



# 一体化步进电机

## Integrated stepper motor

Modbus 通信用户手册（开环）

Modbus communication user manual (open loop)

版 本 号：B02

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北京立迈胜控制技术有限责任公司  
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## 1 关于手册 About this 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步进电机的编程和操作方法。

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

### 1.2 适用范围 Scope of application

适用于 STM86 系列 RS485 总线一体化步进电机（开环）。

Suitable for STM86 series RS485 bus integrated stepping motor (open loop).

适用于 STM57 H 系列 RS485 总线一体化步进电机（开环）。

Suitable for STM57 H series RS485 bus integrated stepper motor (open loop).

适用于 STM57 V 系列 RS485 总线一体化步进电机（开环）。

Suitable for STM57 V series RS485 bus integrated stepper motor (open loop).

适用于 STM42 系列 RS485 总线一体化步进电机（开环）。

Suitable for STM42 series RS485 bus integrated stepper motor (open loop).

适用于 SDM57 V 系列 RS485 总线电机驱动器。

Suitable for SDM57 V series RS485 bus motor driver.

适用于 SDM42 系列 RS485 总线电机驱动器。

Suitable for SDM42 series RS485 bus motor driver.

### 1.3 版本信息 Version Information

| 手册版本<br>Manual<br>Version | 日期<br>Date | 修改记录<br>Modification records   |
|---------------------------|------------|--|
| A01                       | 2018-8-22  | 创建 Establish   |
| A02                       | 2019-1-25  | 完善寄存器列表内容，增加离线编程使用的寄存器<br>Improve the contents of the register list and increase the registers used for offline programming  |
| A03                       | 2019-4-13  | 完善寄存器列表内容<br>Improve register list contents  |
| A04                       | 2019-5-16  | 完善寄存器列表内容，增加脉冲输入模式<br>Improve the contents of the register list and increase the pulse input mode  |
| A05                       | 2020-3-20  | 完善寄存器列表内容，增加保存参数描述，修改部分电机参数范围，增加 28 系列参数<br>Improve the contents of the register list, increase the description of the saved parameters, modify the range of some motor parameters, and increase the 28 series of parameters |
| B                         | 2021-3-10  | 增加英文翻译 Add English translation   |
| B01                       | 2022-10-31 | 修改 3.3 状态字 12 的功能描述 Modified the function description of 3.3 Status word 12  |
| B02                       | 2024-05-17 | 修改 I/O 定义 Modify the I/O definition  |

## 2 通信功能 communication function

### 2.1 一般信息 General information

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. 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。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 / multiple slave. Only the master can issue queries. The slave station performs the processing required by the query and responds with a 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 a Modbus serial link, each 8-bit byte in the message contains two 4-digit 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 as a continuous character stream.

帧描述： Frame description:

表 2-1

| 子节点地址<br>Child node address | 功能代码<br>Function code | 数据<br>Data                   | CRC  |
|-----------------------------|-----------------------|------------------------------|--|
| 1 字节<br>1 byte              | 1 字节<br>1 byte        | 0 到 252 字节<br>0 to 252 bytes | 2 字节<br>2 bytes<br>CRC 低 CRC 高<br>CRC low CRC high |

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 2-1。

Message frames are distinguished by an idle interval of at least 3.5 characters in time, called t3.5. This module uses the standard t3.5 as the idle interval to distinguish. RTU frame transmission idle interval distinction diagram, see Figure 2-1.

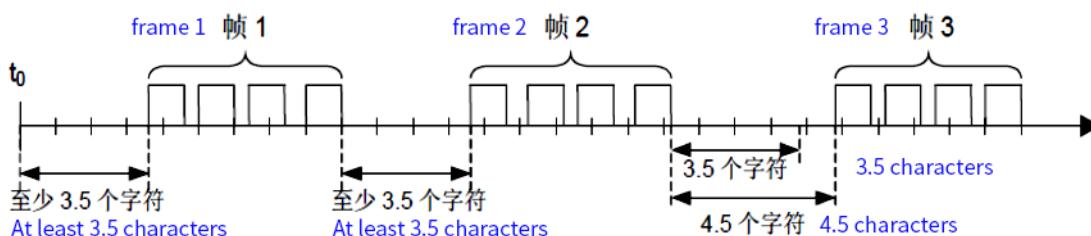


图 2-1 RTU 帧传输空闲间隔区分示意图  
 Figure 2-1 RTU frame transmission idle interval

如果两个字符之间的空闲间隔大于 1.5 个字符时间，则报文帧被认为不完整，应该被接受节点丢弃。该空闲时间称为 t1.5，本模块采用标准 t1.5 时间。RTU 帧传输判定非正常帧空闲间隔示意图，见图 2-2。

If the idle interval between two characters is greater than 1.5 character time, the message

frame is considered incomplete and should be discarded by the receiving node. This idle time is called t1.5, and this module uses standard t1.5 time. The schematic diagram of RTU frame transmission judging abnormal frame idle interval is shown in Figure 2-2.

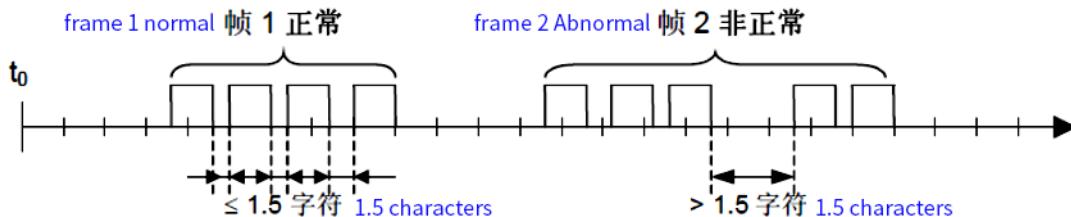


图 2-2 RTU 帧传输判定非正常帧空闲间隔示意图  
 Figure 2 RTU frame transmission to determine the abnormal frame idle interval

## 2.3 数据类型 data types

Modbus 以一系列具有不同特征表格上的数据模型为基础。基本表格为：

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

表 2-2

| 基本表格<br>Basic form        | 对象类型<br>Object type   | 访问类型<br>Access type | 内容<br>Content   |
|---------------------------|-----------------------|---------------------|---|
| 输入寄存器<br>Input register   | 16-比特字<br>16-bit word | 只读<br>read-only     | I/O 系统提供这种类型数据<br>I / O system provides this type of data |
| 保持寄存器<br>Holding register | 16-比特字<br>16-bit word | 读写<br>Read / Write  | 通过应用程序改变这种类型数据<br>Change this type of data by application |

## 2.4 Modbus-RTU 功能码 Modbus-RTU function code

表 2-3

| 项目<br>Item               | 功能码名称<br>Function code name     | 功能码<br>Function code | 子功能码<br>Sub-function code | 广播报文<br>Broadcast message |
|--------------------------|---------------------------------|----------------------|---------------------------|---------------------------|
| 16 比特访问<br>16-bit access | 读输入寄存器 Read input register      | 0x04                 | —                         |                           |
|                          | 读保持寄存器 Read holding register    | 0x03                 | —                         |                           |
|                          | 写单个寄存器 Write a single register  | 0x06                 | —                         |                           |
|                          | 写多个寄存器 Write multiple registers | 0x10                 | —                         |                           |

## 2.5 Modbus-RTU 常用功能码 Modbus-RTU commonly used function codes

### 2.5.1 读保持寄存器(0x03) Read Holding Register (0x03)

读保持寄存器 0x0001 波特率当前的值。

Read the current value of the holding register 0x0001 baud rate.

请求报文 Request message

表 2-4

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
| 01                    | 0x03                 | 00 01                     | 00 01                        | 略 Skip                     |

响应报文 Response message

表 2-5

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Bytes | 寄存器值<br>Register Value | CRC 校验值<br>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).

### 2.5.2 读输入寄存器 (0x04) Read Input Register (0x04)

读输入寄存器 0x0017 输入电压的值。

Read the value of the input voltage at input register 0x0017.

请求报文 Request message

表 2-6

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
| 01                    | 0x04                 | 00 17                     | 00 01                        | 略 Skip                     |

响应报文 Response message

表 2-7

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Bytes | 寄存器值<br>Register Value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|--------------|------------------------|----------------------------|
| 01                    | 0x04                 | 02           | 00 18                  | 略 Skip                     |

当前的输入电压值为 0x0018(24V)。

The current input voltage value is 0x0018 (24V).

### 2.5.3 写单个保持寄存器(0x06) Writing a Single Holding Register (0x06)

设置从站地址 0x01 中保持寄存器 0x0001 波特率为 0x01(9.6kbps)。

Set the baud rate of the holding register 0x0001 in the slave address 0x01 to 0x01 (9.6kbps).

### 请求报文 Request message

表 2-8

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器值<br>Register Value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------|----------------------------|
| 01                    | 0x06                 | 00 01                     | 00 01                  | 略 Skip                     |

### 响应报文 Response message

表 2-9

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器值<br>Register Value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------|----------------------------|
| 01                    | 0x06                 | 00 01                     | 00 01                  | 略 Skip                     |

### 2.5.4 写多个保持寄存器(0x10) Write Multiple Holding Registers (0x10)

设置从站地址 0x01 中保持寄存器 0x0001 波特率为 0x01(9.6kbps)和保持寄存器 0x0002 网络数据格式为 0x00(8 数据位、 偶校验、 1 停止位)。

Set the baud rate of the holding register 0x0001 in the slave address 0x01 to 0x01 (9.6kbps) and the network data format of the holding register 0x0002 to 0x00 (8 data bits, even parity, 1 stop bit).

### 请求报文 Request message

表 2-10

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | 字节数<br>Number of bytes | 寄存器值<br>Register Value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|------------------------|------------------------|----------------------------|
| 01                    | 0x10                 | 00 01                     | 00 02                        | 04                     | 00 01 00 00            | 略 Skip                     |

### 响应报文 Response message

表 2-11

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
| 01                    | 0x10                 | 00 01                     | 00 02                        | 略 Skip                     |

## 2.6 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 device sends a request to the slave device, the master wants to get a normal response. Interrogation by the master can cause one of four events:

1. 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 a request without a communication error and can process the query normally, the slave device will return a normal response.*
2. 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 does not receive the request due to a communication error, it cannot return a response. The master program will be processed as a timeout.*
3. 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 receives the request, but detects a communication error (parity, CRC ...), then it cannot return a response. The master program will process as a timeout.*
4. 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，通知客户机出错误的原因。  
*If the slave device receives a request without a communication error but cannot process the request (for example, if the request reads a non-existent input register), then the slave will return an exception response to notify the client of the cause of the error .*

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 responds with the function code field to assign the function code of the original request. The MSB of all function codes is 0 (their values are all lower than 80 in hex). In the abnormal response, the MSB of the function code is set 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 identify 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)。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。

Data field: In a normal response, the slave can return data or statistical values (any information requested in the request) in the data field. In the exception response, the slave returns an 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 for all supported function codes is the function code plus 0x80.

所有异常功能码为 0x83、0x84、0x86、0x88、0x90、0x97。

All exception function codes are 0x83, 0x84, 0x86, 0x88, 0x90, 0x97.

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:

表 2-12

| 从站地址<br>Slave<br>address | 功能码<br>Function<br>code | 异常码<br>Exception<br>code | CRC 校验值<br>CRC check<br>value |
|--------------------------|-------------------------|--------------------------|-------------------------------|
| 01                       | 0x86                    | 01                       | 略 Skip                        |

表 2-13

| 异常码<br>Exception<br>code | 异常名称<br>Exception<br>name         | 描述<br>Description   |
|--------------------------|-----------------------------------|---|
| 01                       | 非法功能码<br>Illegal Function<br>Code | 功能码无法识别，不在 0x00~0x0F 以内<br>Function code cannot be identified, not<br>within 0x00 ~ 0x0F                                  |
| 02                       | 非法数据地址<br>Illegal data<br>address | 数据地址超出定义<br>Data address exceeds definition   |
| 03                       | 非法数据值<br>Illegal data<br>value    | 寄存器存储之外的值<br>Values outside register storage  |
| 04                       | 从设备故障<br>Slave device<br>failure  | 产生不可重新获得的错误<br>Produces an unrecoverable error  |
| 05                       | 确认<br>confirm                     | 从站处理时间较长，需要主站经常询问<br>The slave station takes a long time to<br>process, requiring the master station to<br>frequently ask |
| 06                       | 从设备忙<br>Busy from<br>device       | 等待从站设备空闲时主站发送请求<br>Wait for the master to send a request<br>while the slave device is idle                                |

## 2.7 通信参数配置 Communication parameter configuration

### 2.7.1 通信波特率设置 Communication 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 speed of the device can be changed by setting the communication baud rate register of the RS-485 communication interface, but the parameters need to be saved after setting the baud rate, and will take effect after the device is turned on or restarted next time.

波特率参数对应的是地址为 0x0001 的保持寄存器，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 baud rate parameter corresponds to a holding register with an address of 0x0001, and the function codes of the operable holding registers are 0x03, 0x06, and 0x10. The factory default baud rate is 115.2kbps.

设置从站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

表 2-14

| 从站地址<br>Slave<br>address | 功能码<br>Function<br>code | 寄存器地址<br>Register<br>address | 寄存器值<br>Register<br>Value | CRC 校验值<br>CRC check<br>value |
|--------------------------|-------------------------|------------------------------|---------------------------|-------------------------------|
| 01                       | 0x06                    | 00 01                        | 00 05                     | 略 Skip                        |

响应报文 Response message

表 2-15

| 从站地址<br>Slave<br>address | 功能码<br>Function<br>code | 寄存器地址<br>Register<br>address | 寄存器值<br>Register<br>Value | CRC 校验值<br>CRC check<br>value |
|--------------------------|-------------------------|------------------------------|---------------------------|-------------------------------|
| 01                       | 0x06                    | 00 01                        | 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

表 2-16

| 从站地址<br>Slave<br>address | 功能码<br>Function<br>code | 寄存器地址<br>Register<br>address | 寄存器值<br>Register<br>Value | CRC 校验值<br>CRC check<br>value |
|--------------------------|-------------------------|------------------------------|---------------------------|-------------------------------|
| 01                       | 0x06                    | 00 08                        | 73 76                     | 略 Skip                        |

响应报文 Response message

表 2-17

| 从站地址<br>Slave<br>address | 功能码<br>Function<br>code | 寄存器地址<br>Register<br>address | 寄存器值<br>Register<br>Value | CRC 校验值<br>CRC check<br>value |
|--------------------------|-------------------------|------------------------------|---------------------------|-------------------------------|
| 01                       | 0x06                    | 00 08                        | 73 76                     | 略 Skip                        |

设置值及与波特率的对应表：

Setting value and corresponding table with baud rate:

表 2-18

| 十六进制<br>Hex | 波特率<br>Baud rate |
|-------------|------------------|
| 0           | 9.6kbps          |
| 1           | 9.6kbps          |
| 2           | 19.2kbps         |
| 3           | 38.4 kbps        |
| 4           | 57.6kbps         |
| 5           | 115.2kbps        |
| 6           | 256kbps          |
| 7           | 500kbps          |
| 8           | 1Mbps            |
| 9           | 1.5Mbps          |

### 2.7.2 从站地址 Slave Address

设备的地址的通过设置保持寄存器地址 0x0000 值，能够设置的范围 1~247。出厂默认从站地址为 0x01。从站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 device address can be set from 1 to 247 by setting the holding register address 0x0000. The factory default slave address is 0x01. After the slave address is set successfully, you need to save the parameter settings, which will take effect after the device is turned on or restarted next time. For specific operations, refer to the baud rate setting.

### 2.7.3 网络数据格式 Network Data Format

设备通信的网络数据格式通过设置保持寄存器地址 0x0002 值来改变。设置值对应表如下表

The network data format of the device communication is changed by setting the value of the holding register address 0x0002. The setting value correspondence table is as follows

表 2-19

| 十六进制<br>Hex | 描述<br>Description  |
|-------------|--|
| 0           | 8 数据位、偶校验、1 停止位<br>8 data bits, even parity, 1 stop bit  |
| 1           | 8 数据位、奇校验、1 停止位<br>8 data bits, odd parity, 1 stop bit   |
| 2           | 8 数据位、无奇偶校验、1 停止位<br>8 data bits, no parity, 1 stop bit  |
| 3           | 8 数据位、无奇偶校验、2 停止位<br>8 data bits, no parity, 2 stop bits |

改变设备通信的网络数据格式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。

After changing the network data format of the device communication, you need to set the save parameter settings, which will take effect after the device is turned on or restarted next time. For specific operations, refer to the baud rate setting.

#### 2.7.4 终端电阻 Termination resistor

在网络搭建过程中，如果网络终止嵌入连接其他 Modbus 设备，则需要在网络的最后接入 120 欧姆的终端匹配电阻。

During the network building process, if the network terminates the embedded connection to other Modbus devices, you need to connect a 120 ohm terminal matching resistor at the end of the network.

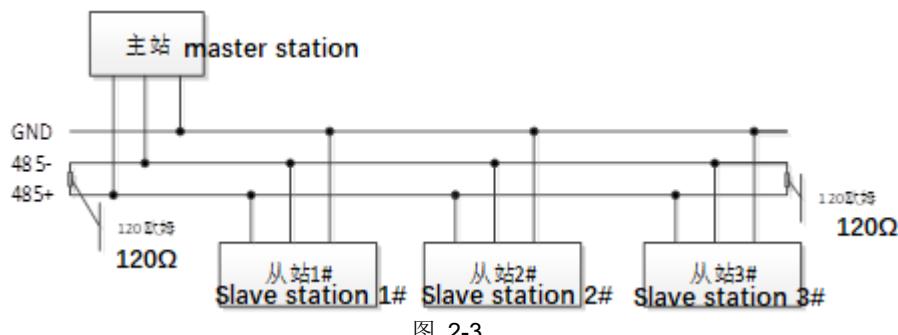


图 2-3

#### 2.7.5 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 115200，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, it can be restarted after power off after preemption by broadcast message. The broadcast preemption request message must 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 115200, the parity bit is None, 8 data bits, and 1 stop bit. The motor serial number uses the hexadecimal high byte first.

表 2-20 广播抢占请求报文  
Broadcast preemption request message

| 从站地址<br>Slave<br>address | 功能码<br>Function<br>code | 电机序列号<br>Motor serial<br>number | CRC 校验值<br>CRC check<br>value |
|--------------------------|-------------------------|---------------------------------|-------------------------------|
| 0x00                     | 0xD2                    | 0x00 00 00 00                   | 略 Skip                        |

广播报文没有应答报文。通过查询状态来判断是否操作成功。

The broadcast message has no reply message. Query the status to determine whether the operation was successful.

### 3 运动控制指令 Motion control instructions

#### 3.1 电机运行状态机 Motor running state machine

通过运行一个状态机，来控制切换一体化步进电机的运行状态。在 Modbus 中控制字对应保持寄存器地址 0x0051，状态字对应输入寄存器地址 0x001F

By running a state machine, the operating state of the integrated stepping motor is controlled and switched. In Modbus, the control word corresponds to the holding register address 0x0051, and the status word corresponds to the input register address 0x001F.

**控制字：**通过控制字请求状态更改。下表列出了导致相应状态转换的位组合。

Control word: Request a status change via a control word. The following table lists the bit combinations that cause the corresponding state transitions.

**状态转换：**下图中，是可能的状态转换。

State transitions: The following figure shows the possible state transitions.

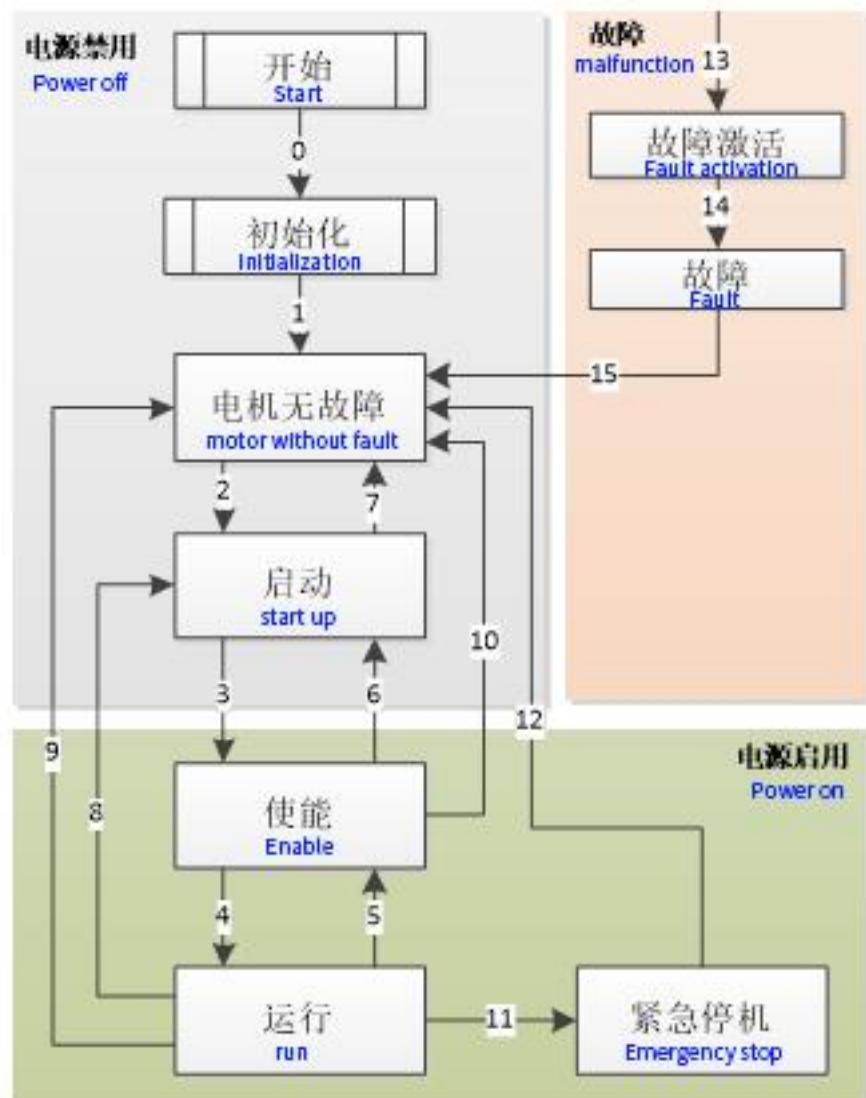


图 3-1

各状态描述如下表： The states are described in the following table:

表 3-1

| 状态 status                      | 描述 description   |
|--------------------------------|--|
| 初始化<br>initialization          | 电机驱动器初始化、内部自检完成。<br>Motor driver initialization and internal self-test are complete.<br>电机驱动器的参数不能设置，也不能执行驱动功能。<br>The parameters of the motor driver cannot be set and the drive function cannot be performed.  |
| 电机无故障<br>No fault of the motor | 电机驱动器无故障或错误已排除。<br>No faults or errors in the motor drive have been eliminated.<br>可以对驱动参数进行设置。<br>You can set the drive parameters.   |
| 启动<br>start up                 | 电机驱动器启动，参数可以设置。<br>The motor driver starts and the parameters can be set.  |
| 使能<br>Enable                   | 电机驱动器输出电压给电机，电机使能。<br>The motor driver outputs voltage to the motor, and the motor is enabled.<br>驱动器参数可以设置。<br>The drive parameters can be set.   |
| 运行<br>run                      | 电机驱动器正常运行，已针对一种运行模式启用了驱动功能，通过指令控制电机完成相应旋转。驱动器参数不可设置。<br>The motor driver is running normally, the drive function has been enabled for one operating mode, and the motor is controlled to complete the corresponding rotation by instructions. The drive parameters cannot be set.          |
| 紧急停机<br>Emergency stop         | 紧急停机功能被激活，电机驱动器正在执行紧急停机功能指令。驱动器参数不可设置。<br>The emergency stop function is activated and the motor driver is executing the emergency stop function command. The drive parameters cannot be set.  |
| 故障激活<br>Fault activation       | 电机驱动器发生故障，正处于故障停机过程中。<br>The motor driver has failed and is in the process of a fault shutdown.<br>驱动器参数不可设置。<br>The drive parameters cannot be set.   |
| 故障<br>malfunction              | 故障停机完成，所有驱动功能均被禁止，同时允许更改驱动器参数以便排除故障。<br>After the fault stop is completed, all drive functions are disabled, and the drive parameters can be changed to troubleshoot.<br>对于可复位故障，参数更改后，可通过控制字 0x80 使故障复位。<br>For resettable faults, the parameters can be reset via the control word 0x80. |

控制命令字与状态机状态切换如下表：

The control command word and state machine state switch are as follows:

表 3-2

| 状态转换<br>Status transition |  | 控制字<br>control word  | 状态字<br>status word |
|---------------------------|--|--|--------------------|
| 0                         | 开始→初始化<br>Start → initialization                   | 自然过渡，无需控制指令<br>Natural transition without control instructions | —                  |
| 1                         | 初始化→电机无故障<br>Initialization→The motor is faultless | 自然过渡，无需控制指令<br>Natural transition without control instructions | 0x0050             |
| 2                         | 电机无故障→启动<br>Motor is faultless and starts          | 0x06   | 0x0031             |

| 状态转换<br>Status transition |   | 控制字<br>control word   | 状态字<br>status word |
|---------------------------|---|---|--------------------|
| 3                         | 启动→使能<br>Start → Enable                             | 0x07  | 0x0033             |
| 4                         | 使能→运行<br>Enable → operation                         | 0x0F  | 0x0037             |
| 5                         | 运行→使能<br>Run → Enable                               | 0x07  | 0x0033             |
| 6                         | 使能→启动<br>Enable → Start                             | 0x06  | 0x0031             |
| 7                         | 启动→电机无故障<br>Start-up→motor without failure          | 0x00  | 0x0050             |
| 8                         | 运行→启动<br>Run → start                                | 0x06  | 0x0031             |
| 9                         | 运行→电机无故障<br>Run → motor without fault               | 0x00  | 0x0050             |
| 10                        | 使能→电机无故障<br>Enabling → motor without fault          | 0x00  | 0x0050             |
| 11                        | 运行→快速停机<br>Operation → quick shutdown               | 0x02  | 0x0017             |
| 12                        | 紧急停机→电机无故障<br>Emergency stop→ motor without failure | 快速停机方式 0x003B 选择为 0~1, 停机完成后, 自然过渡, 无需控制指令<br>Select 0 ~ 1 for the quick stop mode 0x003B. After the shutdown is completed, Natural transition without control instructions | 0x0050             |
| 13                        | →故障激活<br>→Failure activation                        | 驱动器一旦发生故障, 自动切换到故障停机状态, 无需控制指令<br>Once the driver fails, it will automatically switch to the fault stop state without control instruction.                                  | —                  |
| 14                        | 故障激活→故障<br>Fault activation→ Fault                  | 故障停机完成后, 自然过渡, 无需控制指令<br>After the shutdown is completed, the transition is natural and no control instructions are required  | 0x0018             |
| 15                        | 故障→电机无故障<br>Fault → No fault in the motor           | 0x80<br>bit7 上升沿有效;<br>bit7 rising edge is valid;<br>bit7 保持为 1, 其他控制指令均无效。<br>Bit 7 remains at 1 and other control instructions are invalid.                               | 0x0050             |

### 3.2 控制字 Control Word

控制字的位，定义如下：

The bits of the control word are defined as follows:

表 3-3

| MSB     |      |   | LSB                 |   |                       |                              |                               |                |
|---------|------|---|---------------------|---|-----------------------|------------------------------|-------------------------------|----------------|
| 15...11 | 10,9 | 8 | 7                   | 6 ,5 ,4   | 3                     | 2                            | 1                             | 0              |
| —       | —    | — | 故障复位<br>Fault reset | 操作模式特<br>殊定义位<br>Operation<br>mode<br>special<br>definition bit | 运行使能<br>Run<br>enable | 快速<br>停机<br>Fast<br>Shutdown | 电压<br>使能<br>voltage<br>Enable | 启动<br>start up |

**LSB Bit4、5、6:** 这些位是具体的运行模式。下表概述：

LSB Bit 4, 5, 6: These bits are specific operating modes. The following table outlines:

表 3-4

| Bit | 位置模式<br><b>Position mode</b>  | 速度模式<br><b>Speed mode</b> | 原点回归模式<br><b>Home position return mode</b>                                     |
|-----|---|---------------------------|--|
| 4   | 设置新的目标位置<br>Set new target position<br>0→1, 表示有新的动作<br>0→1, indicating a new action | x                         | 原点回归开始<br>Origin return begins<br>0→1, 表示有新的动作<br>0→1, indicating a new action |
| 5   | x   | x                         | x  |
| 6   | 0: GOTO 模式<br>0: GOTO mode<br>1: MOVE 模式<br>1: MOVE mode                            | x                         | x  |

注意：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。

Note: The individual assignment of each bit of the control word is meaningless. It must be combined with other control bits to form a certain control instruction.

bit0~bit3 和 bit7 在各个运行模式下意义相同，必须按顺序发送命令，才可将电机驱动器按照状态机切换流程引导入预计的状态，每一命令对应一种确定的状态。

Bit0 ~ bit3 and bit7 have the same meaning in each operating mode. You must send commands in order to guide the motor driver into the expected state according to the state machine switching process. Each command corresponds to a certain state.

### 3.3 状态字 Status word

数据描述 Data description

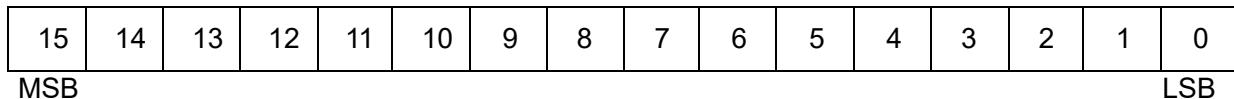


表 3-5

| Bit  | Desc   |
|------|--|
| 0    | 启动 start up  |
| 1    | 使能 Enable  |
| 2    | 运行 run   |
| 3    | 故障 malfunction   |
| 4    | 电压使能 Voltage enable  |
| 5    | 快速停机使能 Fast shutdown enabled   |
| 6    | 电机无故障 No fault of the motor  |
| 7    | 警告 caveat  |
| 8    | —  |
| 12   | 0-运行动作完成<br>1-0 run operation completed<br>1-运行过程中<br>0-1 During operation |
| 9-15 | —  |

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

**Note: Each bit of the status word is meaningless. It must be combined with other control bits to form the current state of the feedback motor.**

### 3.4 停机方式 Stop mode

电机停机方式支持 2 种： Motor shutdown mode supports 2 types:

0 为无减速速度停机； 0 means stop without deceleration;

1 为按一定的减速速度停机； 1 is to stop at a certain deceleration rate;

对于电机在运动停止触发方式为多种： There are several ways to trigger the motor during motion stop:

1. 操作停机 (0x003A) Operation stop (0x003A)

在电机处于运行状态下，通过控制字对电机进行状态切换 5、8 和 9 操作会使电机停机

When the motor is in the running state, switching the state of the motor through the control word 5, 8 and 9 will stop the motor  
(运行→使能 5, 运行→启动 8, 运行→电机无故障 9)。

(Run → Enable 5, Run → Start 8, Run → Motor without fault 9).

关联的保持寄存器 0x003A。

Associated holding register 0x003A.

2. 紧急停机 (0x003B) Emergency stop (0x003B)

在电机非故障状态下，发送控制字值 0x0002 时，执行紧急停机，关联的保持寄存器 0x003B。

In the non-fault state of the motor, when the control word value 0x0002 is sent, an emergency stop is performed and the associated holding register 0x003B.

3. 故障停机 (0x003C) Fault stop (0x003C)

驱动器一旦发生故障，自动切换到故障停机状态，关联的保持寄存器 0x003C。

Once the driver fails, it will automatically switch to the fault stop state and the associated holding register 0x003C.

4. 数字量输入 DI 特殊功能触发停机

Digital input DI special function triggers shutdown

将数字输入相应端口特殊功能配置为立即停机或减速停机。在数字量输入发生变化特殊功能有效时会执行相应的停机动作。DI 特殊功能的配置详见章节 5.1。

Configure the digital input corresponding port special function to stop immediately or decelerate. When the digital input changes, the special stop function will be executed when the special function is valid. The configuration of the special DI functions is described in section 5.1.

## 4 运行模式 operating modes

### 4.1 运行模式选择 Operation mode selection

一体化步进电机支持运行模式有位置模式、速度模式和原点回归模式。通过设置保持寄存器地址 0x0039 的值可以选择不同模式下运行。

The integrated stepping motor supports operation modes including position mode, speed mode and origin return mode. By setting the value of holding register address 0x0039, you can choose to run in different modes.

表 4-1

| 十六进制<br>Hex | 描述<br>Description               |
|-------------|---------------------------------|
| 1           | 位置模式<br>Position mode           |
| 2           | 速度模式<br>Speed mode              |
| 3           | 原点回归模式<br>Origin return<br>mode |
| 4           | 脉冲输入模式<br>Pulse input m<br>ode  |

### 4.2 位置模式 Position mode

位置模式是用于从目前的位置移动到目标位置。在运动过程中，最大加速度，最大减速度，最高速度，最小速度等都考虑在内。

Position mode is used to move from the current position to the target position. During the movement, the maximum acceleration, maximum deceleration, maximum speed, minimum speed, etc. are taken into account.

对于位置模式控制下运动关联参数如下图

The following figure shows the motion related parameters under position mode control.

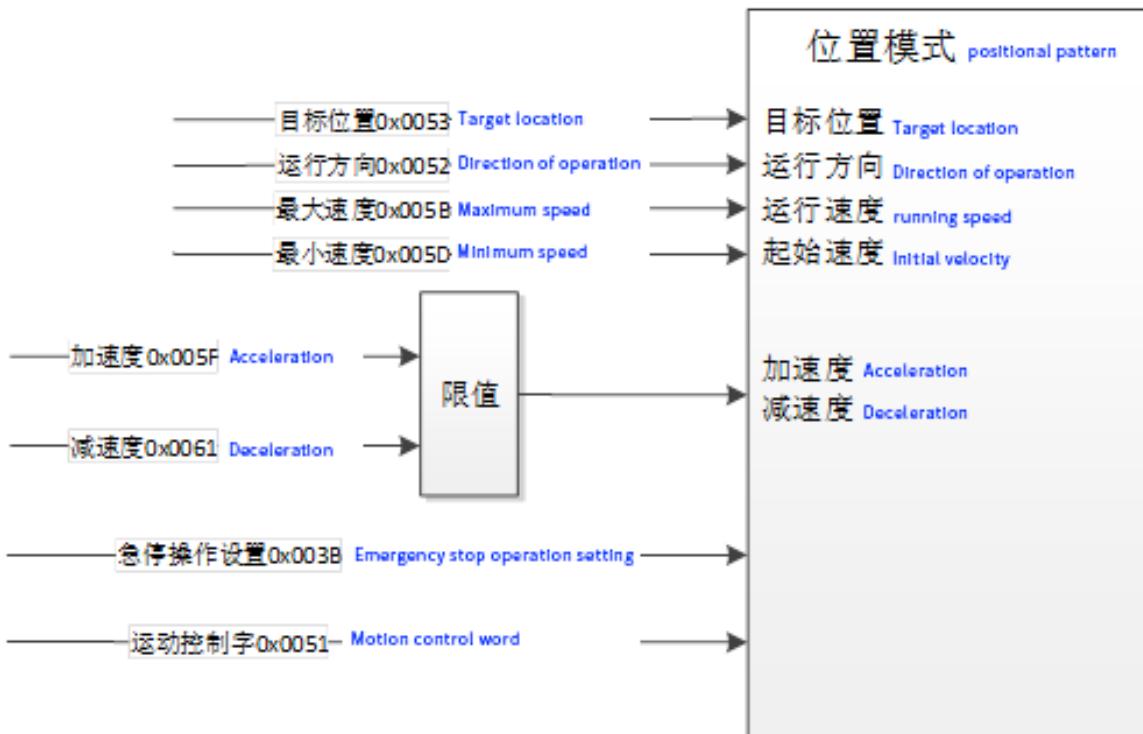


图 4-1

在位置模式下可以设定电机运行的位置范围（位置软件限值），保持寄存器 0x0059 确定运动范围位置最大值，保持寄存器 0x0057 确定运动范围位置最小值，如果位置最大值与位置最小值相等，则电机运行没有软件位置限值。

In the position mode, the position range (position software limit) of the motor can be set, holding register 0x0059 determines the maximum position of the movement range, and holding register 0x0057 determines the minimum position of the movement range. There is no software position limit for motor operation.

位置模式下定位控制分绝对位置定位和相对位置定位。控制字中 bit4 和 bit6 位来决定是进行绝对位置定位还是相对位置定位。

Positioning control in position mode is divided into absolute position positioning and relative position positioning. Bits 4 and 6 in the control word determine whether to perform absolute or relative positioning.

表 4-2

| Modbus 地址<br>Modbus address | 值<br>Value                    | 描述<br>Description  |
|-----------------------------|-------------------------------|--|
| 0x0051                      | 先 0F 后 1F<br>First 0F then 1F | 绝对位置运行，目标位置参数值为绝对位置<br>Absolute position operation, target position parameter value is absolute position |
|                             | 先 4F 后 5F<br>First 4F then 5F | 相对位置运行，目标位置参数值为相对位置<br>Relative position operation, target position parameter value is relative position |

#### 4.2.1 绝对位置运行 Absolute position operation

在位置模式关联参数默认值条件，从站 1 电机运行到绝对位置 1000,000,000 pulses 举例。下述报文中只包含电机地址、功能码和数据部分，省略 CRC 部分。

In the position mode, the parameters are associated with the default value conditions, and the slave 1 motor runs to an absolute position of 1,000,000,000 pulses. The following message contains only the motor address, function code and data, and the CRC is omitted.

表 4-3

| 步骤<br>Step | 请求报文 Request message             | 响应报文 Response message | 备注 Remark   |
|------------|----------------------------------|-----------------------|---|
| 1          | 01 10 00 53 00 02 04 3B 9A CA 00 | 01 10 00 53 00 02     | 设置绝对目标位置 1,000,000,000<br>Set absolute target position 1,000,000,000                      |
| 2          | 01 06 00 51 00 06                | 01 06 00 51 00 06     | 电机启动状态<br>Motor starting state  |
| 3          | 01 06 00 51 00 07                | 01 06 00 51 00 07     | 电机使能状态<br>Motor enable status   |
| 4          | 01 06 00 51 00 0F                | 01 06 00 51 00 0F     | 先发控制字 F<br>Firstly send Control word F  |
| 5          | 01 06 00 51 00 1F                | 01 06 00 51 00 1F     | 再发控制字 1F 电机开始绝对位置运行<br>Then send control word 1F motor starts absolute position operation |

#### 4.2.2 相对位置运行 Relative position operation

在位置模式关联参数默认值条件，从站 1 电机相对于当前位置运行 200pulses，分两次运行动作，每次运行 100pulses。下述报文中只包含电机地址、功能码和数据部分，省略 CRC 部分。

In the position mode, the default value of the related parameter conditions, the slave 1 motor runs 200pulses relative to the current position, and it operates in two operations, each running 100pulses. The following message contains only the motor address, function code and data, and the CRC is omitted.

表 4-4

| 步骤<br>Step | 请求报文 Request message             | 响应报文 Response message | 备注 Remark   |
|------------|----------------------------------|-----------------------|---|
| 1          | 01 10 00 53 00 02 04 00 00 00 64 | 01 10 00 53 00 02     | 设置目标位置 100<br>Set target position 100   |
| 2          | 01 06 00 51 00 06                | 01 06 00 51 00 06     | 电机切换为启动状态<br>The motor switches to the starting state                                     |
| 3          | 01 06 00 51 00 07                | 01 06 00 51 00 07     | 电机切换为使能状态<br>Motor switched to enabled state  |
| 4          | 01 06 00 51 00 4F                | 01 06 00 51 00 4F     | 先发控制字 4F<br>First send Control Word 4F  |
| 5          | 01 06 00 51 00 5F                | 01 06 00 51 00 5F     | 再发控制字 5F 电机开始相对位置运行<br>Then send control word 5F motor starts relative position operation |
| 6          | 01 06 00 51 00 4F                | 01 06 00 51 00 4F     | 先发控制字 4F<br>First send Control Word 4F  |
| 7          | 01 06 00 51 00 5F                | 01 06 00 51 00 5F     | 再发控制字 5F 电机开始相对位置运行<br>Then send control word 5F motor starts relative position operation |

### 4.3 速度模式 Speed mode

速度模式是从当前速度加速到目标速度然后匀速运行。在运动过程中，最大加速度，最大减速度，最大速度，最小速度等都考虑在内。对于速度模式控制下运动关联参数如下图

Speed mode is to accelerate from the current speed to the target speed and then run at a constant speed. During the movement, the maximum acceleration, maximum deceleration, maximum speed, minimum speed, etc. are taken into account. The following figure shows the motion related parameters under speed mode control.

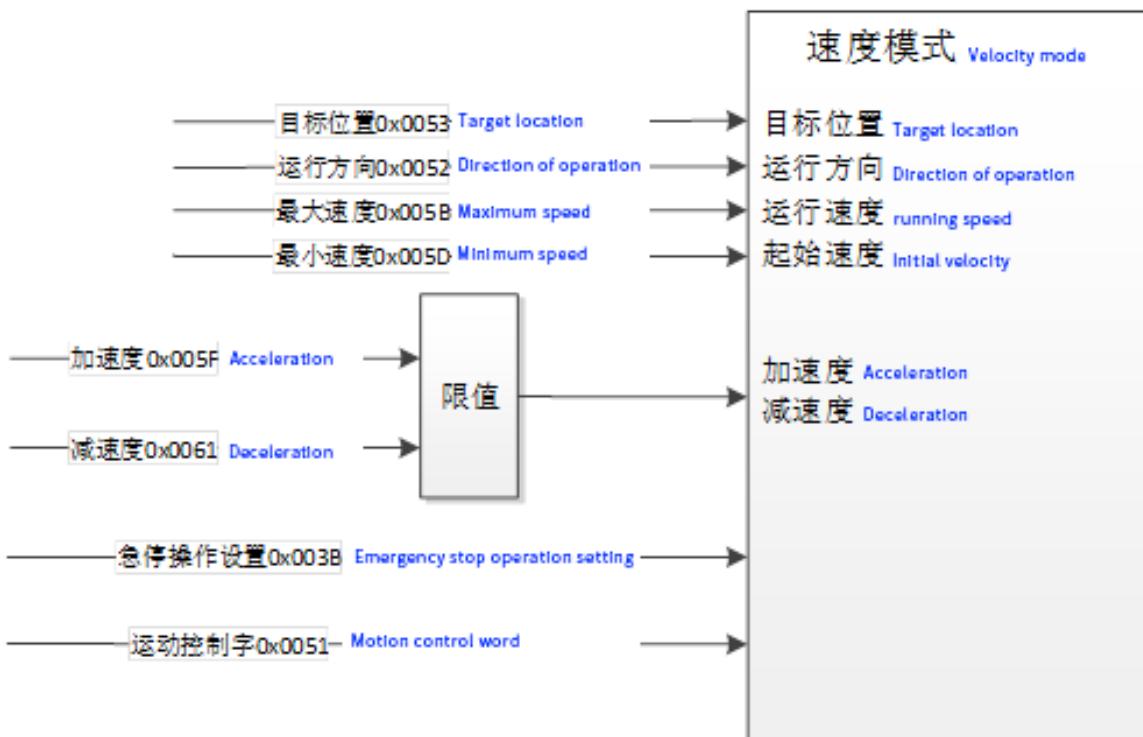


图 4-2

速度模式下控制字只要设置为运行状态。

As long as the control word is set to the running state in the speed mode.

表 4-5

| Modbus 地址<br>Modbus address | 值<br>Value | 描述<br>Description  |
|-----------------------------|------------|--|
| 0x0051                      | 0F         | 比较当前速度是否与目标速度相同，进行相应的加速或者减速<br>Compare whether the current speed is the same as the target speed, and accelerate or decelerate accordingly |

在速度模式关联参数默认值条件，从站 1 电机以 250step/s 速度运行（默认是逆时针方向），切换到 500 step/s 速度运行。下述报文中只包含电机地址、功能码和数据部分，省略 CRC 部分。

In the default condition of the speed mode related parameters, the slave 1 motor runs at 250step / s speed (counterclockwise by default), and switches to 500 step / s speed operation. The following message contains only the motor address, function code and data, and the CRC is omitted.

表 4-6

| 步骤<br><b>Step</b> | 请求报文 Request message             | 响应报文 Response message | 备注 Remark  |
|-------------------|----------------------------------|-----------------------|--|
| 1                 | 01 10 00 55 00 02 04 00 00 00 FA | 01 10 00 55 00 02     | 设置目标速度 250step/s<br>Set target speed 250step / s   |
| 2                 | 01 06 00 51 00 06                | 01 06 00 51 00 06     | 电机切换为启动状态<br>The motor switches to the starting state  |
| 3                 | 01 06 00 51 00 07                | 01 06 00 51 00 07     | 电机切换为使能状态<br>Motor switched to enabled state   |
| 4                 | 01 06 00 51 00 0F                | 01 06 00 51 00 0F     | 电机开始加速，直到速度达到速度 250step/s 匀速<br>The motor starts to accelerate until the speed reaches a constant speed of 250step / s |
| 5                 | 01 10 00 55 00 02 04 00 00 01 F4 | 01 10 00 55 00 02     | 设置目标速度 500step/s<br>Set the target speed to 500step / s  |
| 6                 | 01 06 00 51 00 0F                | 01 06 00 51 00 0F     | 电机开始加速，直到速度达到 500 step/s 匀速<br>The motor starts to accelerate until the speed reaches 500 step / s uniform speed       |

#### 4.4 原点回归模式 Home mode

原点回归模式是用于从当前的位置移动到设备的原点位置。在运动过程中原点回归方式（保持寄存器 0x6B），原点偏移值（保持寄存器 0x69）寻找开关速度（保持寄存器 0x6C），寻找零位开关速度（保持寄存器 0x6E）等都考虑在内。

The origin return mode is used to move from the current position to the origin position of the device. During the movement, the return-to-origin method (holding register 0x6B), the origin offset value (holding register 0x69), the search for the switching speed (holding register 0x6C), and the search for the zero switching speed (holding register 0x6E) are all taken into consideration.

原点回零后，电机所停的位置为机械的原点位置，通过设置原点偏移对象，可以设定机械原点与机械零点的关系：机械原点 = 机械零点+原点偏移

After returning to origin, the position where the motor stops is the origin of the machine. By setting the origin offset object, you can set the relationship between the machine origin and the machine zero: mechanical origin = mechanical zero + Origin Offset

当原点偏移为 0 时，机械原点与机械零点重合。

When the origin offset is 0, the mechanical origin coincides with the mechanical zero.

对于原点模式控制下运动关联参数如下图

For the motion related parameters under the control of the origin mode, the figure below

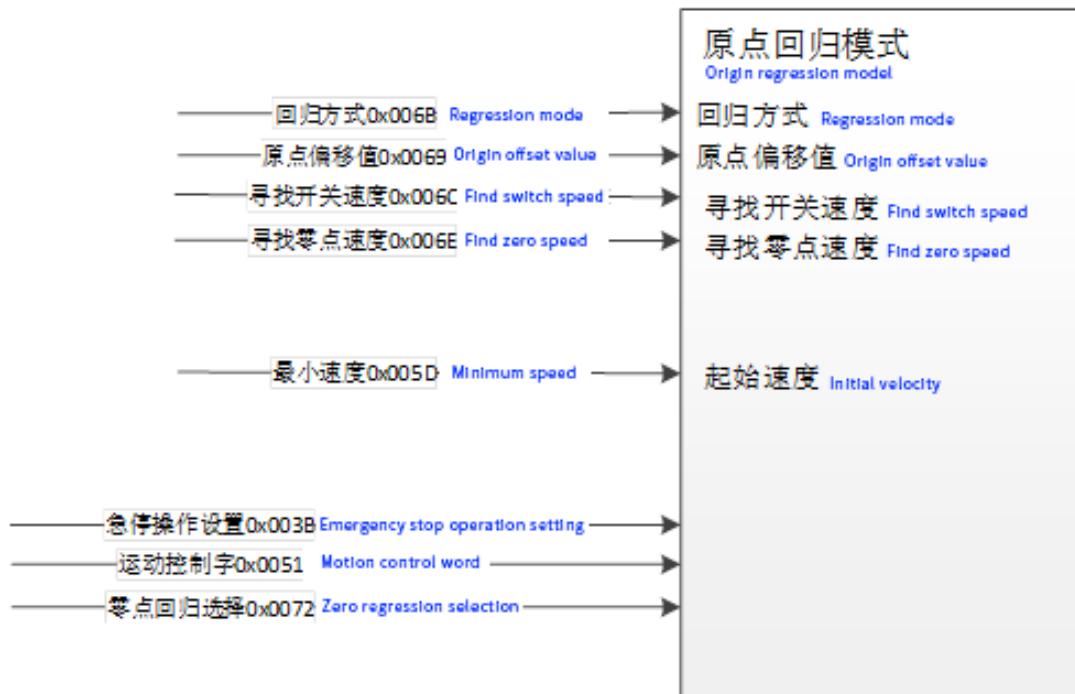


图 4-3

原点回归模式下控制字的设置启动运行原点回归如下  
Setting of control word in OPR mode

表 4-7

| Modbus 地址<br>Modbus address | 值<br>Value                     | 描述 Description  |
|-----------------------------|--------------------------------|---|
| 0x0051                      | 先 0F 后 1F<br>First 0F, then 1F | 电机开始进行原点回归动作<br>the motor starts to return to origin. |

#### 4.4.1 原点回归方式 Origin return method

原点回归的方式有 17~31，其中 31 模式为快速回零方式，如果选择的原点回归方式范围为 17~30，那么在原点回归中需要使用一个原点开关或者限位开关，这些特殊的功能开关需要在 I/O 配置中激活。配置详见章节 8。

There are 17 ~ 31 ways of origin return, among which 31 mode is fast return to zero mode. If the range of origin return method selected is 17 ~ 30, then you need to use an origin switch or limit switch in origin return. These special function switches Requires activation in I / O configuration. See chapter 8 for configuration details.

从实际应用需求角度考虑，我们往往需要电机从零点开始工作，故电机在进行原点回零之后，需要再进行一个“运行到零点位置”的动作。通过设置参数 0x0072 (零点回归)为值为 1 后，一体化电机在原点回归之后会自动回到零点位置。

From the perspective of practical application requirements, we often need the motor to work from zero, so after the motor returns to the zero point, it needs to perform a "run to zero position" action. After setting the parameter 0x0072 (zero point return) to 1, the integrated motor will automatically return to the zero position after the origin return.

原点回归方式 17~30 对应的开关关系如下：

The switch relationship corresponding to the origin return method 17 ~ 30 is as follows:

表 4-8

| 原点回归方式<br>Origin return<br>method | 使用的开关<br>Used switches                                   |
|-----------------------------------|--|
| 17                                | 负限位开关<br>Negative limit switch                           |
| 18                                | 正限位开关<br>Positive limit switch                           |
| 19                                | 原点开关<br>Origin switch                                    |
| 20                                | 原点开关<br>Origin switch                                    |
| 21                                | 原点开关<br>Origin switch                                    |
| 22                                | 原点开关<br>Origin switch                                    |
| 23                                | 原点开关, 正限位开关<br>Origin switch, positive limit<br>switch   |
| 24                                | 原点开关, 正限位开关<br>Origin switch, positive limit<br>switch   |
| 25                                | 原点开关, 正限位开关<br>Origin switch, positive limit<br>switch   |
| 26                                | 原点开关, 正限位开关<br>Origin switch, positive limit<br>switch   |
| 27                                | 原点开关, 负限位开关<br>Origin switch, negative limit<br>switch   |
| 28                                | 原点开关, 负限位开关<br>Origin switch, negative limit<br>switch   |
| 29                                | 原点开关, 负限位开关<br>Origin switch, negative limit<br>switch   |
| 30                                | 原点开关, 负限位开关<br>Origin switch, negative limit<br>switch   |
| 31                                | 无开关, 快速原点回归方式<br>No switch, fast origin return<br>method |

- 原点回归方式 17: Origin return method 17:

机械原点：负限位开关下降沿 Mechanical origin: negative edge of negative limit switch

负限位开关为无效时（这里是低电平）运动初始方向是正向，在遇到负限位开关为有效时（这里是高电平），反向运行遇到负限位开关下降沿停。运动轨迹如下图：

When the negative limit switch is inactive (here is low level), the initial direction of movement is forward. When the negative limit switch is active (here is high level), the reverse operation encounters the falling edge of the negative limit switch and stops. . The movement track is as follows:

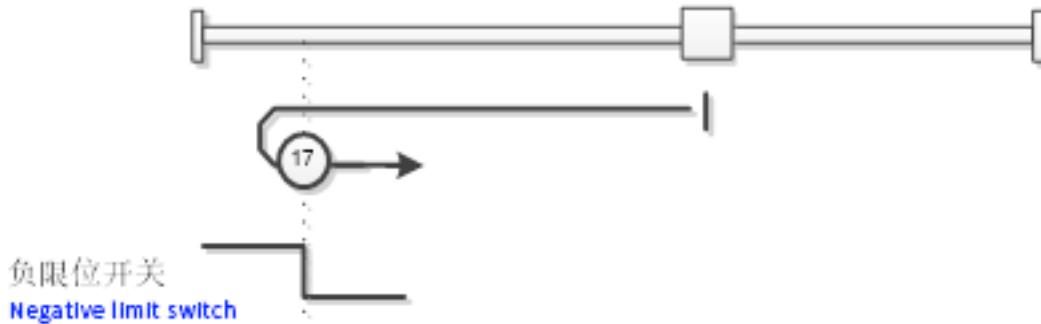


图 4-4

- 原点回归方式 18: Origin return method 18:

机械原点: 正限位开关下降沿

Mechanical origin: falling edge of positive limit switch

如果正限位开关处于无效状态（这里是低电平）运动的初始方向是正向，原点的位置是在正限位开关下降沿后无效状态下。运动轨迹如下图：

If the positive limit switch is in the inactive state (here, low level), the initial direction of movement is forward, and the position of the origin is in the invalid state after the falling edge of the positive limit switch. The movement track is as follows:

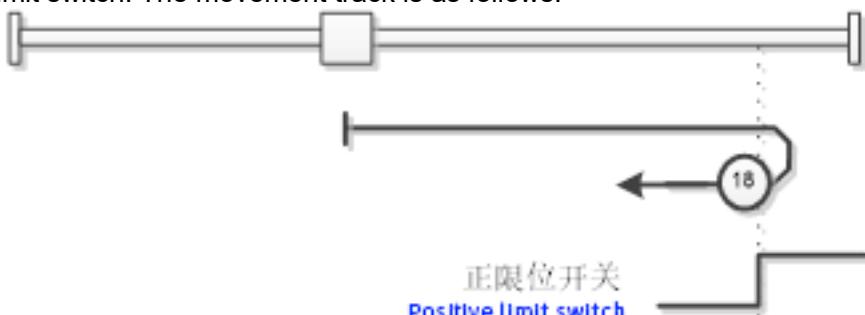


图 4-5

- 原点回归方式 19 和 20: Origin return methods 19 and 20:

机械原点: 原点开关下降沿和上升沿

Mechanical origin: Falling and rising edges of the origin switch

此两种方式的初始方向取决于原点开关的状态。原点开关有效为反向，无效为正向运行，方式 19 是原点开关产生下降沿后停止，方式 20 为原点开关产生上升沿后停止。运动轨迹如下图：

The initial direction of these two methods depends on the state of the origin switch. The origin switch is valid for reverse and invalid for forward operation. Mode 19 is to stop after the origin switch generates a falling edge, and mode 20 is to stop after the origin switch generates a rising edge. The movement track is as follows:

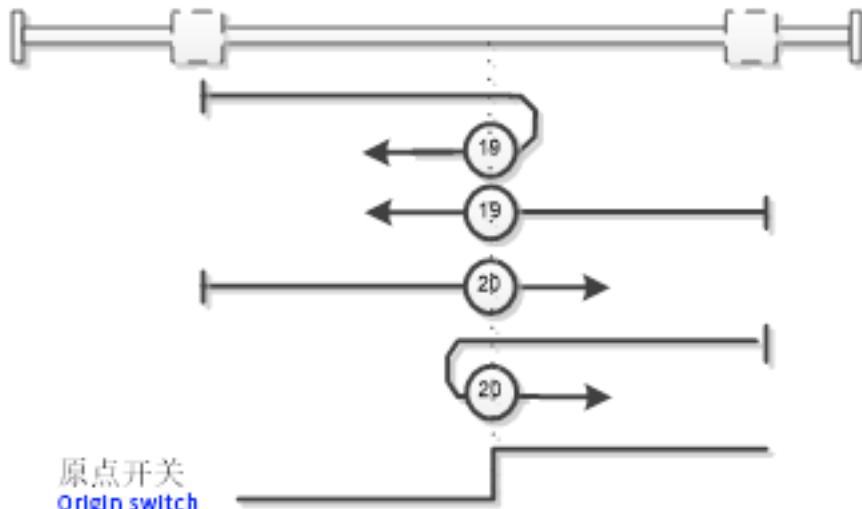


图 4-6

- 原点回归方式 21 和 22: Origin return methods 21 and 22:

机械原点: 原点开关下降沿和上升沿

Mechanical origin: Falling and rising edges of the origin switch

此两种方式的初始方向取决于原点开关的状态。原点开关有效为正向，无效为反向运行，方式 21 是原点开关产生下降沿后停止，方式 22 为原点开关产生上升沿后停止。运动轨迹如下图：

The initial direction of these two methods depends on the state of the origin switch. The origin switch is valid for forward and invalid for reverse operation. Mode 21 is to stop after the origin switch generates a falling edge, and mode 22 is to stop after the origin switch generates a rising edge. The movement track is as follows:

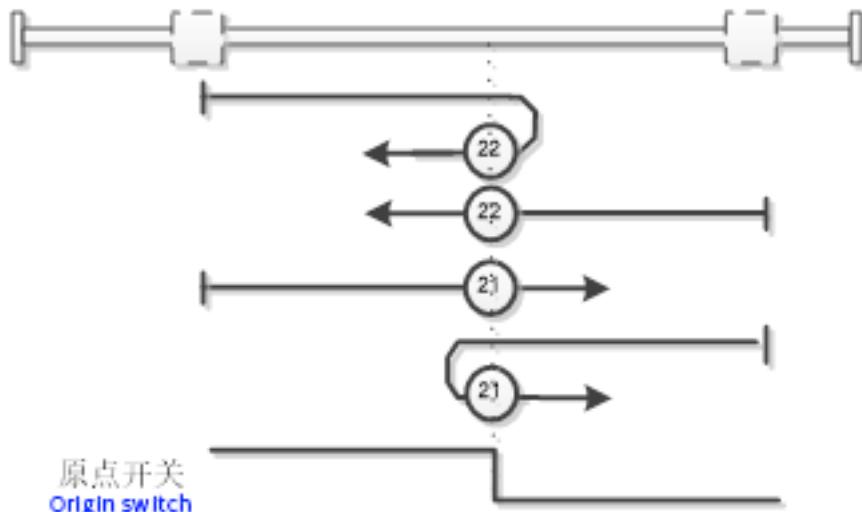


图 4-7

- 原点回归方式 23~26: Origin return 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。

These methods are actually the first movement of the motor to scan the origin switch. The search path is relatively short only when the origin switch is active.

在原点开关处于无效状态下，方式 23 和 24 的初始方向是正向，方式 25 和 26 初始方向是反向。

When the origin switch is in an invalid state, the initial directions of modes 23 and 24 are forward, and the initial directions of modes 25 and 26 are reverse.

如果运动方向没有寻找到原点开关时，在遇到正限位开关需要反向寻找原点开关。

If the origin switch is not found in the direction of movement, you need to find the origin switch in the reverse direction when it encounters the positive limit switch.

方式 23 和 26 是最后在原点开关下降沿停止，方式 24 和 25 是最后在原点开关上升沿停止。

Modes 23 and 26 stop at the falling edge of the origin switch last, and modes 24 and 25 stop at the rising edge of the origin switch last.

运动轨迹如下图：

The movement track is as follows:

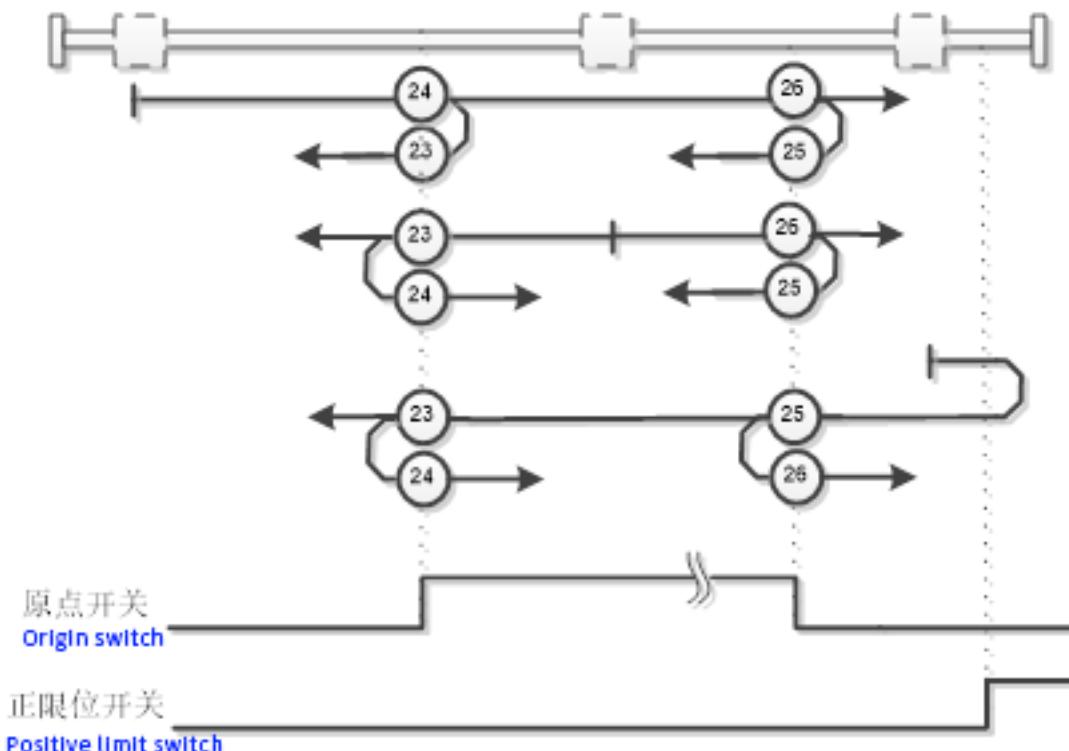


图 4-8

- 原点回归方式 27~30: Origin return 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。

These methods are actually the first movement of the motor to scan the origin switch. The search path is relatively short only when the origin switch is active.

在原点开关处于无效状态下，方式 27 和 30 的初始方向是反向，方式 28 和 29 初始方向是正向。

When the origin switch is in the inactive state, the initial directions of modes 27 and 30 are reverse, and the initial directions of modes 28 and 29 are forward.

如果运动方向没有寻找到原点开关时，在遇到负限位开关需要反向寻找原点开关。

If the origin switch is not found in the direction of movement, you need to find the origin switch in the opposite direction when encountering the negative limit switch.

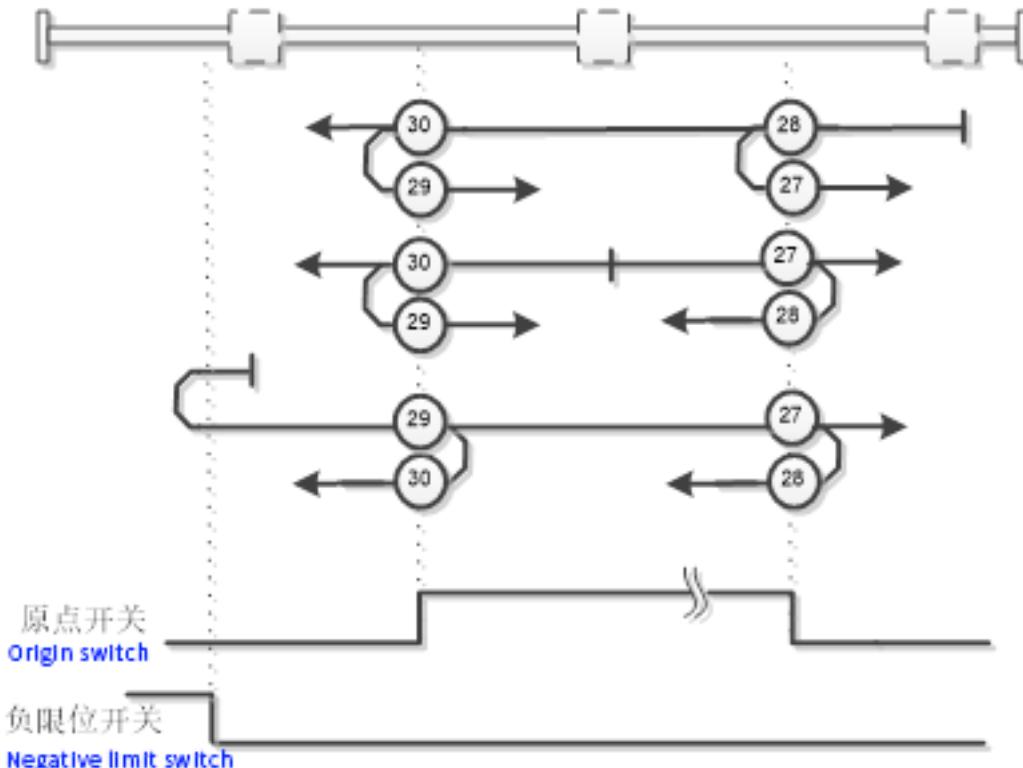


图 4-9

- 原点回归方式 31: Origin return method 31:

方式 31 为快速原点回归方式，设为此方法后发送运行命令后，电机会根据绝对位置自动快速回到原点位置。

Method 31 is the fast origin return method. After setting this method, the motor will automatically return to the origin position quickly according to the absolute position.

**原点回归方式举例： Examples of origin return methods:**

在原点回归模式关联参数默认值条件，原点回归方式 17，数字量输入 DI1 特殊功能为负限位开关。

In the return-to-origin mode associated parameter default value condition, the return-to-origin mode 17, the special function of digital input DI1 is a negative limit switch.

下述报文中只包含电机地址、功能码和数据部分，省略 CRC 部分。

The following message contains only the motor address, function code and data, and the CRC is omitted.

表 4-9

| 步骤<br>Step | 请求报文<br>Request message          | 响应报文<br>Response message | 备注<br>Remark   |
|------------|----------------------------------|--------------------------|--|
| 1          | 01 06 00 6B 00 11                | 01 06 00 6B 00 11        | 设置原点回归方式 17<br>Setting the origin return method 17                       |
| 2          | 01 10 00 2C 00 02 04 00 00 00 01 | 01 10 00 2C 00 02        | 配置数字量输入 DI1 特殊功能为 1<br>Configure digital input DI1 special function to 1 |
| 3          | 01 06 00 51 00 06                | 01 06 00 51 00 06        | 电机切换为启动状态<br>The motor switches to the starting state                    |
| 4          | 01 06 00 51 00 07                | 01 06 00 51 00 07        | 电机切换为使能状态<br>Motor switched to enabled state                             |
| 5          | 01 06 00 51 00 0F                | 01 06 00 51 00 0F        | 先发控制字 0F<br>First send Control word 0F                                   |

|   |                   |                   |                                       |
|---|-------------------|-------------------|---------------------------------------|
| 6 | 01 06 00 51 00 1F | 01 06 00 51 00 1F | 再发控制字 1F<br>Then send Control Word 1F |
|---|-------------------|-------------------|---------------------------------------|

## 4.5 脉冲输入模式 Pulse input mode

脉冲输入模式是一种用户通过 IO 口向电机输入 PWM 来控制电机运动的运动模式。

The pulse input mode is a motion mode in which the user inputs PWM to the motor through the IO port to control the motion of the motor.

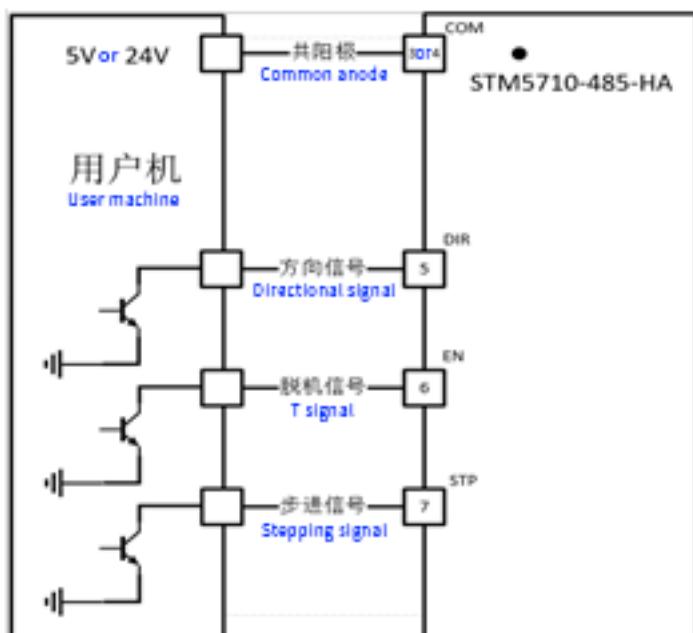
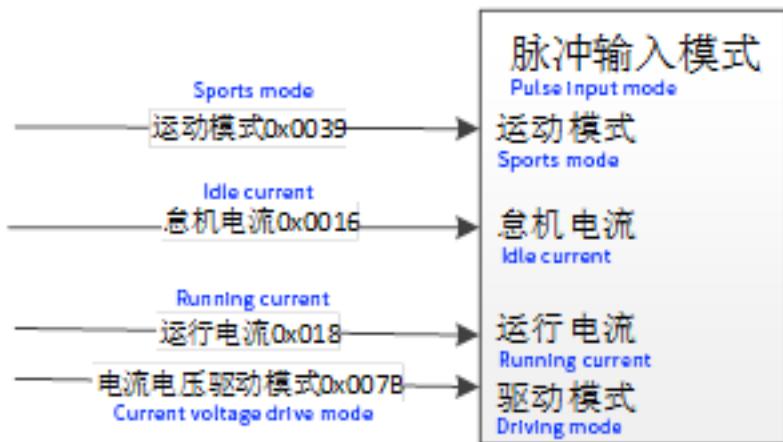


图 4-10

脉冲输入模式工作必须首先将保持寄存器 (0x007B) 设置为 0x01，然后进行参数保存，最后重新上电之后才可以执行后续操作。

In the pulse input mode, you must first set the holding register (0x007B) to 0x01, then save the parameters, and then perform the subsequent operations after power-on again.

运动模式：将参数设置为 0x04（脉冲输入模式）。

Sport mode: Set the parameter to 0x04 (pulse input mode).

怠机电流：电机抱机时流过线圈的电流。

Idle current: the current flowing through the coil when the motor is holding the machine.

运行电流：电机运行时流过线圈的电流。

Running current: The current flowing through the coil when the motor is running.

EN 引脚：使能，低电平使能，高电平脱机。

EN pin: enable, low level enable, high level offline.

STP 引脚：输入 PWM 波脉冲信号。

STP pin: Input PWM wave pulse signal.

DIR 引脚：方向：低电平反转，高电平正转。

DIR pin: direction: low level reverse, high level forward.

有故障报警时，如果 DX1 配置为输出模式，则 DO1 输出高电平报警信号。

When there is a fault alarm, if DX1 is configured as the output mode, DO1 outputs a high-level alarm signal.

在脉冲输入模式下，部分参数不可用。具体参数参考第 7 章寄存器列表。

In the pulse input mode, some parameters are not available. For specific parameters, refer to Chapter 7 Register List.

## 5 特殊功能 Special functions

### 5.1 数字量输入与输出 Digital inputs and outputs

一体化步进电机具有输入与输出的接口。集成的数字量输入接口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。

The integrated stepper motor has interfaces for input and output. The integrated digital input interface is used to connect sensors that assist motion control, such as limit micro switches, photoelectric switches, Hall sensors, etc.

数字量输入和数字量输出的连接和端口定义请参照电机使用说明书。

For the definition and connection of digital input and digital output, please refer to the motor manual.

#### 5.1.1 数字量输入 Digital input

数字量输入端口的信号的电压范围参照电机使用说明书。

For the voltage range of the signal of the digital input port, refer to the motor instruction manual.

此设备数字量输入参数有两种，一种固定为输入 DI1~3，一种可配置为数字量输入的 DX1~1。

There are two types of digital input parameters for this device, one is fixed to input DI1 ~ 3, and the other can be configured as digital input DX1 ~ 1.

例如 DX1 配置参数 0x0034 第 0bit 设置为 0 时，DX1 端口配置为输入；设置为 1 时，端口配置为输出。

For example, when the 0th bit of DX1 configuration parameter 0x0034 is set to 0, the DX1 port is configured as an input; when it is set to 1, the port is configured as an output.

下图显示了 DI 涉及输入关联参数以及内部流程图：

The following figure shows the DI related input parameters and internal flowchart:

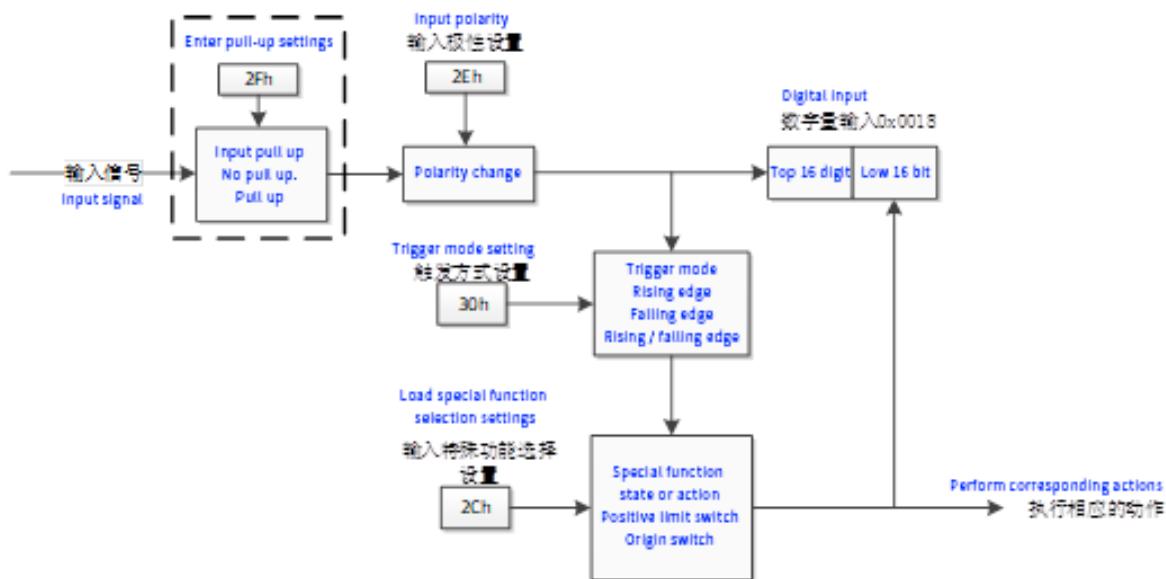


图 5-1

注：仅 STM57L 系列有输入上拉设置功能

Note: Only STM57L series has input pull-up setting function

关联参数的详细说明:

Detailed description of the associated parameters:

- **输入极性参数 0x002Eh Input polarity parameter 0x002Eh**

参数 16 位数据定义如下:

The parameter 16-bit data is defined as follows:

表 5-1

| 位<br>Bit          | 15~8 | 7 | 6 | 5 | 4   | 3   | 2   | 1   | 0   |
|-------------------|------|---|---|---|-----|-----|-----|-----|-----|
| 描述<br>description | —    | — | — | — | DX2 | DX1 | DI3 | DI2 | DI1 |

对应每位值为 1 时，相应的端口的输入电平进行取反操作。

When the corresponding bit value is 1, the input level of the corresponding port is inverted.

注：不同型号驱动器 DX 的数量不同，详细说明请参照电机使用说明书。

Note: The number of different types of driver DX is different, please refer to the motor manual for details.

- **输入上拉参数 0x002Fh Enter the pull-up parameter 0x002Fh**

参数 16 位数据定义如下: The parameter 16-bit data is defined as follows:

表 5-2

| 位<br>Bit          | 15~8 | 7 | 6 | 5 | 4   | 3   | 2   | 1   | 0   |
|-------------------|------|---|---|---|-----|-----|-----|-----|-----|
| 描述<br>description | —    | — | — | — | DX2 | DX1 | DI3 | DI2 | DI1 |

对应每位值为 1 时，相应的端口使能。注：仅 STM57L 系列此地址功能有效。

When the corresponding bit value is 1, the corresponding port is enabled. Note: This address function is valid only for STM57L series.

- **触发方式 0x0030h Trigger mode 0x0030h**

共 4 字节，第 0~3bit→DI1，依次类推，每个 DI 占用 4 位。信号的触发方式可以设置。

There are 4 bytes, 0 ~ 3bit0DI1, and so on. Each DI occupies 4 bits. The trigger mode of the signal can be set.

表 5-3

| 位<br>Bit          | 31...20 | 19...16 | 15...12 | 11...8 | 7...4 | 3...0 |
|-------------------|---------|---------|---------|--------|-------|-------|
| 描述<br>description | —       | DX2     | DX1     | DI3    | DI2   | DI1   |

每个 DI 对应的值含义: Meaning of the value of each DI:

0: 无效; 0: invalid;

1: 上升沿触发; 1: rising edge trigger;

2: 下降沿触发; 2: falling edge trigger;

3: 上升沿/下降沿触发。 3: rising / falling edge trigger.

- **输入特殊功能 0x002Ch Input special function 0x002Ch**

共 4 字节，第 0~3bit→DI1，依次类推，每个 DI 占用 4 位。

There are 4 bytes, 0 ~ 3bit0DI1, and so on. Each DI occupies 4 bits.

表 5-4

| 位<br>Bit          | 31...20 | 19...16 | 15...12 | 11...8 | 7...4 | 3...0 |
|-------------------|---------|---------|---------|--------|-------|-------|
| 描述<br>description | —       | DX2     | DX1     | DI3    | DI2   | DI1   |

每个 DI 设定的值: Value set by each DI:

0: 无动作 0: No action

1: 负限位开关 1: negative limit switch

2: 正限位开关 2: Positive limit switch

3: 参考开关 3: reference switch

4: 立即停机 4: Stop immediately

5: 减速度停机 5: Deceleration stop

6: 运行方向, 上升沿正方向, 下降沿反向 (速度模式下)

6: Running direction, positive direction of rising edge, negative direction of falling edge (in speed mode)

7: 使能, 上升沿使能, 下降沿脱机 (速度模式下)

7: Enable, rising edge enable, falling edge offline (in speed mode)

8: 运行/停止, 上升沿运行, 下降沿停止 (速度模式下)

8: Run / stop, rising edge running, falling edge stopping (in speed mode)

以上特殊功能仅 1~2 可以在脉冲输入模式下使用。

Only the above 1 ~ 2 special functions can be used in the pulse input mode.

以上特殊功能中 1~3 需要在原点回归模式下根据需要使用的开关进行配置。DI 配置了相应特殊功能后, 特殊功能变化或动作会随着 DI 发生改变而改变。

Among the above special functions, 1 ~ 3 need to be configured according to the switches used in the origin return mode. After DI is equipped with corresponding special functions, special function changes or actions will change as DI changes.

注: 对于负限位开关、正限位开关不支持上升沿/下降沿触发。

Note: For negative limit switch, positive limit switch does not support rising / falling edge trigger.

#### ● 数字量输入 0x0018h Digital input 0x0018h

输入寄存器中地址 0x0018 数字量输入参数共 4 字节, 高 16 位表示 DI 状态, 低 16 位表示特殊功能开关状态 (正限位开关状态, 负限位开关状态, 原点开关状态)

There are 4 bytes of digital input parameters at address 0x0018 in the input register. The upper 16 bits indicate the DI status, and the lower 16 bits indicate the special function switch status (positive limit switch status, negative limit switch status, origin switch status)

定义如图: The definition is as follows:

表 5-5

| 高 16 位 Upper 16 bits |     |     |     |     |     | 低 16 位 lower 16 bits |                              |  |  |
|----------------------|-----|-----|-----|-----|-----|----------------------|------------------------------|--|--|
| 31...2<br>1          | 20  | 19  | 18  | 17  | 16  | 15...<br>3           | 2                            | 1  | 0  |
| —                    | DX2 | DX1 | DI3 | DI2 | DI1 | —                    | 原点<br>开关<br>Origin<br>switch | 正限位<br>开关<br>Positive<br>limit<br>switch | 负限位<br>开关<br>Negative<br>limit<br>switch |

数字量输入参数显示了当前数字量状态, 正限位开关、负限位开关、原点开关状态是只有在特殊功能配置后才能显示当前状态, 否则为 0。

The digital input parameters show the current digital status. The status of the positive limit switch, negative limit switch, and origin switch can be displayed only after the special function configuration, otherwise it is 0.

### 5.1.2 数字量输出 Digital output

此设备数字量输出为可配置为数字量输出的 DX1~1。

The digital output of this device is DX1 ~ 1 which can be configured as digital output.

DX1 配置参数 0x0034 第 0bit 设置为 0 时，DX1 端口配置为输入；设置为 1 时，端口配置为输出。

When the 0th bit of DX1 configuration parameter 0x0034 is set to 0, the DX1 port is configured as an input; when set to 1, the port is configured as an output.

以下描述为 DX1 设置为 1，数字量输出。

In the following description, DX1 is set to 1 and digital output.

下图显示了 DO 涉及输出的对象设置：

The following figure shows the object settings of DO involving output:

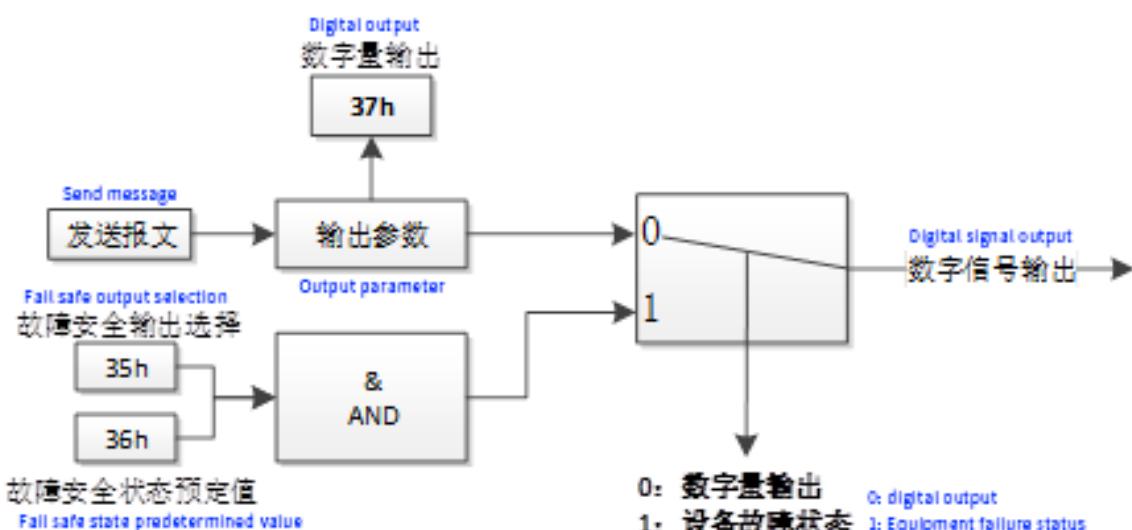


图 5-2

- 故障安全输出选择 0x0035h Fail-safe output selection 0x0035h

设备内部出现错误时，输出端选择。第 0 位 → DO1，依次类推。

When an error occurs inside the device, the output is selected. Bit 0 is → DO1, and so on.

表 5-6

| 位<br>Bit          | 15~8 | 7 | 6 | 5 | 4 | 3 | 2 | 1   | 0   |
|-------------------|------|---|---|---|---|---|---|-----|-----|
| 描述<br>description | —    | — | — | — | — | — | — | DX2 | DX1 |

设置值定义： Setting value definition:

0: 保留上一次的输出值 0: retain the last output value

1: 按故障安全状态预定值输出 1: Output according to the preset value of the fail-safe state

- 故障安全状态预定值 0x0036h Fail-safe state preset value 0x0036h

共 8 位，第 0 位 → DO1，依次类推。 There are 8 bits in total, 0 is → DO1, and so on.

表 5-7

| 位<br>Bit          | 15~8 | 7 | 6 | 5 | 4 | 3 | 2 | 1   | 0   |
|-------------------|------|---|---|---|---|---|---|-----|-----|
| 描述<br>description | —    | — | — | — | — | — | — | DX2 | DX1 |

设置值的定义：代表故障安全状态预定值

Definition of set value: predetermined value representing fail-safe status

- 数字量输出 **0x0037h Digital output 0x0037h**

共 4 字节，高 16 位表示 DO 输出的值。

A total of 4 bytes, the upper 16 bits represent the value of the DO output.

表 5-8

| 高 16 位 Upper 16 bits |     | 低 16 位 lower 16 bits |        |
|----------------------|-----|----------------------|--------|
| 31...18              | 17  | 16                   | 15...0 |
| —                    | DX2 | DX1                  | —      |

数字量输出参数改变数字量输出端口状态。

Digital output parameters change the status of digital output ports.

表 5-9

| 步骤 Step | 请求报文 Request message             | 响应报文 Response message | 备注 Remark   |
|---------|----------------------------------|-----------------------|---|
| 1       | 01 10 00 37 00 02 04 00 01 00 00 | 01 10 00 37 00 02     | 设置数字量输出 DX1 输出 1<br>Set digital output DX1 output 1 |

## 5.2 设置原点、零点 Set origin and zero

对于电机位置零点和原点可以通过设置参数实现，而无需改变机械位置实现原点和零点移动。当设置当前的机械位置为位置原点后，当前位置等于原点偏移值。

The zero and origin of the motor position can be achieved by setting parameters, without the need to change the mechanical position to achieve the origin and zero movement. When the current mechanical position is set as the position origin, the current position is equal to the origin offset value.

表 5-10

| 步骤 Step | 请求报文 Request message | 响应报文 Response message | 备注 Remark          |
|---------|----------------------|-----------------------|--------------------|
| 1       | 01 06 00 48 53 48    | 01 06 00 48 53 48     | 设置原点<br>Set origin |

设置位置零点，原点偏移值会根据当前位置零点与当前位置原点作出相应改变。

Set the position zero point, the origin offset value will be changed according to the current position zero point and the current position origin.

表 5-11

| 步骤 Step | 请求报文 Request message | 响应报文 Response message | 备注 Remark        |
|---------|----------------------|-----------------------|------------------|
| 1       | 01 06 00 47 53 5A    | 01 06 00 47 53 5A     | 设置零点<br>Set zero |

## 5.3 报警的获取与清除 Obtaining and Clearing Alarms

### 5.3.1 报警 Alarm

报警相关操作有获取最近报警信息、获取历史报警信息、获取历史报警个数和清除历史报警等操作。设备中有 16 个报警队列，采用堆栈方式存储，遵循先进先出规则。

Alarm-related operations include obtaining the latest alarm information, obtaining historical alarm information, obtaining the number of historical alarms, and clearing historical alarms. There are 16 alarm queues in the device, which are stored in a stack mode and follow the FIFO rule.

- 错误寄存器 Error register

错误寄存器长度 16 位，各位信息定义如下表所示：

The length of the error register is 16 bits. The definition of each bit is shown in the following table:

表 5-12

| 错误寄存器位定义 Definition of error register bits |                     |                |                    |                     |                   |               |               |                    |
|--|---------------------|----------------|--------------------|---------------------|-------------------|---------------|---------------|--------------------|
| Bit 15~<br>Bit 8                           | Bit 7               | Bit 6          | Bit 5              | Bit 4               | Bit 3             | Bit 2         | Bit 1         | Bit 0              |
| —  | 制造商<br>Manufacturer | 预留<br>Reserved | 子协议<br>Subprotocol | 通信<br>Communication | 温度<br>Temperature | 电压<br>Voltage | 电流<br>Current | 常规<br>Conventional |

当有错误（错误、报警、故障）产生时，Bit0 常规位会被填充为“1”，其他位会根据错误分类（见：错误代码说明与分类）来选择相应位填充为“1”，当错误排除后相应错误分类对应的位复位为“0”，如果所有错误都排除了，常规错误位才复位为“0”。

When an error (error, alarm, fault) occurs, the Bit0 regular bit will be filled with "1", and other bits will be selected according to the error classification (see: Error Code Description and Classification) to fill the corresponding bit with "1". After the error is eliminated, the bit corresponding to the corresponding error classification is reset to "0". If all errors are eliminated, the general error bit is reset to "0".

请求报文 Request message

表 5-13

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
| 01                    | 0x04                 | 00 25                     | 00 01                        | 略 Skip                     |

响应报文 Response message

表 5-14

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 寄存器值<br>Register value             | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|------------------------------------|----------------------------|
| 01                    | 0x04                 | 02                     | 2 字节错误寄存器<br>2-byte error register | 略 Skip                     |

- 错误存储器的报警个数 Number of alarms in error memory  
当前错误存储器列表中存在报警个数。

The number of alarms in the current error memory list.

主站请求报文 Master Request Message

表 5-15

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
| 01                    | 0x04                 | 00 27                     | 00 01                        | 略 Skip                     |

响应报文 Response message

表 5-16

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 寄存器值<br>Register value                                | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|---|----------------------------|
| 01                    | 0x04                 | 02                     | 2 字节错误存储器报警数量<br>Number of 2-byte error memory alarms | 略 Skip                     |

- 错误存储器 Error memory

错误存储器是历史报警的记录，错误存储器最大保存 8 条，在错误存储器都被占用的情况下，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，类似堆栈过程。

The error memory is a record of historical alarms. A maximum of 8 error memories can be stored. When the error memory is occupied, a new alarm will be generated, which will delete the earliest error. The previous errors will move downward in turn, similar to the stack process.

错误存储器的诊断查询会返回 16 个字节的数据。

A diagnostic query of the error memory will return 16 bytes of data.

表 5-17

| 错误分类<br>Error classification | 错误码 (16 进制)<br>Error code (hexadecimal) | 故障动作<br>Fault action | 含义<br>Meaning                       |
|------------------------------|---|----------------------|-------------------------------------|
| 电流<br>Current                | 2200                                    | 是 yes                | 过流保护<br>Overcurrent protection      |
| 电压<br>Voltage                | 3110                                    | 是 yes                | 电源过电压<br>Power overvoltage          |
| 电压<br>Voltage                | 3120                                    | 是 yes                | 电源欠电压<br>Power undervoltage         |
| 温度<br>Temperature            | 4310                                    | 否 no                 | 过热报警<br>Overheating alarm           |
| 子协议<br>Sub-agreement         | 7121                                    | 否 no                 | 失速报警<br>Stall alarm                 |
| 子协议<br>Sub-agreement         | 8612                                    | 否 no                 | 限位报警<br>Limit alarm                 |
| 制造商<br>Manufacturer          | FF00                                    | 是 yes                | 过热关机<br>Thermal shutdown            |
| 制造商<br>Manufacturer          | FF01                                    | 否 no                 | 错误的命令<br>Wrong command              |
| 制造商<br>Manufacturer          | FF02                                    | 否 no                 | 不能执行的命令<br>Unexecutable command     |
| 制造商<br>Manufacturer          | FF0E                                    | 否 no                 | 超负限位报警<br>Over-negative limit alarm |
| 制造商<br>Manufacturer          | FF0F                                    | 否 no                 | 超正限位报警<br>Over positive limit alarm |

|                     |      |      |   |
|---------------------|------|------|---|
| 制造商<br>manufacturer | FF11 | 否 no | SPI 通信失败报警<br>SPI communication failure alarm |
|---------------------|------|------|---|

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（状态字值 0x18）。在故障恢复后需要通过发送控制 0x80 来清除故障（控制字 bit7 上升沿有效），才能进行正常的操作。

The "Yes (No)" of the fault action in the above list indicates whether the motor enters the fault state after the fault occurs (status word value 0x18). After the fault is recovered, the fault needs to be cleared by sending control 0x80 (the rising edge of the control word bit7 is valid) in order to perform normal operations.

#### 请求报文 Request message

表 5-18

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
| 01                    | 0x04                 | 00 28                     | 00 08                        | 略 Skip                     |

#### 响应报文 Response message

表 5-19

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 数据<br>Data                                      | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|---|----------------------------|
| 01                    | 0x04                 | 02                     | 错误存储器值 (16 字节)<br>Error memory value (16 bytes) | 略 Skip                     |

### 5.3.2 清空错误存储器 Clearing the Error Memory

清空错误存储器中所有的报警信息。 Clear all alarm messages in the error memory.

#### 请求报文 Request message

表 5-20

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器值<br>Register value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------|----------------------------|
| 01                    | 0x06                 | 00 73                     | 6C 64                  | 略 Skip                     |

#### 响应报文 Response message

表 5-21

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器值<br>Register value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------|----------------------------|
| 01                    | 0x06                 | 00 73                     | 6C 64                  | 略 Skip                     |

### 5.3.3 当前的错误报警 Current error alarm

获取最近错误报警值。 Get the latest error alarm value.

#### 主站请求报文 Master Request Message

表 5-22

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器数量<br>Number of registers | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------------|----------------------------|
|                       |                      |                           |                              |                            |

|    |      |       |       |        |
|----|------|-------|-------|--------|
| 01 | 0x04 | 00 26 | 00 01 | 略 Skip |
|----|------|-------|-------|--------|

响应报文 Response message

表 5-23

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 寄存器值<br>Register value    | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|---------------------------|----------------------------|
| 01                    | 0x04                 | 02                     | 报警错误码<br>Alarm error code | 略 Skip                     |

### 5.3.4 清除故障状态 Clear fault status

清除故障。 Clear the fault.

主站请求报文 Master Request Message

表 5-24

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器值<br>Register value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------|----------------------------|
| 01                    | 0x06                 | 00 51                     | 00 80                  | 略 Skip                     |

响应报文 Response message

表 5-25

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 寄存器值<br>Register value | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------------------|----------------------------|
| 01                    | 0x06                 | 00 51                     | 00 80                  | 略 Skip                     |

## 5.4 硬件自检 Hardware self-test

用于检测设备电机驱动部分硬件是否正常。在设备初次上电会自动进行自检功能，如果发现有报警，需要排除故障，故障排除后需要再次发送命令进行自检，确保硬件真的恢复正常。当电机状态字属于操作运行状态（0x33、0x37 等）时，从站不能进行自检。

sed to check whether the hardware of the motor drive part of the equipment is normal. After the device is powered on for the first time, the self-test function is automatically performed. If an alarm is found, the fault needs to be rectified. After the fault is removed, you need to send a command to perform a self-test again to ensure that the hardware really returns to normal. When the motor status word is in operation status (0x33, 0x37, etc.), the slave cannot perform self-test.

表 5-26

| 硬件自检结果 Hardware self-test results |                                   |       |       |      |
|-----------------------------------|-----------------------------------|-------|-------|------|
| Bit15~ Bit4                       | Bit 3                             | Bit 2 | Bit 1 | Bit0 |
| —                                 | 驱动自检结果<br>Drive self-test results | —     | —     | —    |

Bit 3 值为 1 时表示驱动自检时出现错误，值为 0 表示自检时无问题。

When the value of Bit 3 is 1, it indicates that an error occurred during the drive self-test, and the value of 0 indicates that there is no problem during the self-test.

### 主站请求报文 Master Request Message

表 5-27

| 从站地址<br><b>Slave address</b> | 功能码<br><b>Function code</b> | 寄存器地址<br><b>Register address</b> | 寄存器值<br><b>Register value</b> | CRC 校验值<br><b>CRC check value</b> |
|------------------------------|-----------------------------|----------------------------------|-------------------------------|-----------------------------------|
| 01                           | 0x06                        | 00 74                            | 74 65                         | 略 Skip                            |

### 响应报文 Response message

表 5-28

| 从站地址<br><b>Slave address</b> | 功能码<br><b>Function code</b> | 寄存器地址<br><b>Register address</b> | 寄存器值<br><b>Register value</b> | CRC 校验值<br><b>CRC check value</b> |
|------------------------------|-----------------------------|----------------------------------|-------------------------------|-----------------------------------|
| 01                           | 0x06                        | 00 74                            | 74 65                         | 略 Skip                            |

## 5.5 版本信息 Version Information

设备的硬件版本、软件版本和产品序列号通过功能码 04 可以查询，序列号查询：

The hardware version, software version, and product serial number of the device can be queried through function code 04, and the serial number can be queried:

### 主站请求报文 Master Request Message

表 5-29

| 从站地址<br><b>Slave address</b> | 功能码<br><b>Function code</b> | 寄存器地址<br><b>Register address</b> | 数据<br><b>Dtaa</b> | CRC 校验值<br><b>CRC check value</b> |
|------------------------------|-----------------------------|----------------------------------|-------------------|-----------------------------------|
| 01                           | 0x04                        | 00 02                            | 00 02             | 略 Skip                            |

## 响应报文 Response message

表 5-30

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 数据<br>Dtaa | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|------------|----------------------------|
| 01                    | 0x04                 | 04                     | XX XX      | 略 Skip                     |

硬件版本查询： Hardware version query:

## 主站请求报文 Master Request Message

表 5-31

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 数据<br>Dtaa | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------|----------------------------|
| 01                    | 0x04                 | 00 04                     | 00 02      | 略 Skip                     |

## 响应报文 Response message

表 5-32

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 数据<br>Dtaa | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|------------|----------------------------|
| 01                    | 0x04                 | 04                     | XX XX      | 略 Skip                     |

软件版本查询： Software version query:

## 主站请求报文 Master Request Message

表 5-33

| 从站地址<br>Slave address | 功能码<br>Function code | 寄存器地址<br>Register address | 数据<br>Dtaa | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|---------------------------|------------|----------------------------|
| 01                    | 0x04                 | 00 0A                     | 00 02      | 略 Skip                     |

## 响应报文 Response message

表 5-34

| 从站地址<br>Slave address | 功能码<br>Function code | 字节数<br>Number of bytes | 数据<br>Dtaa | CRC 校验值<br>CRC check value |
|-----------------------|----------------------|------------------------|------------|----------------------------|
| 01                    | 0x04                 | 04                     | XX XX      | 略 Skip                     |

## 6 电机配置 Motor configuration

电压是指驱动器的输入电压，电阻是指电机的相电阻，电感是指电机的相电感，反应电动势系数。

Voltage refers to the input voltage of the driver, resistance refers to the phase resistance of the motor, and inductance refers to the phase inductance of the motor, which reflects the electromotive force coefficient.

注意：不同电机，以上特性肯定有所不同，所以在更换电机时一定要注意修改这几项参数

Note: The above characteristics must be different for different motors, so be sure to modify these parameters when replacing the motor

## 7 寄存器列表 Register list

设置状态表示允许写参数的设备状态。参数设置允许表示设备状态机状态（电机运行状态机）是允许进行参数的读写操作。无限制代表在任何状态都可以读写参数。电机脱机情况下是指电机驱动部分没有电流输出，电机轴处于自由状态。生效方式中再次通电表示此参数在设置新的值后需要保存参数，重新启动电机才能有效；立即生效不需要重启电机操作，即可在本次运动有效。有些参数需要大小为 32bit 的存储空间来存储，Modbus 协议中的寄存器宽度为 16 bit，因而要使用 2 个寄存器来表示 1 个数据。当参数占用两个寄存器时，数据采用大端模式。单位 pulses 表示脉冲。

The setting status indicates the status of the device that allows parameters to be written. The parameter setting allows to indicate the state of the machine (motor running state machine) is to allow reading and writing of parameters. Unlimited means that parameters can be read and written in any state. When the motor is offline, it means that the motor drive part has no current output, and the motor shaft is in a free state. Re-energizing in the effective mode means that this parameter needs to be saved after setting a new value to restart the motor to be effective; it takes effect immediately without restarting the motor operation to be effective in this movement. Some parameters require a 32-bit storage space to store, and the register width in the Modbus protocol is 16 bits, so two registers are used to represent one data. When the parameters occupy two registers, the data is in big-endian mode. The unit pulses indicates pulses.

①：带此标志为：脉冲输入模式下此参数不可设置

①：With this flag: This parameter cannot be set in pulse input mode

表 7-1 保持寄存器列表 Holding register list

| Modbus 地址<br>Modbus address | 名称<br>Name                    | 描述<br>Description  | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status | 生效方式<br>Effective mode |
|-----------------------------|-------------------------------|--|------------------------------|--------------------|------------|----------------------|------------------------|------------------------|
| 0                           | 节点地址<br>Node address          | Modbus 从站的地址<br>Modbus slave address   | 1                            | 1~247              | -          | 1                    | 无限制<br>Unlimited       | 再次通电<br>Power up again |
| 1                           | 波特率<br>Baud rate              | 0x00:9.6kbps<br>0x01:9.6kbps<br>0x02:19.2kbps<br>0x03:38.4 kbps<br>0x04:57.6kbps<br>0x05:115.2kbps<br>0x06:256kbps<br>0x07:500kbps<br>0x08:1Mbps<br>0x09:1.5Mbps   | 1                            |                    | -          | 5                    | 无限制<br>Unlimited       | 再次通电<br>Power up again |
| 2                           | 网络数据格式<br>Network data format | 0x00:8 数据位、 偶校验、 1 停止位<br>0x00: 8 data bits, even parity, 1 stop bit<br>0x01:8 数据位、 奇校验、 1 停止位<br>0x01: 8 data bits, odd parity, 1 stop bit<br>0x02:8 数据位、 无奇偶校验、 1 停止位<br>0x02: 8 data bits, no parity, 1 stop bit<br>0x03:8 数据位、 无奇偶校验、 2 停止位<br>0x03: 8 data bits, no parity, 2 stop bits | 1                            | 0~3                | -          | 2                    | 无限制<br>Unlimited       | 再次通电<br>Power up again |

| Modbus 地址<br>Modbus address | 名称<br>Name  | 描述<br>Description  | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|---|--|------------------------------|--------------------|------------|----------------------|-------------------------------------|-------------------------------|
| 3                           | Modbus 返回等待时间<br>Modbus return waiting time       | 设置 Modbus 的通信请求由接收方发出，到响应数据发送的追加的等待时间。<br><br>Modbus Return Waiting Time Set the additional waiting time for Modbus communication request sent by the receiver to response data sending.<br>注:即使设置值 0，响应数据也会造成时间延迟。<br><br>Note: Even if the value is set to 0, the response data will cause a time delay. | 1                            | 0~10000            | ms         | 0                    | 无限制<br>Unlimited                    | 再次通电<br>Power up again        |
| 4~7                         | 保留<br>Keep  |  | 4                            |                    | Ms         |                      |                                     |                               |
| 8                           | 保存所有参数<br>Save all parameters                     | 写 0x7376 保存，读参数为 1 表示支持指令保存<br><br>Write 0x7376 to save, read parameter 1 to support saving instructions<br>注：保存参数需要 200ms 左右的时间<br><br>Note: It takes about 200ms to save the parameters  | 1                            | UNSIGNED16         | -          | 1                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 9-A                         | 保留<br>Keep  |  | 2                            |                    | -          |                      |                                     |                               |
| B                           | 恢复所有参数默认值<br>Restore all parameter default values | 写 0x6C64 恢复所有参数制造商默认值<br><br>Write 0x6C64 to restore all parameter manufacturer defaults   | 1                            | UNSIGNED16         | -          | 1                    | 参数设置允许<br>Parameter setting allowed | 再次通电<br>Power up again        |
| C~D                         | 保留<br>Keep  |  | 2                            |                    | -          |                      |                                     |                               |
| E                           | 电阻<br>resistance                                  | 电机的电阻<br>Motor resistance  | 2                            | UNSIGNED32         | mOhm       | 290                  | 无限制<br>Unlimited                    | 再次通电<br>Power up again        |

| Modbus 地址<br>Modbus address | 名称<br>Name  | 描述<br>Description  | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status | 生效方式<br>Effective mode        |
|-----------------------------|---|--|------------------------------|--------------------|------------|----------------------|------------------------|-------------------------------|
| 10                          | 电感<br>inductance                                    | 电机的电感<br>Motor inductance  | 2                            | UNSIGNED32         | uH         | 1770                 | 无限制<br>Unlimited       | 再次通电<br>Power up again        |
| 12                          | 反应电动势系数<br>Reaction electromotive force coefficient | 电机的反应电动势系数<br>Motor's Response EMF Coefficient                         | 2                            | UNSIGNED32         | mV/Hz      | 46                   | 无限制<br>Unlimited       | 再次通电<br>Power up again        |
| 14                          | 电压<br>Voltage                                       | 电源的电压<br>Voltage of the power supply                                   | 1                            | UNSIGNED8          | V          | 24                   | 无限制<br>Unlimited       | 再次通电<br>Power up again        |
| 15                          | 减速电流①<br>Deceleration current①                      | STM86 系列电机峰值电流<br>Deceleration current STM86 series motor peak current | 1                            | 0~10000            | mA         | 1000                 | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
|                             |   | 非 STM86 系列电机峰值电流<br>Non-STM86 series motor peak current                | 1                            | 0~4000             | mA         | 1000                 | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
| 16                          | 怠机电流<br>Idle current                                | STM86 系列电机峰值电流<br>STM86 series motor peak current                      | 1                            | 0~10000            | mA         | 500                  | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
|                             |   | 非 STM86 系列电机峰值电流<br>Non-STM86 series motor peak current                | 1                            | 0~4000             | mA         | 500                  | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
| 17                          | 加速电流①<br>Acceleration current①                      | STM86 系列电机峰值电流<br>Deceleration current STM86 series motor peak current | 1                            | 0~10000            | mA         | 1000                 | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
|                             |   | 非 STM86 系列电机峰值电流<br>Non-STM86 series motor peak current                | 1                            | 0~4000             | mA         | 1000                 | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
| 18                          | 运行电流<br>Running current                             | STM86 系列电机峰值电流<br>Deceleration current STM86 series motor peak current | 1                            | 0~10000            | mA         | 1000                 | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |

| Modbus 地址<br>Modbus address | 名称<br>Name                 | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range  | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status                         | 生效方式<br>Effective mode        |
|-----------------------------|----------------------------|---|------------------------------|---|------------|----------------------|--|-------------------------------|
|                             |                            | 非 STM86 系列电机峰值电流<br>Non-STM86 series motor peak current   | 1                            | 0~4000  | mA         | 1000                 | 无限制<br>Unlimited                               | 立即生效<br>Effective immediately |
| 19                          | 过载电流<br>Overload current   | 非 STM86 电机 单位: 100mA 取值:<br>375 mA ~ 6 A<br>Non-STM86 motor Unit: 100mA Value:<br>375 mA ~ 6 A                              | 1                            | 0~60  | 100mA      | 40                   | 无限制<br>Unlimited                               | 立即生效<br>Effective immediately |
|                             |                            | STM86 电机 单位: 100mA 取值: 375<br>mA ~ 10A<br>STM86 motor Unit: 100mA Value: 375<br>mA ~ 10A                                    | 1                            | 0~100   | 100mA      | 80                   | 无限制<br>Unlimited                               | 立即生效<br>Effective immediately |
| 1A                          | 细分<br>Subdivision          | 00: 1 step<br>01: 1/2 step<br>02: 1/4 step<br>03: 1/8 step<br>04: 1/16step<br>05: 1/32step<br>06: 1/64step<br>07: 1/128step | 1                            | 非 28 系列:<br>0~7<br>Non-28<br>series: 0~7<br>28 系列:<br>0~4<br>28 series: 0~<br>4 | -          | 7                    | 电机脱机<br>情况下<br>When the<br>motor is<br>offline | 立即生效<br>Effective immediately |
| 1B~1E                       | 保留<br>Keep                 |   | 4                            |   | -          |                      |  |                               |
| 1F                          | 驱动参数<br>Driving parameters | 低速优化<br>Low speed optimization<br>0: 禁用 0: Disable<br>1: 启用 1: enable   | 1                            | 0~1   | —          | 1                    | 参数设置<br>允许<br>Parameter setting allowed        | 立即生效<br>Effective immediately |
| 20~2B                       | 保留<br>Keep                 |   | 12                           |   | -          |                      |  |                               |

| Modbus 地址<br>Modbus address | 名称<br>Name                        | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|-----------------------------------|---|------------------------------|--------------------|------------|----------------------|-------------------------------------|-------------------------------|
| 2C                          | 输入特殊功能<br>Enter special functions | <p>共 4 字节, 第 0~3 位是 DI1, 依次类推, 每个 DI 占用 4 位。<br/>         There are 4 bytes, the 0th to the 3rd bit is DI1, and so on, each DI occupies 4 bits.</p> <p>每个字节对应的值:<br/>         The corresponding value of each byte:</p> <ul style="list-style-type: none"> <li>0: 无动作 0: No action</li> <li>1: 负限位开关 1: negative limit switch</li> <li>2: 正限位开关 2: Positive limit switch</li> <li>3: 原点开关 3: Origin switch</li> <li>4: 立即停机 4: Stop immediately</li> <li>5: 减速度停机 5: Deceleration stop</li> <li>6: 运行方向, 上升沿正方向, 下降沿反向 (速度模式下)<br/>                     6: Running direction, positive direction of rising edge, negative direction of falling edge (in speed mode)</li> <li>7: 使能, 上升沿使能, 下降沿脱机 (速度模式下)<br/>                     7: Enable, rising edge enable, falling edge offline (in speed mode)</li> <li>8: 运行/停止, 上升沿运行, 下降沿停止 (速度模式下)<br/>                     8: Run / stop, rising edge running, falling edge stopping (in speed mode)<br/>                     (注: 脉冲输入模式下仅 1~2 功能可用)<br/>                     (Note: Only 1 ~ 2 functions are available in pulse input mode)</li> </ul> | 2                            | 0~<br>2290649224   | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |

| Modbus 地址<br>Modbus address | 名称<br>Name                        | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|-----------------------------------|---|------------------------------|--------------------|------------|----------------------|-------------------------------------|-------------------------------|
| 2E                          | 输入极性取反:<br>Invert input polarity: | 1 共 8 位, 第 0 位 àDI1, 依次类推<br>1 total 8 bits, 0th bit àDI1, and so on<br>每位值:<br>Each bit value:<br>0: 不取反 0: Do not negate<br>1: 取反 1: negate   | 1                            | UNSIGNED8          | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 2F                          | 输入上拉使能:<br>Input pull-up enable:  | 共 8 位, 第 0 位 àDIO, 依次类推<br>8 bits in total, 0th bit à DIO, and so on<br>每位值: Each bit value:<br>0: 无效 0: Invalid<br>1: 使能 1: enable<br>(注: 仅 57 系列此地址功能有效)<br>(Note: this address function is only valid for 57 series)   | 1                            | UNSIGNED8          | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 30                          | 输入触发方式:<br>Input trigger mode:    | 共 4 字节, 第 0~3 位 àDI1, 依次类推,<br>每个 DI 占用 4 位。<br>A total of 4 bytes, 0~3 bits àDI1, and<br>so on, each DI occupies 4 bits.<br>每个字节对应的值:<br>The value corresponding to each byte:<br>0: 无效<br>0: invalid<br>1: 上升沿触发;<br>1: Trigger on rising edge;<br>2: 下降沿触发;<br>2: Falling edge trigger;<br>3: 上升沿/下降沿触发。<br>3: Rising edge/falling edge trigger. | 2                            | 0~<br>858993459    | -          | 69905                | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 32                          | 保留<br>Keep                        |   | 2                            |                    | -          |                      |                                     |                               |

| Modbus 地址<br>Modbus address | 名称<br>Name   | 描述<br>Description  | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|--|--|------------------------------|--------------------|------------|----------------------|-------------------------------------|-------------------------------|
| 34                          | 特殊 I/O 输入输出设置:<br>Special I / O input and output settings: | 输入输出端口的配置, 共 8 位, 第 0 位 àDX1, 依次类推<br>I / O port configuration, a total of 8 bits, 0th bit àDX1, and so on<br>每位值: Each bit value:<br>0: 端口配置输入<br>0: Port configuration input<br>1: 端口配置输出<br>1: port configuration output  | 1                            | UNSIGNED8          | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 35                          | 故障安全输出选择: ①<br>Fail-safe output selection: ①               | 设备内部出现错误时, 输出端选择。共 8 位, 第 0 位 àDO1, 依次类推<br>When an error occurs inside the device, the output is selected. 8 bits in total, 0th bit àDO1, and so on<br>每位值: Each bit value:<br>0: 保留上一次的输出值<br>0: retain the last output value<br>1: 按故障安全状态预定值输出<br>1: Output according to the preset value of the fail-safe state | 1                            | UNSIGNED8          | -          | 0                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 36                          | 故障安全状态预定①<br>Fail-safe status booking①                     | 共 8 位, 第 0 位 àDO1, 依次类推<br>8 bits in total, 0th bit àDO1, and so on<br>每位值: 代表故障安全状态预定值<br>Each bit value: a predetermined value representing a fail-safe state  | 1                            | UNSIGNED8          | -          | 0                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 37                          | 数字量输出:<br>Digital output:                                  | 共 4 字节, 高 16 位表示 D0 输出的值, 低 16 位表示 D0 特殊功能值<br>A total of 4 bytes, the upper 16 bits represent the value of D0 output, and the lower 16 bits represent the value of D0 special function  | 2                            | UNSIGNED32         | -          | 0                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |

| Modbus 地址<br>Modbus address | 名称<br>Name  | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range               | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status | 生效方式<br>Effective mode        |
|-----------------------------|---|---|------------------------------|----------------------------------|------------|----------------------|------------------------|-------------------------------|
| 39                          | 运行的模式:<br>Mode of operation:                      | 1: 位置模式 1: Position mode<br>2: 速度模式 2: speed mode<br>3: 原点回归 3: Origin return<br>4: 脉冲输入模式(注:仅 57H 系列电机有此模式)<br>4: Pulse input mode (Note: only 57H series motors have this mode) | 1                            | 非 57H 系列<br>1~3<br>57H 系列<br>1~4 | -          | 1                    | 电机脱机下<br>Motor offline | 立即生效<br>Effective immediately |
| 3A                          | 操作启停设置: ①<br>Operation start and stop settings: ① | 取值范围: 0~1 Value range: 0 ~ 1<br>0 为无减速速度停机<br>0 means stop without deceleration<br>1 为按减速速度停机<br>1 is to stop at deceleration   | 1                            | 0~1                              | -          | 1                    | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
| 3B                          | 急停操作设置: ①<br>Emergency stop operation setting: ①  | 取值范围: 0~1<br>Value range: 0 ~ 1<br>0: 为无减速速度停机<br>0: Stop without deceleration<br>1: 为按减速速度停机<br>1: Stop at deceleration  | 1                            | 0~1                              | -          | 1                    | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
| 3C                          | 故障操作设置: ①<br>Fault operation settings: ①          | 取值范围: 0~1<br>Value range: 0 ~ 1<br>0: 为无减速速度停机<br>0: Stop without deceleration<br>1: 为按减速速度停机<br>1: Stop at deceleration  | 1                            | 0~1                              | -          | 0                    | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |
| 3D~42                       | 保留 Keep   |   | 6                            |                                  | -          |                      |                        |                               |
| 43                          | 失速检测阈值①<br>Stall detection threshold①             | STM86 系列电机 单位: 100mA 取值:<br>31.25 A~10 A<br>STM86 series motor Unit: 100mA<br>Value: 31.25 A ~ 10 A   | 2                            | 0~100                            | 100mA      | 80                   | 无限制<br>Unlimited       | 立即生效<br>Effective immediately |

| Modbus 地址<br>Modbus address | 名称<br>Name                            | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|---------------------------------------|---|------------------------------|--------------------|------------|----------------------|-------------------------------------|-------------------------------|
|                             | 失速检测阈值①<br>Stall detection threshold① | 非 86 系列电机 单位: mA 取值:<br>31.25 mA ~ 4 A<br>Non-86 series motor Unit: mA Value:<br>31.25 mA ~ 4 A                                       | 2                            | 0~4000             | mA         | 3000                 | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 45                          | 保留<br>Keep                            |   | 1                            |                    | -          |                      |                                     |                               |
| 46                          | 保留<br>Keep                            |   | 1                            |                    | -          |                      |                                     |                               |
| 47                          | 设置零点<br>Set zero                      | 写入 0x535A 设置零点; 读参数为 1 表示支持指令<br>Write 0x535A to set the zero point; read a parameter of 1 to support the instruction                 | 1                            | 仅 0x535A           | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 48                          | 设置原点①<br>Set origin①                  | 写入 0x5348 设置原点; 读参数为 1 表示支持指令<br>Write 0x5348 to set the origin; read a parameter of 1 to support the instruction                     | 1                            | 仅 0x5348           | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 49~4F                       | 保留<br>Keep                            |   | 8                            |                    | -          |                      |                                     |                               |
| 51                          | 运动控制字①<br>Motion control word①        | 参照《一体化步进电机 Modbus 通信用户手册(开环)》第 3 节内容<br>Refer to Section 3 of "Integrated Stepper Motor Modbus Communication User Manual (Open Loop)" | 1                            | UNSIGNED16         | -          | 0                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 52                          | 运动方向①<br>Direction of movement①       | 0: 为反转 1: 为正传<br>0: Reverse 1: Forward  | 1                            | 0~1                | -          | 0                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 53                          | 位置模式下目标位置①                            | 电机运动停止时运动到的绝对位置<br>Absolute position to which the motor moves   | 2                            | INTEGER32          | pulse      | 0                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |

| Modbus 地址<br>Modbus address | 名称<br>Name                                | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit          | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|---|---|------------------------------|--------------------|---------------------|----------------------|-------------------------------------|-------------------------------|
|                             | Target position in position mode①         |   |                              |                    |                     |                      |                                     |                               |
| 55                          | 速度模式下目标速度①<br>Target speed in speed mode① | 电机正常运动时想要达到的速度<br>The speed you want to achieve when the motor is moving normally             | 2                            | 0~15610            | Step/s              | 100                  | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 57                          | 位置最小值①<br>Position minimum①               | 小于当前位置电机不再运动<br>Less than the current position the motor no longer moves                      | 2                            | INTEGER32          | pulse               | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 59                          | 位置最大值①<br>Position max①                   | 大于当前位置电机不再运动<br>Motors no longer move above the current position                              | 2                            | INTEGER32          | pulse               | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 5B                          | 最大速度①<br>Maximum speed①                   | 允许电机运行时的最大速度<br>Maximum speed when the motor is allowed to run                                | 2                            | 0~15610            | Step/s              | 250                  | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 5D                          | 最小速度①<br>Minimum speed①                   | 当驱动参数 3 为 1 时，值默认为 0<br>When drive parameter 3 is 1, the value defaults to 0                  | 2                            | 0~1000             | Step/s              | 16                   | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 5F                          | 加速度①<br>Acceleration①                     | 电机从当前速度增加到目标速度期间的加速度<br>Acceleration during motor increase from current speed to target speed | 2                            | 1~59590            | Step/s <sup>2</sup> | 1000                 | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |

| Modbus 地址<br>Modbus address | 名称<br>Name   | 描述<br>Description  | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit          | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|--|--|------------------------------|--------------------|---------------------|----------------------|-------------------------------------|-------------------------------|
| 61                          | 减速速度①<br>Deceleration①                                       | 电机从当前速度增加到目标速度期间的减速速度<br>Deceleration during motor increase from current speed to target speed     | 2                            | 1~59590            | Step/s <sup>2</sup> | 1000                 | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 63~67                       | 保留   |  | 5                            | -                  | -                   | -                    |                                     |                               |
| 69                          | 原点偏移值①<br>Origin offset value①                               | 单位: pulse<br>Unit: pulse   | 2                            | INTEGER32          | pulse               | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 6B                          | 原点回归的方式:<br>①<br>Way of origin return:①                      | 17~30 寻找开关方式, 31 内部设定方式<br>17 ~ 30 find the switch mode, 31 internal setting mode                  | 1                            | 17~31              | -                   | 17                   | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 6C                          | 寻找开关的速度<br>①<br>Find the speed of the switch①                | 在原点回归模式下, 寻找限位开关、原点开关时的速度<br>Speed in search of limit switch and origin switch in home return mode | 2                            | 0~15610            | Step/s              | 100                  | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 6E                          | 寻找零位的开关速度①<br>Find the switching speed of the zero position① | 在原点回归模式下, 寻找零点位置时的速度<br>In the home return mode, the speed when searching for the zero position    | 2                            | 0~15610            | Step/s              | 100                  | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 70                          | 保留<br>Keep   |  | 2                            | -                  | -                   | -                    |                                     |                               |

| Modbus 地址<br>Modbus address | 名称<br>Name                       | 描述<br>Description  | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status              | 生效方式<br>Effective mode        |
|-----------------------------|----------------------------------|--|------------------------------|--------------------|------------|----------------------|-------------------------------------|-------------------------------|
| 72                          | 零点回归①<br>Zero return①            | 在电机进行原点回归完成后是否再运行到零点位置，0x01 启用、0x00 禁用<br>Whether to run to the zero position after the home position return is completed. 0x01 is enabled and 0x00 is disabled.   | 1                            | 0~1                | -          | 0                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 73                          | 清空错误存储器<br>Clear error memory    | 发送 0x6C64 对所有的错误寄存器进行清零操作<br>Send 0x6C64 to clear all error registers  | 1                            | 仅 0x6C64           | —          | 1                    | 无限制<br>Unlimited                    | 立即生效<br>Effective immediately |
| 74                          | 硬件自检<br>Hardware self-test       | 发送 0x7465 进行硬件自检<br>Send 0x7465 for hardware self-test   | 1                            | 仅 0x7465           | —          | 1                    | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 75                          | 用户程序控制①<br>User program control① | 0x00: 禁止; 0x01: 使能; 0x02: 启动; 0x03: 停止（仅在一体化电机嵌入式软件中使用）<br>0x00: Disable; 0x01: Enable; 0x02: Start; 0x03: Stop (only used in integrated motor embedded software)  | 1                            | 0~0x03             | —          | 0x00                 | 参数设置允许<br>Parameter setting allowed | 立即生效<br>Effective immediately |
| 76                          | 用户程序状态①<br>User program status1① | 状态表示, 可读不可写（仅在一体化电机嵌入式软件中使用）。<br>State display, readable but not writable (only used in integrated motor embedded software).<br>位 8: 上电是否启动;<br>Bit 8: Whether to start after power-on;<br>位 4: 程序是否正在运行;<br>Bit 4: Whether the program is running;<br>位 0: 用户程序是否存在。<br>Bit 0: Whether the user program exists. | 1                            | 0~0x111            | —          | 0x000                | 无限制<br>Unlimited                    | 不生效<br>Failed                 |

| Modbus 地址<br>Modbus address | 名称<br>Name                                     | 描述<br>Description   | 寄存器数量<br>Number of registers | 数据范围<br>Data range | 单位<br>Unit | 默认值<br>Default value | 设置状态<br>Setting status | 生效方式<br>Effective mode |
|-----------------------------|--|---|------------------------------|--------------------|------------|----------------------|------------------------|------------------------|
| 77~7A                       | 保留 Keep  |   | 4                            |                    |            |                      |                        |                        |
| 7B                          | 电压电流模式切换<br>Voltage and current mode switching | 此寄存器仅适用于 86 一体化步进电机与 57 驱动模块<br>This register is only applicable to 86 integrated stepper motor and 57 drive module<br>0x00: 电压模式 0x01: 电流模式<br>0x00: voltage mode 0x01: current mode | 1                            | 0~0x1              | —          | 0x00                 | 无限制<br>Unlimited       | 再次通电<br>Power up again |

注：上表中参数“0x47 设置零点”、“0x48 设置原点”、“0x51 运动控制字”、“0x52 运动方向”、“0x53 位置模式下目标位置”和“0x55 速度模式下目标速度”修改后不可保存，每次重上电后均为默认值。

Note: The parameters "0x47 set zero", "0x48 set origin", "0x51 motion control word", "0x52 motion direction", "target position in 0x53 position mode" and "target speed in 0x55 speed mode" in the table above are modified It cannot be saved. It is the default value after each power-on.

## 输入寄存器列表 Input register list

表 7-2

| 地址<br>Address | 名称<br>Name                           | 描述<br>Description  | 寄存器数<br>量<br>Number<br>of<br>registers |
|---------------|--------------------------------------|--|--|
| 0             | 厂商名称<br>Trade Names                  |  | 2                                      |
| 2             | 产品序列号<br>Product Serial Number       |  | 2                                      |
| 4             | 硬件版本号<br>Hardware version number     |  | 2                                      |
| 6             | 保留 Keep                              |  | 2                                      |
| 8             | 保留 Keep                              |  | 2                                      |
| A             | 软件件版本号<br>Software version number    | 软件版本号<br>Software version number   | 2                                      |
| C             | 工作时间<br>operating hours              | 设备累积工作时间（单位：h）<br>Equipment cumulative working time (unit: h)  | 2                                      |
| E~14          | 保留 Keep                              |  | 8                                      |
| 16            | 驱动电路状态<br>Drive circuit status       | 驱动电路的内部状态<br>Internal state of the drive circuit   | 1                                      |
| 17            | 输入电压<br>Input voltage                | 单位：V<br>Unit: V  | 1                                      |
| 18            | 数字量输入<br>Digital input               | 共 4 字节，高 16 位表示 DI 输入的值，低 16 位表示 DI 特殊功能值即（正限位开关状态，负限位开关状态，原点开关状态）<br>There are 4 bytes in total. The upper 16 bits represent the value of the DI input, and the lower 16 bits represent the value of the special DI function (positive limit switch status, negative limit switch status, origin switch status) | 2                                      |
| 1A~1C         | 保留 Keep                              |  | 4                                      |
| 1E            | 当前的操作模式<br>Current operating mode    | 当前电机运行的运动模式<br>Current motor running sport mode  | 1                                      |
| 1F            | 运动状态字①<br>Motion status word<br>①    | 电机运行状态字<br>Motor running status word   | 1                                      |
| 20            | 当前运动方向<br>Current movement direction | 当前电机运行的方向<br>Current motor running direction   | 1                                      |
| 21            | 当前显示位置                               | 当前电机的位置（单位：pulse）<br>Current motor position (unit: pulse)  | 2                                      |

| 地址<br>Address | 名称<br>Name                                     | 描述<br>Description   | 寄存器数<br>量<br>Number<br>of<br>registers |
|---------------|--|---|--|
|               | Current display position                       |   |  |
| 23            | 当前运行的速度①<br>Current speed ①                    | 显示的值为当前电机运行的速度*10 (单位: Step/s)<br>The displayed value is the current running speed of the motor * 10 (unit: Step / s) | 2                                      |
| 25            | 出错误寄存器<br>Error register                       | 0   | 1                                      |
| 26            | 当前的错误报警值<br>Current false alarm value          | 0   | 1                                      |
| 27            | 错误存储器的报警个数<br>Number of alarms in error memory | 0   | 1                                      |
| 28            | 历史报警 1<br>History alarm 1                      | 0   | 1                                      |
| 29            | 历史报警 2<br>History alarm 2                      | 0   | 1                                      |
| 2A            | 历史报警 3<br>History alarm 3                      | 0   | 1                                      |
| 2B            | 历史报警 4<br>History alarm 4                      | 0   | 1                                      |
| 2C            | 历史报警 5<br>History alarm 5                      | 0   | 1                                      |
| 2D            | 历史报警 6<br>History alarm 6                      | 0   | 1                                      |
| 2E            | 历史报警 7<br>History alarm 7                      | 0   | 1                                      |
| 2F            | 历史报警 8<br>History alarm 8                      | 0   | 1                                      |

## 8 指令速查表 Instruction cheat sheet

表 8-1

| 项目 Project   |   | 指令 instruction   |
|--|---|--|
| 读参数 (保持寄存器)<br>Read parameters (holding registers) |   | 01 03 xx xx 00 0z (CRC 略) (CRC Skip)   |
| 读参数 (输入寄存器)<br>Read parameter (input register)     |   | 01 04 xx xx 00 0z (CRC 略) (CRC Skip)   |
| 写参数<br>Write parameters                            | 参数大小: 1 寄存器<br>Parameter size: 1 register | 01 06 xx xx yy yy (CRC 略) (CRC Skip)   |
| 写参数<br>Write parameters                            | 参数大小: 2 寄存器<br>Parameter size: 2 register | 01 10 xx xx 00 02 04 yy yy yy yy (CRC 略) (CRC Skip)  |
| 位置模式下相对运动<br>Relative motion in position mode      | 设置目标位置<br>Set destination                 | 01 10 00 53 00 02 04 yy yy yy yy (CRC 略) (CRC Skip)  |
|  | 设置运动方向<br>Set the direction of motion     | 01 06 00 52 00 00 或 01 06 00 52 00 01 (CRC 略) (CRC Skip)   |
|  | 电机启动<br>Motor start                       | 01 06 00 51 00 06 (CRC 略) (CRC Skip)<br>若电机已处于位置模式下, 该步可省<br>If the motor is already in position mode, this step can be saved                  |
|  | 切换到位置模式<br>Switch to position mode        | 01 06 00 39 00 01 (CRC 略) (CRC Skip)<br>若电机已处于位置模式下, 该步可省<br>If the motor is already in position mode, this step can be saved                  |
|  | 电机启动<br>Motor start                       | 01 06 00 51 00 06 (CRC 略) (CRC Skip)   |
|  | 电机使能<br>Motor enable                      | 01 06 00 51 00 07 (CRC 略) (CRC Skip)   |
|  | 发控制字 4F<br>Send control word 4F           | 01 06 00 51 00 4F (CRC 略) (CRC Skip)   |
|  | 发控制字 5F<br>Send control word 5F           | 01 06 00 51 00 5F (CRC 略) (CRC Skip)   |
|  | 继续运动<br>Keep moving                       | 修改目标位置和运动方向 (如果需要的话), 先后发控制字 4F、5F<br>Modify the target position and movement direction (if necessary), send control words 4F, 5F successively |
| 位置模式下绝对运动<br>Absolute motion in position mode      | 设置目标位置<br>Set destination                 | 01 10 00 53 00 02 04 yy yy yy yy (CRC 略) (CRC Skip)  |
|  | 电机启动<br>Motor start                       | 01 06 00 51 00 06 (CRC 略) (CRC Skip)<br>若电机已处于位置模式下, 该步可省<br>If the motor is already in position mode, this step can be saved                  |
|  | 切换到位置模式<br>Switch to position mode        | 01 06 00 39 00 01 (CRC 略)<br>若电机已处于位置模式下, 该步可省<br>If the motor is already in position mode, this step can be saved                             |

| 项目 Project                                  | 指令 instruction  |   |
|---|---|---|
|   | be saved  |   |
| 电机启动<br>Motor start                         | 01 06 00 51 00 06 (CRC 略) (CRC Skip)  |   |
| 电机使能<br>Motor enable                        | 01 06 00 51 00 07 (CRC 略) (CRC Skip)  |   |
| 发控制字 0F<br>Send control word 0F             | 01 06 00 51 00 0F (CRC 略) (CRC Skip)  |   |
| 发控制字 1F<br>Send control word 1F             | 01 06 00 51 00 1F (CRC 略) (CRC Skip)  |   |
| 继续运动<br>Keep moving                         | 修改目标位置 (如果需要的话), 先后发控制字 0F、1F<br>Modify the target position (if needed), send control words 0F, 1F successively |   |
| 速度模式下运动<br>Movement in speed mode           | 设置目标速度<br>Set target speed  | 01 10 00 55 00 02 04 yy yy yy yy (CRC 略)  |
|   | 设置运动方向<br>Set the direction of motion   | 01 06 00 52 00 00 或 01 06 00 52 00 01 (CRC 略)<br>(CRC Skip)   |
|   | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)<br>若电机已处于速度模式下, 该步可省<br>If the motor is already in speed mode, this step can be saved                |
|   | 切换到速度模式<br>Switch to speed mode   | 01 06 00 39 00 02 (CRC 略) (CRC Skip)<br>若电机已处于速度模式下, 该步可省<br>If the motor is already in speed mode, this step can be saved                |
|   | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)  |
|   | 电机使能<br>Motor enable  | 01 06 00 51 00 07 (CRC 略) (CRC Skip)  |
|   | 发控制字 0F<br>Send control word 0F   | 01 06 00 51 00 0F (CRC 略) (CRC Skip)  |
|   | 修改运行速度<br>Modify running speed  | 修改目标速度和运动方向 (如果需要的话), 发控制字 0F<br>Modify target speed and direction of motion (if needed), send control word 0F                            |
| 原点回归模式下运动<br>Movement in origin return mode | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)<br>若电机已处于原点回归模式下, 该步可省<br>If the motor is already in the origin return mode, this step can be saved. |
|   | 切换到速度模式<br>Switch to speed mode   | 01 06 00 39 00 02 (CRC 略) (CRC Skip)<br>若电机已处于原点回归模式下, 该步可省<br>If the motor is already in the origin return mode, this step can be saved. |
|   | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)  |
|   | 电机使能<br>Motor enable  | 01 06 00 51 00 07 (CRC 略) (CRC Skip)  |
|   | 发控制字 0F   | 01 06 00 51 00 0F (CRC 略) (CRC Skip)  |

| 项目 Project   | 指令 instruction  |  |
|--|---|--|
|  | Send control word 0F  |  |
|  | 发控制字 1F<br>Send control word 1F   | 01 06 00 51 00 1F (CRC 略) (CRC Skip)   |
| 电机运动状态切换<br>Motor motion state switching                                   | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)   |
|  | 电机使能<br>Motor enable  | 01 06 00 51 00 07 (CRC 略) (CRC Skip)   |
|  | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)   |
|  | 运行<br>run   | 01 06 00 51 00 0F (CRC 略) (CRC Skip)   |
|  | 电机使能<br>Motor enable  | 01 06 00 51 00 07 (CRC 略) (CRC Skip)<br>在运行状态下发送以上可停止<br>Sending above can be stopped in the running state   |
|  | 电机启动<br>Motor start   | 01 06 00 51 00 06 (CRC 略) (CRC Skip)<br>在运行状态下发送以上可停止<br>Sending above can be stopped in the running state   |
|  | 电机急停<br>Motor emergency stop  | 01 06 00 51 00 06 (CRC 略) 或 01 06 00 51 00 02 (CRC 略) (CRC Skip)<br>写控制字 02 进行急停后，在下次运动前，需先写控制字 06<br>After writing control word 02 for emergency stop, you need to write control word 06 before the next exercise |
| 恢复参数到制造商默认值<br>Restore the parameters to the manufacturer's default values | 01 06 00 0B 6C 64 (CRC 略)<br>01 06 00 0B 6C 64 (CRC is omitted)   |  |
| 恢复参数到用户自定义默认值<br>Restore parameters to user-defined default values         | 01 06 00 0B 64 6C (CRC 略)<br>01 06 00 0B 64 6C (CRC is omitted)   |  |
| 保存参数到制造商参数列表<br>Save parameters to manufacturer parameter list             | 01 06 00 08 73 76 (CRC 略)<br>01 06 00 08 73 76 (CRC is omitted)   |  |
| 保存参数到用户自定义参数列表<br>Save parameters to user-defined parameter list           | 01 06 00 08 76 73 (CRC 略)<br>01 06 00 08 76 73 (CRC is omitted)   |  |
| 清除设备故障状态<br>Clear equipment fault status                                   | 01 06 00 51 00 80 (CRC 略)<br>01 06 00 51 00 80 (CRC is omitted)<br>故障源已经清除后，发送该指令可解除设备故障状态<br>After the fault source has been cleared, send this command to clear the equipment fault state |  |

注：上表中“xx xx”表示参数地址；“00 0z”表示寄存器的数量；“yy yy yy yy”表示具体参数值。

Note: In the above table, "xx xx" indicates the parameter address; "00 0z" indicates the number of registers; "yy yy yy yy" indicates the specific parameter value.

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