两侧的的频带宽度 Specific description: Set the frequency band width on both sides of the center frequency of the mechanical resonance										
	0Fh	1A0h	Notch1DepthLevel	第 1 组陷波器深度	uint16	0~100	RW	NO	0	%	立即生效		

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				Group 1 trap depth							Effective immediately
				具体描述: 0-不进行陷波, 100-最大陷波深度 Specific description: 0- no notch, 100~ maximum notch depth							
	10h	1A1h	Notch2Freq	第 2 组陷波器频率 Group 2 notch frequency	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately
	11h	1A2h	Notch2WidthLevel	第 2 组陷波器陷波宽度 Notch width of the second group notch filter	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately
	12h	1A3h	Notch2DepthLevel	第 2 组陷波器深度 Group 2 trap depth	uint16	0~100	RW	NO	0	1	立即生效 Effective immediately
	13h	1A4h	Notch3Freq	第 3 组陷波器频率 Group 3 notch frequency	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately
	14h	1A5h	Notch3WidthLevel	第 3 组陷波器陷波宽度 Group 3 notch width	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately
	15h	1A6h	Notch3DepthLevel	第 3 组陷波器深度 Group 3 trap depth	uint16	0~100	RW	NO	0	1	立即生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
200Ah (故障与保护参数) (Fault and protection)				Group 3 trap depth							Effective immediately
	16h	1A7h	Notch4Freq	第 4 组陷波器频率 Group 4 notch frequency	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately
	17h	1A8h	Notch4WidthLevel	第 4 组陷波器陷波宽度 4th wave trap notch width	uint16	0~2000	RW	NO	0	1Hz	立即生效 Effective immediately
	18h	1A9h	Notch4DepthLevel	第 4 组陷波器深度 Group 4 trap depth	uint16	0~100	RW	NO	0	1	立即生效 Effective immediately
	06h	1BCh	OverSpeedThr	超速故障阈值 Overspeed fault threshold	uint16	0~65535	RW	NO	0	1	立即生效 Effective immediately

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
para meter s)											
200B _h (监控参数) (Moni toring para meter s)	01 _h	1DE _h	DriverState	电机驱动器内部状态 Motor drive internal state	uint16	0~12	RO	NO	0	1	-
			具体描述: 0~未准备好、1~准备好、6~位置闭环控制、8~速度闭环控制、9~转矩控制、10~开环控制、12~错误 Specific description: 0~ not ready, 1~ ready, 6~ position closed loop control, 8~ speed closed loop control, 9~ torque control, 10~ open loop control, 12~ error								
	02 _h	1DF _h	ActualMotorSpeed	实际电机转速 Actual motor speed	int16	-32768~32767	RO	NO	-	1rpm	-
	04 _h	1E1 _h	InterTorqueRef	内部转矩指令 Internal torque command	int16	-32768~32767	RO	NO	0	0	-
	05 _h	1E2 _h	MonitoredDiStates	输入信号(DI 信号)监视 Input signal (DI signal) monitoring	uint16	0~65535	RO	NO	0	1	-
	06 _h	1E3 _h	MonitoredDoStates	输出信号(DO 信号)监 视 Output signal (DO signal) monitoring	uint16	0~65535	RO	NO	0	1	-

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	0Ah	1E8h	PosRefToSpeed	输入 PWM 频率 Input PWM frequency	uint16	0~65535	RO	NO	0	1Hz	-
	0Fh	1F0h	TotalPowerOnTime	总上电时间 Total power-on time	uint32	0~4294967295	RO	NO	0	0.1s	-
	12h	1F4h	PnCurrentEffectValA	A 相电流有效值 A phase current effective value	uint16	0~65535	RO	NO	0	0.01A	-
	13h	1F5h	PnCurrentEffectValB	B 相电流有效值 B phase current effective value	uint16	0~65535	RO	NO	0	0.01A	-
	14h	1F6h	PnCurrentEffectValC	C 相电流有效值 C phase current effective value	uint16	0~65535	RO	NO	0	0.01A	-
	15h	1F7h	BusVoltage	母线电压值 Bus voltage	uint16	0~65535	RO	NO	0	0.1V	-
	16h	1F8h	ModuleTemperature	模块温度值 Module temperature value	int16	-32768~-32767	RO	NO	0	1°C	-
	2Dh	211h	ActualMotorSpeed01	实际电机转速 Actual motor speed	uint16	0~65535	RO	NO	-	0.1rpm	-
	01h	22Fh	CommunicationSelect	通讯方式选择	uint16	0~2	RW	NO	1	1	再次通电

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method	
				Selection of communication method							Power on again	
				具体描述: 0~外部脉冲控制 (默认 CAN 通信), 1~EtherCAT, 2~CAN Specific description: 0~External pulse control (default CAN communication), 1~EtherCAT, 2~CAN								
200Ch (通信参数) (Communication parameters)	02h	230h	ServoShaftAddress	驱动器轴地址 Drive axis address	uint16	1~247	RW	NO	1	1	再次通电 Power on again	
			1~247: 多台电机进行组网时, 每个电机只能有唯一的地址, 否则会导致通信异常或无法通信。 1~247: When multiple motors are networked, each motor can only have a unique address, otherwise it will cause abnormal communication or unable to communicate.									
	03h	231h	SerialPortBaudRate	串口波特率设置 Serial port baud rate setting	uint16	0~8	RW	NO	8	1	再次通电 Power on again	
			电机的通信速率必须和上位机通信速率一致, 否则无法通信。 The communication rate of the motor must be the same as the communication rate of the host computer, otherwise it cannot communicate.									
	18h	246h	SynchronizationMode	同步模式使能 Synchronous mode enable	uint16	0~1	RW	NO	0	1	再次通电 Power on again	

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
200Eh (故 障代 码) (error code)	01h	25Bh	MotorOverLoad	电机过载 Motor overload	int32	- 214748364~2 147483647	RW	NO	67183377	1	立即生效 Effective immediately
	02h	25Dh	MotorlockRotor	电机堵转 Motor blocked	int32	- 214748364~2 147483647	RW	NO	8978	1	立即生效 Effective immediately
	03h	25Fh	OverVoltage	电源过压 Power overvoltage	int32	- 214748364~2 147483647	RW	NO	78352	1	立即生效 Effective immediately
	04h	261h	UnderVoltage	电源欠压 Power supply undervoltage	int32	- 214748364~2 147483647	RW	NO	16855584	1	立即生效 Effective immediately
	05h	263h	OverDriveTemp	温度过高 Temperature is too high	int32	- 214748364~2 147483647	RW	NO	82448	1	立即生效 Effective immediately
	06h	265h	UnderDriveTemp	温度过低 The temperature is too low	int32	- 214748364~2 147483647	RW	NO	82464	1	立即生效 Effective immediately
	07h	267h	ParameterError	参数设置错误 Parameter setting error	int32	- 214748364~2 147483647	RW	NO	90912	1	立即生效 Effective immediately

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
障代 码) (error code)	08h	269h	OverSpeed	电机超速 Motor overspeed	int32	- 214748364~2 147483647	RW	NO	94992	1	立即生效 Effective immediately
	09h	26Bh	CommError	通信故障 Communication failure	int32	- 214748364~2 147483647	RW	NO	95489	1	立即生效 Effective immediately
	0Ah	26Dh	HomingError	原点回归超时错误 Origin return timeout error	int32	- 214748364~2 147483647	RW	NO	34320	1	立即生效 Effective immediately
	0Bh	26Fh	FollowingError	位置超差错误 Location error	int32	- 214748364~2 147483647	RW	NO	34321	1	立即生效 Effective immediately
	0Ch	271h	PosSwlimitError	软件超限故障 Software overrun fault	int32	- 214748364~2 147483647	RW	NO	50431507	1	立即生效 Effective immediately
	0Dh	273h	PosGaugeError	超限开关故障 Over-limit switch failure	int32	- 214748364~2 147483647	RW	NO	50431507	1	立即生效 Effective immediately
	OEh	275h	PhaseOutputError	输出相故障 Output phase failure	int32	- 214748364~2 147483647	RW	NO	12933	1	立即生效 Effective immediately

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
障代 码) (error code)	0F _h	277 _h	ProfileCalcFault	曲线规划计算错误 Curve planning calculation error	int32	- 214748364~2 147483647	RW	NO	67208725	1	立即生效 Effective immediately
	10 _h	279 _h	ProfilePosTargetOverflow	目标位置溢出 Target position overflow	int32	- 214748364~2 147483647	RW	NO	99862	1	立即生效 Effective immediately
	11 _h	27B _h	ProfileParaTooSmall	曲线规划参数过小 Curve planning parameters are too small	int32	- 214748364~2 147483647	RW	NO	83985943	1	立即生效 Effective immediately
2011 _h (多 段 位 置 功 能 参 数)	01 _h	291 _h	MultiPosRunMode	多段位置运行方式 Multi-step position operation mode	uint16	0~2	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 详见 6.16.4 章节 Specific description: see chapter 6.16.4 for details								
	02 _h	292 _h	PosRefProfileNum	位置指令终点段数 Position command end segment number	uint16	1~16	RW	NO	1	1	停机生效 Shutdown effective
	具体描述: 设置多段位置指令的总段数 Description: Set the total number of multi-segment position commands										
	04 _h	294 _h	MultiPosTimeUnit	多段位置循环次数	uint16	0~65535	RW	NO	0	1	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method	
(Multi -stage positi on functi on para meter s)				Multi-stage position cycle times							Shutdown effective	
				具体描述: 多段位置运行方式为 1 的循环次数 Specific description: The number of cycles for the multi-segment position operation mode is 1								
	05h	295h	DisplaceRefType	位置指令类型选择 Position command type selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective	
			具体描述: 0-相对位移; 1-绝对位移 Specific description: 0-relative displacement; 1-absolute displacement	Shutdown effective								
	06h	296h	StartPosSequRunSel e	多段位置循环起点段 Multi-segment position cycle start segment	uint16	0~16	RW	NO	0	1	停机生效 Shutdown effective	
			具体描述: 多段位置运行方式为 1 的起点段 Specific description: the starting point segment with multi-segment position running mode of 1									
	07h	297h	Displace1	第 1 段移动位移 1st stage displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户 单位 User units	停机生效 Shutdown effective	
	08h	299h	Displace1MaxSpeed	第 1 段位移最大运行速度	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective	

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能参数) (Multi-stage position function parameters)				Maximum running speed of the first stage displacement							
2011h (多段位置功)	09h	29Ah	Displace1AccelDecelTime	第 1 段位移加减速时间 1st stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
				具体描述：设置多段位置第 1 段电机由 0rpm 匀变速到 1000rpm 的时间 Specific description: Set the time for the 1st stage motor of the multi-stage position to be changed from 0rpm to 1000rpm							
2011h (多段位置功)	0Ah	29Bh	Displace1DoneWaitTime	第 1 段位移完成后等待时间 Waiting time after the 1st displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
				具体描述：多段位置第 1 段位移运行完成后，运行下一段位移前的等待时间 Specific description: Waiting time before running the first displacement after the completion of the first displacement in the multi-segment position							
	0Bh	29Ch	Displace2	第 2 段移动位移 2nd moving displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户单位 User units	停机生效 Shutdown effective

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能 参 数) (Multi -stage positi on functi on para meter s) 2011h (多 段 位	0C _h	29E _h	Displace2MaxSpeed	第 2 段位移最大运行速度 Maximum running speed of 2nd stage displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	0D _h	29F _h	Displace2AccelDecelTi me	第 2 段位移加减速时间 2nd stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	0E _h	2A0 _h	Displace2DoneWaitTi me	第 2 段位移完成后等待时间 Waiting time after completion of the 2nd displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	0F _h	2A1 _h	Displace3	第 3 段移动位移 3rd moving displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户 单位 User units	停机生效 Shutdown effective
	10 _h	2A3 _h	Displace3MaxSpeed	第 3 段位移最大运行速度	uint16	0~3000	RW	NO	1	rpm	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
置功能参数) (Multi-stage position function parameters)				Maximum running speed of the third stage displacement							Shutdown effective
	11 _h	2A4 _h	Displace3AccelDecelTime	第 3 段位移加减速时间 3rd stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	12 _h	2A5 _h	Displace3DoneWaitTime	第 3 段位移完成后等待时间 Waiting time after the third stage displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	13 _h	2A6 _h	Displace4	第 4 段移动位移 4th movement displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户单位 User units	停机生效 Shutdown effective
	14 _h	2A8 _h	Displace4MaxSpeed	第 4 段位移最大运行速度 Maximum running speed of the 4th stage displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2011h (多 段 位 置 功)	15h	2A9h	Displace4AccelDecelTime	第 4 段位移加减速时间 4th stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	16h	2AAh	Displace4DoneWaitTime	第 4 段位移完成后等待时间 Waiting time after the 4th displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	17h	2ABh	Displace5	第 5 段移动位移 5th moving displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824 User units	User units	停机生效 Shutdown effective
	18h	2ADh	Displace5MaxSpeed	第 5 段位移最大运行速度 Maximum running speed of the 5th displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	19h	2AEh	Displace5AccelDecelTime	第 5 段位移加减速时间	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
能 参 数) (Multi -stage positi on functi on para meter s)				5th stage displacement acceleration/decelerati on time							
	1Ah	2AFh	Displace5DoneWaitTi me	第 5 段位移完成后等待 时间 Waiting time after the 5th displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	1Bh	2B0h	Displace6	第 6 段移动位移 6th moving displacement	int32	-2147483648 ~2147483647	RW	NO	- 1073741 824	用户 单位 User units	停机生效 Shutdown effective
	1Ch	2B2h	Displace6MaxSpeed	第 6 段位移最大运行速 度 6th displacement maximum operating speed	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
2011h (多 段 位 置 功	1Dh	2B3h	Displace6AccelDecelTi me	第 6 段位移加减速时间 6th stage displacement acceleration/decelerati on time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
能 参 数) (Multi -stage positi on functi on para meter s) 2011h (多 段 位	1Eh	2B4h	Displace6DoneWaitTi me	第 6 段位移完成后等待 时间 Waiting time after the 6th displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	1Fh	2B5h	Displace7	第 7 段移动位移 7th moving displacement	int32	-2147483648 ~2147483647	RW	NO	- 1073741 824	用户 单位 User units	停机生效 Shutdown effective
	20h	2B7h		第 7 段位移最大运行速 度 7th displacement maximum running speed	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	21h	2B8h	Displace7AccelDecelTi me	第 7 段位移加减速时间 7th stage displacement acceleration and deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	22h	2B9h	Displace7DoneWaitTi me	第 7 段位移完成后等待 时间	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
置功能参数) (Multi-stage position function parameters)				Waiting time after completion of the 7th displacement							
	23h	2BAh	Displace8	第 8 段移动位移 8th movement displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户单位 User units	停机生效 Shutdown effective
	24h	2BCh	Displace8MaxSpeed	第 8 段位移最大运行速度 Maximum running speed of the 8th displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	25h	2BDh	Displace8AccelDecelTime	第 8 段位移加减速时间 8th displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	26h	2BEh	Displace8DoneWaitTime	第 8 段位移完成后等待时间 Waiting time after the 8th displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	27 _h	2BF _h	Displace9	第 9 段移动位移 9th moving displacement	int32	-2147483648 ~2147483647	RW	NO	- 1073741 824	用户 单位 User units	停机生效 Shutdown effective
	28 _h	2C1 _h	Displace9MaxSpeed	第 9 段位移最大运行速度 9th displacement maximum operating speed	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	29 _h	2C2 _h	Displace9AccelDecelTi me	第 9 段位移加减速时间 9th displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2A _h	2C3 _h	Displace9DoneWaitTi me	第 9 段位移完成后等待时间 Waiting time after the 9th displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2B _h	2C4 _h	Displace10	第 10 段移动位移 10th movement displacement	int32	-2147483648 ~2147483647	RW	NO	- 1073741 824	用户 单位 User units	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
										User units	
	2C _h	2C6 _h	Displace10MaxSpeed	第 10 段位移最大运行速度 Maximum running speed of the 10th displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	2D _h	2C7 _h	Displace10AccelDecelTime	第 10 段位移加减速时间 10th stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2E _h	2C8 _h	Displace10DoneWaitTime	第 10 段位移完成后等待时间 Waiting time after the 10th displacement is completed	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2F _h	2C9 _h	Displace11	第 11 段移动位移 11th moving displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户单位 User unit	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
									User units		
	30h	2CBh	Displace11MaxSpeed	第 11 段位移最大运行速度 Maximum running speed of the 11th displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	31h	2CCh	Displace11AccelDecelTime	第 11 段位移加减速时间 11th stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	32h	2CDh	Displace11DoneWaitTime	第 11 段位移完成后等待时间 Waiting time after the 11th displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	33h	2CEh	Displace12	第 12 段移动位移 12th movement displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户 单位 User units	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	34h	2D0h	Displace12MaxSpeed	第 12 段位移最大运行速度 Maximum running speed of the 12th displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	35h	2D1h	Displace12AccelDecelTime	第 12 段位移加减速时间 12th stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	36h	2D2h	Displace12DoneWaitTime	第 12 段位移完成后等待时间 Waiting time after completion of the 12th displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	37h	2D3h	Displace13	第 13 段移动位移 13th movement displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户 单位 User units	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	38h	2D5h	Displace13MaxSpeed	第 13 段位移最大运行速度 Maximum running speed of the 13th displacement	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective
	39h	2D6h	Displace13AccelDecelTime	第 13 段位移加减速时间 Stage 13 displacement acceleration and deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	3Ah	2D7h	Displace13DoneWaitTime	第 13 段位移完成后等待时间 Waiting time after completion of the 13th displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	3Bh	2D8h	Displace14	第 14 段移动位移 14th moving displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户 单位 User units	停机生效 Shutdown effective
	3Ch	2DAh	Displace14MaxSpeed	第 14 段位移最大运行速度	uint16	0~3000	RW	NO	1	rpm	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				Maximum running speed of the 14th displacement							Shutdown effective
	3D _h	2DB _h	Displace14AccelDecel Time	第 14 段位移加减速时间 14th stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	3E _h	2DC _h	Displace14DoneWaitTime	第 14 段位移完成后等待时间 Waiting time after completion of the 14th displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	3F _h	2DD _h	Displace15	第 15 段移动位移 15th movement displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户单位 User units	停机生效 Shutdown effective
	40 _h	2DF _h	Displace15MaxSpeed	第 15 段位移最大运行速度	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				Maximum running speed of the 15th displacement							
	41h	2E0h	Displace15AccelDecel Time	第 15 段位移加减速时间 15th stage displacement acceleration and deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	42h	2E1h	Displace15DoneWaitTime	第 15 段位移完成后等待时间 Waiting time after the 15th displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	43h	2E2h	Displace16	第 16 段移动位移 16th movement displacement	int32	-2147483648 ~2147483647	RW	NO	-1073741824	用户 单位 User units	停机生效 Shutdown effective
	44h	2E4h	Displace16MaxSpeed	第 16 段位移最大运行速度	uint16	0~3000	RW	NO	1	rpm	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
				Maximum running speed of the 16th displacement							
	45h	2E5h	Displace16AccelDecel Time	第 16 段位移加减速时间 16th stage displacement acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	46h	2E6h	Displace16DoneWaitTime	第 16 段位移完成后等待时间 Waiting time after the 16th displacement	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	01h	2E9h	MultiSpeedRunMode	多段速度指令运行方式 Multi-step speed command operation mode	uint16	0~2	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 详见 6.17.4 章节 Specific description: see chapter 6.17.4 for details								
	02h	2EAh	SpeedRefProfileNum	速度指令终点段数选择	uint16	0~16	RW	NO	1	1	停机生效

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2012h (多段速度功能参数) (Multi-stage speed function parameters)				Speed command end segment selection							Shutdown effective
	03h	2EBh	MultiSpeedTimeUnit	多段速度循环次数 Multi-speed cycle times	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective
	0Ch	2F4h	SpeedRef1	第 1 段速度指令 1st speed instruction	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	0Dh	2F5h	SpeedRef1RunTime	第 1 段指令运行时间 Section 1 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	0Eh	2F6h	SpeedRef1AccelDecel Time	第 1 段加减速时间 1st acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	0Fh	2F7h	SpeedRef2	第 2 段指令 Instruction 2	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	10h	2F8h	SpeedRef2RunTime	第 2 段指令运行时间 Section 2 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
meter) 2012h (多 段 速 度 参 数 (Multi -stage speed functi on para meter)	11h	2F9h	SpeedRef2AccelDecel Time	第 2 段加减速时间 2nd acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	12h	2FAh	SpeedRef3	第 3 段指令 Instruction 3	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	13h	2FBh	SpeedRef3RunTime	第 3 段指令运行时间 Section 3 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	14h	2FCh	SpeedRef3AccelDecel Time	第 3 段加减速时间 3rd acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	15h	2FDh	SpeedRef4	第 4 段指令 Instruction 4	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	16h	2FEh	SpeedRef4RunTime	第 4 段指令运行时间 Section 4 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	17h	2FFh	SpeedRef4AccelDecel Time	第 4 段加减速时间 4th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
2012h (多 段 速 度 参 数) (Multi -stage speed functi on)	18h	300h	SpeedRef5	第 5 段指令 Instruction 5	int16	0~3000	RW	NO	-6000	rpm	停机生效
	19h	301h	SpeedRef5RunTime	第 5 段指令运行时间 Section 5 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	1Ah	302h	SpeedRef5AccelDecel Time	第 5 段加减速时间 5th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	1Bh	303h	SpeedRef6	第 6 段指令 Instruction 6	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	1Ch	304h	SpeedRef6RunTime	第 6 段指令运行时间 Section 6 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	1Dh	305h	SpeedRef6AccelDecel Time	第 6 段加减速时间 6th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	1Eh	306h	SpeedRef7	第 7 段指令 Instruction 7	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
para meter) 2012h (多 段 速 度 参 数) (Multi -stage speed functi on para	1F _h	307 _h	SpeedRef7RunTime	第 7 段指令运行时间 Section 7 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	20 _h	308 _h	SpeedRef7AccelDecel Time	第 7 段加减速时间 7th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	21 _h	309 _h	SpeedRef8	第 8 段指令 Instruction 8	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	22 _h	30Ah	SpeedRef8RunTime	第 8 段指令运行时间 Section 8 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	23 _h	30B _h	SpeedRef8AccelDecel Time	第 8 段加减速时间 8th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	24 _h	30C _h	SpeedRef9	第 9 段指令 Instruction 9	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	25 _h	30D _h	SpeedRef9RunTime	第 9 段指令运行时间 Section 9 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
meter)	26h	30Eh	SpeedRef9AccelDecel Time	第 9 段加减速时间 9th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	27h	30Fh	SpeedRef10	第 10 段指令 Instruction 10	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	28h	310h	SpeedRef10RunTime	第 10 段指令运行时间 Section 10 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	29h	311h	SpeedRef10AccelDece ITime	第 10 段加减速时间 10th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2Ah	312h	SpeedRef11	第 11 段指令 Instruction 11	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	2Bh	313h	SpeedRef11RunTime	第 11 段指令运行时间 Section 11 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2Ch	314h	SpeedRef11AccelDece ITime	第 11 段加减速时间 11th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	2D _h	315 _h	SpeedRef12	第 12 段指令 Instruction 12	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	2E _h	316 _h	SpeedRef12RunTime	第 12 段指令运行时间 Section 12 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	2F _h	317 _h	SpeedRef12AccelDeceITime	第 12 段加减速时间 12th acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	30 _h	318 _h	SpeedRef13	第 13 段指令 Instruction 13	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	31 _h	319 _h	SpeedRef13RunTime	第 13 段指令运行时间 Section 13 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	32 _h	31A _h	SpeedRef13AccelDeceITime	第 13 段加减速时间 13th acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	33 _h	31B _h	SpeedRef14	第 14 段指令 Instruction 14	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	34h	31Ch	SpeedRef14RunTime	第 14 段指令运行时间 Section 14 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	35h	31Dh	SpeedRef14AccelDece lTime	第 14 段加减速时间 14th acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	36h	31Eh	SpeedRef15	第 15 段指令 Instruction 15	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	37h	31Fh	SpeedRef15RunTime	第 15 段指令运行时间 Section 15 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	38h	320h	SpeedRef15AccelDece lTime	第 15 段加减速时间 15th acceleration/deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
	39h	321h	SpeedRef16	第 16 段指令 Instruction 16	int16	0~3000	RW	NO	-6000	rpm	停机生效 Shutdown effective
	3Ah	322h	SpeedRef16RunTime	第 16 段指令运行时间 Section 16 instruction running time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective

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	3B _h	323 _h	SpeedRef16AccelDece ITime	第 16 段加减速时间 16th acceleration/ deceleration time	uint16	0~65535	RW	NO	0	ms	停机生效 Shutdown effective
2017 _h (虚 拟 输 入 端 子 参 数) (Virt ual input termi nal para	01 _h	326 _h	VDI1FunSelec	VDI1 端子功能选择 VDI1 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 详见 7.1 章节 Specific description: see chapter 7.1								
	02 _h	327 _h	VDI1LogicSelec	VDI1 端子逻辑选择 VDI1 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
			具体描述: 详见 7.1 章节 Specific description: see chapter 7.1								
	03 _h	328 _h	VDI2FunSelec	VDI2 端子功能选择 VDI2 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	04 _h	329 _h	VDI2LogicSelec	VDI2 端子逻辑选择 VDI2 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	05 _h	32A _h	VDI3FunSelec	VDI3 端子功能选择 VDI3 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
meter s) 2017h (虚 拟 输 入 端 子 参 数) (Virtu al input termi nal	06h	32Bh	VDI3LogicSelec	VDI3 端子逻辑选择 VDI3 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	07h	32Ch	VDI4FunSelec	VDI4 端子功能选择 VDI4 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	08h	32Dh	VDI4LogicSelec	VDI4 端子逻辑选择 VDI4 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	09h	32Eh	VDI5FunSelec	VDI5 端子功能选择 VDI5 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	0Ah	32Fh	VDI5LogicSelec	VDI5 端子逻辑选择 VDI5 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	0Bh	330h	VDI6FunSelec	VDI6 端子功能选择 VDI6 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	0Ch	331h	VDI6LogicSelec	VDI6 端子逻辑选择 VDI6 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
para meter s)	0D _h	332 _h	VDI7FunSelec	VDI7 端子功能选择 VDI7 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	0E _h	333 _h	VDI7LogicSelec	VDI7 端子逻辑选择 VDI7 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	0F _h	334 _h	VDI8FunSelec	VDI8 端子功能选择 VDI8 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	10 _h	335 _h	VDI8LogicSelec	VDI8 端子逻辑选择 VDI8 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	11 _h	336 _h	VDI9FunSelec	VDI9 端子功能选择 VDI9 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	12 _h	337 _h	VDI9LogicSelec	VDI9 端子逻辑选择 VDI9 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	13 _h	338 _h	VDI10FunSelec	VDI10 端子功能选择 VDI10 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresp onding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibil ity	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	14h	339h	VDI10LogicSelec	VDI10 端子逻辑选择 VDI10 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	15h	33Ah	VDI11FunSelec	VDI11 端子功能选择 VDI11 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	16h	33Bh	VDI11LogicSelec	VDI11 端子逻辑选择 VDI11 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	17h	33Ch	VDI12FunSelec	VDI12 端子功能选择 VDI12 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	18h	33Dh	VDI12LogicSelec	VDI12 端子逻辑选择 VDI12 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	19h	33Eh	VDI13FunSelec	VDI13 端子功能选择 VDI13 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	1Ah	33Fh	VDI13LogicSelec	VDI13 端子逻辑选择 VDI13 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method
	1B _h	340 _h	VDI14FunSelec	VDI14 端子功能选择 VDI14 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	1C _h	341 _h	VDI14LogicSelec	VDI14 端子逻辑选择 VDI14 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	1D _h	342 _h	VDI15FunSelec	VDI15 端子功能选择 VDI15 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	1E _h	343 _h	VDI15LogicSelec	VDI15 端子逻辑选择 VDI15 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
	1F _h	344 _h	VDI16FunSelec	VDI16 端子功能选择 VDI16 terminal function selection	uint16	0~45	RW	NO	0	1	停机生效 Shutdown effective
	20 _h	345 _h	VDI16LogicSelec	VDI16 端子逻辑选择 VDI16 terminal logic selection	uint16	0~1	RW	NO	0	1	停机生效 Shutdown effective
2031 _h (通信给)	01 _h	373 _h	VDI_VirtualLevelCommSet	通信给定 VDI 虚拟电平 Communication given VDI virtual level	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 modbus 地址 Corresponding modbus address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessibility	能否映射 Can it be mapped	出厂设 定 Factory setting	单位 Unit	生效方式 Effective method		
定相关变量 (Communication given relevant variables)			具体描述: 2031h: 01h 的 bit(n)=1 表示 VDI(n+1) 为高电平; bit(n)=0 表示 VDI(n+1) 为低电平 Specific description: 2031h: 01h bit(n)=1 means VDI(n+1) is high level; bit(n)=0 means VDI(n+1) is low level										
	02h	374h	DoStateCommSet	通信给定 Do 输出状态 Communication given Do output status	uint16	0~65535	RW	NO	0	1	停机生效 Shutdown effective		

10.3 子协议定义参数 6000h 组说明 Sub-protocol definition parameter 6000h group description

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
603F_h	00 _h	37F _h	Error Code	错误码,详见 9.1 章节 Error code, see chapter 9.1 for details	uint16	0~65535	RO	TPDO	0	-	-
6040_h	00 _h	380 _h	Control word	控制字 Control word	uint16	0~65535	RW	RPDO	0	1	停机生效 Shutdown effective
6041_h	00 _h	381 _h	Status word	状态字 Status word	uint16	0~65535	RO	TPDO	0	1	-
6042_h	00 _h	382 _h	VI target velocity	VM 模式的目标速度 Target speed in VM mode	int16	-3000~3000	RW	RPDO	0	1rpm	停机生效 Shutdown effective
6043_h	00 _h	383 _h	VI velocity demand	VM 模式生效的目标速度 Target speed for VM mode to take effect	int16	-3000~3000	RO	TPDO	0	1rpm	-
6044_h	00 _h	384 _h	vi velocity actual value	VM 模式下实际速度 Actual speed in VM mode	int16	--2147483648~2147483647	RO	TPDO	0	1rpm	-
6046_h	01 _h	385 _h	VI velocity min amount	VM 模式的速度最小值 Minimum speed in VM mode	uint32	0~3000	RW	RPDO	10	1rpm	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
	02h	387h	VI velocity max amount	VM 模式的速度最大值 Maximum speed in VM mode	uint32	0~3000	RW	RPDO	3000	1rpm	停机生效 Shutdown effective
6048h	01h	389h	delta speed	VM 模式的加速度=delta speed/delta time	uint32	0~429496 7295	RW	RPDO	500	1rpm	停机生效 Shutdown effective
	02h	38Bh	delta time	Acceleration in VM mode = delta speed/delta time	uint16	1~65535	RW	RPDO	1	1s	停机生效 Shutdown effective
6049h	01h	38Ch	delta speed	VM 模式的减速度=delta speed/delta time	uint32	0~429496 7295	RW	RPDO	500	1rpm	停机生效 Shutdown effective
	02h	38Eh	delta time	VM mode deceleration = delta speed/delta time	uint16	1~65535	RW	RPDO	1	1s	停机生效 Shutdown effective
604Ah	01h	38Fh	delta speed	VM 模式的急停速度=delta speed/delta time	uint32	0~429496 7295	RW	RPDO	800	1rpm	停机生效 Shutdown effective
	02h	391h	delta time	Emergency stop speed in VM mode = delta speed/delta time	uint16	1~65535	RW	RPDO	1	1s	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
604Ch	01h	394h	vl dimension factor numerator	VM 模式的缩放系数 Scaling factor for VM mode	int32	-21474836 48~21474 83647	RW	RPDO	0	1	停机生效 Shutdown effective
	02h	396h	vl dimension factor denominator		int32	-21474836 48~21474 83647	RW	RPDO	0	1	停机生效 Shutdown effective
605Ah	00h	3BFh	Quick stop option code	快速停机方式选择, 详见 4.1.4 章节 For quick stop mode selection, see chapter 4.1.4 for details	int16	0~2	RW	NO	2	1	停机生效 Shutdown effective
605Dh	00h	3C0h	Halt option code	暂停方式选择, 详见 4.1.4 章节 For the selection of pause mode, please refer to chapter 4.1.4	int16	1~2	RW	NO	1	1	停机生效 Shutdown effective
605Eh	00h	3C1h	Fault reaction option code	故障停机方式选择, 详见 4.1.4 章节 For the selection of fault shutdown mode, please refer to chapter 4.1.4	int16	0~2	RO	NO	0	1	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
6060_h	00 _h	3C2 _h	ModeOperati on	模式选择, 详见 6.1 章节 Mode selection, see chapter 6.1 for details	int8	0~10	RW	RPDO	1	1	停机生效 Shutdown effective
6061_h	00 _h	3C3 _h	Modes of operation display	运行模式显示, 详见 6.2 章 节 Operating mode display, see chapter 6.2 for details	int8	0~10	RO	TPDO	1	1	-
6062_h	00 _h	3C4 _h	Position demand value	驱动器内部当前生效的目 标位置指令值 The currently valid target position command value inside the drive	int32	-21474836 48~21474 83647	RO	TPDO	0	用户单位 User units	-
6063_h	00 _h	3C6 _h	Position actual encoder value	电机当前的绝对位置反馈 Motor current absolute position feedback	int32	-21474836 48~21474 83647	RO	TPDO	0	编码器单 位 Encoder unit	-
6064_h	00 _h	3C8 _h	Position actual user value	电机当前的用户绝对位置 反馈 Motor current user absolute position feedback	int32	-21474836 48~21474 83647	RO	TPDO	0	用户单位 User units	-
具体描述: 位置反馈 6064 _h × 齿轮比 (6091 _h) = 位置反馈 6063 _h Specific description: position feedback 6064 _h × gear ratio (6091 _h) = position feedback 6063 _h											

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
6065h	00h	3CAh	Following error Window	位置偏差过大阈值 Threshold for excessive position deviation	uint32	0~429496 7295	RW	RPDO	50	用户单位 User units	停机生效 Shutdown effective
			具体描述: 位置偏差超过±6065h时, 且时间到达 6066h 时, 报跟踪错误 Specific description: When the position deviation exceeds ±6065h, and the time reaches 6066h, a tracking error is reported								
6066h	00h	3CCh	Following error time out	位置偏差过大超时 Excessive position deviation timeout	uint16	0~65535	RW	RPDO	30000	1ms	停机生效 Shutdown effective
			具体描述: 位置偏差超过 ±6065h 时, 且时间到达 6066h 时, 报跟踪错误 Specific description: When the position deviation exceeds ±6065h, and the time reaches 6066h, a tracking error is reported								
6067h	00h	3CDh	Position Window	位置到达阈值 Location reached threshold	uint32	0~429496 7295	RW	RPDO	10	用户单位 User units	停机生效 Shutdown effective
			具体描述: 位置偏差在 ±6067h 以内, 且时间达到 6068h 时, 认为位置到达, 位置类模式下, 状态字 6041h 的 bit10=1 Specific description: When the position deviation is within ±6067h, and the time reaches 6068h, the position is considered to be reached. In position mode, bit10 of status word 6041h=1								
6068h	00h	3CFh	Position Window time	位置到达时间窗口 Position arrival time window	uint16	0~65535	RW	RPDO	5	1ms	停机生效 Shutdown effective
			具体描述: 位置偏差在 ±6067h 以内, 且时间达到 6068h 时, 认为位置到达, 位置类模式下, 状态字 6041h 的 bit10=1 Specific description: When the position deviation is within ±6067h and the time reaches 6068h, it is considered that the position has arrived. In position mode, bit10 of status word 6041h=1								

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
6069h	00h	3D0h	Velocity sensor actual value	速度传感器的反馈值 Feedback value of speed sensor	int32	-21474836 48~21474 83647	RO	TPDO	0	用户单位 /s User unit/s	-
606Bh	00h	3D3h	Velocity demand value	控制器内部生效的速度指 令值 Speed command value valid inside the controller	int32	-21474836 48~21474 83647	RO	RPDO	0	用户单位 /s User unit/s	-
606Ch	00h	3D5h	Velocity actual value	当前的实际速度反馈值 Current actual speed feedback value	int32	-21474836 48~21474 83647	RO	TPDO	0	rpm	-
606Dh	00h	3D7h	Velocity Window	速度到达阈值 Speed reaches threshold	uint16	0~65535	RW	RPDO	500	rpm	停机生效 Shutdown effective
			具体描述：目标速度 60FFh(转化成电机速度 rpm)与电机实际速度的差值在±606D 以内，且时间达到 606Eh 时，认为速度到达，状态字 6041h 的 bit10=1 Specific description: The difference between the target speed 60FFh (converted to the motor speed rpm) and the actual motor speed is within ±606D, and when the time reaches 606Eh, the speed is considered to be reached, and bit10=1 of status word 6041h								
606Eh	00h	3D8h	Velocity Window time	速度到达时间窗口 Speed arrival time window	uint16	0~65535	RW	RPDO	5	ms	停机生效 Shutdown effective
			具体描述：目标速度 60FFh(转化成电机速度 rpm)与电机实际速度的差值在±606D 以内，且时间达到 606Eh 时，认为速度到达，状态字 6041h 的 bit10=1 Specific description: The difference between the target speed 60FFh (converted to the motor speed rpm) and the actual motor speed is within ±606D, and when the time reaches 606Eh, the speed is considered to be reached, and bit10=1 of status word 6041h								

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method		
			Specific description: The difference between the target speed 60FFh (converted to the motor speed rpm) and the actual motor speed is within ±606D, and when the time reaches 606Eh, the speed is considered to be reached, and bit10=1 of status word 6041h										
606Fh	00h	3D9h	Velocity treshold	零度到达阈值 Zero reaches the threshold	uint16	0~65535	RW	RPDO	5	用户单位 /s User unit/s	停机生效 Shutdown effective		
			具体描述: 当前速度 6069h 在±606F 之内, 且时间到达 6070h, 认为零速到达, 状态字 6041h 的 bit12=1 Specific description: The current speed of 6069h is within ±606F, and the time reaches 6070h. It is considered that the zero speed has arrived, and bit12=1 of the status word 6041h										
6070h	00h	3DAh	Velocity treshold time	零度到达时间窗口 Zero-degree arrival time window	uint16	0~65535	RW	RPDO	5	ms	停机生效 Shutdown effective		
			具体描述: 当前速度 6069h 在±606F 之内, 且时间到达 6070h, 认为零速到达, 状态字 6041h 的 bit12=1 Specific description: The current speed of 6069h is within ±606F, and the time reaches 6070h. It is considered that the zero speed has arrived, and bit12=1 of the status word 6041h										
6071h	00h	3DBh	Target torque	目标转矩 Target torque	int16	-1000~100 0	RW	RPDO	0	0.10%	停机生效 Shutdown effective		
			具体描述: 100.0% 对应于 1 倍的电机额定转矩 Specific description: 100.0% corresponds to 1 times the rated torque of the motor										
6072h	00h	3DCh	Max torque	最大转矩 Max Torque	uint16	0~2000	RW	RPDO	1000	0.10%	停机生效 Shutdown effective		

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
6073h	00h	3DDh	Max current	最大电流 Maximum current	uint16	0~2000	RW	NO	1500	0.10%	停机生效 Shutdown effective
6074h	00h	3DEh	Torque demamnd value	转矩指令, 反映使能状态下已输入得转矩指令 Torque command, reflecting the torque command that has been input in the enabled state	int16	- 32768~32 767	RO	TPDO	0	0.10%	-
6075h	00h	3DFh	Motor rated current	额定电流 Rated current	uint32	0~11700	RW	RPDO	11700	0.001A	停机生效 Shutdown effective
6076h	00h	3E1h	Motor rate torque	额定力矩 Rated torque	uint32	0~1270	RW	RPDO	1270	0.01N.m	停机生效 Shutdown effective
6077h	00h	3E3h	Torque actual value	转矩反馈值 Torque feedback value	int16	- 32768~32 767	RO	TPDO	-	mN.m	-
6078h	00h	3E4h	Current actual value	电流反馈值(对应额定电流 的百分比) Current feedback value (corresponding to the	int16	- 32768~32 767	RO	TPDO	-	0.10%	-

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
				percentage of rated current)							
607Ah	00h	3E7h	Target position	目标位置 Target location	int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 User units	停机生效 Shutdown effective
607Bh	01h	3E9h	MinPosRang Limt	位置范围最小限制 Position range minimum limit	int32	-21474836 48~21474 83647	RW	RPDO	- 104857 6	用户单位 User units	停机生效 Shutdown effective
	02h	3EBh	MaxPosRan gLimt	位置范围最大限制 Maximum limit of location range	int32	-21474836 48~21474 83647	RW	RPDO	104857 6	用户单位 User units	停机生效 Shutdown effective
607Ch	00h	3EDh	Home offset	原点偏移值 Origin offset value	int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 User units	停机生效 Shutdown effective
			具体描述: 设置在原点回归模式下机械零点偏离电机原点的物理位置; 在完成原点回归操作时, 状态字 6041h 的 bit15=1 时生效 Specific description: Set the physical position where the mechanical zero point deviates from the motor origin in the homing mode; when the homing operation is completed, bit 15 of status word 6041h becomes effective								
607Dh	01h	3EFh	MinPosLimt	软件绝对位置最小限制 Software absolute position minimum limit	int32	-21474836 48~21474 83647	RW	RPDO	-65535	用户单位 User units	停机生效 Shutdown effective
	02h	3F1h	MaxPosLimt	软件绝对位置最大限制 Maximum absolute position of software	int32	-21474836 48~21474 83647	RW	RPDO	65535	用户单位 User units	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method
607Eh	00h	3F3h	Polarity	指令极性, 详见 5.3 章节 Command polarity, see chapter 5.3 for details	uint8	0~255	RW	NO	0	1	停机生效 Shutdown effective
607Fh	00h	3F4h	Max profile velocity	最大轮廓速度 Maximum profile speed	uint32	0~500000	RW	RPDO	500000	用户单位 /s User unit/s	停机生效 Shutdown effective
6080h	00h	3F6	Max motor speed	电机最大速度 Motor speed	uint32	0~4000	RW	RPDO	4000	rpm	停机生效 Shutdown effective
6081h	00h	3F8h	Profile velocity	轮廓速度 profile speed	uint32	0~500000	RW	RPDO	500000	用户单位 /s User unit/s	停机生效 Shutdown effective
				具体描述: 设置轮廓位置模式下该段位移指令的匀速运行速度, 具体计算如下: 电机转速 (rpm) = $\frac{6081h \times \text{齿轮比} \ 6091h}{\text{编码器分辨率}} \times 60$ Specific description: Set the uniform speed of the displacement command in the profile position mode, the specific calculation is as follows: motor speed (rpm) = $\frac{6081h * \text{gear ratio} (6091h)}{\text{Encoder resolution}} * 60$							
6082h	00h	3FAh	End velocity	轮廓终点速度 profile end speed	uint32	0~500000	RW	RPDO	0	用户单位 /s	停机生效 Shutdown effective

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										User unit/s	
6083h	00h	3FC _h	Profile acceleration	轮廓加速度 profile acceleration	uint32	0~429496 7295	RW	RPDO	409600	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective
6084h	00h	3FE _h	Profile deceleration	轮廓减速度 profile deceleration	uint32	0~429496 7295	RW	RPDO	409600	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective
6085h	00h	400 _h	Quick Stop deceleration	快速停机减速度 Quick stop deceleration	uint32	0~429496 7295	RW	RPDO	500000	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective
6086h	00h	402 _h	Motion profile type	轮廓斜坡类型 Type of profile slope	int16	0~3	RW	RPDO	3	1	停机生效 Shutdown effective
			具体描述：设置电机位置指令或速度指令的曲线类型。0-线性，3-S 曲线 Description: Set the curve type of motor position command or speed command. 0~linear, 3~S curve								
6087h	00h	403 _h	Torque slope	转矩斜坡 Torque ramp	uint32	0~429496 7295	RW	RPDO	10	0.10%	停机生效 Shutdown effective
具体描述：设置轮廓转矩模式下的转矩指令加速度，其意义为：每秒转矩指令增量											

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				Specific description: Set the torque command acceleration in profile torque mode, its meaning is: torque command increment per second							
6088h	00h	405h	Torque profile type	转矩斜坡类型 Torque ramp type	int16	0~2	RW	RPDO	0	1	停机生效 Shutdown effective
			具体描述: 0-斜坡, 2-无斜坡 Specific description: 0~slope, 2~no slope								
608Fh	01h	406h	Encoder increments	编码器增量 Encoder increment	uint32	0~429496 7295	RW	NO	10000	1	停机生效 Shutdown effective
	02h	408h	Motor revolutions	电机转数 Motor speed	uint32	0~429496 7295	RW	NO	1	1	停机生效
6091h	01h	40Eh	Motor revolutions	传动比 Transmission ratio	uint32	0~429496 7295	RW	NO	1	1	停机生效 Shutdown effective
	02h	410h	Shaft revolutions		uint32	0~429496 7295	RW	NO	1	1	停机生效 Shutdown effective
6098h	00h	416h	Homing method	原点回归方式, 详见 6.7.4 章节 For the origin return method, see chapter 6.7.4 for details	int8	17~30	RW	RPDO	20	1	停机生效 Shutdown effective

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6099 _h	01 _h	417 _h	Speed during search for switch	找开关速度（高速） Find the switching speed (high speed)	uint32	0~429496 7295	RW	RPDO	10000	用户单位 /s User unit/s	停机生效 Shutdown effective
6099 _h	02 _h	419 _h	Speed during search for zero	找原点速度（低速） Find origin speed (low speed)	int32	-21474836 48~21474 83647	RW	RPDO	2730	用户单位 /s User unit/s	停机生效 Shutdown effective
609A _h	00 _h	41B _h	Homing acceleration	原点回归加速度 Origin return acceleration	uint32	0~429496 7295	RW	RPDO	409600	用户单位 /s	停机生效 Shutdown effective
60A3 _h	00 _h	41D _h	Profile jerk use	轮廓加速度使用数目， 本设备只使用 60A4h:01h 和 60A4h:02h The number of profile acceleration used, this device only uses 60A4h:01h and 60A4h:02h	Usint8	2	RW	RPDO	2	1	停机生效 Shutdown effective
60A4 _h	01 _h	41E _h	Profile jerk 1	轮廓加速度 profile acceleration	uint32	0~429496 7295	RW	NO	50000	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective

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	02h	420h	Profile jerk 2	轮廓减加速度 profile deceleration	uint32	0~429496 7295	RW	NO	50000	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective
60B0h	00h	426h	Position offset	位置偏置 Position offset	int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 User units	停机生效 Shutdown effective
			具体描述：设置周期同步位置模式下的位置指令偏置量，偏置后：目标位置=607Ah+60B0h Specific description: Set the position command offset in the cycle synchronous position mode, after offset: target position=607Ah+60B0h								
60B1h	00h	428h	Velocity offset	速度偏置 Speed offset	int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 User units	停机生效 Shutdown effective
			具体描述：设置周期同步速度模式下的速度指令偏置量，偏置后：目标速度=60FFh+60B1h Specific description: Set the speed command offset in cycle synchronous Velocity mode, after offset: target speed=60FFh+60B1h								
60B2h	00h	42Ah	Torque offset	转矩偏置 Torque bias	int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 User units	停机生效 Shutdown effective
			具体描述：设置周期同步转矩模式下的转矩指令偏置量，偏置后：目标转矩 = 6071h+60B2h Specific description: Set the torque command offset in the cyclic torque mode, after offset: target torque = 6071h+60B2h								
60C1h	01h	42Dh	Interpolation data record	插补的目标位置 Interpolated target position	int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 User units	停机生效 Shutdown effective

索引 Index	子索引 Subindex	对应 MODBUS 地址 Corresponding MODBUS address	名称 Name	描述 Description	数据类型 Type of data	数据范围 Data range	可访问性 Accessi bility	能否映射 Can it be mapped	出厂设定 Factory setting	单位 Unit	生效方式 Effective method						
60C2h	01h	42Fh	Interpolation time period value	插补周期时间常数 t Interpolation cycle time constant t	uint8	0~255	RW	NO	20	s	停机生效 Shutdown effective						
	02h	430h	Interpolation time index	插补周期时间指数 n Interpolation cycle time index n	Int8	-128~127	RW	NO	-1	1	停机生效 Shutdown effective						
60C5h	00h	43Bh	Max acceleration	最大轮廓加速度 Maximum profile acceleration	uint32	0~429496 7295	RW	RPDO	500000	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective						
60C6h	00h	43Dh	Max deceleration	最大轮廓减速度 Maximum profile deceleration	uint32	0~429496 7295	RW	RPDO	500000	用户单位 /s ² User unit/s ²	停机生效 Shutdown effective						
60F2h	00h	43Fh	Positioning option code	定位选项 Targeting options	uint16	0~2	RW	RPDO	0	1	停机生效 Shutdown effective						
			具体描述如下: The specific description is as follows:														
<table border="1"> <tr> <td>Bit1</td><td>Bit0</td><td>描述 Description</td></tr> <tr> <td>0</td><td>0</td><td>相对位置移动，相对于目标位置 (607Ah) Relative position movement, relative to the target position (607Ah)</td></tr> </table>				Bit1	Bit0	描述 Description	0	0	相对位置移动，相对于目标位置 (607Ah) Relative position movement, relative to the target position (607Ah)								
Bit1	Bit0	描述 Description															
0	0	相对位置移动，相对于目标位置 (607Ah) Relative position movement, relative to the target position (607Ah)															

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			0	1	相对位置移动, 相对于已输入的位置指令 (60FC _h) Relative position movement, relative to the input position command (60FC _h)							
			1	0	相对位置移动, 相对于已输入的位置指令 (6064 _h) Relative position movement, relative to the input position command (6064 _h)							
60F4_h	00 _h	440 _h	Following error actual value	用户位置偏差 User position deviation		int32	-21474836 48~21474 83647	RO	TPDO	0	用户单位 User units	-
60FA_h	00 _h	444 _h	Control effort	调节器输出 Regulator output		int32	-21474836 48~21474 83647	RO	TPDO	0	指令单位 Command unit	-
60FC_h	00 _h	446 _h	Position demand internal value	电机位置指令 Motor position command		int32	-21474836 48~21474 83647	RO	TPDO	0	用户单位 User units	-
			具体描述: 位置指令 60FC _h =位置指令 6062 _h ×电子齿轮比(6091 _h) Specific description: position command 60FC _h =position command 6062 _h ×electronic gear ratio (6091 _h)									
60FF_h	00 _h	448 _h	Target velocity	目标速度 Target speed		int32	-21474836 48~21474 83647	RW	RPDO	0	用户单位 /s User unit/s	停机生效 Shutdown effective
			具体描述: 设置轮廓速度模式与周期同步速度模式下, 用户速度指令									

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Specific description: Set the user speed command in the profile Velocity mode and cycle synchronous Velocity mode											

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