EC88D

Ether CAT 总线数显混合伺服驱动器

使用手册

Ether CAT Digital Display Hybrid Servo Drive

User's Manual

用户手册/User's Manual

目录

前言/Foreword

感谢您使用本公司总线型混合伺服驱动器。

Thank you for using our hybrid servo drive.

在使用本产品前，请务必仔细阅读本手册，了解必要的安全信息、注意事项以及操作方法等。
错误的操作可能引发极其严重的后果。

Before using this product, please read this manual carefully to understand the necessary safety information, precautions, and operation methods.Incorrect operation can have extremely serious consequences.

本产品的设计和制造不具备保护人身安全免受机械系统威胁的能力，请用户在机械系统设计和制造过程中考虑安全防护措施，防止因不当的操作或产品异常造成事故。

This product is designed and manufactured without the ability to protect personal safety from mechanical system threats. Users are advised to consider safety precautions during mechanical system design and manufacturing to prevent accidents caused by improper operation or product abnormalities.

由于产品的改进，手册内容可能变更，恕不另行通知。用户对产品的任何改装我公司将不承担任何责任。
阅读时，请注意手册中的以下标示：

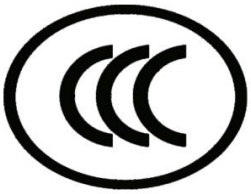
Due to product improvements, the contents of this manual are subject to change without notice. Our company will not be responsible for any modification of the product by the user.
When reading, please pay attention to the following signs in the manual:

注意：提醒您注意文字中的要点。

小心：表示错误的操作可能导致人身伤害和设备损坏。

本产品经过国家强制 3C 认证，CE 认证，ROHS 认证

This product has passed the national mandatory 3C certification, CE certification, ROHS certification



1 概述/Overview

1.1 产品介绍/Product Introduction

EC88D 是我公司十多年来新推出的 Ether CAT 总线型 LCD 屏显示的混合伺服驱动器，采用最新浮点 32 位 MCU 数字处理技术，驱动器控制算法采用先进的变电流技术和先进的变频技术，驱动器发热小，电机振动小，运行平稳。用户可以设置 1-255 内的任意 ID 地址以及额定电流内的任意电流值，电机匹配等，能够满足大多数场合的应用需要。该总线型驱动器可以驱动多种两相混合伺服电机，闭环步进电机等。由于采用内置微细分技术，平滑滤波技术，即使在低细分的条件下，也能够达到高细分的效果，低中高速运行都很平稳，噪音超小。驱动器内部集成了参数上电自动整定功能，能够针对不同电机自动生成最优运行参数，最大限度发挥电机的性能。

EC88D is a hybrid servo drive for Ether CAT bus LCD display that has been introduced by our company for more than ten years. It adopts the latest floating-point 32-bit MCU digital processing technology. The drive control algorithm uses advanced variable current technology and advanced frequency conversion technology. The heat is small, the motor vibration is small, and the operation is stable. The user can set any ID address within 1-255 and any current value within the rated current, motor matching, etc.

Can meet the needs of applications in most occasions. The bus driver can drive a variety of two-phase hybrid servo motors, closed-loop stepper motors, and more. Thanks to the built-in micro-segmentation technology and smoothing filtering technology, even in the case of low subdivision, high subdivision can be achieved, and the operation at low, medium and high speeds is smooth and the noise is extremely small. The parameter internal power-on auto-tuning function is integrated in the drive, which can automatically generate optimal operating parameters for different motors to maximize the performance of the motor.

1.2 特性/Characteristics

●全新浮点 32 位 MCU 技术
New Floating Point 32 Bit MCU Technology
●2 路模拟量 0-5V 输入
2-way analog input of 0-5V
●4 路光耦隔离 OC 输出
4-way optocoupler isolation OC output
●参数上电自动整定功能
Automatic parameter power-on setting function
●变电流控制使电机发热大为降低
Variable current control greatly reduces the heat generation of the motor.
●编码器线数 500-5000 线均可配置
The number of encoder lines can be configured from 500 to 5000.
●可驱动多种混合伺服电机，例如 28，42，57，60，86 等机座混合伺服（闭环步进）系列电机
Can drive a variety of hybrid servo motors, such as 28, 42, 57, 60, 86 and other frame hybrid servo (closed-loop stepping) series motors
●5 路光隔离信号输入，其中 2 路为高速光耦隔离
5-way optical isolation signal input, of which 2-way is high-speed optocoupler isolation
●通讯频率 100MHz
Communication frequency: 100MHz
●电流可在 0.5-8A 之间随负载变化而变换
The current can vary between 0.5 and 8A depending on the load
●出厂默认细分为 50000（可通过软件修改）
The factory is subdivided into 50000 by default (can be modified by software)

1.3 应用领域/Application areas

适合各种中小型自动化设备和仪器，例如：锂电设备、3C 电子设备、雕刻机、打标机、切割机、激光照排、雕刻机，绘图仪、数控机床、自动装配设备等。在用户期望小噪声、高速度的设备中应用效果特佳。

Suitable for all kinds of small and medium-sized automation equipment and instruments, such as: lithium battery equipment, 3C electronic equipment, engraving machine, marking machine, cutting machine, laser phototypesetting, engraving machine, plotter, CNC machine tool, automatic assembly equipment, etc. It is especially effective in applications where users expect small noise and high speed.

2 性能指标/Performance Index

2.1 EtherCAT 特性/EtherCAT characteristics

参数 Parameter		EC88D
EtherCAT 通信指标 Communication indicator	链路层 Link Layer	100BASE-TX 以太网 100BASE-TX Ethernet
	通信端口 Communication Port	RJ45 标准网口 RJ45 standard network interface
	网络拓扑 Network Topology	线型，树型，星型等 A line, tree, star, etc
	波特率 Baud rate	100Mbps 全双工通信 100 Mbps Full Duplex Communication
	同步管理器 Synchronization Manager	SM0：邮箱接收/SM0: Mailbox Receive
		SM1：邮箱发送/SM1: Mailbox Send
		SM2：过程数据输出 RPDO SM2: Process Data Output RPDO
		SM3：过程数据输入 TPDO SM3: Process Data Input TPDO
	通信模式 Communication Mode	SM 同步模式 SM synchronization mode
		DC 同步模式，同步周期 250us~4000us DC sync mode, sync cycle 250us ~ 4000us
	应用层协议 Application Layer Protocol	COE：CANopen Over EtherCAT
	Cia402 工作模式 Working Mode	循环同步位置模式（Cyclic Synchronous Position Mode） 循环同步速度模式（Cyclic Synchronous Velocity Mode） 位置模式（Profile Position Mode） 速度模式（Profile Velocity Mode） 回原点模式（Homing Mode）

2.2 电气特性/Electrical characteristics

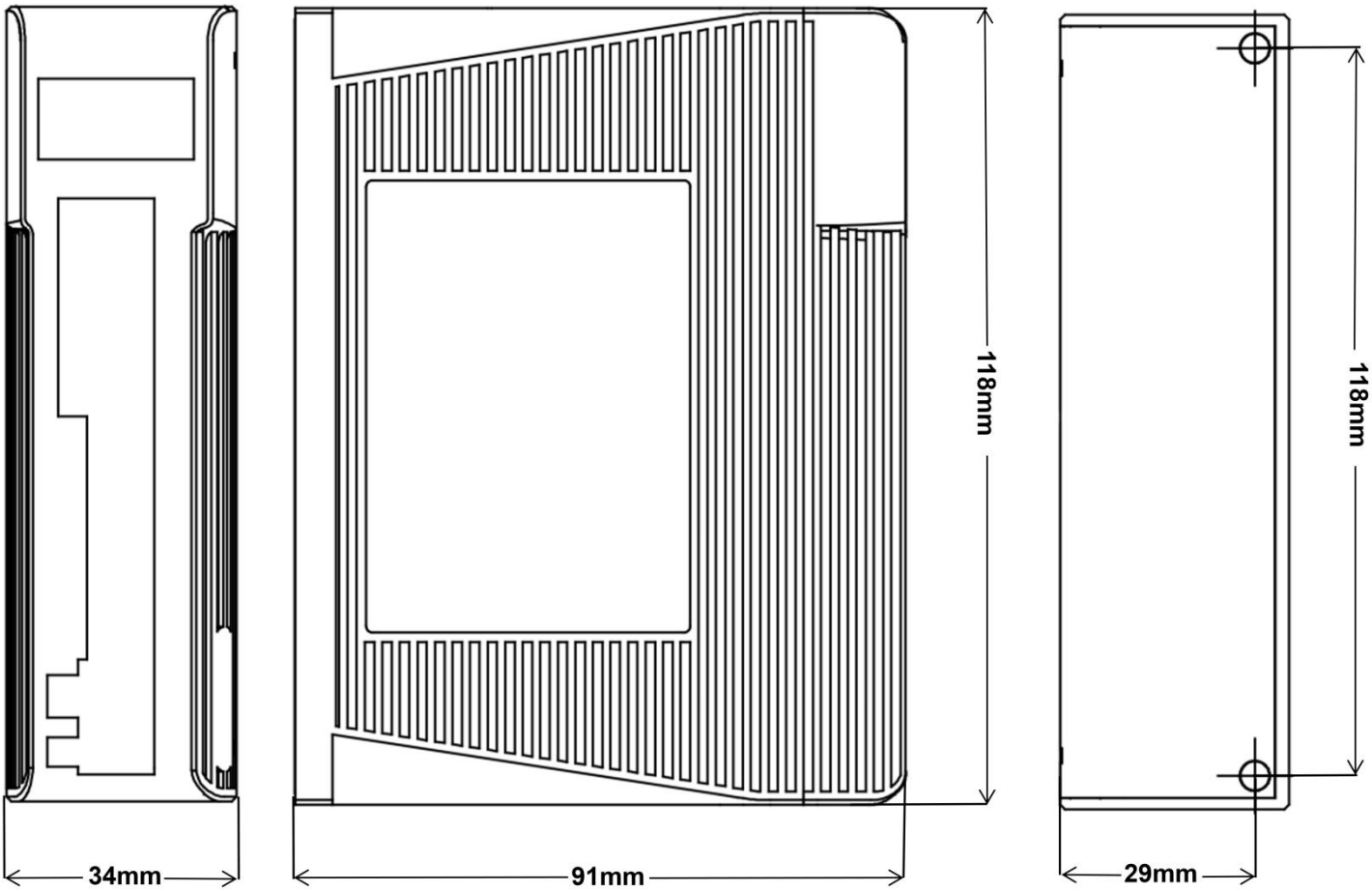
说明 Explanation	EC88D			
	最小值 Minimum Value	典型值 Typical Value	最大值 Maximal Value	单位 Unit
输出电流(峰值) Output current (peak)	0.5	-	8.0	A
输入电源电压（直流） Input Supply Voltage (DC)	20	24/36/48/60	80	VDC
控制信号输入电流 Control Signal Input Current	6	10	16	mA
控制信号接口电平 Control Signal Interface Level	4.5	5	24	Vdc
OC 输出上拉电压 OC output pull-up voltage	5	-	24	Vdc
Ether-CAT 通讯频率 Ether-CAT communication frequency	-	100	-	MHz
绝缘电阻 Insulation Resistance	100			MΩ

2.3 使用环境/Use environment

冷却方式 Cooling Mode		自然冷却或强制风冷 Natural Cooling or forced air cooling
使用环境 Service Environment	场合 Occasion	不能放在其它发热的设备旁，要避免粉尘、油雾、腐蚀性气体，湿度太大及强振动场所，禁止有可燃气体和导电灰尘； Can not be placed next to other heating equipment, to avoid dust, oil mist, corrosive gases, humidity is too large and strong vibration sites, prohibited combustible gases and conductive dust;
	温度 Temperature	-10℃ ～ +50℃
	湿度 Humidity	40 ～ 90%RH
	振动 Vibration	5.9m/s2MAX
保存温度 Storage temperature		-20℃～60℃
使用海拔 Use Elevation		1000 米以下 Below 1000 meters
重量 Weight		0.35KG

3 安装/Installation

3.1 安装尺寸/Mounting dimensions



※设计安装尺寸时，注意考虑端子大小及布线

※ Pay attention to considering and wiring terminal size

3.2 安装方法/Installation method

驱动器的可靠工作温度通常在 60℃以内，电机工作温度为 80℃以内；

The reliable operating temperature of the driver is usually within 60℃, and the motor operating temperature is within 80℃;

建议使用时选择自动半流方式，马达停止时电流自动减一半，以减少电机和驱动器的发热；

It is recommended to use the automatic semi-flow mode when using the motor. When the motor stops, the current is automatically reduced by half to reduce the heat of the motor and the drive;

安装驱动器时请采用竖着侧面安装，使散热齿形成较强的空气对流；

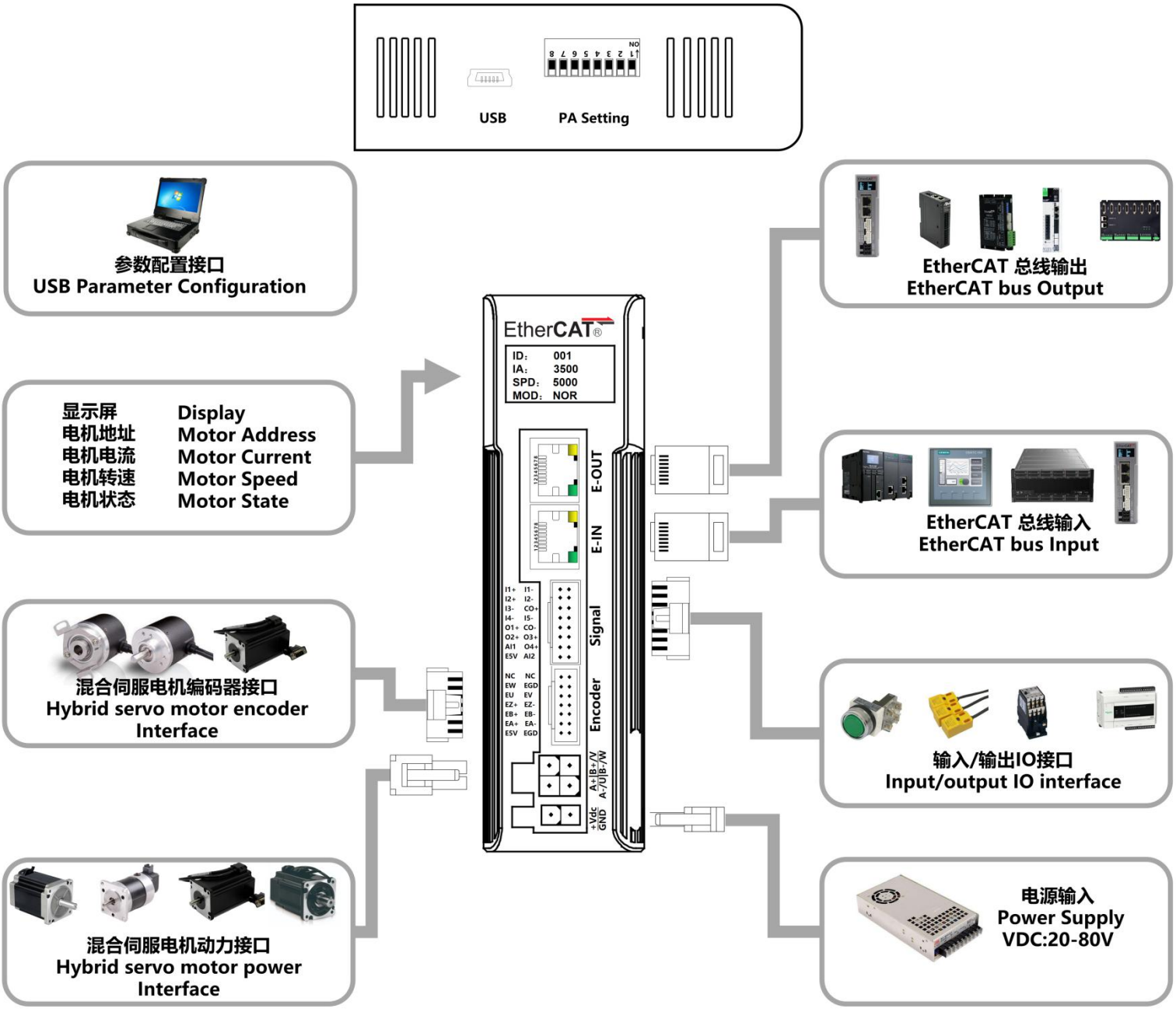
Install the drive with vertical side mounting so that the heat dissipating teeth form a strong air convection;

必要时机内靠近驱动器处安装风扇，强制散热，保证驱动器在可靠工作温度范围内工作；

Install a fan near the drive when necessary to force heat dissipation to ensure that the drive works within a reliable operating temperature range;

4 驱动器端口与接线/Driver ports and wiring

4.1 接线示意图/Schematic diagram of wiring



4.2 端口定义/Port Definition

4.2.1 状态指示界面/Status Indicator Interface

上电后 LCD 屏亮说明驱动器电源正常，当驱动器接通电源时，LCD 屏显示界面会显示公司相关信息，然后跳到正常界面，正常界面一般情况出厂会默认四行数据，如下：

After power-on, the LCD screen lights up to indicate that the drive power is normal. When the drive is powered on, the LCD screen display interface will display the company-related information, and then jump to the normal interface. The normal interface will default to four lines of data, as follows:

显示行号 Display Line Number	显示内容 Display Content	内容或单位 Content or unit	说明 Explanation
1	地址 address	ID 地址数 ID address number	当前驱动器的地址 Address of the current drive
2	电机机座 Motor size	TC42/TC57/TC60/TC86	闭环电机的机座号显示 Frame Number Display of Closed Loop Motor
3	实时速度 Real-time speed	RPM	每分钟多少转 How many revolutions per minute
4	算法模式 Algorithm mode	FOC/PM/LEAD/全电流 FOC/PM/LEAD/Ffull current	显示当前控制算法 Display the current control algorithm

备注：显示内容可以根据客户需求定制任何内容，在控制算法中，FOC 为矢量控制变电流算法，温升低，响应好，适用于丝杆传动结构，PM 为功率角算法，电流大，发热大，但刚性好，适用于皮带传动结构。

Remarks: Display content can be customized according to customer needs. In the control algorithm, FOC is vector control variable current algorithm, low temperature rise, good response, suitable for screw drive structure, PM is power angle algorithm, large current, large heat , but good rigidity, suitable for belt drive structure.

当驱动器出现故障时，LCD 屏会显示驱动器当前故障。

When the drive fails, the LCD screen will show the current fault of the drive.

当驱动器损坏时，LCD 屏可能不能亮或显示不正常。

When the drive is damaged, the LCD screen may not light or display abnormally.

4.2.2 拨码开关/Dial switch

A.闭环电机选择
Closed-loop motor size choose

Motor	SW1	SW2	Remark
【28】	on	on	当SW1/SW2设为off/off时，可通过软件设定匹配的电机 When SW1 SW2 as off/off, It can be set by software
【42】	off	on	
【57】【60】	on	off	
Default【86】	off	off	

B.开环/闭环电机选择
Open loop closed-loop motor choose

Motor	SW3
Open-loop	on
Closed-loop	off

C.驱动控制模式设定
Drive control mode setting

Drive control mode	SW4	Remark
FOC	off	Apply to screw
PM	on	Apply to belt

D.电机初始方向设置
Set the initial direction of motor

Direction	SW5	Remark
CCW	off	Counterclockwise
CW	on	Clockwise

E.滤波时间设置
Filtering time Settings

Filter Sel	SW6	SW7	Remark
Default【0ms】	on	on	当SW6/SW7设为on/on时，可通过软件设定滤波时间 When SW1 SW2 as off/off, It can be set by software
【2ms】	off	on	
【12ms】	on	off	
【25ms】	off	off	

F.地址功能设置
Address feature set

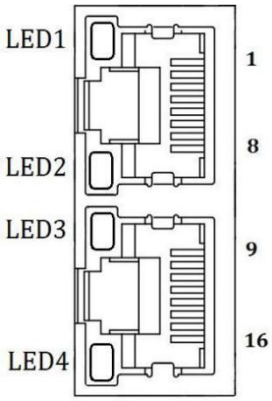
Address feature	SW8	Remark
YES	on	适配倍福/汇川/松下/基恩士/凌华/众为兴/正运动/研华/合信/信捷等主站，主站有自动扫描匹配地址功能，无需硬件实现设置地址的主站，拨码SW1-SW7的A-E功能描述有效 Apply to BECKHOFF/INOVANCE/PANASONIC/Keyence/adlink/ADTECH/ZMOTION/ADVANTECH/COTRUST/XINJE Etc. master station,master station automatic scan matching address function, without hardware implementation set the address of the host, Dial the code SW1-SW7 A-E function description effectively
NO	off	适配欧姆龙，翠欧等主站，这类主站需要通过硬件（比如拨码或上位机）来实现驱动器地址设置，那么拨码SW1-SW7的A-E功能描述无效，SW1-SW7将参考如下地址表设置 Apply to OMRON/TRIO Etc. master station, such as this kind of master station needs through hardware, (such as dial the code or PC) to implement the drive address Settings, then dial the code SW1-SW7 A-E functional description is invalid SW1 - SW7 will refer to the following ID table Settings

ID Table

ID	SW1	SW2	SW3	SW4	SW5	SW6	SW7	Remark
Reserved(Default)	on	on	on	on	on	on	on	通过拨码硬件设置，驱动器SW1-SW7的ID表格计算值计算公式为： ID=1*S1+2*S2+4*S3+8*S4+16*S5+32*S6+64*S7默认ID值为0，0表示广播地址，可以通过上位机或其它软件设置地址更高的地址。那么驱动器的相关参数，功能和性能通过上位机配置。 Through dial code hardware setup, drive SW1 - SW7 ID form value calculation formula is: ID=1*S1+2*S2+4*S3+8*S4+16*S5+32*S6+64*S7 Default ID value for the broadcast address 0, 0, can be set by PC or other software address higher.Then drive related parameters, the function and performance through the PC configuration.
1	off	on	on	on	on	on	on	
2	on	off	on	on	on	on	on	
3	off	off	on	on	on	on	on	
4	on	on	off	on	on	on	on	
5	off	on	off	on	on	on	on	
.....	.....	.....	.....	.....	.....	.....	.....	
126	on	off	off	off	off	off	off	
127	off	off	off	off	off	off	off	

4.2.3 EtherCAT 通讯端口/EtherCAT Communication Port

EtherCAT 总线接口端子
EtherCAT bus interface terminal

图示 Drawing	针脚号 Pin number	信号 Signal	功能 Features
	1，9	E_TX+	EtherCAT 数据发送正端 EtherCAT data transmission positive end
	2，10	E_TX-	EtherCAT 数据发送负端 EtherCAT data transmission negative end
	3，11	E_RX+	EtherCAT 数据接收正端 EtherCAT data reception front end
	4，12	NC	NC
	5，13	NC	NC
	6，14	E_RX-	EtherCAT 数据接收负端 EtherCAT data receiving negative end
	7，15	NC	NC
	8，16	NC	NC
	连接器外壳	PE	屏蔽接地 Shield ground

备注：EtherCAT 总线的线缆长度建议不超过 100 米，推荐使用带双层屏蔽的超五类百兆以太网线缆或者更好线缆。
Note: The cable length of the EtherCAT bus is recommended to be no more than 100 meters. It is recommended to use a super CAT.5 100M Ethernet cable with double shielding or better cable.

LED 灯状态
LED status

名称 Name	颜色 Color	状态 Status	描述 Description
LED1 LED3	绿色 Green	不亮 Not bright	物理层链路无建立 Physical layer link is not established
		常亮 Constantly bright	物理层链路建立 Physical layer link establishment
		快速闪 Fast flash	链路建立后交互数据 Interaction data after establishment
LED2 LED4	黄色 yellow	不亮 Not bright	物理层链路无建立 Physical layer link is not established
		常亮 Constantly bright	物理层链路建立 Physical layer link establishment
		快速闪 Fast flash	链路建立后交互数据 Interaction data after establishment

4.2.4 控制信号输入/输出端口/Control Signal Input/Output Port

输入/输出 IO 接口

Input/output IO interface

接口名称 Interface name	功能 Features
I1+	高速信号：脉冲上升沿有效；I1 高电平时 4.5～24Vdc，低电平时 0～0.5V。为了可靠响应脉冲信号，脉冲宽度应大于 1.5μs。 High speed signal: pulse rising edge is effective;I1 High level 4.5 ~ 24Vdc, low level 0 ~ 0.5V. In order to respond to the pulse signal reliably, the pulse width should be greater than 1.5 μs.
I1-	
I2+	高速信号：脉冲上升沿有效；I2 高电平时 4.5～28Vdc，低电平时 0～0.5V。为了可靠响应脉冲信号，脉冲宽度应大于 1.5μs。 High speed signal: pulse rising edge is effective;I2 High level 4.5 ~ 28Vdc, low level 0 ~ 0.5V. In order to respond to the pulse signal reliably, the pulse width should be greater than 1.5 μs.
I2-	
CO+	低速信号：I3，I4，I5 的共阳极输入，电平 5-28V 兼容 Low speed signal: common anode input for I3, I4, I5, level 5-28V compatible
I3-	低速信号 I3 的负极输入 Negative Input of Low Speed Signal I3
I4-	低速信号 I4 的负极输入 Negative Input of Low Speed Signal I4
I5-	低速信号 I5 的负极输入 Negative Input of Low Speed Signal I5
CO-	共阴极 OC 射极输出，O1+,O2+,O3+,O4+射极 OC 输出公共端 Common cathode OC emitter output, O1+, O2+, O3+, O4+ emitter OC output common end
O1+	O1+射极输出，最大上拉电压 24Vdc，上拉电阻 2KΩ，最大输出电流 100mA O1+ emitter output, maximum pull-up voltage 24Vdc, pull-up resistance 2KΩ, maximum output current 100mA
O2+	O2+射极输出，最大上拉电压 24Vdc，上拉电阻 2KΩ，最大输出电流 100mA O2+ emitter output, maximum pull-up voltage 24Vdc, pull-up resistance 2KΩ, maximum output current 100mA
O3+	O3+射极输出，最大上拉电压 24Vdc，上拉电阻 2KΩ，最大输出电流 100mA O3+ emitter output, maximum pull-up voltage 24Vdc, pull-up resistance 2KΩ, maximum output current 100mA
O4+	O4+射极输出，最大上拉电压 24Vdc，上拉电阻 2KΩ，最大输出电流 100mA O4+ emitter output, maximum pull-up voltage 24Vdc, pull-up resistance 2KΩ, maximum output current 100mA
AI1	IO 输入/输出口配置，可定义 0-5V 模拟量电压输入，需联系厂商 IO Input/Output Configuration, Define 0-5V Analog Voltage Input, Contact Vendor
AI2	IO 输入/输出口配置，可定义 0-5V 模拟量电压输入，需联系厂商 IO Input/Output Configuration, Define 0-5V Analog Voltage Input, Contact Vendor
E5V	提供电压 5V，电流 50mA Provide a voltage of 5V and a current of 50mA

4.2.5 编码器输入端口/CODEC INPUT PORT

低压伺服电机/直流无刷伺服电机/空心杯伺服和外转子伺服电机/编码器接口
Low voltage servo motor/Brushless dc servo motor/Hollow glass servo motor/Outer rotor servo moto/Encoder Interface

接口名称 Interface name	功能 Features
EA+	编码器 A 信号差分输入接口。 Encoder A signal differential input interface.
EA-	
EB+	编码器 B 信号差分输入接口。 Encoder B signal differential input interface.
EB-	
EZ+	编码器 Z 信号差分输入接口。带 Z 信号的才会用到，不带 Z 信号的编码器可以不用该接口。 Encoder Z signal differential input interface.Only those with Z signal can be used, and the encoder without Z signal can not use the interface.
EZ-	
EU	霍尔 U 信号单端输入，用于直流伺服电机，外转子伺服电机，空心杯伺服电机，无刷伺服电机，混合伺服不用。 Hall U signal single input, used for DC servo motor, outer rotor servo motor, hollow cup servo motor, brushless servo motor, hybrid servo motor.
EV	霍尔 V 信号单端输入，用于直流伺服电机，外转子伺服电机，空心杯伺服电机，无刷伺服电机，混合伺服不用。 Hall VU signal single input, used for DC servo motor, outer rotor servo motor, hollow cup servo motor, brushless servo motor, hybrid servo motor.
EW	霍尔 W 信号单端输入，用于直流伺服电机，外转子伺服电机，空心杯伺服电机，无刷伺服电机，混合伺服不用。 Hall W signal single input, used for DC servo motor, outer rotor servo motor, hollow cup servo motor, brushless servo motor, hybrid servo motor.
E5V	给电机的编码器和霍尔元件提供直流电压 5V，电流 100mA。 Provide a DC voltage of 5V and a current of 100mA to the encoder and Hall element of the motor.
Egnd	5V 参考端负极 5V reference terminal negative electrode
gnd	5V 参考端负极 5V reference terminal negative electrode
NC	预留本公司内部技术人员使用，不能外接任何其他电路，否则烧坏驱动器 Reserved for the use of the company's internal technical personnel, can not be external to any other circuit, otherwise burn out the driver.
NC	预留本公司内部技术人员使用，不能外接任何其他电路，否则烧坏驱动器 Reserved for the use of the company's internal technical personnel, can not be external to any other circuit, otherwise burn out the driver.

4.2.6 电源及电机输出端口/Output ports of power supply and motor

供电与电机动力接口

Power supply and motor power interface

接口名称 Interface name	功能 Features
GND	直流电源地 DC power supply negative electrode
+VDC	直流电源正极，供电电压范围：直流 20-80Vdc，推荐 24Vdc 或 48Vdc 工作。 DC power supply positive, supply voltage range: DC 20-80Vdc, recommended 24Vdc or 48Vdc operation.
A+	步进电机 A+相绕组接口，开环步进和混合伺服用到，直流伺服该接口不用 Stepping motor A + phase winding interface, open loop stepper and hybrid servo are used, DC servo is not used.
A-/U	步进电机 A-相绕组接口或直流伺服 U 相绕组接口 Stepping motor A-phase winding interface or DC servo U-phase winding interface
B+/V	步进电机 B+相绕组接口或直流伺服 V 相绕组接口 Stepping motor B + phase winding interface or DC servo V phase winding interface
B-/W	步进电机 B-相绕组接口或直流伺服 W 相绕组接口 Stepping motor B-phase winding interface or DC servo W-phase winding interface

电源电压在规定范围之间都可以正常工作，EC88D 驱动器最好采用非稳压型直流电源供电，也可以采用变压器降压＋桥式整流＋电容滤波。但注意应使整流后电压纹波峰值不超过其规定的最大电压。建议用户使用低于最大电压的直流电压供电，避免电网波动超过驱动器电压工作范围。

The power supply voltage can work normally between the specified ranges. The EC88D driver is preferably powered by an unregulated DC power supply, or a transformer buck + bridge rectifier + capacitor filter. Note, however, that the peak voltage ripple after rectification should not exceed its specified maximum voltage. It is recommended that the user supply power with a DC voltage lower than the maximum voltage to prevent the grid from fluctuating beyond the operating range of the driver voltage.

如果使用稳压型开关电源供电，应注意开关电源的输出电流范围需设成最大。

If using a regulated switching power supply, be aware that the output current range of the switching power supply must be set to maximum.

请注意：

Please note:

接线时要注意电源正负极切勿反接；

When wiring, pay attention to the positive and negative poles of the power supply, do not reverse connection;

最好用非稳压型电源；

It is better to use an unstable power supply;

采用非稳压电源时，电源电流输出能力应大于驱动器设定电流的 60%即可；

The output capacity of the power supply current should be greater than 60% of the set current of the driver when an unstable power supply is used;

采用稳压开关电源时，电源的输出电流应大于或等于驱动器的工作电流；

When a regulated switching power supply is adopted, the output current of the power supply shall be greater than or equal to the working current of the driver;

为降低成本， 两三个驱动器可共用一个电源，但应保证电源功率足够大。

To reduce costs, two or three drives can share a power supply, but the power supply should be large enough.

5 适配电机/Adaptive Motor

5.1 电机规格/Motor Specification

型号 Model	电机基座 NEMA	机身长度 length	扭矩 Torque	额定电流 Current	轴长 Shaft length	轴径 Shaft Diameter	匹配驱动 Match the Drives
TC28-02	28mm NEMA11	65mm	0.2Nm	1.8 A	21mm	5mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC42-04	42mm NEMA17	69mm	0.4Nm	2.3 A	24mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC42-08	42mm NEMA17	82mm	0.8Nm	2.3 A	24mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC57-10	57mm NEMA23	73mm	1.0Nm	5 A	21mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC57-28	57mm NEMA23	100mm	2.8Nm	5 A	21mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC57-28BK	57mm NEMA23	131mm	2.8Nm	5 A	21mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC60-40	60mm NEMA24	109mm	4.0Nm	5 A	21mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC60-40BK	60mm NEMA24	143mm	4.0Nm	5 A	21mm	8mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS506D/TS808C/TS608-B/TS508-D
TC86-45	86mm NEMA34	97mm	4.5Nm	6 A	40mm	14mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS808AHTS608-B/TS508-D
TC86-85	86mm NEMA34	133mm	8.5Nm	6 A	40mm	14mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS808AHTS608-B/TS508-D
TC86-120	86mm NEMA34	172mm	12Nm	6 A	40mm	14mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS808AHTS608-B/TS508-D
TC86-45BK	86mm NEMA34	138mm	4.5Nm	6 A	40mm	14mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS808AHTS608-B/TS508-D
TC86-85BK	86mm NEMA34	174mm	8.5Nm	6 A	40mm	14mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS808AHTS608-B/TS508-D
TC86-120BK	86mm NEMA34	213mm	12Nm	6 A	40mm	14mm	EC88D/XC88D/ESC57/RSC872/CSC808 TS808AHTS608-B/TS508-D

备注：混合伺服驱动器对混合伺服电机的相关参数匹配比较敏感，建议客户使用我司的混合伺服驱动器时，同时要求使用我司的混合伺服电机，如此才能保证电机的中高速性能，运行的平稳性，低振动和低发热。

Remark: The hybrid servo drive is sensitive to the matching of the relevant parameters of the hybrid servo motor. It is recommended that customers use our hybrid servo drive and also use our hybrid servo motor to ensure the high-speed performance and smooth running of the motor. Low vibration and low heat.

5.2 电机尺寸/Motor dimensions

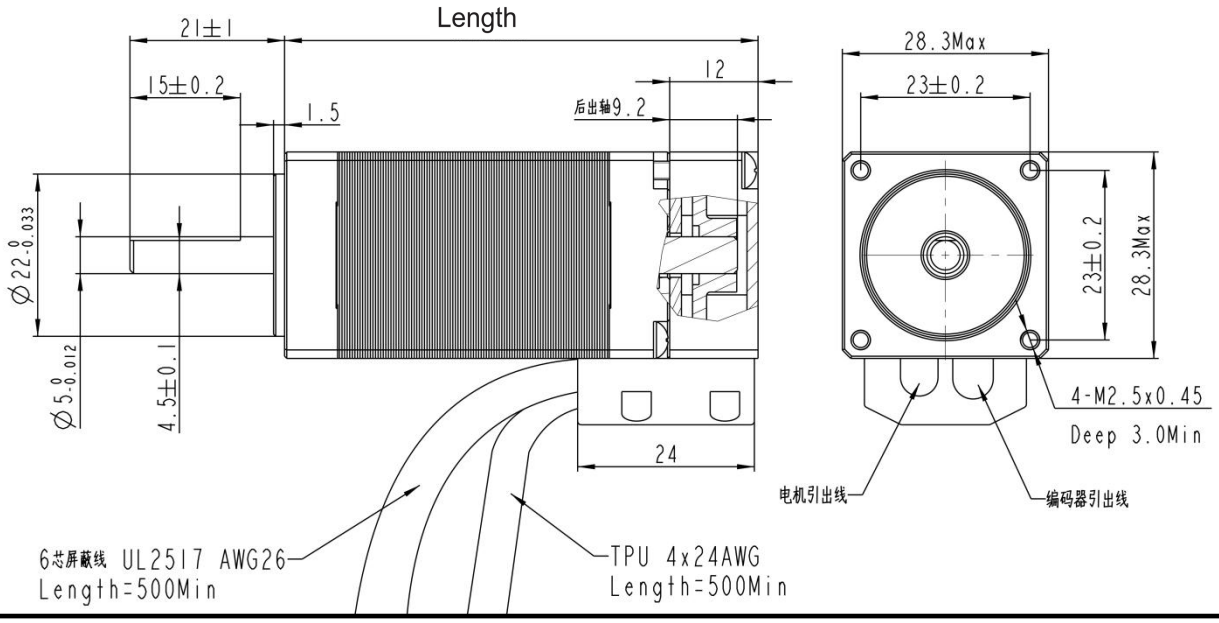
28 闭环电机

NEMA11 Closed-loop step motor

电机轴长/轴径/双输出轴等规格均可根据客户需求定制

Motor shaft length/diameter/double output shaft and other specifications

Can be customized according to customer's requirements



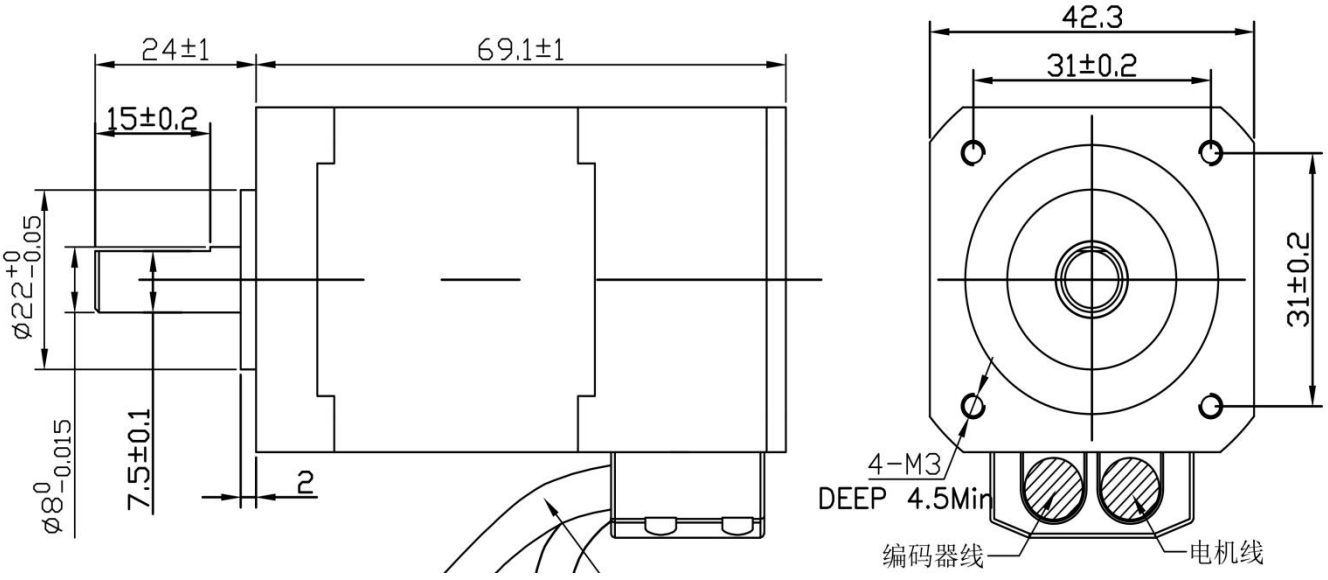
42 闭环电机

NEMA17 Closed-loop step motor

电机轴长/轴径/双输出轴等规格均可根据客户需求定制

Motor shaft length/diameter/double output shaft and other specifications

Can be customized according to customer's requirements



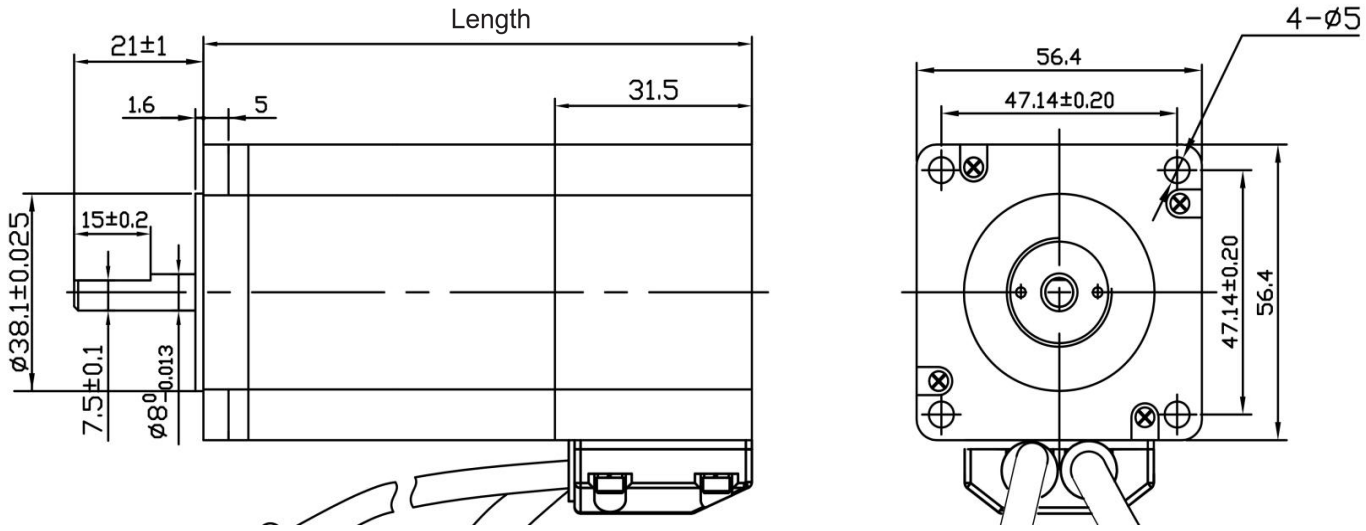
57 闭环电机

NEMA23 Closed-loop step motor

电机轴长/轴径/双输出轴等规格均可根据客户需求定制

Motor shaft length/diameter/double output shaft and other specifications

Can be customized according to customer's requirements



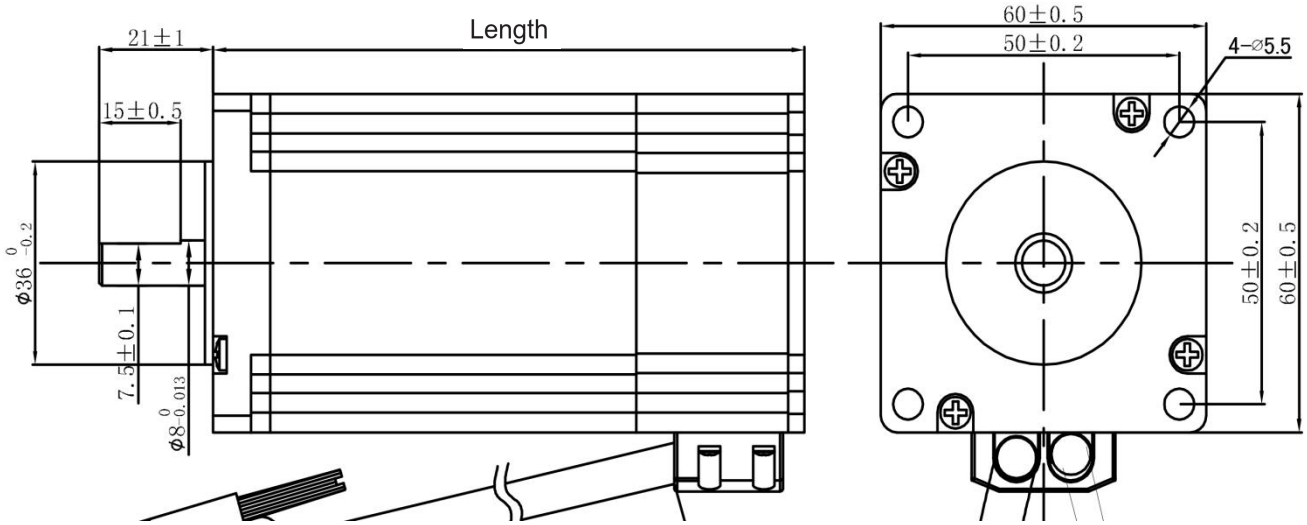
60 闭环电机

NEMA24 Closed-loop step motor

电机轴长/轴径/双输出轴等规格均可根据客户需求定制

Motor shaft length/diameter/double output shaft and other specifications

Can be customized according to customer's requirements



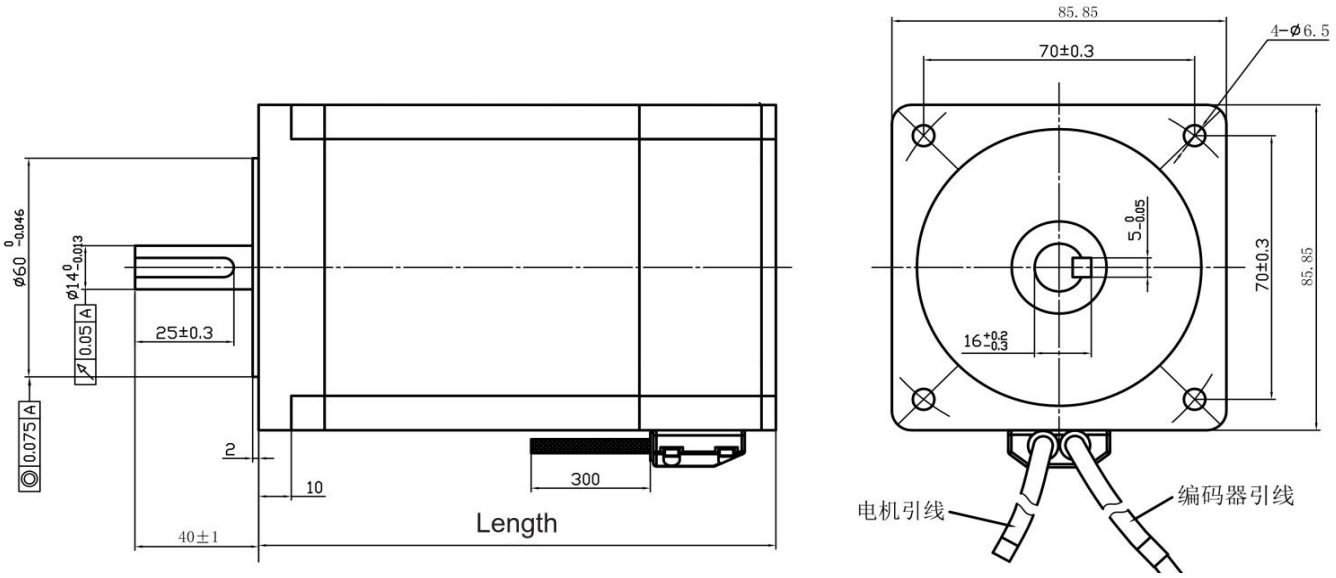
86 闭环电机

NEMA34 Closed-loop step motor

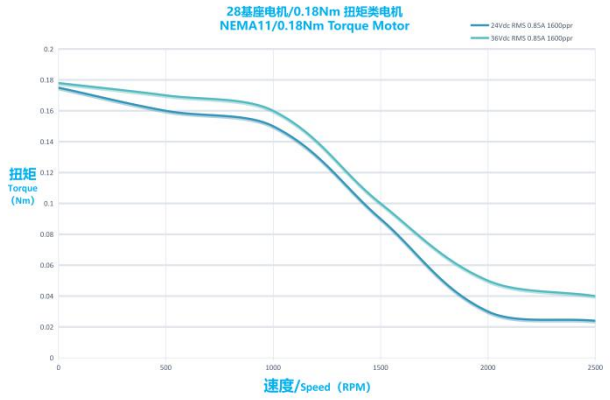
电机轴长/轴径/双输出轴等规格均可根据客户需求定制

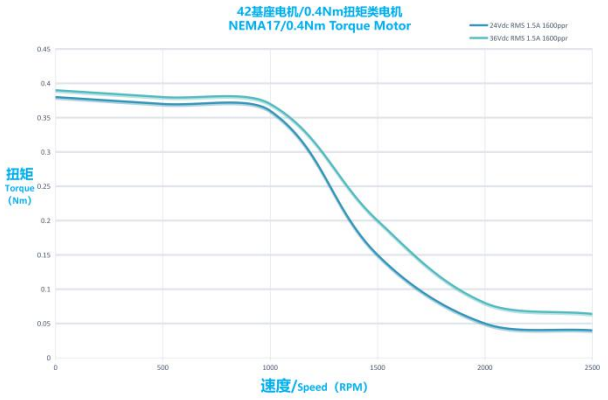
Motor shaft length/diameter/double output shaft and other specifications

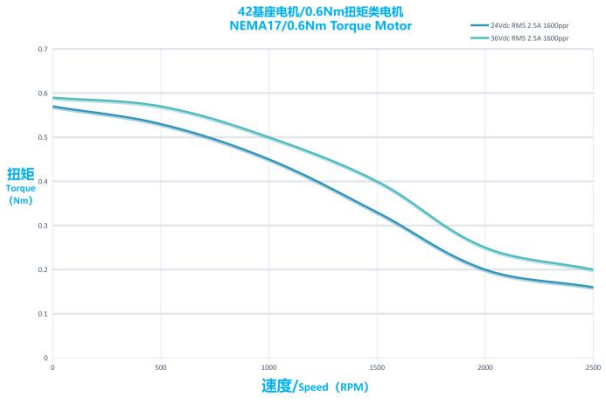
Can be customized according to customer's requirements

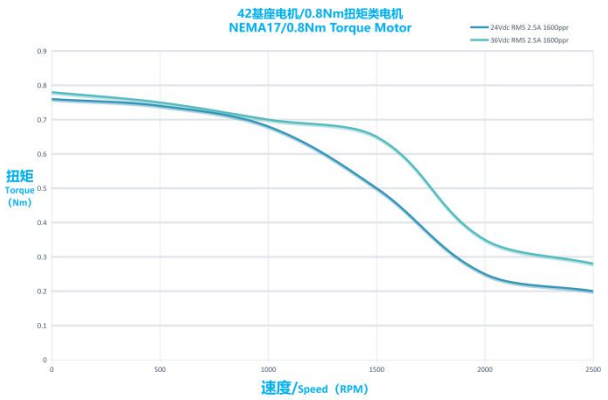


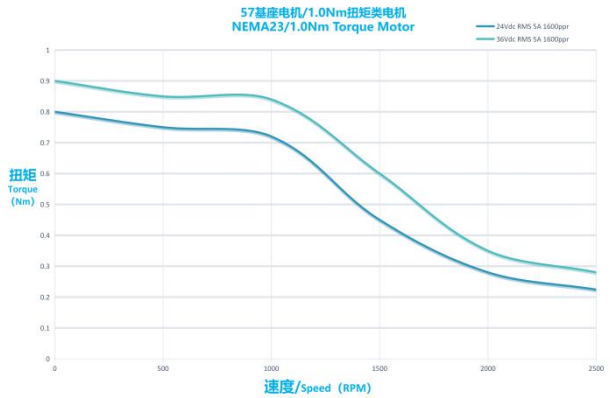
5.3 技术参数/Technical parameters

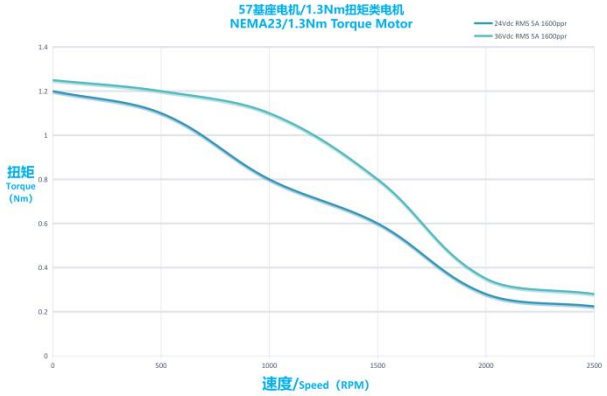


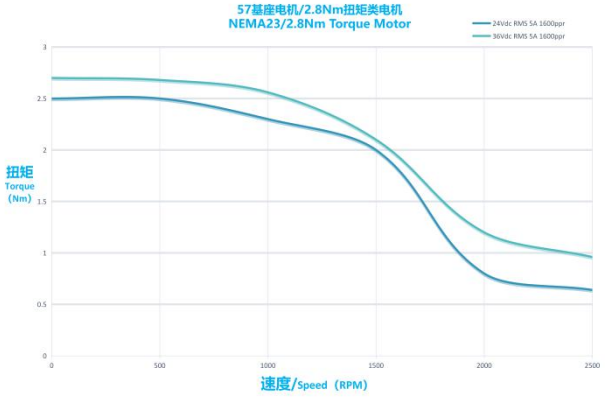


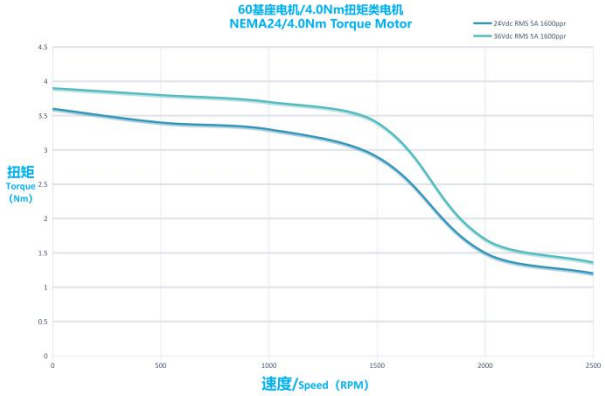


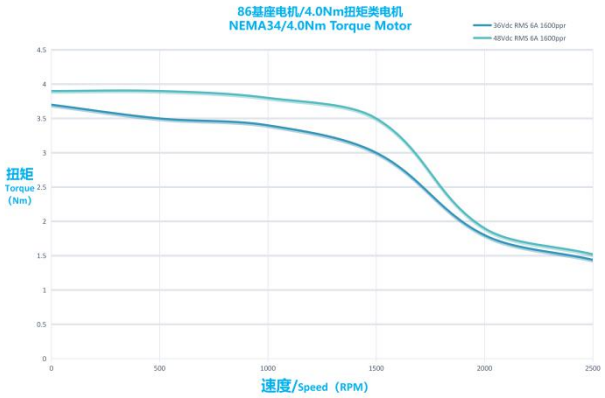


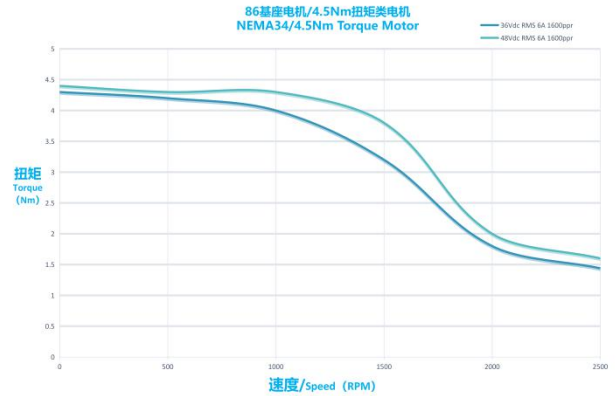

57基座电机/1.0Nm扭矩类电机
NEMA23/1.0Nm Torque Motor
24Vdc RMS 5A 1600ppr
36Vdc RMS 5A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）

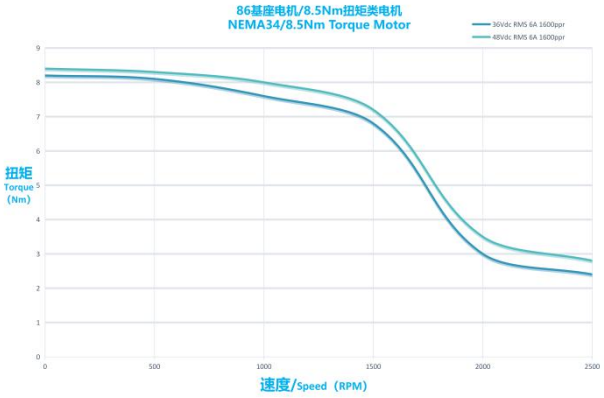

57基座电机/1.3Nm扭矩类电机
NEMA23/1.3Nm Torque Motor
24Vdc RMS 5A 1600ppr
36Vdc RMS 5A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）

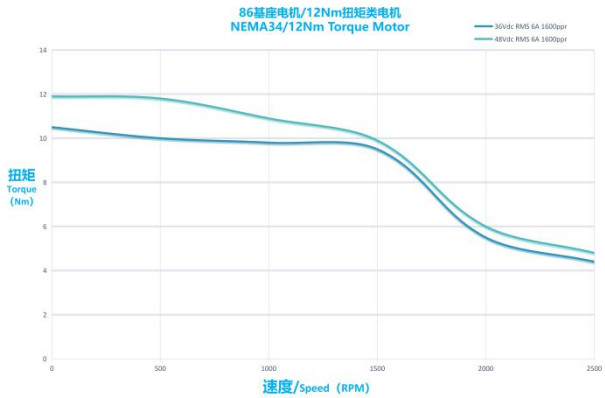

57基座电机/2.8Nm扭矩类电机
NEMA23/2.8Nm Torque Motor
24Vdc RMS 5A 1600ppr
36Vdc RMS 5A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）


60基座电机/4.0Nm扭矩类电机
NEMA24/4.0Nm Torque Motor
24Vdc RMS 5A 1600ppr
36Vdc RMS 5A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）


86基座电机/4.0Nm扭矩类电机
NEMA34/4.0Nm Torque Motor
36Vdc RMS 6A 1600ppr
48Vdc RMS 6A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）


86基座电机/4.5Nm扭矩类电机
NEMA34/4.5Nm Torque Motor
36Vdc RMS 6A 1600ppr
48Vdc RMS 6A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）

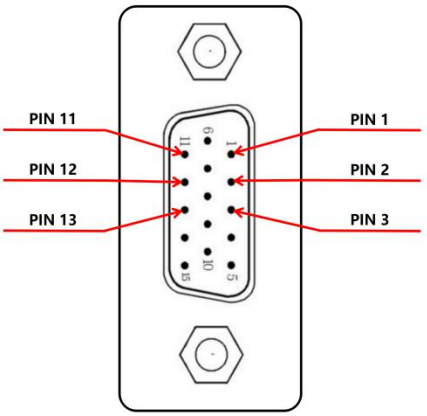

86基座电机/8.5Nm扭矩类电机
NEMA34/8.5Nm Torque Motor
36Vdc RMS 6A 1600ppr
48Vdc RMS 6A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）


86基座电机/12Nm扭矩类电机
NEMA34/12Nm Torque Motor
36Vdc RMS 6A 1600ppr
48Vdc RMS 6A 1600ppr
扭矩
Torque
(Nm)
速度/Speed（RPM）

5.4 编码器线规格（仅适用闭环电机）/Encoder line specification (closed loop motor only

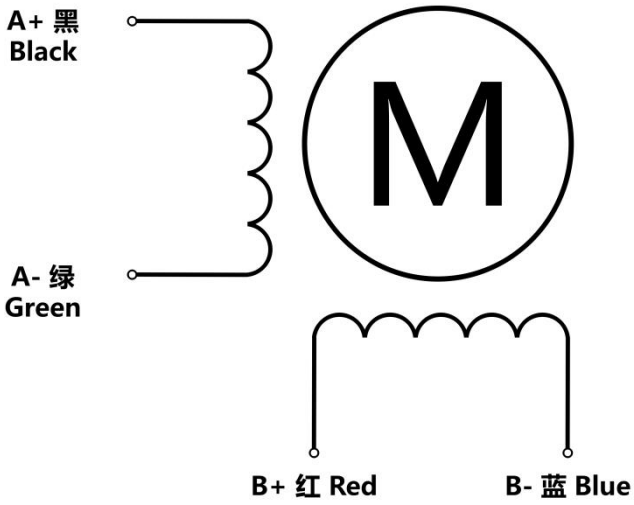
编码器线用于连接电机编码器和驱动器，下图为编码器线尺寸图，标配编码器线长度为 0.3m，另有 1m、2m、3m、5m、8m、10m、12m 等规格可选。我公司出品编码器延长线自带定义标签，无需分辨颜色。如需定制请联系我公司

The encoder cable is used to connect the motor encoder and driver. The figure below shows the encoder wire size drawing. The standard encoder wire length is 0.3m, and other specifications such as 1m, 2m, 3m, 5m, 8m, 10m, 12m are optional. . Our company's encoder extension cable comes with a defined label, no need to distinguish colors. If you need to customize, please contact our company.



PIN No.	定义 Define
PIN 1	EA+
PIN 2	VCC
PIN 3	GND
PIN 11	EB+
PIN 12	EB-
PIN 13	EA-

5.5 电机接线图/Motor wiring diagram



6 EtherCAT 总线/EtherCAT bus

EtherCAT 是德国倍福(Beckhoff)公司提出的基于开放式实时以太网的现场总线技术， 具有性能优异、拓扑结构灵活和系统配置简单等特点。同时，它还符合甚至降低了现场总线的使用成本。EtherCAT 的特点还包括高精度设备同步，可选线缆冗余，和功能性安全协议(SIL3)。EtherCAT 是一种完全开放的技术，目前它已经被纳入国际标准 IEC61158、IEC61784 以及 ISO15745-4。

EtherCAT is a fieldbus technology based on open real-time Ethernet proposed by Beckhoff in Germany. It features excellent performance, flexible topology and simple system configuration. At the same time, it also meets or even reduces the cost of using the fieldbus. EtherCAT also features high-precision device synchronization, optional cable redundancy, and a functional safety protocol (SIL3). EtherCAT is a completely open technology. It has been incorporated into the international standards IEC61158, IEC61784 and ISO15745-4.

6.1 EtherCAT 技术原理/Principle of EtherCAT Technology

传统的基于以太网的现场总线解决方案必须接收以太网数据包将其解码，之后再将过程数据复制到各个设备，这极大的损害了现场总线的实时能力。

Traditional Ethernet-based fieldbus solutions must receive Ethernet packets to decode them, and then copy the process data to each device, which greatly compromises the real-time capabilities of the fieldbus.

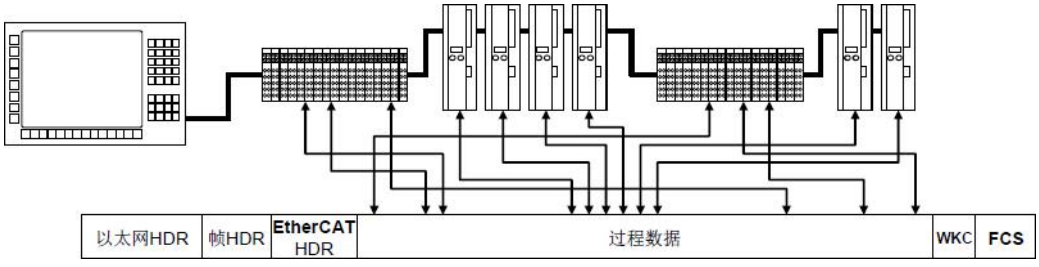
通过采用 EtherCAT 技术，Beckhoff 突破了其它以太网解决方案的这些系统限制： 不必再像从前那样在每个连接点接收以太网数据包，然后进行解码并复制过程数据。当帧通过每一个设备（直达 I/O 端子模块）时，EtherCAT 从站控制器读取与该设备相关的数据。同样，输入数据可以飞速插入至数据流中。帧被传递（仅被延迟几位）过去的时候，从站会识别出相关命令，并进行相应处理。此过程是在从站控制器中通过硬件实现的，因此与协议堆栈软件的 Run-Time 系统或处理器性能无关。网段中的最后一个 EtherCAT 从站将经过充分处理的报文发回，这样该报文就作为一种响应报文由第一个从站返回到主站。

By adopting EtherCAT technology, Beckhoff broke through these system limitations of other Ethernet solutions: Instead of receiving Ethernet packets at each connection point as before, then decoding and copying the process data. When a frame passes through each device (direct I/O terminal module), the EtherCAT Slave Controller reads the data associated with that device. Similarly, input data can be quickly inserted into the data stream.

When the frame is passed (only a few bits are delayed), the slave will recognize the relevant command and process it accordingly. This process is implemented in hardware in the slave controller and is therefore independent of the Run-Time system or processor performance of the protocol stack software. The last EtherCAT slave in the segment sends the fully processed message back so that the message is returned as a response message from the first slave to the master.

从以太网的角度看，EtherCAT 总线网段是一个可接收和发送以太网帧的大型以太网设备。但是，该“设备“不包含带下游微处理器的单个以太网控制器，而只包含大量的 EtherCAT 从站。与其它任何以太网设备一样，EtherCAT 不需要通过交换机就可以建立通讯，因而产生一个纯粹的 EtherCAT 系统。

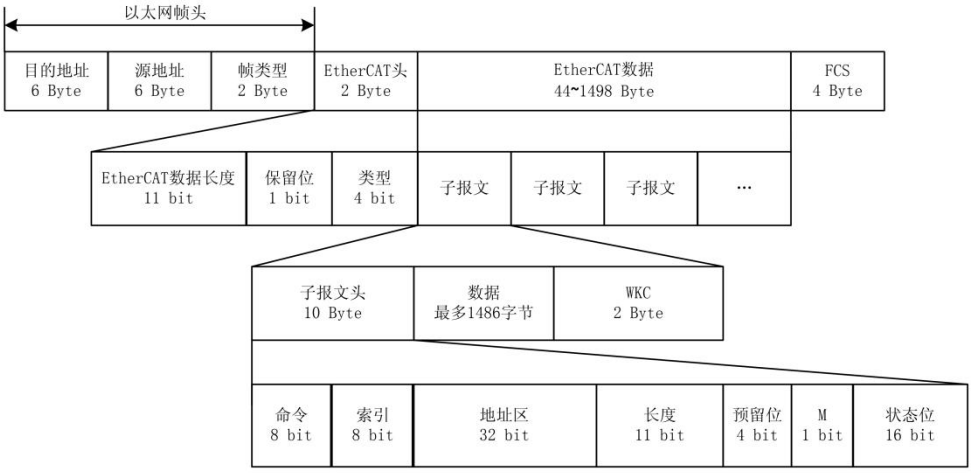
From an Ethernet perspective, the EtherCAT bus segment is a large Ethernet device that can receive and transmit Ethernet frames. However, the "device" does not include a single Ethernet controller with a downstream microprocessor, but only a large number of EtherCAT slaves. Like any other Ethernet device, EtherCAT does not require a switch to establish communication, resulting in a pure EtherCAT system.



6.2 EtherCAT 数据结构/EtherCAT data structure

EtherCAT 数据直接使用以太网数据帧传输，数据帧使用帧类型 0x88A4。EtherCAT 数据包括 2 个字节的数据头和 44~1498 字节的数据。数据区由一个或多个 EtherCAT 子报文组成，每个子报文对应独立的设备或从站存储区域，如下图所示。表中给出了 EtherCAT 数据帧结构定义。

EtherCAT data is transmitted directly using Ethernet data frames, which use the frame type 0x88A4. The EtherCAT data consists of a 2-byte header and 44 to 1498 bytes of data. The data area consists of one or more EtherCAT sub-messages, each of which corresponds to a separate device or slave storage area, as shown in the following figure. The EtherCAT data frame structure definition is given in the table.



名称 Name	说明 Description
目的地址 Destination Address	接收方 MAC 地址 Receiver MAC address
源地址 Source Address	发送方 MAC 地址 Sender MAC address
帧类型/Frame type	0x88A4
EtherCAT 头：长度 EtherCAT Head: Length	EtherCAT 数据区长度，即所有子报文长度总和 EtherCAT data area length, which is the sum of all sub-message lengths
EtherCAT 头：类型 EtherCAT Head: type	1：表示与从站通讯，其余保留 1: indicates communication with the slave, the rest remains
FCS (Frame Check Sequeuce)	帧校验序列/Frame check sequence

每个 EtherCAT 子报文包括子报文头、数据域和相应的工作计数器（WKC,Working Counter）记录了子报文被从站操作的次数，主站为每个通信服务子报文设置预期的 WKC。发送子报文中的工作计数器初值为 0，子报文被从站正确处理后，工作计数器的值将增加一个增量，主站比较返回子报文中的 WKC 和预期 WKC 来判断子报文是否被正确处理。WKC 由 ESC 在处理数据帧的同时进行处理，不同的通信服务对 WKC 的增加方式不同。

Each EtherCAT sub-message includes a sub-message header, a data field, and a corresponding work counter (WKC, Working Counter), which records the number of times the sub-message is operated by the slave station, and the primary station sets an expected value for each communication service sub-message. WKC. The initial value of the work counter in the transmitted sub-message is 0. After the sub-message is correctly processed by the slave, the value of the work counter is incremented by one increment. The master compares the WKC and the expected WKC in the sub-message to determine the sub-report. Whether the text is positive Do it. WKC is processed by the ESC while processing data frames, and different communication services are added differently to WKC.

6.3 EtherCAT 报文寻址/EtherCAT message addressing

EtherCAT 通信由主站发送 EtherCAT 数据帧读写从站设备的内部存储区来实现，

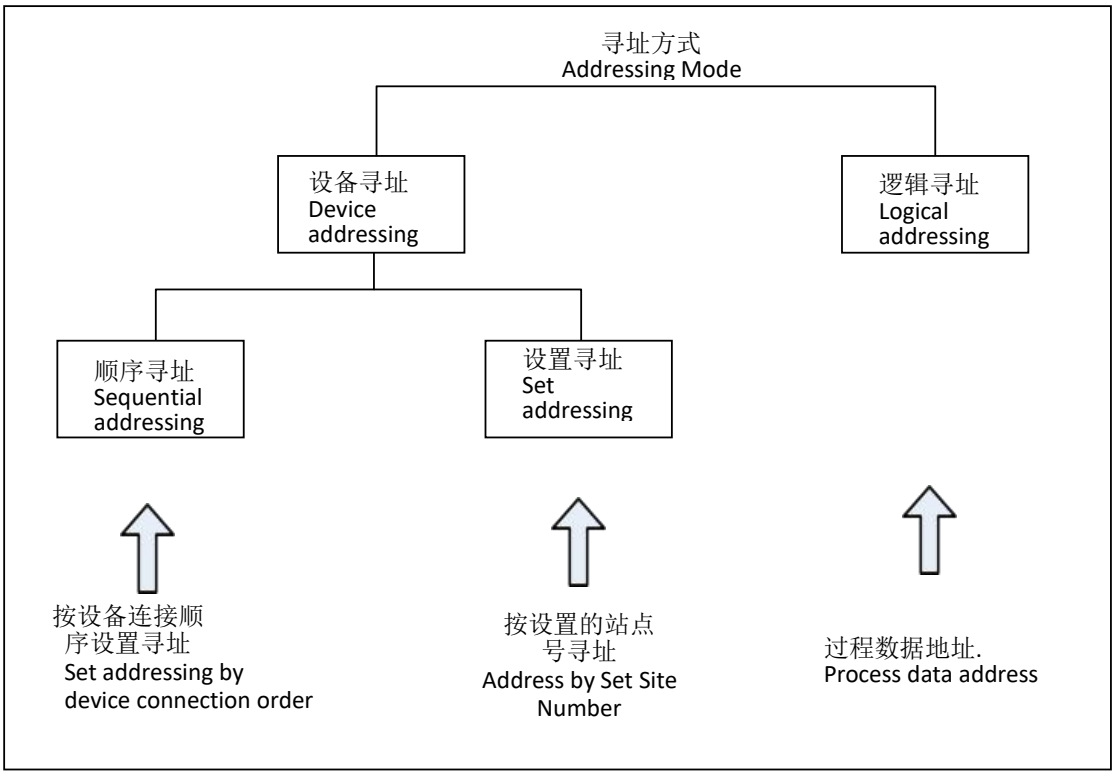
EtherCAT communication is implemented by the master station sending EtherCAT data frames to the internal memory of the slave device.

EtherCAT 报文使用多种寻址方式操作 ESC 内部存储区，实现多种通信服务。

EtherCAT messages operate in a variety of addressing modes to operate the ESC internal memory area for a variety of communication services.

EtherCAT 网段内可以使用两种寻址方式：设备寻址和逻辑寻址。设备寻址针对某一个从站进行读写操作。逻辑寻址面向过程数据，可以实现多播，同一个子报文可以读写多个从站设备。支持所有寻址模式的从站称为完整型从站，而只支持部分寻址模式的从站称为基本从站。

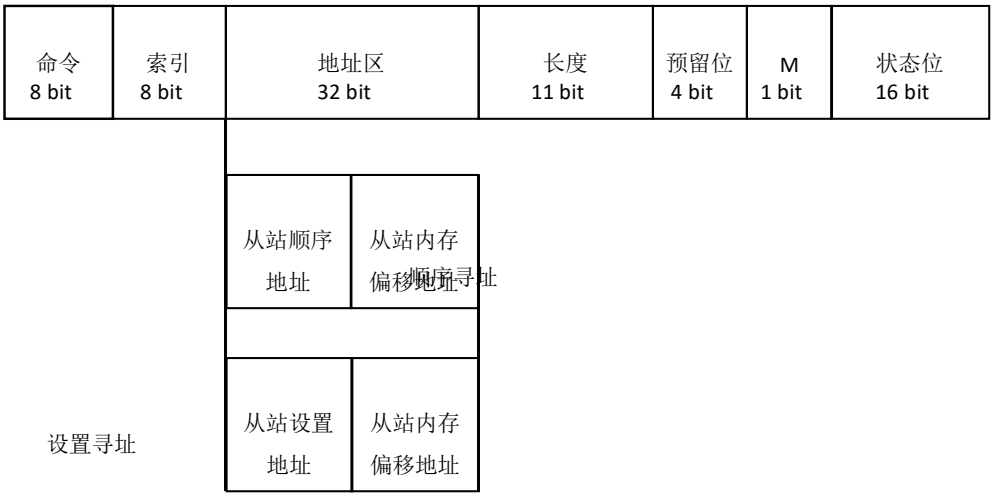
Two addressing modes are available within the EtherCAT segment: device addressing and logical addressing. Device addressing is performed for a single slave to read and write. Logical addressing is oriented to process data, which enables multicasting. The same sub-packet can read and write multiple slave devices. A slave that supports all addressing modes is called a full slave, while a slave that only supports partial addressing mode is called a basic slave.



6.3.1 设备寻址 /Equipment addressing

在设备寻址时，EtherCAT 子报文头内的 32 位地址分为 16 位从站设备地址和 16 位从站设备内部物理存储空间地址。16 位从站设备地址可以寻址 65535 个从站设备，每个设备内最多可以有 64K 字节的本地地址空间。

When addressing a device, the 32-bit address in the EtherCAT sub-header is divided into a 16-bit slave device address and a 16-bit slave device internal physical memory address. The 16-bit slave device address can address 65535 slave devices, each with up to 64K bytes of local address space.



EtherCAT 设备寻址结构

EtherCAT device addressing structure

设备寻址时，每个报文只寻址唯一的一个从站设备，但它有两种不同的设备寻址机制， 分别为顺序寻址和设置寻址。

When the device is addressed, each message is addressed to only one slave device, but it has two different device addressing mechanisms, sequential addressing and set addressing.

顺序寻址/Sequential addressing

顺序寻址时，从站的地址由其在网段内的连接位置确定，用一个负数来表示每个从站在网段内由接线顺序决定的位置。顺序寻址子报文在经过每个从站设备时，其位置地址加 1； 从站在接收报文时，顺序地址为 0 的报文就是寻址到自己的报文。由于这种机制在报文经过时更新设备地址，所以又被称为“自动增量寻址”。

In sequential addressing, the address of the slave is determined by its connection location within the network segment, with a negative number indicating the position determined by the wiring sequence for each slave station segment. When the sequential addressing sub-message passes through each slave device, its location address is incremented by one; when the slave station receives the message, the packet with the sequential address of 0 is addressed to its own message. Since this mechanism updates the device address as the message passes, it is also referred to as "automatic incremental addressing."

设置寻址/Set addressing

设置寻址时，从站的地址与其在网段内的连接顺序无关。地址可以由主站在数据链路启动阶段配置给从站，也可以由从站在上电初始化的时候从自身的配置数据存储区装载，然后由主站在链路启动阶段使用顺序寻址方式读取各个从站的设置地址，并在后续运行中使用。

When addressing is set, the address of the slave is independent of its connection order within the network segment. The address can be configured by the primary station to the secondary station during the data link startup phase, or can be loaded from its own configuration data storage area by the secondary station during power-up initialization, and then the primary station uses the sequential addressing mode during the link startup phase. Read the setup address of each slave and use it in subsequent runs.

6.3.2 逻辑寻址 /Logical addressing

逻辑寻址时，从站地址并不是单独定义的，而是使用寻址段内 4 GB 逻辑地址空间中的一段区域。报文内的 32 位地址区作为整体的数据逻辑地址完成设备的逻辑寻址。

For logical addressing, the slave address is not defined separately, but instead uses an area of the 4 GB logical address space within the addressed segment. The 32-bit address area in the message completes the logical addressing of the device as the overall logical address of the data.

EtherCAT 逻辑寻址结构/EtherCAT logical addressing structure

逻辑寻址方式由现场总线内存管理单元(FMMU，Fieldbus Memory Management Unit) 实现， FMMU 功能位于每一个 ESC 内部，将从站本地物理存储地址映射到网段内逻辑地址。

The logical addressing mode is implemented by the Fieldbus Memory Management Unit (FMMU). The FMMU function is located inside each ESC, and the local physical storage address of the slave is mapped to the logical address in the network segment.

6.4 EtherCAT 分布时钟 /EtherCAT distributed clock

分布时钟（DC，Distributed Clock），可以使所有 EtherCAT 设备使用相同的系统时间，从而控制各设备任务的同步执行。从站设备可以根据同步的系统时间产生同步信号，用于中断控制或触发数字量输入输出。支持分布武时钟的从站称为 DC 从站。分布时钟具有以下主要功能：

Distributed Clock (DC) allows all EtherCAT devices to use the same system time to control the synchronous execution of each device task.The slave device can generate a synchronization signal based on the synchronized system time for interrupt control or triggering the digital input and output.A slave station that supports distributed clocks is called a DC slave station.The distributed clock has the following main functions:

实现从站之间时钟同步/Realize clock synchronization between slave stations

为主站提供同步时钟/Provides a synchronous clock for the primary station

产生同步的输出信号/Generate a synchronized output signal

为输入事件产生精确的时间标记/Generate precise time stamps for input events

产生用户步的中断/Interrupt the user step

同步更新数字量输出/Synchronous update digital quantity output

同步采样数字量输入/Synchronously sampled digital input

6.5 EtherCAT 通信模式 /EtherCAT communication mode

在实际自动化控制系统中，应用程序之间通常有两种数据交换形式：时间关键（time critical）和非时间关键

（non-time critical）。时间关键表示特定的动作必须在确定的时间窗口内完成。如果不能在要求的时间窗口内完成通信，则有可能引起控制失效。时间关键的数据通常周期性发送，称为周期性过程数据通信。非时间关键数据可以非周期性发送，在 EtheCAT 中采用非周期性邮箱数据通信。

In a real automation control system, there are usually two forms of data exchange between applications: time critical and non time critical. Time critical means that a particular action must be completed within a certain time window. Failure to complete communication within the required time window may result in control failures. Time critical data is usually sent periodically, which is called periodic process data communication. Non-time critical data can be sent aperiodically, and aperiodic mailbox data communication is adopted in EtheCAT.

EtherCAT 协议中非周期性数据通信称为邮箱数据通信，它可以双向进行：主站到从站和从站到主站。它支持全双工、两个方向独立通信和多用户协议。邮箱通信数据头中包括一个地址域，使主站可以重寄邮箱数据。邮箱数据通信是实现参数交换的标准方式，如果需要配置周期性过程数据通信或需要其他非周期性服务时需要使用邮箱数据通信。通常邮箱通信只对应一个从站，所以报文中使用设备寻址模式。

Acyclic data communication in the EtherCAT protocol is called mailbox data communication, which can be done in both directions: from master to slave and from master to master. It supports full-duplex, two-way independent communication and multi-user protocols. The mailbox communication header includes an address field that allows the primary station to resend mailbox data. Mailbox data communication is a standard way to implement parameter exchange. If you need to configure periodic process data communication or need other non-cyclical services, you need to use mailbox data communication.

Usually mailbox communication only corresponds to one slave, so the device addressing mode is used in the message.

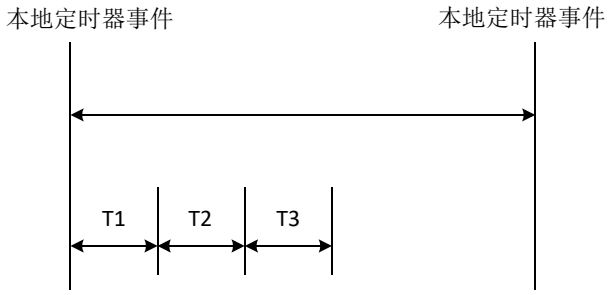
周期性过程数据通信通常使用 FMMU 进行逻辑寻址，主站可以使用逻辑读、写或读、写命令同时操作多个从站。在周期性数据通信模式下，主站和从站有多种同步运行模式。

Periodic Process Data communication is typically logically addressed using the FMMU, which can simultaneously operate multiple slaves using logical read, write, or read and write commands. In the cyclic data communication mode, the master station and the slave station have multiple synchronous operation modes.

6.5.1 Free Run 模式 /Free Run Mode

在自由运行模式下，本地控制周期由一个本地定时器中断产生。周期时间可以由主站设定，这是从站的可选功能。自由运行模式的本地周期如下图所示。其中 T1 为本地微处理器从 ESC 复制数据并计算输出数据的时间；T2 为输出硬件延时；T3 为输入锁存偏移时间。这些参数反映了从站的时间性能。

In free-running mode, the local control cycle is generated by a local timer interrupt. Cycle time can be set by the master station, which is an optional feature of the slave station. The local cycles of the free-running mode are shown in the following figure. Wherein T1 is a time for the local microprocessor to copy data from the ESC and calculate output data; T2 is output hardware delay; T3 is the input latch offset time. These parameters reflect the time performance of the slave station.

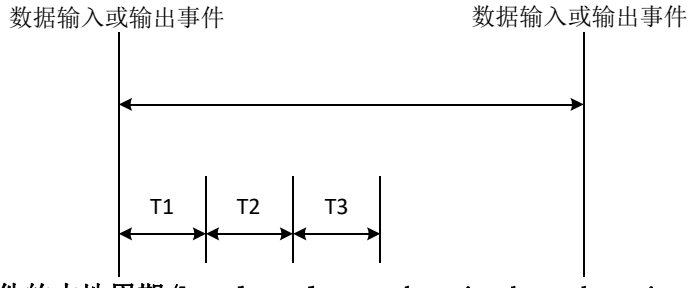


Free Run 模式的本地周期/Local cycle of Free Run mode

6.5.2 SM2/3 模式 /SM2/3 mode

本地周期在发生数据输入或输出事件的时候触发，如下图所示。主站可以将过程数据帧的发送周期写给从站，从站可以检查是否支持这个周期时间或对周期时间进行本地优化。从站可以选择支持这个功能。通常同步于数据输出事件，如果从站只有输入数据，则同步于数据输入事件。

The local cycle is triggered when a data input or output event occurs, as shown in the following figure. The master station can write the transmission cycle of the process data frame to the slave station, and the slave station can check whether the cycle time is supported or the cycle time is locally optimized. The slave can choose to support this feature. Usually synchronized to the data output event, if the slave only has input data, it is synchronized to the data input event.



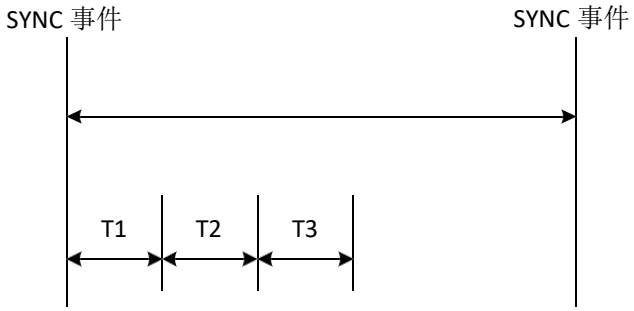
同步于数据输入或输出事件的本地周期/Local cycle synchronized to data input or output events

6.5.3 DC 模式 /DC mode

本地周期由 SYNC 事件触发，如下图所示。主站必须在 SYNC 事件之前完成数据帧的发送。此时要求主站时钟也要同步于参考时钟。该模式即为高精度的时间同步模式，在该模式下，系统会将第一个有 DC 时钟的从站时间作为系统时间，然后再用这个系统时间来作为所有设备的参考时间（加上传输延时，抖动等等时间误差）来生成 SYNC0 或者 SYNC1 同步信号。该模式要求主站有很强的实时性能。

The local period is triggered by the SYNC event as shown in the following figure. The primary station must complete the transmission of the data frame before the SYNC event. At this point, the master clock is also required to be synchronized to the reference clock. This mode is a high-precision time synchronization mode, in which the system uses the first slave time with a DC clock as the system time, and then uses this system time as the reference time for all devices (plus transmission). Delay,

Jitter and other time errors) to generate a SYNC0 or SYNC1 sync signal. This mode requires the host to have strong real-time performance.



同步于 SYNC 事件的本地周期/Synchronize to the local cycle of the SYNC event

6.6 EtherCAT 状态机 /EtherCAT state machine

EtherCAT 应用关系协议状态机（ESM）用于在启动和工作期间协调主站和从站，其状态的改变主要由主站和从站间的交互所导致。

The EtherCAT Application Relational Protocol State Machine (ESM) is used to coordinate master and slave during startup and operation, and its state change is primarily caused by the interaction between the master and the slave.

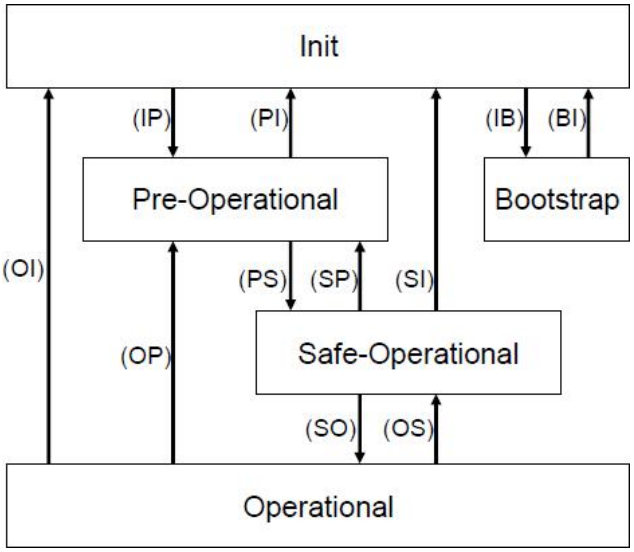
ESM 定义了 5 种状态：

ESM defines five states:

名称 Name	说明 Description
Init	初始化状态，在应用层（COE）上主站与从站无直接通讯； In the initialization state, there is no direct communication between the master station and the slave station on the application layer (COE); 如果从站支持邮箱，该状态下，与邮箱相关的同步管理器被配置； If the slave station supports mailboxes, the synchronization manager associated with the mailbox is configure in this state;
Pre-Operational	预操作状态，如果从站支持邮箱，此状态下服务数据通信（SDO）被使 能，并完成进一步初始化和参数配置，PDO 不可用； In the pre-operation state, if the slave station supports mailboxes, service data communication (SDO) is enable in this state, and further initialization and parameter configuration is completed, PDO is not available;
Safe- Operational	安全操作状态，输入过程数据通信（TPDO）被使能，此时输入缓存区 已被配置； A secure operation state in which input process data communication (TPDO) is enabled when the input cache has bee configured;
Operational	操作状态，输出过程数据通信（RPDO）被使能，此时输出缓存区已被 配置； In the operation state, the output process data communication (RPDO) is enabled, at which time the output cach is configured;
Bootstrap	引导状态，可接受 FOE 协议下载永久性设置，多用于设备固件更新； Boot status, can accept FOE protocol download permanent settings, mostly for device firmware updates;

各状态之间的切换如下示意图所示：.

The switching between states is shown in the following diagram:



6.7 应用层协议/COE Application Layer Protocol COE

CANopen 最初是为基于 CAN 总线的系统所制定的应用层协议。EtherCAT 协议在应用层支持 CANopen 协议，并作了相应的扩充，其主要功能有：

CANopen was originally developed as an application layer protocol for systems based on the CAN bus. The EtherCAT Protocol supports CANopen protocol in the application layer, and has been extended correspondingly.

使用邮箱通信访问 CANopen 对象字典及其对象，实现网络初始化；

Using mailbox communication to access CANopen object dictionary and its objects to realize network initialization;

使用 CANopen 应急对象和可边的事件驱动 PDO 消息，实现网络管理；

The network management is realized by using CANopen emergency object and editable event-driven PDO message;

使用对象字典映射过程数据，周期性传输指令数据和状态数据；

Using object dictionary to map process data, periodically transmitting instruction data and state data;

6.7.1 COE 对象字典/COE Object Dictionary

CoE 协议完全遵从 CANopen 协议，其对象字典的定义也相同。第 8 节对象字典列表列出了 COE 所有通信数据对象，其中针对 EtherCAT 通信扩展了相关通信对象 0x1C00~0x1C4F，用于设置存储同步管理器的类型、通信参数和 PDO 数据分配。

The CoE protocol is fully compliant with the CANopen protocol and its object dictionary definition is the same. Section 8 Object Dictionary List lists all COE communication data objects. The related communication objects 0x1C00~0x1C4F are extended for EtherCAT communication to set the type of storage synchronization manager, communication parameters and PDO data allocation.

6.7.2 服务数据对象（SDO)/Service Data Objects (SDO)

SDO 报文主要用来访问设备的对象字典，对 CANopen 网络中的设备进行配置。SDO 通信方式基于客户机/服务器（Client/Server）模型，即发送的报文必须得到接收者的确认。访问者被称为客户机（Client），对象字典被访问并对读写请求进行响应的设备称为服务器（Server）。协议中规定，读取对象字典的值称为上传（Upload），而修改参数的值则称为下载（Download）。

The SDO message is mainly used to access the device's object dictionary and configure the devices in the CANopen network. The SDO communication method is based on the client/server model, that is, the transmitted message must be confirmed by the receiver. A visitor is called a client, and a device whose object dictionary is accessed and responds to read and write requests is called a server.The protocol stipulates that the value of the read object dictionary is called Upload, and the value of the modified parameter is called Download.

6.7.3 过程数据对象（PDO)/Process Data Objects (PDO)

SDO 协议用于对对象字典的操作，处理实时性不高的数据，对实时性要求较高的数据通常通过 PDO 传输。

PDO 通信方式基于生产者/消费者(Producer/Consumer)模型,数据从一个设备(生产者)那里发送到另一个设备(消费者)或许多其它设备(广播方式)，并且是无确认模式的传输， 数据传送被限制在 1 到 8 个字节。CANopen 设备通过描述 PDO 的两种参数：通讯参数（Communication Parameter）和映射参数（Mapping Parameter）完成接收或发送。

SDO protocol is used for the operation of object dictionary, processing real-time data is not high, real-time data is usually transmitted through PDO. PDO communication is based on the Producer/Consumer model, where data is sent from one device (producer) to another device (consumer) or many other devices (broadcast), and is transmitted without acknowledgment mode, with data transmission limited to 1 to 8 bytes. The CANopen device receives or transmits PDO by describing two parameters of PDO: Communication Parameter and Mapping Parameter.

7 驱动器控制协议 CiA 402 /Driver Control Protocol CiA 402

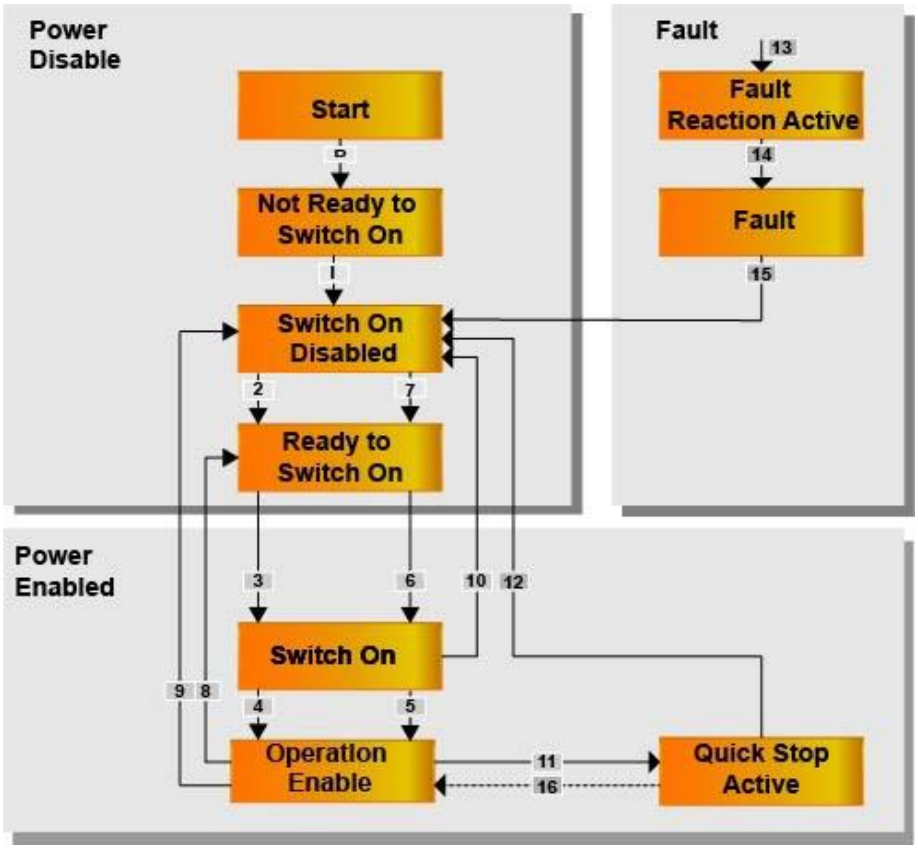
7.1 CIA402 状态机 /CIA402 state machine

CiA402 协议中定义了运动控制设备的标准状态机，同时还定义了各种运行模式，以及它们在对象字典中的定义。

标准状态机（State machine）描述了设备的状态和驱动可能的控制序列。每一步状态表示了一个特定的内部或者外部行为，设备的状态也决定了哪些命令可以被接收。

The standard state machine for motion control devices is defined in the CiA402 protocol. Various modes of operation and their definitions in the object dictionary are also defined.

The standard state machine describes the state of the device and the possible control sequence of the drive. Each step state represents a specific internal or external behavior, and the state of the device determines which commands can be received.



驱动器状态机/Drive state machine

状态机各状态对应说明如下表：
The status of each state machine is described in the following table:

状态名 State name	说明 Description
Not Ready to Switch on	设备电源已接通，驱动器已经初始化，并执行内部自检，制动器也被激活。 The device has been powered up, the driver has been initialized, an internal self-test has been performed, and the brakes have been activated.
Switch on Disabled	CANopen 通信已开始，可以利用 SDO 通信服务对驱动器进行参数设置。 CANopen communication has started, and the SDO communication service can be used to set the parameters of the drive.
Ready to Switch on	驱动器继续进行参数设置，电机没有被励磁。 The drive continues with the parameter setting and the motor is not excited.
Switched on	驱动器电机准备好状态，输出级电压将在该状态中最后接通，但不能执行驱动功能。 The drive motor is ready for the state in which the output stage voltage is finally turned on, but cannot perform the drive function.
Operation Enable	驱动器电机使能，驱动器正常运行状态，按照控制模式控制电机。 The driver motor is enabled, the driver is in normal operation, and the motor is controlled according to the control mode.
Quick Stop Active	快速停止功能被激活，驱动功能已启动，同时启动了电机。 The quick stop function is activated, the drive function is started, and the motor is started.
Fault Reaction Active	驱动器检测到报警发生，按照设定方式停机，电机仍使能。 The driver detects that an alarm has occurred, stops according to the set mode, and the motor is still enabled.
Fault	错误出现，允许更改驱动器参数。 Error occurred, allowing drive parameters to be changed.

驱动器状态机通过控制字（对象 6040h）的 bit0~bit3、bit7 位来控制，具体描述如下表：
The drive state machine is controlled by bits 0~bit3 and bit7 of the control word (object 6040h), as described in the following table:

控制字切换状态/Control word switching status

命令 Command	控制字/Control word					状态切换 State Switching
	Bit7	Bit3	Bit2	Bit1	Bit0	
Shutdown	0	X	1	1	0	2,6,8
Switchon	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3+4
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4,16
Fault reset	0→1	X	X	X	X	15

状态机中各个状态可以通过状态字（对象 6041h）的 bit0~bit3、bit5、bit6 显示，具体描述如下表：
Each state in the state machine can be displayed by bit0~bit3, bit5, and bit6 of the status word (object 6041h), as described in the following table:
控制字切换状态/Control word switching status

状态字 /Status word						状态/Status
Bit6	Bit5	Bit3	Bit2	Bit1	Bit0	
0	X	0	0	0	0	Not ready to switch on
1	X	0	0	0	0	Switch on disabled
0	1	0	0	0	1	Ready to switch on
0	1	0	0	1	1	Switched on
0	1	0	1	1	1	Operation enabled
0	0	0	1	1	1	Quick stop active
0	X	1	1	1	1	Fault reaction active
0	X	1	0	0	0	Fault

驱动器的状态描述主要通过控制字 6040h 与状态字 6041h 实现，因此对控制字和状态字的熟练使用十分必要，下表简要描述了控制字和状态字各位的在初始化工作下的定义。

The state description of the drive is mainly implemented by the control word 6040h and the status word 6041h, so the skilled use of the control word and the status word is necessary. The following table briefly describes the definition of the control word and the status word for each bit.

控制字/Control word	使能指令 Enable command	功能说明 Function description
6040h	00	初始化步骤 0：此时 6041 低 4 位状态为：0000，电机释放； Initialization Step 0: At this time 6041 low 4-bit state is: 0000, motor release;
	06	初始化步骤 1：此时 6041 低 4 位状态为：0001，电机释放； Initialization Step 1: At this time 6041 low 4-bit state is: 0001, the motor is released;
	07	初始化步骤 2：此时 6041 低 4 位状态为：0011，电机使能； Initialization Step 2: At this time 6041 low 4-bit state is: 0011, the motor is enabled;
	0F	初始化步骤 3：此时 6041 低 4 位状态为：0111，电机使能； Initialization Step 3: At this time 6041 low 4-bit state is: 0111, the motor is enabled;

7.2 工作模式 /Mode of operation

CANopen 通过对象 6060h(Mode of Operation)对驱动器工作模式进行设置,并通过对象 6061h(Mode of operation display）反映驱动器当前的工作模式状态。
CANopen sets the drive operating mode via object 6060h (Mode of Operation) and reflects the current operating mode status of the drive via the object 6061h (Mode of operation display).

EC88D 驱动器目前支持 4 种工作模式：
循环同步位置模式（Cyclic Synchronous Position Mode）CSP；
位置模式（Profile Position Mode）PP；
速度模式（Profile Velocity Mode）PV；
回原点模式（Homing Mode）HM；

驱动器工作模式/Drive mode

索引 Index	子索引 Subindex	名称 Name	说明 Description
6060h	00	工作模式 Operating mode	0：未定义；/Not defined; 1：位置模式；/Profile Position Mode 3：速度模式；/Profile Velocity Mode 6：回原点模式；/Homing Mode 8：循环同步位置模式；/Cyclic Synchronous Position Mode

7.3 循环同步位置模式（CSP）/Cyclic Synchronous Position Mode (CSP)

序号 No.	对象字典 Object dictionary	对象字典含义 Object dictionary meaning	设定值 Set value	单位 Unit
1	6060H	操作模式 Operating mode	8	Nc
2	6040H	控制字 Control word	根据需要设定 Set as needed	Nc
3	607AH	目标位置 target location	根据需要设定 Set as needed	Unit
4	2000H	电机一圈脉冲数 Motor pulse number	根据需要设定 Set as needed	P

7.4 位置模式（PP）/Position Mode (PP)

序号 No.	对象字典 Object dictionary	对象字典含义 Object dictionary meaning	设定值 Set value	单位 Unit
1	6060H	操作模式 Operating mode	1	Nc
2	6040H	控制字 Control word	根据需要设定 Set as needed	Nc
3	607AH	目标位置 target location	根据需要设定 Set as needed	Unit
4	6081H	位置模式下的协议速度 Protocol Speed in Location Mode	根据需要设定 Set as needed	Unit/S
5	6082H	位置模式下的起跳速度和停止速度 Take-off speed and stop speed in position mode	根据需要设定 Set as needed	Unit/S
6	6083H	协议加速度 Protocol Acceleration	根据需要设定 Set as needed	Unit/(S*S)
7	6084H	协议减速度 Protocol Deceleration	根据需要设定 Set as needed	Unit/(S*S)
8	6085H	急停减速度，是否使用取决于605A的值 SCRAM deceleration, depending on the value of 605A	根据需要设定 Set as needed	Unit/(S*S)
9	605AH	急停减速度是否采用（5：采用；其他值：不采用） Whether the emergency stop deceleration is adopted (5: adopted; other values: not adopted)	根据需要设定 Set as needed	Nc
10	2000H	电机一圈脉冲数 Motor pulse number	根据需要设定 Set as needed	P

7.5 速度模式（PV）/Speed Mode (PV)

序号 No.	对象字典 Object dictionary	对象字典含义 Object dictionary meaning	设定值 Set value	单位 Unit
1	6060H	操作模式 Operating mode	3	Nc
2	6040H	控制字 Control word	根据需要设定 Set as needed	Nc
3	60FFH	速度模式下的协议速度 Protocol speed in speed mode	根据需要设定 Set as needed	Unit/S
4	6083+00H	协议加速度 Protocol acceleration	根据需要设定 Set as needed	Unit/(S*S)
5	6084+00H	协议减速度 Protocol deceleration	根据需要设定 Set as needed	Unit/(S*S)

7.6 原点模式（HM）/Origin Mode (HM)

序号 No.	对象字典 Object dictionary	对象字典含义 Object dictionary meaning	设定值 Set value	单位 Unit
1	**6060H**	操作模式 Operating mode	6	Nc
2	**6040H**	控制字 Control word	根据需要设定 Set as needed	Nc
3	**6098H**	原点方式 Origin Mode	根据需要设定 Set as needed	Nc
4	**6099-01H**	寻找极限开关的速度 Find the speed of the limit switch	根据需要设定 Set as needed	**Unit/S**
5	**6099-02H**	寻找原点的速度 The speed of finding the origin	根据需要设定 Set as needed	**Unit/S**
6	**609A-00H**	回零加/减速度 Zero Return Acceleration/deceleration	根据需要设定 Set as needed	**Unit/S**
7	**607C-00H**	原点偏移量 Offset of origin	根据需要设定 Set as needed	**P**

8 对象字典 /Object Dictionary

8.1. 驱动器输入输出口设置 /Drive input and output settings

8.1.1 驱动器输入口设置 /Drive input settings

驱动器丝印上 IN1~IN3 为单端输入口，对应输入口 1~3，驱动器上 pl+,pl-,dr+,dr-为差分高速输入口，对应输入口 4~5。

IN1~IN3 on the driver screen is single-ended input port, corresponding to input port 1~3, pl+, pl-, dr+, dr- on the driver is differential high-speed input port, corresponding to input port 4~5.

与 IO 输入信号相关的参数列表：

List of parameters related to the IO input signal:

地址 Address	参数名称 Parameter Name	属性 Attribute	出厂默认 Factory Default	参数可设置范围 Parameter Settable Range	说明 Description
2152h+01	输入数字 IO 口 1 功能选择 Input digital IO port 1 function selection	R/W/S	1	0—32768	1：原点信号 2：左限位 4：右限位 1: origin signal 2: left limit 4: Right limit
2152h+02	输入数字 IO 口 2 功能选择 Input digital IO port 2 function selection	R/W/S	2	0—32768	1：原点信号 2：左限位 4：右限位 1: origin signal 2: left limit 4: Right limit
2152h+03	输入数字 IO 口 3 功能选择 Input digital IO port 3 function selection	R/W/S	4	0—32768	1：原点信号 2：左限位 4：右限位 1: origin signal 2: left limit 4: Right limit
2152h+04	输入数字 IO 口 4 功能选择 Input digital IO port 4 function selection	R/W/S	8	0—32768	1：原点信号 2：左限位 4：右限位 1: origin signal 2: left limit 4: Right limit
2152h+05	输入数字 IO 口 5 功能选择 Input digital IO port 5 function selection	R/W/S	0	0—32768	1：原点信号 2：左限位 4：右限位 1: origin signal 2: left limit 4: Right limit
2153h+01	输入数字 IO 口 1 滤波时间 Input digital IO port 1 filter time	R/W/S	20	1—60000	单位/Unit：50us
2153h+02	输入数字 IO 口 2 滤波时间 Input digital IO port 2 filter time	R/W/S	20	1—60000	单位/Unit：50us
2153h+03	输入数字 IO 口 3 滤波时间 Input digital IO port 3 filter time	R/W/S	20	1—60000	单位/Unit：50us
2153h+04	输入数字 IO 口 4 滤波时间 Input digital IO port 4 filter time	R/W/S	20	1—60000	单位/Unit：50us
2153h+05	输入数字 IO 口 5 滤波时间 Input digital IO port 5 filter time	R/W/S	20	1—60000	单位/Unit：50us
2154h+00	输入数字IO 电平极性配置 Input Digital IO Level Polarity Configuration	R/W/S	0	0/1	0：正逻辑/Positive logic 1：反逻辑/inverse logic bit0: IO1 极性设置/Polarity setting bit1: IO2 极性设置/Polarity setting bit2: IO3 极性设置/Polarity setting bit3: IO4 极性设置/Polarity setting bit4: IO5 极性设置/Polarity setting
2155h+00	输入数字 IO1 电平 Input digital IO1 level	R	0	0~32768	Bit0 对应外部输入 1，以此类推 Bit0 corresponds to external input 1, and so on.

以下是 IO 状态的功能状态：
The following are the functional states of the IO state:

地址 Address	参数名称 Parameter Name	属性 Attribute	说明 Description
60FDh+00	输入IO状态 Input IO status	R	bit0：负限位，bit1：正限位，bit2：原点信号 Bit0: negative limit, bit1: positive limit, bit2: origin signal

8.1.2 驱动器输出口设置 /Drive Output settings

（1）外部电源由用户提供，但是必需注意，如果电源的极性接反，会使步进驱动器损坏。
The external power supply is provided by the user, but it must be noted that if the polarity of the power supply is reversed, the stepper drive will be damaged.

（2）输出为集电极开路形式，最大电流 50mA，外部电源最大电压 25V。因此，开关量输出信号的负载必须满足这个限定要求。如果超过限定要求或输出直接与电源连接，会使步进驱动器损坏。
The output is in the form of open collector, the maximum current is 50mA, and the maximum voltage of the external power supply is 25V. Therefore, the load of the digital output signal must meet this limit. If the limit is exceeded or the output is directly connected to the power supply, the stepper drive will be damaged.

（3）如果负载是继电器等电感性负载，必须在负载两端反并联续流二极管。如果续流二极管接反，会使步进驱动器损坏。
If the load is an inductive load such as a relay, the freewheeling diode must be connected in anti-parallel across the load. If the freewheeling diode is reversed, the stepper drive will be damaged.

与 IO 输出信号相关的参数列表：
List of parameters related to the IO output signal:

地址 Address	参数名称 Parameter Name	属性 Attribute	出厂默认 Factory Default	参数可设置范围 Parameter Settable Range	说明 Description
2005h+01	输出口 1 功能阻态设置 Output port 1 function resistance setting	R/W/S	1	1—4	bit0：报警输出/alarm output bit1：ready 输出/ready output Bit2: 到位输出/In place output
2005h+02	输出口 2 功能阻态设置 Output port 2 function resistance setting	R/W/S	1	1—4	bit0：报警输出/alarm output bit1：ready 输出/ready output Bit2: 到位输出/In place output
2008h+00	输出口 1 阻态设置 Output port 1 resistance setting	R/W/S	0	0/1	0：有报警、准备好或到位时光耦导通 0: Optocoupler is turned on when there is an alarm, ready or in place 1：有报警、准备好或到位时光耦截止 1: Optocoupler cutoff when there is an alarm, ready or in place 位定义：bit0 对应 out1 以此类推 Bit definition: bit0 corresponds to out1 and so on

8.2 驱动器节点地址/Drive Node Address

主站可以自动扫描节点地址，也可以人为设置。

The main station can automatically scan the node address, or it can be set artificially.

（1）拨码开关设置/ setting of dial switch

当 2151h 对象为 0 时，用户可采用驱动器上的拨码开关设置从站地址。（注：此地址设定在驱动器重新投入电源时才有效）。

When the 2151h object is 0, the user can use the dial switch on the driver to set the slave address. (Note: This address setting is not valid until the drive is repowered)

（2）读取固定站点别名/ Read the fixed site alias

主站可以配置站点别名到 EEPROM 0x0004 字地址，当 2051h 对象数据为 0，且驱动器前面板旋码地址为 0 时，在驱动器重新投入电源后，0x0004 字地址数据将被设定为站点别名。

The primary station can configure the site alias to EEPROM 0x0004 word address. When the 2051h object data is 0 and the drive front spin address is 0, the 0x0004 word address data is set to the site alias after the drive is repowered.

（3）对象字典设定站点别名/The object dictionary sets the site alias

2151h 设定为 1 时，驱动器在重新得电后将使用 2150h 对象的数据作为站点别名地址。

When 2151h is set to 1, the drive will use the data of the 2150h object as the site alias address after it is recharged.

地址 Address	参数名称 Parameter Name	属性 Attribute	出厂默认 Factory Default	参数可设置范围 Parameter Settable Range	说明 Description
2150h+00	从站地址 Slave address	R/W/S	1	1—65535	从站地址 Slave address
2151h+00	从站地址来源 Slave address source	R/W/S	0	0~2	0：来源于拨码，当拨码为 0 时，来源于 EEPROM. 1：来源于 2150h 0: Originated from the dial code, when the dial code is 0, it is derived from EEPROM. 1: from 2150h

8.3 电机旋转方向设定/Motor rotation direction setting

主站发送位置指令，设定该功能可实现电机正反转

The master station sends a position command, setting this function to realize the motor forward and reverse

地址 Address	参数名称 Parameter Name	属性 Attribute	出厂默认 Factory Default	参数可设置范围 Parameter Settable Range	说明 Description
2051h+00	电机运行方向 Motor running direction	R/W/S	0	0/1	0：电机运行方向不变 0: The motor is running in the same direction 1：电机运行方向取反 1: Reverse the running direction of the motor

8.4 每转脉冲数/细分数/电子齿轮/Pulses per revolution / number of subdivisions / electronic gears

步进电机无单独的电子齿轮参数，只需要设置每转脉冲数即可

There is no separate electronic gear parameter for the stepper motor. You only need to set the number of pulses per revolution.

地址 Address	参数名称 Parameter Name	属性 Attribute	出厂默认 Factory Default	参数可设置范围 Parameter Settable Range	说明 Description
2001h+00	每转脉冲数 Number of pulses per revolution	R/W/S	50000	200—51200	表示电机运行一转所需要的脉冲个数 Indicates the pulse required for the motor to run one revolution Rush number

8.5 保存参数/Saving parameters

（1）保存参数：主站通过操作 0x1010-04 来保存用户参数到 EEPROM，如果驱动器检测到主控发送的 0x1010-04 的数据是 0x65766173 时，驱动器会保存当前的参数到 EEPROM。（注意：EEPROM 写入操作中，请不要关闭电源，否则可能会导致写入错误数据，若发生此种情况，请重新设置全部参数，再保存参数）。

Save parameters: The master saves the user parameters to the EEPROM by operating 0x1010-04. If the drive detects that the 0x1010-04 data sent by the master is 0x65766173, the drive saves the current parameters to the EEPROM. (Note: Do not turn off the power during EEPROM write operation, otherwise it may cause incorrect data to be written. If this happens, reset all parameters and save the parameters).

（2）恢复出厂：主站通过操作 0x1011-04 来恢复出厂值，如果驱动器检测到主控发送的 0x1011-04 的数据是 0x64616f6c 时，驱动器会恢复出厂默认值。

Restore the factory: The master restores the factory value by operating 0x1011-04. If the drive detects that the 0x1011-04 data sent by the master is 0x64616f6c, the drive will restore the factory defaults.

8.2 厂家参数

地址 Address	参数名称 Parameter Name	属性 Attribute	出厂默认 Factory Default	参数可设置范围 Parameter Settable Range	说明 Description
2000h+00	峰值电流	R/W/S	3200	1—最大电流	最大电流由驱动器软件定义(mA)。
2001h+00	每转脉冲数	R/W/S	50000	200—51200	表示电机运行一转所需要的脉冲个数
2002h+00	待机时间	R/W/S	500	100—10000	单位：ms
2005h+01	输出口 1 功能阻态设置	R/W/S	1	1—4	bit0：报警输出 bit1：ready 输出 Bit2：到位输出
2005h+02	输出口 2 功能阻态设置	R/W/S	1	1—4	bit0：报警输出 bit1：ready 输出 Bit2：到位输出
2008h+00	输出口 1 阻态设置	R/W/S	0	0/1	0：有报警、准备好或到位时光耦导通 1：有报警、准备好或到位时光耦截止 位定义：bit0 对应 out1 以此类推
2009h+00	脉冲滤波使能	R/W/S	0	0/1	0：不使能 1：使能(Fir 滤波时间起作用)
2010h+02	滤波时间	R/W/S	1000	50—25600	Fir 时间范围为 50—25600us
2013h+00	电流环自整使能	R/W/S	1	0/1	电流环 PI 上电自动整定功能： 0：不使能 1：使能
2015h+00	电流环 Kp	R/W/S	1000	200—32767	自整定使能时，该项只读；不使能时用户可改写
2016h+00	电流环 Ki	R/W/S	200	0—32767	自整定使能时，该项只读；不使能时用户可改写
2017h+00	电流环 Kc	R/W/S	100	80—300	自动获取，不允许客户修改
2020h+00	电机电阻	R/W/S	1000	1—20000	单位：mOhms
2021h+00	电机电感	R/W/S	1	1—6000	单位：uH
2024h+00	混合伺服开闭环控制选择	R/W/S	2	0~2	1：运行于开环模式 2：运行于闭环控制模式
2025h+00	混合伺服控制模式	R/W/S	5	0—10	0：拨码选择 1：Lead 2：PM 3：FOC 4：自测 5：CL
2026h+00	混合伺服锁轴电流	R/W/S	50	0—100	单位：%，开环使用
2029h+00	混合伺服编码器线数	R/W/S	1000	200—60000	p/r
2030h+00	混合伺服位置超差报警值	R/W/S	1000	1—60000	p
2039h+00	外部位置总数 H	R	0	0~65535	接收的位置指令累加值高 16bit
2040h+00	外部位置总数 L	R/W	0	0~65535	接收的位置指令累加值低 16bit 写：写入 1 清除计数器
2041h+00	编码器反馈总数 H	R	0	0~65535	编码器反馈总数高 16bit
2042h+00	编码器反馈总数 L	R/W	0	0~65535	编码器反馈总数低 16bit 写：写入 1 清除计数器
2051h+00	电机运行方向	R/W/S	0	0/1	0：电机运行方向不变 1：电机运行方向取反
2053h+00	到位信号输出阻态	R/W/S	0	0~1	0:低阻 1：高阻
2056h+00	故障检测选择	R/W/S	0xc3	0—0xffff	查阅相关文档再修改
2057h+00	允许使能信号清故障选择	R/W/S	0	0/1	0：不允许 1：允许
2058h+00	使能信号电流软启动时间	R/W/S	1	0—10000	为减小电机上电和使能时转子的振动。单位：50us
2083h+00	上电是否左右摆动	R/W/S	0	0/1	0:无动作 1:左右摆动
2137h+00	位置环 KP	R/W/S	120	0~150	无
2138h+00	位置环 KI	R/W/S	50	0~150	无
2139h+00	位置环 KVFF	R/W/S	70	0~150	无

2140h+00	速度环 KP	R/W/S	60	0~150	无
2150h+00	从站地址	R/W/S	1	1—65535	从站地址
2151h+00	从站地址来源	R/W/S	0	0~2	0：来源于拨码，当拨码为 0 时，来源于 EEPROM. 1：来源于 2150h
2152h+01	输入数字 IO 口 1 功能选择	R/W/S	1	0—32768	1：原点信号 2：左限位 4：右限位
2152h+02	输入数字 IO 口 2 功能选择	R/W/S	2	0—32768	1：原点信号 2：左限位 4：右限位
2152h+03	输入数字 IO 口 3 功能选择	R/W/S	4	0—32768	1：原点信号 2：左限位 4：右限位
2152h+04	输入数字 IO 口 4 功能选择	R/W/S	8	0—32768	1：原点信号 2：左限位 4：右限位
2152h+05	输入数字 IO 口 5 功能选择	R/W/S	0	0—32768	1：原点信号 2：左限位 4：右限位
2153h+01	输入数字 IO 口 1 滤波时间	R/W/S	20	1—60000	单位：50us
2153h+02	输入数字 IO 口 2 滤波时间	R/W/S	20	1—60000	单位：50us
2153h+03	输入数字 IO 口 3 滤波时间	R/W/S	20	1—60000	单位：50us
2153h+04	输入数字 IO 口 4 滤波时间	R/W/S	20	1—60000	单位：50us
2153h+05	输入数字 IO 口 5 滤波时间	R/W/S	20	1—60000	单位：50us
2154h+00	输入数字 IO 电平极性配置	R/W/S	0	0/1	0：正逻辑 1：反逻辑 bit0: IO1 极性设置 bit1: IO2 极性设置 bit2: IO3 极性设置 bit3: IO4 极性设置 bit4: IO5 极性设置
2155h+00	输入数字 IO1 电平	R	0	0~32768	Bit0 对应外部输入 1，以此类推
2093h+00	清除故障记录	R/W			

模式及控制参数
Mode and control parameters

地址 Address	参数名称 Parameter Name	属性 Attribute	说明 Description
6040h+00	控制字	R/W	控制字
6041h+00	状态字	R	状态字
6060h+00	模式设置	RW	工作模式： 1—位置模式 3—速度模式 6—回原点模式 8-循环同步位置模式
6061h+00	模式查询	R	显示驱动器的工作模式
6062h+00	命令位置	R	显示电机命令位置
6064h+00	实际位置	R	显示电机实际位置
606Bh+00	命令速度	R	显示电机命令速度
606Ch+00	实际速度	R/W	显示电机的实际速度，单位：RPM
607Ah+00	目标位置	R/W	工作模式 1 下的目标位置，如果控制字设定为开始运动，转变成为有效指令位置
607Ch+00	原点偏移	R/W	原点偏移
6081h+00	梯形速度	R/W	工作模式 1 时的梯形曲线的最大速度
6082h+00	起止速度	R/W	工作模式 1 时的起跳速度和停止速度
6083h+00	梯形加速度	R/W	梯形曲线的加速度
6084h+00	梯形减速度	R/W	梯形曲线的减速度
6085h+00	快速停止减速度	R/W	急停减速度，是否使用取决于 605A 的值
6098h+00	回原点模式	R/W	寻找原点模式
6099h+01	回原点模式速度	R/W	寻找极限开关的速度
6099h+02	回原点模式速度	R/W	寻找原点信号的速度
609Ah+00	回原点加速度	R/W	寻找原点时加速度
60F4h+00	位置误差	R	位置误差
60FDh+00	输入 IO 状态	R	bit0：负限位，bit1：正限位，bit2：原点信号
60FFh+00	目标速度	R/W	工作模式 3 时的最大速度

9 保修及售后服务 /Warranty and after-sales service

9.1 保修 /Guarantees

请保留好包装箱以便运输、储存或需要退回本公司维修时使用。一年保修期：
Please keep the packing box for transportation, storage or need to return to the company for maintenance.One year warranty period:
来自本驱动器使用一年内因为产品自身的原因造成的损坏，负责保修。
From the use of this drive within one year because of the product itself caused by the damage, responsible for the warranty.

不在保修之列：/Not covered by warranty:
不恰当的接线、电源电压和用户外围配置造成的损坏。/Damage caused by improper wiring, power supply voltage and user peripheral configuration.
无本公司书面授权条件下，用户擅自对产品进行更改。/Without the written authorization of the company, users make changes to the products without authorization.
超出电气和环境的要求使用。/Use beyond electrical and environmental requirements.
驱动器序列编号被撕下或无法辨认。/The drive serial number has been torn off or is unreadable.
外壳被明显破坏。/The outer shell was visibly damaged.
不可抗拒的灾害。/An irresistible disaster.

9.2 售后服务 /Aftersales Service

+862161507699

Email：info@yanlan.net

您拨打电话之前，请先记录以下信息：
Before you call, please record the following information:
故障现象/Fault phenomenon
产品型号和序列号/Product model and serial number
安装日期或者生产日期/Installation date or production date