

PHU&RHU 系列 CANopen 与 EtherCAT 通信手册

PHU&RHU Series CANopen and EtherCAT Communication Manual

V1.06



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一、引言

Introduction

1.1 手册目的和范围

Purpose and Scope of the Manual

本手册旨在为用户提供基于 CANopen 和 EtherCAT 通信协议的产品全面指导。内容涵盖协议基础、软件配置、运动控制功能应用，以及故障诊断与排除的完整流程。本手册是用户进行设备集成、调试和维护的核心技术文档。

This manual is intended to provide users with comprehensive guidance for products based on CANopen and EtherCAT communication protocols. It covers the fundamentals of the protocols, software configuration, motion control function applications, as well as the complete process of troubleshooting and fault diagnosis. This manual serves as the core technical document for users to integrate, debug, and maintain the equipment.

1.2 CANopen 和 EtherCAT 协议概述

Overview of CANopen and EtherCAT Protocols

CANopen: 一种基于 CAN 总线的高层应用协议和通信配置文件。它以其坚固性、灵活性和相对简单性著称，广泛应用于实时性要求并非极端严苛的工业现场。

EtherCAT: 一种高性能的工业以太网技术，采用“飞读飞写”的处理机制，实现了极高的数据刷新率和极低的通信抖动。它特别适用于需要高同步精度的复杂多轴运动控制应用。

关系: 在 EtherCAT 中，可以通过 CoE (CANopen over EtherCAT) 方式，使用熟悉的 CANopen 对象字典模型来配置设备，有效结合了 EtherCAT 的高性能和 CANopen 的配置便利性。

CANopen: A high-level application protocol and communication profile based on the CAN bus. It is known for its robustness, flexibility, and relative simplicity, and is widely used in industrial environments where real-time requirements are not extremely strict.

EtherCAT: A high-performance industrial Ethernet technology. It utilizes an "on-the-fly"

processing mechanism for data frames, achieving extremely high data refresh rates and very low communication jitter. It is particularly suited for complex multi-axis motion control applications requiring high synchronization precision.

Relationship: In EtherCAT, devices can be configured using the CoE (CANopen over EtherCAT) method, which employs the familiar CANopen object dictionary model, effectively combining the high performance of EtherCAT with the configuration convenience of CANopen.

1.3 术语与缩写

Terminology and Abbreviations

表 1-1 术语缩写

Table 1-1 Terminology Abbreviations

Abbreviation	Full Form	Explanation
NMT	Network Management	CANopen 协议中用于网络管理的服务，负责网络的初始化、配置和错误控制。 In the CANopen protocol, it is a service used for network management, responsible for network initialization, configuration, and error control.
COB-ID	Communication Object Identifier	一个标识符字段，定义了 CAN 帧的优先级和功能，包含主站与之通信的从站 ID 和 COB 类型。 An identifier field that defines the priority and function of a CAN frame, including the ID of the slave station communicating with the master and the COB type.
SDO	Service Data Object	CANopen 中一种用于主从设备间可靠、点对点的参数配置与数据传输的通信机制。 A communication mechanism used for reliable, point-to-point parameter configuration and data

Abbreviation	Full Form	Explanation
		transfer between master and slave devices in CANopen.
PDO	Process Data Object	CANopen 中一种用于高效、实时数据传输的关键通信机制。 A key communication mechanism for high-efficiency, real-time data transmission in CANopen.
OD	Object Dictionary	对象字典是设备所有可配置和可监测参数的集中列表。 A centralized list of all configurable and monitorable parameters of a device.
COE	CANopen over EtherCAT	EtherCAT 上一种广泛应用的应用层协议，它将 CANopen 设备配置文件、对象字典和通信机制（SDO, PDO）移植到高性能的 EtherCAT 网络上。 A widely used application layer protocol on EtherCAT, it migrates CANopen device profiles, object dictionaries, and communication mechanisms (SDO, PDO) to the high-performance EtherCAT network.
FOE	File Access over EtherCAT	基于 EtherCAT 的文件传输协议，常用于从站设备的固件更新、参数文件或配置文件的传输。 A file transfer protocol based on EtherCAT, commonly used for firmware updates, and the transfer of parameter or configuration files on

Abbreviation	Full Form	Explanation
		slave devices.
SM	SyncManager	EtherCAT 从站控制器（ESC）内的硬件单元，用于管理主站和从站之间的数据交换缓冲区，确保过程数据（PDO）的同步和一致性。通常每个从站有最多 4 个 SyncManager。 A hardware unit within the EtherCAT Slave Controller (ESC) used to manage the data exchange buffer between the master and slave, ensuring the synchronization and consistency of process data (PDO). Typically, each slave has up to 4 SyncManager.
ESC	EtherCAT Slave Controller	EtherCAT 从站控制器，是每个 EtherCAT 从站设备的核心芯片，处理 EtherCAT 协议，管理数据通信和分布式时钟。 The core chip of each EtherCAT slave device, which processes the EtherCAT protocol and manages data communication and distributed clocks.
FMMU	Fieldbus Memory Management Unit	现场总线内存管理单元。是 ESC 内部的关键硬件模块，用于将网络上的数据帧地址映射到从站设备的本地物理地址（如寄存器、RAM），是实现 EtherCAT“飞驰”式数据帧处理的核心。 Fieldbus Memory Management Unit. It is a critical hardware module within the ESC, used to

Abbreviation	Full Form	Explanation
		map the addresses of data frames on the network to the local physical addresses of the slave devices (such as registers and RAM). It is the core component for achieving EtherCAT's high-speed data frame processing.
TxPDO	Transmit Process Data Object	从站向主站发送的过程数据对象。代表了从站的输出数据（从从站的角度看是“发送”）。 A Process Data Object sent from the slave to the master. It represents the output data of the slave (from the slave's perspective, it is "transmitted").
RxPDO	Receive Process Data Object	主站向从站发送的过程数据对象。代表了从站的输入数据（从从站的角度看是“接收”）。 A Process Data Object sent from the master to the slave. It represents the input data of the slave (from the slave's perspective, it is "received").
CSP	Cyclic Synchronous Position	循环同步位置模式。一种高性能的伺服驱动操作模式，主站周期性地发送目标位置、速度、转矩等指令。 A high-performance servo drive operation mode where the master cyclically sends target position, velocity, torque and other commands.
CSV	Cyclic Synchronous Velocity	循环同步速度模式。伺服驱动操作模式，主站周期性地发送目标速度和转矩指令。 A servo drive operation mode where the master

Abbreviation	Full Form	Explanation
		cyclically sends target velocity and torque commands.
CST	Cyclic Synchronous Torque	循环同步转矩模式。伺服驱动操作模式，主站周期性地发送目标转矩指令。 A servo drive operation mode where the master cyclically sends target torque commands.
PP	Profile Position	轮廓位置模式。一种非周期同步的模式，主站发送一个位置目标，驱动器按照预设的轮廓（加速度、速度）自行完成运动。 A non-cyclical synchronous mode where the master sends a position target, and the drive completes the motion autonomously according to preset profiles (acceleration, velocity).
PV	Profile Velocity	轮廓速度模式。类似 PP 模式，但用于速度控制。 Similar to PP mode, but used for velocity control.
PT	Profile Torque	轮廓转矩模式。类似 PP 模式，但用于转矩控制。 Similar to PP mode, but used for torque control.

1.4 适用产品版本

Applicable Product Versions

本手册适用于本系列产品固件版本 V0.37 及以上。

This manual applies to firmware versions V0.37 and above for this series of products.

二、CANopen 通信协议详解

Detailed Explanation of the CANopen Communication Protocol

2.1 对象字典（OD）

Object Dictionary

对象字典（Object Dictionary, OD）是 CANopen 协议的核心概念，它定义了设备中所有可访问数据的结构化集合。每个 CANopen 设备都必须包含一个对象字典，它充当了设备功能参数与外部网络通信之间的桥梁，是设备自我描述和自我配置的基础。

The Object Dictionary (OD) is a core concept in the CANopen protocol. It defines a structured collection of all accessible data in a device. Every CANopen device must contain an object dictionary, which serves as the bridge between the device's functional parameters and external network communication. It is the foundation for self-description and self-configuration of the device.

对象字典是一个有序的对象组，每个对象采用一个 16 位的索引（Index）进行寻址，索引范围从 0x0000 到 0xFFFF。为了进一步访问索引对象内的单个元素，每个索引下还可定义一个 8 位的子索引（Sub-index）。

The object dictionary is an ordered group of objects, with each object being addressed by a 16-bit index (Index), with a range from 0x0000 to 0xFFFF. For further access to individual elements within an index object, an 8-bit sub-index (Sub-index) can be defined under each index.

可以将对象字典想象为一本有多章节（索引）的书，每个章节下可能有多个小节（子索引）。这种结构使得我们可以精确地访问设备中的任何一个参数，无论是简单的布尔变量还是复杂的数组成员。对象字典中的每个条目都通过特定的属性来描述，包括对象名称、数据类型（如 UNSIGNED32、VISIBLE_STRING 等）、访问属性（只读、只写、可读可写）以及是强制性的（Mandatory）还是可选的（Optional）。

Think of the object dictionary as a book with many chapters (indexed by the 16-bit index), where each chapter may contain several subsections (sub-indexes). This structure allows for precise access to any parameter within the device, whether a simple Boolean variable or a complex array

member. Each entry in the object dictionary is described by specific attributes, including the object name, data type (e.g., UNSIGNED32, VISIBLE_STRING), access attributes (read-only, write-only, read-write), and whether it is mandatory or optional.

为了便于设备之间的互操作性，对象字典的内容通常由电子数据表（EDS）文件或设备配置文件（DCF）来定义。EDS 文件是设备对象字典的模板，由设备制造商提供；而 DCF 则是针对特定应用实例配置后的文件，包含了具体的参数值。

To ensure interoperability between devices, the contents of the object dictionary are often defined by an Electronic Data Sheet (EDS) file or a Device Configuration File (DCF). An EDS file is a template for the device's object dictionary provided by the manufacturer, while the DCF is a file configured after specific application instances, containing concrete parameter values.

不同数据类型索引分区配置表如 2-1 所示。

Table 2-1 shows the index partition configuration for different data types.

表 2-1 CANopen 对象字典索引分区定义

Table 2-1 Definition of CANopen Object Dictionary Index Partitions

Index Range	Description
0000h	Reserved
0001h~ 025Fh	数据类型 Data Types
0260h ~ 0FFFh	Reserved
1000h~1FFFh	通讯对象子协议区 Communication Profile Area
2000h ~5FFFh	制造商特定子协议区 Manufacturer-Specific Profile Area
6000h ~9FFFh	标准化设备子协议区 Standardized Device Profile Area
A000h~AFFFh	网络变量（符合 IEC61131-3） Network Variables (compliant with IEC 61131-3)
B000h ~ BFFFh	用于路由网关的系统变量

	System Variables for Routing Gateways
C000h ~ FFFFh	Reserved

2.2 NMT 状态机与网络管理

NMT State Machine and Network Management

2.2.1 NMT 状态机

NMT State Machine

网络管理（NMT）是 CANopen 协议中用于监控和控制网络节点状态的机制。它基于主从（Master/Slave）模型，由 NMT 主站负责管理网络中的一个或多个 NMT 从站。每个 CANopen 设备内部都有一个 NMT 状态机，它定义了设备的四种基本运行状态。

Network Management (NMT) is the mechanism in CANopen for monitoring and controlling the status of network nodes. It is based on a master-slave model, with the NMT master managing one or more NMT slaves in the network. Each CANopen device contains an NMT state machine, which defines four basic operating states of the device.

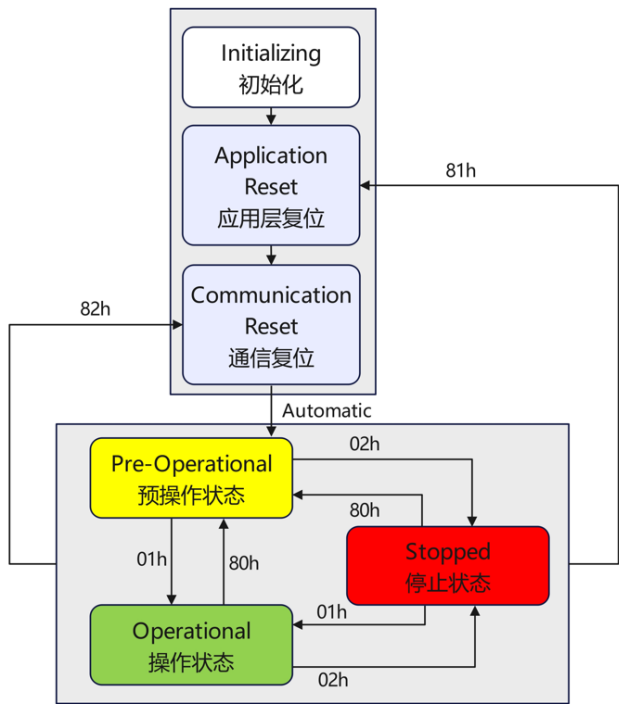


图 2-1 NMT 状态机

Figure 2-1 NMT State Machine

NMT 状态机决定通信状态所能使用的通信对象，具体如表 2-2 所示。

The NMT state machine determines the communication objects that can be used in each communication state, as shown in Table 2-2.

表 2-2 NMT 状态与通信对象

Table 2-2 NMT States and Communication Objects

State	Description	Allowed Communication Objects
Initialization	设备上电或复位后的自检和初始化状态。 Self-check and initialization state after power-up or reset.	Boot-UP
Pre-Operational	设备已就绪，可以进行配置，但不能进行过程数据（PDO）的实时传输。 The device is ready for configuration, but real-time transfer of process data (PDO) is not possible.	SDO、SYNC、EMCY、NMT
Operational	设备完全运行状态，允许所有通信。 Device is fully operational, and all communications are allowed.	PDO、SDO、SYNC、EMCY、NMT
Stopped	设备应用功能被暂停，但基本的网络管理通信仍可能进行。 Device's application function is paused, but basic network management communication may still occur.	NMT

2.2.2 NMT 模块控制报文

NMT Module Control Message

NMT 模块控制报文的 COB-ID 为 0x000，其数据报文长度始终为 2 个字节，其具体格式如下：

The COB-ID of the NMT module control message is 0x000, and its data message length is always 2 bytes. The specific format is as follows:

表 2-3 NMT 模块控制报文格式

Table 2-3 NMT Module Control Message Format

NMT 模块控制报文格式		
NMT Module Control Message Format		
COB-ID	Data	
	Byte0	Byte1
0x000	CMD	Node ID

表 2-4 NMT 命令

Table 2-4 NMT Commands

Command (CMD)	Description
0x01	命令节点变更为“operational” Command node to change to "operational"
0x02	命令节点变更为“stopped” Command node to change to "stopped"
0x80	命令节点变更为“pre-operational ” Command node to change to "pre-operational"
0x81	相当于硬件复位，节点参数恢复为功率上电默认值 Equivalent to hardware reset, restoring node parameters to the default power-up values
0x82	复位节点的通信参数，重新初始化 CANopen 协议栈 Reset the node's communication parameters and re-initialize the CANopen protocol stack

2.2.3 NMT 节点监控报文

NMT Node Monitoring Message

NMT 节点监控报文的 COB-ID 为 0x700+Node ID，其数据报文长度始终为 1 个字节，其具体格式如下：

The COB-ID of the NMT node monitoring message is 0x700+Node ID, and its data message length is always 1 byte. The specific format is as follows:

表 2-5 NMT 节点监控报文格式

Table 2-5 NMT Node Guarding Message Format

NMT 节点监控报文格式 NMT Node Guarding Message Format	
COB-ID	Data
	Byte0
0x700+ Node ID	00

表 2-6 NMT 状态码

Table 2-6 NMT State Codes

Status Code	Description
0x00	初始化状态 boot up/initialization
0x04	停止状态 stopped
0x05	操作状态 Operational
0x7F	预操作状态 pre-operational

2.3 服务数据对象（SDO）

Service Data Object

服务数据对象（SDO）是 CANopen 协议中用于主从设备间进行可靠、点对点参数配置

和数据传输的通信机制。其主要目的是访问 CANopen 节点的对象字典(Object Dictionary), 从而实现对节点参数的读取、写入和控制。

The Service Data Object (SDO) is a communication mechanism in the CANopen protocol used for reliable, point-to-point parameter configuration and data transfer between master and slave devices. Its primary purpose is to access the Object Dictionary (OD) of the CANopen node, enabling reading, writing, and control of node parameters.

SDO 最大可发送 4 个字节数据, 当数据长度超过 4 个字节时就拆分成多个报文来传输, 这种模式称为分段传输, 而 4 字节及以下的传输称为加速传输。SDO 报文的标准长度为 8 个字节, 其通用格式如下:

An SDO can transmit up to 4 bytes of data. When the data length exceeds 4 bytes, it is divided into multiple messages for transmission; this mode is called segmented transfer. Transmission of 4 bytes or less is referred to as expedited transfer. The standard length of an SDO message is 8 bytes, and its general format is as follows:

表 2-7 SDO 数据报文说明

Table 2-7 SDO Data Message Description

Byte	Definition	Description
Byte0	命令码 Command code	决定 SDO 的类型和行为 Determines the type and behavior of the SDO
Byte1- Byte2	索引 Object index	对象字典的 16 位索引 The 16-bit index of the object in the object dictionary
Byte3	子索引 Object sub-index	对象字典的 8 位子索引 The 8-bit sub-index of the object in the object dictionary
Byte4- Byte7	数据 Data	传输的数据或控制信息 The data or control information transmitted

2.3.1 写入 SDO 数据

Writing SDO Data

当主站需要向从站节点写入参数时，必须严格遵循 SDO 协议帧格式构建请求报文。该报文应依次包含以下关键字段：命令说明符（用于指示写入操作和传输模式）、目标索引与子索引（用于定位对象字典中的具体条目），以及待写入的数据。

When the master needs to write parameters to the slave node, it must strictly follow the SDO protocol frame format to construct the request message. This message should sequentially contain the following key fields: command specifier (used to indicate the write operation and transfer mode), target index and sub-index (used to locate specific entries in the object dictionary), and the data to be written.

表 2-8 写 SDO 报文格式
Table 2-8 SDO Write Message Format

Operation	COB-ID	Data							
		Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Master Write	0x600+ Node ID	23h	Index	Sub- Index	Data				
		27h			Data				-
		2Bh			Data			-	-
		2Fh			Data	-	-	-	-
Slave Normal Response	0x580+ Node ID	60h	Index	Sub- Index	-	-	-	-	-
Slave Error Response		80h			Abort codes				

注：返回 0x80 时，表示 SDO 操作失败，Abort codes 详情参考 5.1 章 SDO 中止码。
Note: A return value of 0x80 indicates that the SDO operation failed. For details on abort codes, refer to Chapter 5.1 SDO Abort Codes.

例子：以伺服 ID=1 为例

Example: Using a servo with ID=1

表 2-9 写 SDO 示例

Table 2-9 Write SDO Example

Operation	COB-ID	Message Data (Hex)
设置运行模式为轮廓位置模式 (0x6060 写入 1) Set the operation mode to Profile Position mode (Write 1 to object 6060h)	601	2F 60 60 00 01 00 00 00
	581	60 60 60 00 00 00 00 00
控制字设置为 6 (0x6040 写入 6) Set the Control word to 6 (Write 6 to object 6040h)	601	2B 40 60 00 06 00 00 00
	581	60 40 60 00 00 00 00 00

2.3.2 读取 SDO 数据

Reading SDO Data

当主站需要读取关节模組的参数时，必须首先构建一个 SDO 读取请求帧。该请求帧需包含指定的指令码（标识读取操作）、目标对象的索引与子索引。关节在接收到该请求后，将访问其内部对象字典，并将指定对象的数据通过一条 SDO 上传响应帧返回给主站。

When the master needs to read parameters from the joint module, it must first construct an SDO read request frame. This request frame should include the specified command code (indicating the read operation), and the target object's index and sub-index. After receiving the request, the joint module will access its internal object dictionary and return the specified object's data to the master via an SDO upload response frame.

表 2-10 读 SDO 报文格式

Table 2-10 SDO Read Message Format

Operation	COB-ID	Data							
		Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Master Read	0x600+	40h	Index		Sub-	-	-	-	-

	Node ID			Index				
Slave Normal Response	0x580+ Node ID	43h	Index	Sub-Index	Data			
		47h			Data			-
		4Bh			Data		-	-
		4Fh			Data	-	-	-
Slave Error Response		80h			Abort codes			

注：返回 0x80 时，表示 SDO 操作失败，Abort codes 详情参考 5.1 章 SDO 中止码。

Note: A return value of 0x80 indicates that the SDO operation failed. For details on abort codes, refer to Chapter 5.1 SDO Abort Codes.

例子：以伺服 ID=1 为例

Example: Using a servo with ID=1

表 2-11 读 SDO 示例

Table 2-11 Read SDO Example

Operation	COB-ID	Message Data (Hex)
读取当前运行模式 （读取 0x6061 地址数据） Read Current Operation Mode (Read data from object 6061h)	601	40 61 60 00 00 00 00 00
	581	4F 61 60 00 01 00 00 00
读取状态字反馈 （读取 0x6041 地址数据） Read Status word Feedback (Read data from object 6041h)	601	40 41 60 00 00 00 00 00
	581	4B 41 60 00 31 01 00 00

2.4 过程数据对象（PDO）

Process Data Object

过程数据对象（PDO）是 CANopen 协议中实现高效率、实时数据传输的关键机制，其通信方向以从站设备为视角进行定义：发送 PDO（TxPDO）指关节模组向主站发送数据（如

状态信息），接收 PDO（RxPDO）指模组从主站接收数据（如控制指令）。使用 PDO 前需配置其通信参数与映射参数，本系列模组支持 4 个 RxPDO 和 4 个 TxPDO，每个 PDO 最多可映射 8 字节数据，以满足实时控制需求。

Process Data Objects (PDOs) are a key mechanism in the CANopen protocol for efficient, real-time data transmission. The communication direction is defined from the perspective of the slave device: Transmit PDO (TxPDO) refers to the joint module sending data to the master (such as status information), and Receive PDO (RxPDO) refers to the module receiving data from the master (such as control commands). Before using PDOs, their communication parameters and mapping parameters need to be configured. This series of modules supports 4 RxPDOs and 4 TxPDOs, with each PDO capable of mapping up to 8 bytes of data to meet real-time control requirements.

表 2-12 PDO 通信与映射对象

Table 2-12 PDO Communication and Mapping Objects

PDOs	Communication Object	Communication Object Index	Mapping Object Index	COB-ID
RxPDOs	RxPDO1	0x1400	0x1600	0x200+Node_ID
	RxPDO2	0x1401	0x1601	0x300+Node_ID
	RxPDO3	0x1402	0x1602	0x400+Node_ID
	RxPDO4	0x1403	0x1603	0x500+Node_ID
TxPDOs	TxPDO1	0x1800	0x1A00	0x180+Node_ID
	TxPDO2	0x1801	0x1A01	0x280+Node_ID
	TxPDO3	0x1802	0x1A02	0x380+Node_ID
	TxPDO4	0x1803	0x1A03	0x480+Node_ID

表 2-13 PDO 映射参数格式

Table 2-13 PDO Mapping Parameter Format

Bit0-Bit7	Bit8-Bit15	Bit17-Bit31
对象数据长度 Object Data Length (in bits)	对象子索引 Object Sub-index	对象索引 Object Index

表 2-14 PDO 数据报文格式

Table 2-14 PDO Data Message Format

Communication Object	COB-ID	Number of Bytes	Data
RxPDO1	0x200+Node_ID	Up to 8 bytes	Up to 8 bytes
RxPDO2	0x300+Node_ID	Up to 8 bytes	Up to 8 bytes
RxPDO3	0x400+Node_ID	Up to 8 bytes	Up to 8 bytes
RxPDO4	0x500+Node_ID	Up to 8 bytes	Up to 8 bytes
TxPDO1	0x180+Node_ID	Up to 8 bytes	Up to 8 bytes
TxPDO2	0x280+Node_ID	Up to 8 bytes	Up to 8 bytes
TxPDO3	0x380+Node_ID	Up to 8 bytes	Up to 8 bytes
TxPDO4	0x480+Node_ID	Up to 8 bytes	Up to 8 bytes

2.4.1 PDO 传输类型

PDO Transmission Types

PDO 的传输行为（如何及何时发送/接收）由其传输类型参数精确控制。该参数在对象字典中的定义如下：**TxPDO**：在索引 0x1800 至 0x1803（分别对应 TxPDO1 至 TxPDO4）的子索引 0x02 中设置。**RxPDO**：在索引 0x1400 至 0x1403（分别对应 RxPDO1 至 RxPDO4）的子索引 0x02 中设置。传输类型的值决定了 PDO 的触发机制，具体分类如下：

The transmission behavior of a PDO (how and when it is sent/received) is precisely controlled by its transmission type parameter. This parameter is defined in the object dictionary as follows: **TxPDO**: Set in the sub-index 0x02 of index 0x1800 to 0x1803 (corresponding to TxPDO1 to TxPDO4 respectively). **RxPDO**: Set in the sub-index 0x02 of index 0x1400 to 0x1403 (corresponding to RxPDO1 to RxPDO4 respectively). The value of the transmission type determines the triggering mechanism of the PDO, specifically categorized as follows:

表 2-15 TxPDO 传输类型

Table 2-15 TxPDO Transmission Types

传输类型值（十进制） Transmission Type Value (Decimal)	传输机制与描述 Transmission Mechanism and Description
0	同步非周期：该 PDO 可通过远程帧或设备子协议中定义

	的事件（如设备启动）来触发传输。 Synchronous Aperiodic: This PDO can be triggered for transmission by a Remote Frame or by an event defined in the device profile (e.g., device start-up).
1~240	同步周期: PDO 将在每接收到 N 个同步（SYNC）报文后传输一次。例如，设置为 1 时，每收到一个 SYNC 帧发送一次；设置为 5 时，每收到 5 个 SYNC 帧发送一次。数值越小，实时性越高。 Synchronous Cyclic: The PDO will be transmitted each time after receiving N SYNC messages. For example, if set to 1, it is sent upon every SYNC frame; if set to 5, it is sent upon every 5th SYNC frame. A smaller value indicates higher real-time performance.
254	异步，设备协议事件驱动: 当在设备子协议中预定义的特定事件（如错误状态改变、特定状态达到）发生时触发传输。 Asynchronous, Device Profile Event-driven: Transmission is triggered when a specific pre-defined event in the device profile occurs (e.g., error status change, reaching a specific state).
255	异步，生产商特定事件驱动: 传输由设备生产商定义的内部事件（如定时器超时、输入信号变化等）触发。 Asynchronous, Manufacturer-Specific Event-driven: Transmission is triggered by internal events defined by the device manufacturer (e.g., timer timeout, input signal change).

表 2-16 RXPDO 传输类型

Table 2-16 RxPDO Transmission Types

传输类型值（十进制） Transmission Type Value (Decimal)	传输机制与描述 Transmission Mechanism and Description
255	异步（由设备特定事件触发）：该 PDO 可通过远程帧或设备子协议中定义的事件（如设备启动）来触发传输。 Asynchronous (triggered by device-specific event): This PDO can be triggered for transmission by a Remote Frame or by an event defined in the device profile (e.g., device start-up).
0~240	同步周期：PDO 将在每接收到 N 个同步（SYNC）报文后传输一次。例如，设置为 1 时，每收到一个 SYNC 帧发送一次；设置为 5 时，每收到 5 个 SYNC 帧发送一次。数值越小，实时性越高。 Synchronous Cyclic: The PDO will be transmitted each time after receiving N SYNC messages. For example, if set to 1, it is sent upon every SYNC frame; if set to 5, it is sent upon every 5th SYNC frame. A smaller value indicates higher real-time performance.

2.4.2 PDO 配置参数与配置流程

Configuring PDO Transmission Types

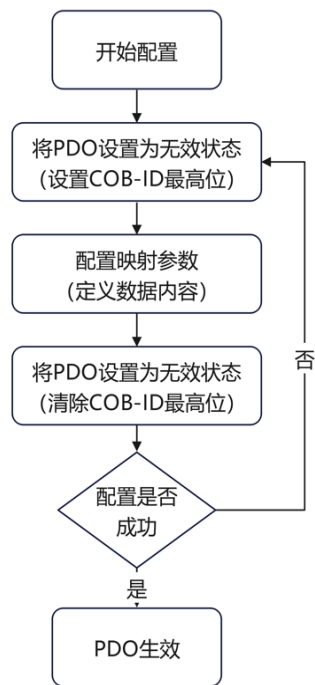


图 2-2 PDO 配置流程

Figure 2-2 PDO Configuration Flowchart

例 1：以伺服 ID=1 为例，将控制字（6040）映射到 RXPDO1

Example 1: Mapping the Control word (6040h) to RPDO1 for a Servo with ID=1

表 2-17 RXPDO1 映射控制字

Table 2-17 RPDO1 Mapping for Control word

Step	COB-ID	Message Data (Hex)
禁用 RxPDO1 Disable RPDO1	601	23 00 14 01 01 02 00 80
	581	60 00 14 01 00 00 00 00
设置传输类型 Set Transmission Type	601	2F 00 14 02 01 00 00 00
	581	60 00 14 02 00 00 00 00
清除原有映射 Clear Existing Mappings	601	2F 00 16 00 00 00 00 00
	581	60 00 16 00 00 00 00 00
映射控制字（6040）	601	23 00 16 01 10 00 40 60

Map Control word (6040h)	581	60 00 16 01 00 00 00 00
写映射对象个数 (1)	601	2F 00 16 00 02 00 00 00
Write Number of Mapped Objects (1)	581	60 00 16 00 00 00 00 00
启用 RxPDO1	601	23 00 14 01 01 02 00 00
Enable RPDO1	581	60 00 14 01 01 00 00 00

例 2：以伺服 ID=1 为例，将状态字（6041）映射到 TXPDO1

Example 2: Taking servo ID=1 as an example, map the status word (6041) to TXPDO1.

表 2-18 TXPDO1 映射状态字

Table 2-18 TPDO1 Mapping for Status word

Step	COB-ID	Message Data (Hex)
禁用 TxPDO1	601	23 00 18 01 81 01 00 80
Disable TPDO1	581	60 00 18 01 00 00 00 00
设置传输类型	601	2F 00 18 02 01 00 00 00
Set Transmission Type	581	60 00 18 02 00 00 00 00
清除原有映射	601	2F 00 1A 00 00 00 00 00
Clear Existing Mappings	581	60 00 1A 00 00 00 00 00
映射状态字（6041）	601	23 00 1A 01 10 00 41 60
Map Status word (6041h)	581	60 00 1A 01 00 00 00 00
写映射对象个数 (1)	601	2F 00 1A 00 02 00 00 00
Write Number of Mapped Objects (1)	581	60 00 1A 00 00 00 00 00
启用 TXPDO1	601	23 00 18 01 81 01 00 00
Enable TPDO1	581	60 00 18 01 00 00 00 00

2.5 同步对象（SYNC）

Synchronization Object

SYNC 对象是 CANopen 协议中用于实现网络节点时间同步的广播通信对象。它由网络

中的 SYNC 生产者（通常是 NMT 主站）周期性地发送，而其他作为 SYNC 消费者的从站在接收到该报文后，同步执行预定的周期性任务，如同步采样输入、更新输出或触发 PDO 的发送。

The SYNC object is a broadcast communication object in the CANopen protocol used to achieve time synchronization among network nodes. It is periodically sent by the SYNC producer in the network (usually the NMT master). Other slave nodes, acting as SYNC consumers, synchronously execute predefined periodic tasks upon receiving this message, such as synchronized sampling of inputs, updating outputs, or triggering the transmission of PDOs.

SYNC 循环周期：主站连续发送两次 SYNC 报文之间的时间间隔。它决定了整个系统同步的基本时间粒度。

SYNC Cycle Period: The time interval between two consecutive SYNC messages sent by the master. It determines the fundamental time granularity for the synchronization of the entire system.

同步窗口长度：在 SYNC 报文发出后，为所有 SYNC 从站预留出的用于完成同步操作的最大时间窗口。从站必须在此时间窗口内完成所有同步相关的任务。

Synchronization Window Length: The maximum time window reserved for all SYNC slave nodes to complete their synchronized operations after the SYNC message is issued. Slave nodes must complete all synchronization-related tasks within this time window.

可以通过以下字典：1006h（循环同步周期）、1007（同步窗口时间）、1005h（同步对象）进行配置。

These parameters can be configured via the following objects in the object dictionary: 1006h（Communication Cycle Period (SYNC cycle period)）、1007（Synchronization Window Length）、1005h（SYNC COB-ID）

表 2-19 SYNC 配置报文

Table 2-19 SYNC Configuration Messages

Operation	COB-ID	Message Data (Hex)
配置 SYNC COB-ID	601	23 05 10 01 80 00 00 00
Configure SYNC COB-ID (Index 0x1005)	581	60 05 10 01 00 00 00 00

配置循环同步周期为 1000 us Configure Communication Cycle Period as 1000 μs (Index 0x1006)	601	23 06 10 00 E8 03 00 00
	581	60 06 10 00 00 00 00 00
配置同步窗口时间 300 us Configure Synchronization Window Length as 300 μs (Index 0x1007)	601	23 07 10 01 2C 01 00 00
	581	60 07 10 01 00 00 00 00

表 2-20 SYNC 报文格式（无数据）

Table 2-20 SYNC Message Format (No Data)

COB-ID	Data
0x80	0

2.6 紧急对象（EMCY）

Emergency Object

紧急报文是 CANopen 节点在检测到内部致命错误时，异步主动发送的一种告警报文。其目的在于将设备的故障状态及时、快速地通知网络中的其他设备（如主站），以便系统采取相应措施。

The Emergency Message is an alarm message that a CANopen node asynchronously and actively transmits upon detecting an internal fatal error. Its purpose is to promptly and rapidly notify other devices on the network (such as the master) of the device's fault condition, enabling the system to take appropriate measures.

表 2-21 紧急报文格式

Table 2-21 Emergency Message Format

COB-ID	Data			
	Byte0~Byte1	Byte2	Byte3	Byte4~Byte7
0x80 + Node ID	紧急错误代码 Emergency	错误寄存器 Error Register	-	-

	Error Code			
--	------------	--	--	--

2.7 网络守护（心跳与节点保护）

Network Guard (Heartbeat and Node Protection)

表 2-22 心跳与节点保护比较与选择

Table 2-22 Heartbeat vs. Node Guarding Comparison and Selection

特性 Characteristic	心跳协议 Heartbeat Protocol	节点保护协议 Node Guarding Protocol
通信模型 Communication Model	生产者/消费者（广播/点对点） Producer/Consumer (Broadcast/Point-to-Point)	主从式（请求-响应） Master-Slave (Request-Response)
网络负载 Network Load	相对较低（节点周期性发送，与节点数成正比） Relatively low (Nodes send periodically, load proportional to node count)	相对较高（主站需轮询每个节点） Relatively high (Master must poll each slave)
实现复杂度 Implementation Complexity	从站实现简单，只需定时发送 Simple slave implementation, only requires periodic sending	主站逻辑复杂，需管理所有从站的轮询 Complex master logic, must manage polling for all slaves
实时性 Real-time Performance	故障检测时间 ≤ 心跳生产时间 Fault detection time ≤ Heartbeat producer time	故障检测时间 ≤ 守护时间 Fault detection time ≤ Guard time
推荐场景 Recommended Scenario	现代 CANopen 系统的 首选 ，尤其适用于从站数量多或主站也需要被监控的场景 Preferred for modern CANopen systems, especially with many slaves or when the master also needs monitoring	传统应用，或需要与旧版本设备兼容时 Legacy applications, or when compatibility with older devices is required

2.7.1 心跳保护机制

Heartbeat Protection Mechanism

心跳保护机制基于生产者-消费者模型。在此机制中，心跳生产者会周期性地向网络发送心跳报文，而心跳消费者负责监听这些报文。心跳生产者可以是上位机（NMT 主站）或关节模组（从站），相应地，消费者也可以是上位机或关节模组。

The Heartbeat protection mechanism is based on the producer-consumer model. In this mechanism, the Heartbeat Producer periodically sends Heartbeat messages to the network, and Heartbeat Consumers are responsible for monitoring these messages. The producer can be the host computer (NMT Master) or a joint module (slave), and similarly, the consumer can also be the host computer or a joint module.

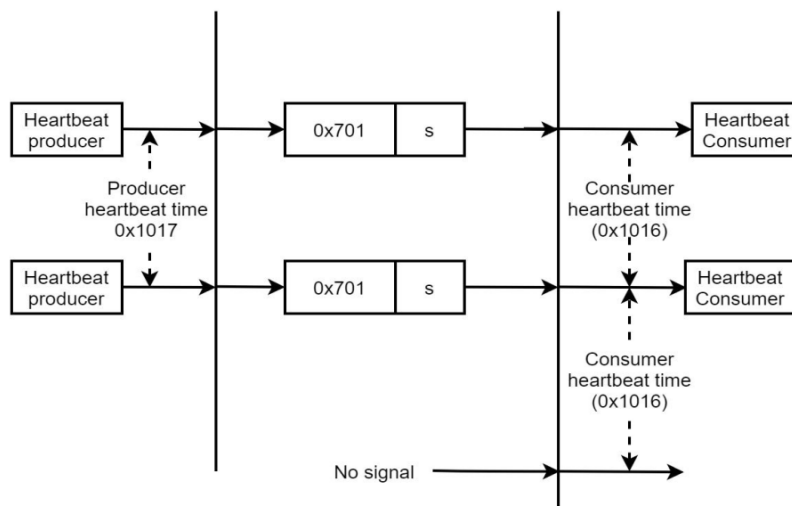


图 2-3 心跳保护机制模型

Figure 2-3 Heartbeat Protection Mechanism Model

心跳保护配置流程如下：

The Heartbeat protection configuration process is as follows:

表 2-23 心跳保护配置流程

Table 2-23 Heartbeat Protection Configuration Process

步骤 Step	配置对象 Target	参数索引 Parameter Index	说明 Description
1	关节模组（消费者）	0x1016	设定消费者心跳时间，需大于上位

	Joint Module (Consumer)		机的生产者心跳时间并包含容差 Set the consumer heartbeat time, which must be greater than the producer's heartbeat time plus a tolerance.
2	上位机/主站（生产者） Host Computer/Master (Producer)	0x1017	上位机自行设定其心跳发送周期 The host computer sets its own heartbeat transmission period.
3	-	-	上位机开始发送心跳报文，机制生效 The host computer starts sending heartbeat messages, activating the mechanism.

完成关节的消费者配置后，只需上位机开始周期性发送心跳报文，即可激活心跳保护机制。

After configuring the joint module as a consumer, the heartbeat protection mechanism is activated once the host computer starts periodically sending heartbeat messages.

表 2-24 心跳报文格式
Table 2-24 Heartbeat Message Format

COB-ID	Data	State
0x700 + Node ID	0	Boot-up
	4	Stopped
	5	Operational
	127	Pre-Operational

2.7.2 节点保护机制

Node Guarding Mechanism

节点保护是一种基于主从式双向问答的通信监护机制。它与心跳协议不同，并非单向广播，而是由 NMT 主站主动发起，与每个从站建立一对一的监护对话。此机制确保主站能监控从站状态，同时从站也能确认主站存活，实现了双向的通信健康检查。

Node Guarding is a communication monitoring mechanism based on a master-slave, bidirectional question-answer model. Unlike the Heartbeat protocol, which is a one-way broadcast, Node Guarding is initiated actively by the NMT Master, establishing a one-to-one guarding dialogue with each slave. This mechanism ensures that the master can monitor the slave's status, while the slave can also confirm the master's presence, achieving bidirectional communication health checks.

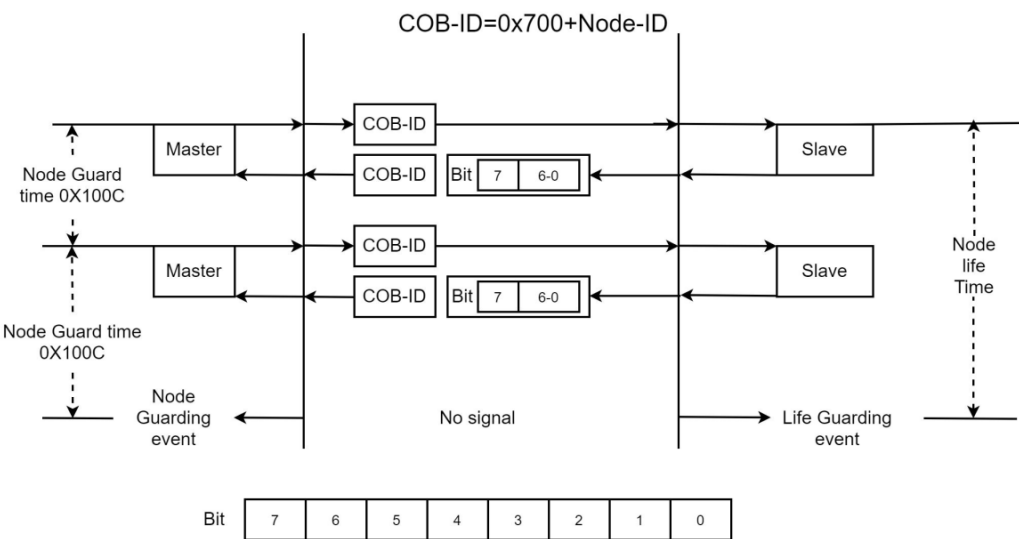


图 2-4 节点保护机制模型
Figure 2-4 Node Guarding Mechanism Model

节点保护配置流程如下：

The Node Guarding configuration process is as follows:

表 2-25 节点保护配置流程
Table 2-25 Node Guarding Configuration Process

步骤 Step	配置对象 Target	参数索引 Parameter Index	说明 Description
1	主站配置 Master Configuration	0x100C (Sub-index 0x04)	通过 SDO 写入，设置节点的 Guard Time Set the node's Guard Time via an SDO write.
2	从站配置（关节） Slave Configuration (Joint)	0x100D	模组内部设定 Life Time Factor Set the Life Time Factor internally in the module.

3	运行与错误检测 Operation & Error Detection	-	①正常：主站发送请求，模组立即回应； Master sends request, module responds immediately. ②从站故障：若从站在 Guard Time 内未回复主站，则判定失败； If the slave does not respond to the master within the Guard Time, it is deemed a failure. ③主站故障：若主站停止发送请求，模组在持续 Life Time（Guard Time*Life Time Factor）内未收到请求后，判定主站通信失败，并触发预定义的错误行为（如进入安全状态）。 If the master stops sending requests, and the module does not receive any request within the Life Time (Guard Time * Life Time Factor), it determines a master communication failure and triggers a pre-defined error behavior (e.g., entering a safe state).
---	---	---	--

表 2-26 节点保护报文格式

Table 2-26 Node Guarding Message Format

Operation	COB-ID	Data	
Master Request	0x700 + Node ID	-	
Slave Response	0x700 + Node ID	Bit0~ Bit6	Bit7
		4=Stopped 5=Operational 127=Pro-Operational	Toggle bit (alternates between 0 and 1 to monitor communication activity).

三、EtherCAT 通信协议详解

Detailed Explanation of the EtherCAT Communication Protocol

3.1 EtherCAT 系统组成与工作原理

EtherCAT System Composition and Operating Principle

3.1.1 系统组成

System Composition

主站：通常是工业 PC（IPC）或嵌入式控制器，需配备标准的以太网控制器（NIC）。

注意：为了实现精确的实时控制，主站通常使用专门的 EtherCAT 主站网卡，或通过 IPC 上安装实时操作系统（如 Windows 下的 TwinCAT RT 内核）将标准网卡驱动替换为 EtherCAT 主站协议栈。运行 EtherCAT 主站协议栈，例如 Beckhoff 的 TwinCAT、Codesys Runtime、Acontis 的 EC-Master 等。主站软件负责网络初始化、配置、过程数据交换和整个网络的调度与管理。

Main Station: The main station is typically an industrial PC (IPC) or embedded controller, and it must be equipped with a standard Ethernet controller (NIC). To achieve precise real-time control, the main station typically uses a dedicated EtherCAT master network card or replaces the standard NIC driver with an EtherCAT master protocol stack by installing a real-time operating system (such as the TwinCAT RT kernel on Windows). EtherCAT master protocol stacks like Beckhoff's TwinCAT, Codesys Runtime, or Acontis EC-Master are commonly used. The master software is responsible for network initialization, configuration, process data exchange, and the scheduling and management of the entire network.

从站：任何 EtherCAT 从站设备，如伺服驱动器、IO 模块、传感器模块等。其核心是专用的 EtherCAT 从站控制器（ESC），如 Beckhoff 的 ET1100、ET2000 系列，TI 的 AMIC110 等。ESC 内部有双端口内存、同步管理器（SM）和 FMMU 单元。

Slave Station: Any EtherCAT slave device, such as servo drives, I/O modules, sensor modules, etc. The core of the slave is a dedicated EtherCAT Slave Controller (ESC), such as Beckhoff's ET1100 and ET2000 series, or TI's AMIC110. The ESC contains dual-port memory, SyncManager

(SM), and FMMU units.

关节模组即属于从站。

Joint modules are slaves.

3.1.2 工作原理

Working Principle

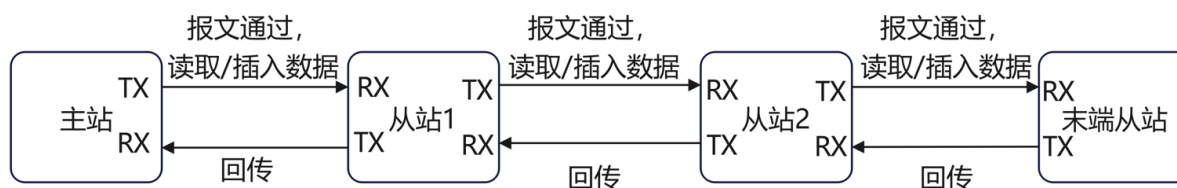


图 3-1 EtherCAT 工作原理图

Figure 3-1 EtherCAT Working Principle Diagram

EtherCAT 的运行原理如图 3-1 所示。在一个通信周期内，主站将以太网数据帧依次发送给各个从站。数据帧经过每个从站时，该从站会根据地址信息从帧中读取对应的输入数据，并将需要反馈的数据写入帧中的相应位置。当数据帧抵达末端从站后，将沿原路返回，经由首个从站送回主站。这种传输机制不仅能够在一个周期内完成所有数据通信，还显著提高了带宽利用效率，数据有效利用率最高可达 90% 以上。

The operating principle of EtherCAT is shown in the diagram. In one communication cycle, the master sends Ethernet data frames to each slave sequentially. As the data frame passes through each slave, the slave reads the corresponding input data from the frame based on address information and writes the feedback data into the appropriate position in the frame. When the data frame reaches the last slave, it returns along the same path and is sent back to the master via the first slave. This transmission mechanism allows all data communication to be completed within a single cycle and significantly improves bandwidth utilization, with an effective data utilization rate of over 90%.

3.2 EtherCAT 状态机（ESM）

EtherCAT State Machine (ESM)

每个 EtherCAT 从站都遵循一个标准的状态机，确保网络有序地启动、运行和停止。

Each EtherCAT slave station follows a standard state machine to ensure the network starts, operates, and stops in an orderly manner.

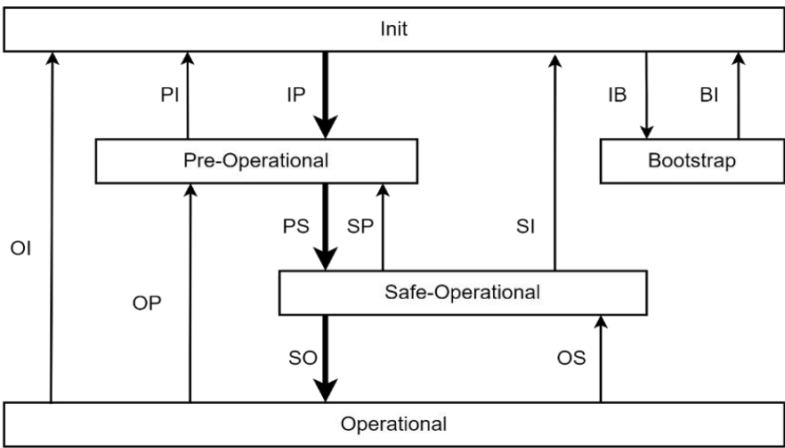


图 3-2 EtherCAT 状态机

Figure 3-2 EtherCAT State Machine

表 3-1 ESM 状态

Table 3-1 ESM States

State	Description	Actions
Init	上电或硬件复位后的初始状态。仅允许访问 ESC 的基本寄存器（如 ESC 类型、版本号）。 The initial state after power-on or hardware reset. Only allows access to basic ESC registers (e.g., ESC type, version number).	硬件上电后的起点。主站配置从站地址、初始化邮箱通信通道和分布式时钟（DC）参数。 The starting point after hardware powers on. The master configures slave addresses, initializes mailbox communication channels, and Distributed Clock (DC) parameters.
Pre-Operational	邮箱通信通道已建立，但	主站通过邮箱通信（如 CoE）配置

State	Description	Actions
	过程数据通信（PDO）尚未开启。 The mailbox communication channel is established, but process data communication (PDO) is not yet active.	从站的设备参数，如设置伺服驱动器的运行模式、比例增益等。这是非实时参数配置的阶段。 The master configures slave device parameters via mailbox communication (e.g., CoE), such as setting the servo drive's operation mode, proportional gain, etc. This is the stage for non-real-time parameter configuration.
Safe-Operational	邮箱通信和过程数据通信均已使能。从站会接收并验证输入过程数据，但输出过程数据（如驱动器的扭矩指令）被锁定在安全状态（如 0）。 Both mailbox communication and process data communication are enabled. The slave receives and validates input process data, but output process data (e.g., torque command to the drive) is locked to a safe state (e.g., 0).	主站开始发送和接收过程数据，并验证数据一致性。此状态用于在完全运行前进行最终检查，确保通信链路和逻辑正确。 The master starts sending and receiving process data and verifies data consistency. This state is used for final checks before full operation, ensuring the communication link and logic are correct.
Operational	完全运行状态。所有通信	设备进入实时控制循环。这是系统

State	Description	Actions
	（邮箱和过程数据）正常进行，从站根据接收到的输出数据正常工作。 Full operational state. All communication (mailbox and process data) proceeds normally, and the slave operates based on the received output data.	执行正常任务（如多轴同步运动）的状态。 The device enters the real-time control loop. This is the state where the system performs normal tasks (e.g., multi-axis synchronous motion).
Bootstrap	一种特殊状态，用于通过 FoE 更新从站固件。 A special state used for updating slave firmware via FoE.	更新固件。 Firmware update.

3.3 邮箱通信 (Mailbox)

Mailbox Communication

邮箱通信是 EtherCAT 系统中用于处理非实时、但要求可靠传输的数据通道。它与高速循环的过程数据通道分离，专门用于设备配置、文件传输、诊断信息读取等不需要在每个通信周期内都发生的任务。

Mailbox communication is a data channel in the EtherCAT system used for processing non-real-time but reliably transmitted data. It is separated from the high-speed cyclic process data channel and is specifically used for tasks such as device configuration, file transfers, and reading diagnostic information that do not need to occur in every communication cycle.

3.3.1 CoE (CANopen over EtherCAT)

它将 CANopen 标准引入 EtherCAT，使用对象字典（一个结构化的参数列表）来管理所有设备参数。通过 SDO（服务数据对象）进行随机、可靠的参数读写。

It introduces the CANopen standard to EtherCAT, using an object dictionary (a structured list of parameters) to manage all device parameters. It performs random, reliable parameter read and write operations via SDO (Service Data Object).

3.3.2 FoE (File Access over EtherCAT)

FoE 协议提供了一个非常简单的基于 TCP/IP TFTP（简单文件传输协议）模型的文件传输服务。

主要功能：用于在从站和主站之间进行文件的上传（Upload，从从站读取文件）和下载（Download，向从站写入文件）。

The FoE protocol provides a very simple file transfer service based on the TCP/IP TFTP (Trivial File Transfer Protocol) model.

Main functions: It is used for uploading (reading files from slaves) and downloading (writing files to slaves) files between the master and slave stations.

3.3.3 SoE (Servo Drive over EtherCAT)

SoE 是针对伺服驱动器的一种特定配置文件（Profile），它定义了伺服驱动器中与运动控制相关的标准对象字典、参数和行为。SoE 并不是一个与 CoE 并列的独立协议，而是基于 CoE 之上的。它规定了伺服驱动器必须实现哪些 CoE 对象、这些对象的含义以及如何通过 PDO 映射循环交换运动控制数据（如目标位置、实际位置、控制字、状态字等）。

SoE（通常遵循 IEC 61800-7 标准）确保了不同制造商生产的伺服驱动器在 EtherCAT 网络上具有互操作性，简化了系统集成。

SoE is a specific configuration profile for servo drives that defines the standard object dictionary, parameters, and behaviors related to motion control in servo drives. SoE is not an independent protocol on par with CoE but is based on CoE. It specifies which CoE objects must be implemented by the servo drive, the meanings of these objects, and how motion control data (such

as target position, actual position, control word, status word, etc.) is exchanged through PDO mapping.

SoE (typically following the IEC 61800-7 standard) ensures interoperability of servo drives from different manufacturers on the EtherCAT network, simplifying system integration.

3.4 过程数据 (Process Data) 与 FMMU/SM

Process Data and FMMU/SM

过程数据是 EtherCAT 实现高速实时控制的基石,其交换机制依赖于两个核心硬件单元: FMMU 和 SM。

Process data is the cornerstone of EtherCAT's high-speed real-time control, and its exchange mechanism relies on two core hardware units: FMMU and SM.

过程数据 (Process Data): 在每个通信周期 (通常为几十微秒到几毫秒) 内,主站与所有从站之间循环交换的数据。这些数据直接映射到主站控制器的内存中,称为“过程映像区”。特点是极低的延迟和极高的确定性,数据在 EtherCAT 帧“飞驰”过每个从站时被实时读写。

Process Data: Data that is cyclically exchanged between the master and all slaves during each communication cycle (typically ranging from tens of microseconds to several milliseconds). This data is directly mapped into the master controller's memory, referred to as the "process image area." It is characterized by extremely low latency and high determinism, with the data being read and written in real-time as the EtherCAT frame “flies” through each slave.

FMMU (现场总线内存管理单元): FMMU 是位于每个从站 ESC 内部的硬件逻辑单元,其核心作用是地址翻译。它将主站逻辑地址空间中一段连续地址,映射到本从站物理内存中的特定地址区域。网络配置阶段,主站为每个从站的 FMMU 进行编程。例如,主站可以配置:“逻辑地址 0x1000-0x1003 映射到从站 1 的物理地址 0x1500 (输出数据区);逻辑地址 0x1004-0x1007 映射到从站 2 的物理地址 0x1600 (输入数据区)”。主站只需向一段连续的逻辑地址读写数据,FMMU 硬件会自动将访问重定向到正确的从站。这使得主站可以像访问本地内存一样访问网络上所有从站的 I/O 数据,极大地简化了应用程序开发。

SM (同步管理器, SyncManager): SM 是位于每个从站 ESC 内部的硬件单元,负责管

理对双端口内存（用于邮箱和过程数据）的访问同步，防止主站和从站应用控制器同时读写同一块内存区域造成数据冲突，确保数据一致性。

FMMU (Fieldbus Memory Management Unit): The FMMU is a hardware logic unit inside each slave's ESC, and its core function is address translation. It maps a continuous address space in the master's logic address space to a specific physical address area in the slave's local memory. During the network configuration stage, the master programs the FMMU for each slave. For example, the master may configure: "Logical address 0x1000-0x1003 maps to slave 1's physical address 0x1500 (output data area); logical address 0x1004-0x1007 maps to slave 2's physical address 0x1600 (input data area)." The master only needs to read and write data to a continuous logical address range, and the FMMU hardware automatically redirects the access to the correct slave. This allows the master to access I/O data of all slaves on the network as if accessing local memory, greatly simplifying application development.

SM (Sync Manager): SM is a hardware unit inside each slave ESC, responsible for managing the synchronized access to dual-port memory (used for mailbox and process data) to prevent data conflicts caused by simultaneous read and write operations by the master and slave application controllers. It ensures data consistency.

3.5 分布式时钟（DC）模式与同步

Distributed Clock (DC) Mode and Synchronization

在从站中，应用程序通过基于分布式时钟单元的 SYNC0 事件实现同步，以确保所有现场总线设备的时间一致性。主站与从站的周期时间配置均以网络中的首个从站为基准，该从站使用 SYNC0 信号作为参考时钟。随后，系统利用此时钟对其他设备及控制器中的从站时钟进行同步。

In the slaves, synchronization is achieved through the SYNC0 event based on the distributed clock unit, ensuring time consistency across all fieldbus devices. The cycle time configuration between the master and slaves is based on the first slave in the network, which uses the SYNC0 signal as the reference clock. The system then uses this clock to synchronize the slave clocks in other devices and controllers.

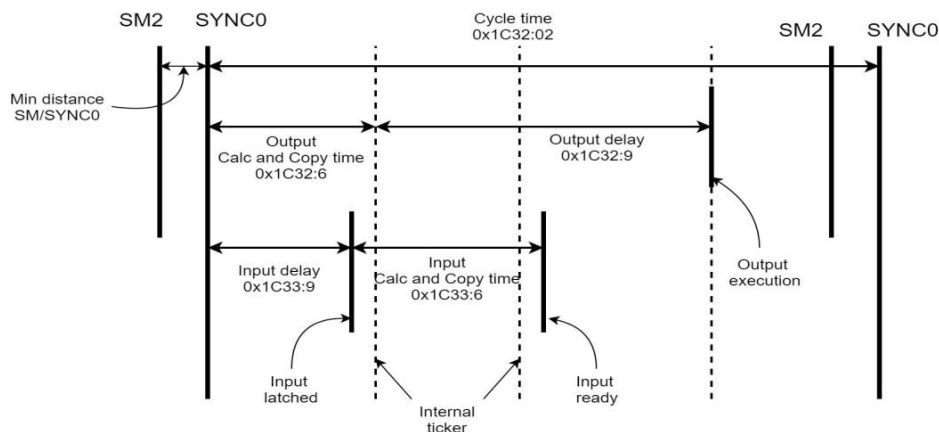


图 3-3 DC 模式时序图

Figure 3-3 DC Mode Timing Diagram

图 3-3 详细展示了分布式时钟（DC）同步模式的时序关系。其中，“Min distance SM/SYNC0”表示 SM2 信号到达与 DC 时钟间的最短时间间隔，若未满足该时间要求，将导致输出延迟。“Output Calc and Copy time”指从检测到 AL 事件到达至从 ESC 中获取数据所需的时间；“Output delay”则定义为应用程序执行输出操作所需的时间。另一方面，“Input delay”是指从站接收 SYNC0 信号与实际输入 SYNC0 信号之间的时间差；“Inputs Calc and Copy time”为将输入数据复制到 ESC 所需的时间。

所有从站均可配置最大 500 μs （最高对应 2 kHz）的输入延时。主站周期时间应设置为该值的整数倍（例如 1 $\times$ 500 μs 、2 $\times$ 500 μs 、3 $\times$ 500 μs ... $n\times$ 500 μs ）。

Figure 3-3 illustrates the timing relationship of the distributed clock (DC) synchronization mode in detail. "Min distance SM/SYNC0" indicates the minimum time interval between the SM2 signal and the DC clock. If this time requirement is not met, it will result in output delay. "Output Calc and Copy time" refers to the time required to get data from the slave ESC after detecting the AL event. "Output delay" defines the time needed for the application to execute the output operation. On the other hand, "Input delay" refers to the time difference between receiving the SYNC0 signal and the actual input SYNC0 signal. "Inputs Calc and Copy time" is the time required to copy input data to the ESC.

All slaves can configure the maximum input delay of 500 μs (up to 2 kHz). The master cycle time should be set as an integer multiple of this value (e.g., 1 $\times$ 500 μs , 2 $\times$ 500 μs , 3 $\times$ 500 μs ... $n\times$ 500 μs).

四、运动控制

Motion Control

4.1 操作时序

Operating Timing

电源打开到伺服使能操作时序（ $T1 > 5s$, $T2 = 500ms$, $T3 > 500ms$ ）。

Power-on to servo enable operation timing ($T1 > 5s$, $T2 = 500ms$, $T3 > 500ms$).

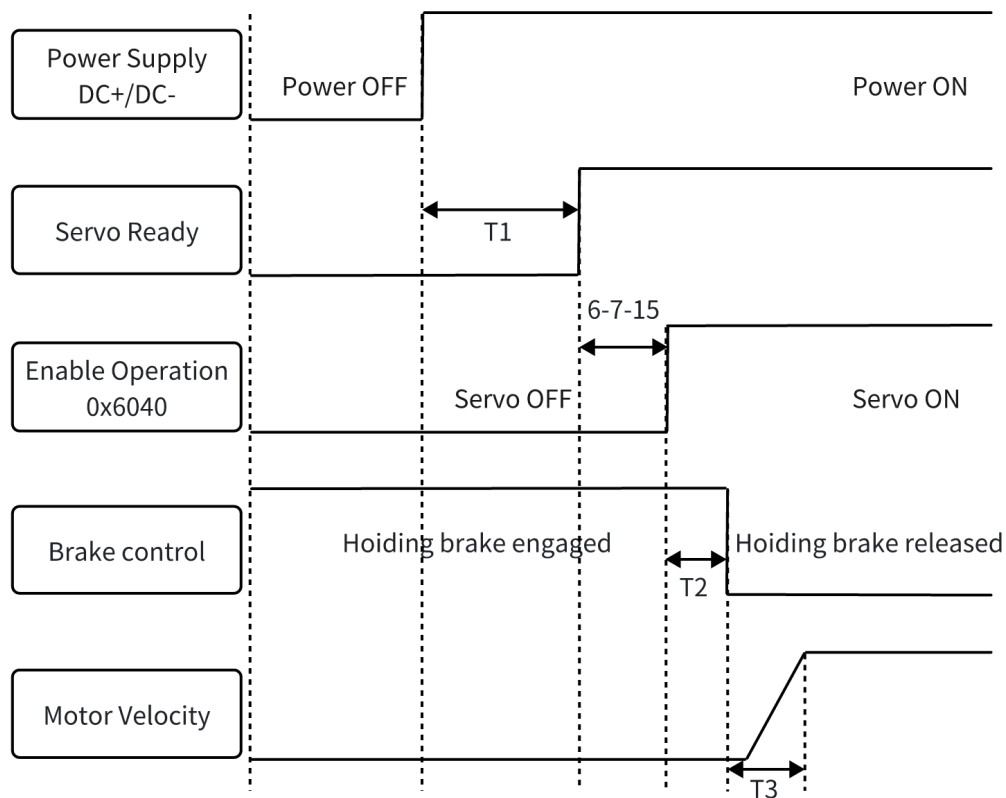


图 4-1 伺服使能操作时序

Figure 4-1 Servo Enable Operating Timing

从伺服使能到伺服下使能操作时序（ $T1 = 100ms$, $T2 > 100ms$ ）。

From servo enable to servo disable operation timing ($T1 = 100ms$, $T2 > 100ms$).

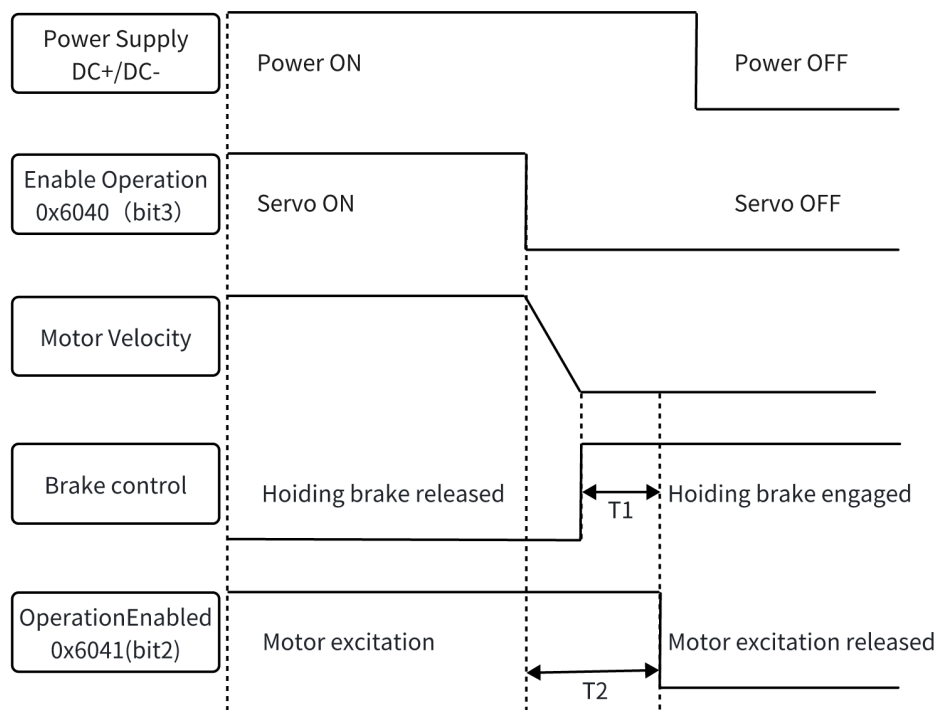


图 4-2 伺服下使能操作时序

Figure 4-2 Servo Disable Operating Timing

4.2 控制环路

Control Loop

关节模组采用内置绝对值双编码器的半闭环控制策略，通过负载端编码器可以计算电机端编码器多圈值。

The joint module adopts a semi-closed loop control strategy with a built-in absolute dual encoder. The load-end encoder is used to calculate the multi-turn value of the motor-end encoder.

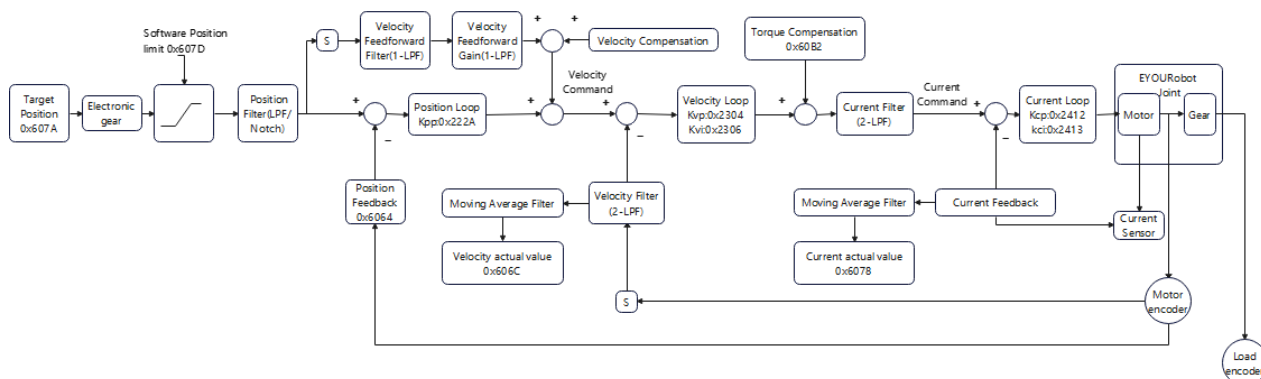


图 4-3 关节控制环路

Figure 4-3 Joint Control Loop

4.3 运行模式

Operating Modes

使用运行模式对象 (0x6060) 来设置所需的运行模式, 使用运行模式显示对象 (0x6061) 读取当前的运行模式。

Use the operating mode object (0x6060) to set the desired operating mode, and use the operating mode display object (0x6061) to read the current operating mode.

关于运行模式切换, 目前支持在使能静止状态下切换运行模式。从其他运行模式切换至位置模式 (PP、CSP) 之前, 需将实际位置 0x6064 的值 赋予目标位置 0x607A。

Regarding mode switching, it is currently supported to switch the operating mode while in the enabled stationary state. Before switching to position mode (PP, CSP) from other operating modes, the actual position at 0x6064 must be assigned to the target position at 0x607A.

表 4-1 运行模式

Table 4-1 Operating Modes

Mode	Abbr.	0x6060/6061	Characteristics
轮廓位置模式 Profile Position Mode	PP	1	主站规划轮廓, 驱动器本地执行 Master plans the profile, drive executes locally.
轮廓速度模式 Profile Velocity Mode	PV	3	主站设定速度轮廓 Master sets the velocity profile.
轮廓转矩模式 Profile Torque Mode	PT	4	主站设定转矩轮廓 Master sets the torque profile.
回零模式 Homing Mode	HM	6	寻找机械原点 Search for mechanical home position.
循环同步位置模式 Cyclic Synchronous Position Mode	CSP	8	主站周期发送位置指令, 同步性最高 Master cyclically sends position commands; highest synchronization.
循环同步速度模式 Cyclic Synchronous Velocity Mode	CSV	9	主站周期发送速度指令 Master cyclically sends velocity commands.
循环同步转矩模式 Cyclic Synchronous Torque Mode	CST	10	主站周期发送转矩指令 Master cyclically sends torque commands.

4.4 状态机

State Machine

伺服驱动器采用基于 CANopen 协议的状态机（Finite State Automaton, FSA）来定义其工作状态及相应的伺服控制功能。主站通过向控制字（对象字典索引 0x6040）写入特定指令序列，控制从站状态机的状态转换；从站则通过状态字（对象字典索引 0x6041）实时反馈当前状态，以响应主站指令。图 4-4 展示了该状态机的完整状态切换流程，具体各状态的详细说明可参考表 4-2。

The servo drive uses a state machine (Finite State Automaton, FSA) based on the CANopen protocol to define its operational states and corresponding servo control functions. The master controls the slave state machine's state transitions by writing specific command sequences to the control word (Object Dictionary Index 0x6040); the slave then provides real-time feedback of the current state through the status word (Object Dictionary Index 0x6041) in response to the master's instructions. Figure 4-4 shows the complete state transition process of this state machine, with a detailed description of each state in Table 4-2.

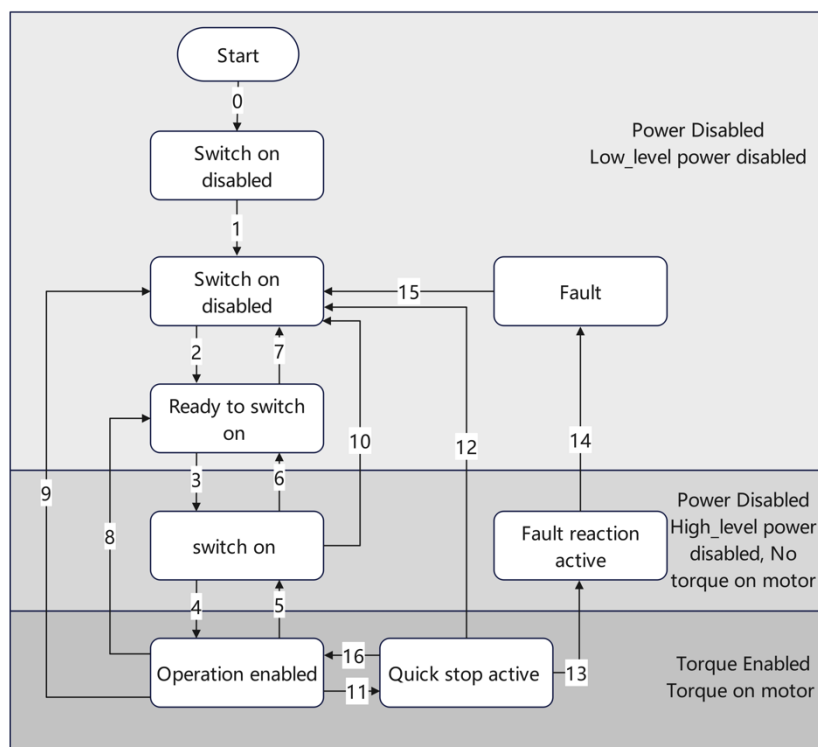


图 4-4 设备状态机

Figure 4-4 Device State Machine

表 4-2 状态字说明

Table 4-2 Status Word Description

State	Bit15~7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Description
初始化 Initialization	xxxx xxxx	0	0	x	0	0	0	0	驱动功能已禁用。 Drive function is disabled.
伺服无故障 Servo No Fault	xxxx xxxx	1	0	x	0	0	0	0	初始化完成，驱动器参数可修改，驱动功能已禁用。 Initialization complete. Drive parameters can be modified. Drive function is disabled.
伺服准备好 Servo Ready	xxxx xxxx	0	1	x	0	0	0	1	驱动器参数可修改，驱动功能已禁用。 Drive parameters can be modified. Drive function is disabled.
等待打开伺服使能 Wait for Servo Enable	xxxx xxxx	0	1	x	0	0	1	1	驱动功能已禁用，驱动器等待打开伺服使能，电流偏置校准完

									成。 Drive function disabled. Drive is waiting for servo enable. Current bias calibration is complete.
伺服运行 Servo Operation	xxxx xxxx	0	1	x	0	1	1	1	未检测到故障。 启用驱动功能， 电机使能。 No fault detected. Drive function enabled. Motor enabled.
快速停机 Quick Stop	xxxx xxxx	0	0	x	0	1	1	1	正在执行快速停机功能，启用驱动功能，电机使能。 Quick stop function is active. Drive function enabled. Motor enabled.
故障反应 Fault Reaction	xxxx xxxx	0	0	x	1	1	1	1	驱动器出现故障，正在执行故障停机过程。 A fault has occurred in the

									drive. The fault stop process is being executed.
故障 Fault	xxxx xxxx	0	0	x	1	0	0	0	驱动器出现故障，驱动器参数可能已修改，驱动功能已禁用。 A fault has occurred in the drive. Drive parameters might have been modified. Drive function is disabled.

说明：

Notes:

Bit 4: Bit 4=1 表示母线电压正常。如果电压欠压或电压过高，不能从 Switched on 转换到 Operation enabled。

Bit 4=1 indicates the DC bus voltage is normal. If the voltage is under-voltage or over-voltage, transition from 'Switched on' to 'Operation enabled' is not possible.

Bit 7: 如果状态字的 Bit 7（警告）为 1，则表示存在警告事件。警告不是错误或故障，状态机的状态不会改变。

If Bit 7 (Warning) of the Status Word is 1, it indicates a warning event exists. A warning is not an error or fault and does not change the state machine's state.

Bit 9: 如果设置了 Bit 9，设备执行现场总线命令。如果 Bit 9 被重置，则设备将通过不同的接口进行控制。在这种情况下，仍然可以通过现场总线读取或写入参数。

If Bit 9 is set, the device executes fieldbus commands. If Bit 9 is reset, the device is controlled via a different interface. Parameters can still be read or written via the fieldbus in this case.

Bit 10: 到达目标:

- 1) 当状态字 Bit 10 置为 1 时, 表示电机到达预设值。
- 2) 在运行模式修改时, Bit 10 置为 1。

Target Reached:

- 1) When Status Word Bit 10 is set to 1, it indicates the motor has reached the setpoint.
- 2) Bit 10 is also set to 1 when the operation mode is changed.

Bit 12~15: 详见 4.5 章节。

See Section 4.5 for details.

4.5 控制字与状态字

Control Word and Status Word

4.5.1 控制字

Control Word

控制字是一个 16 位的整数, 其标准对象字典索引为 0x6040。控制字的核心作用是控制驱动器的状态机转换。驱动器的运行遵循一个明确的状态机 (例如 DS402 规范中定义的状态机), 主站需要通过发送特定的控制字序列来引导驱动器从一个状态切换到另一个状态。

The control word is a 16-bit integer with the standard object dictionary index of 0x6040. The core function of the control word is to control the state machine transitions of the drive. The operation of the drive follows a defined state machine (such as the state machine defined in the DS402 specification), and the master needs to send a specific control word sequence to guide the drive from one state to another.

表 4-3 控制字

Table 4-3 Control Word

Bit	Name	Description
-----	------	-------------

0	伺服使能 Servo enabled	1-有效, 0-无效 1 - Valid, 0 - Invalid
1	接通主回路电 Main circuit powered on	1-有效, 0-无效 1 - Valid, 0 - Invalid
2	快速停机 Quick stop	0-有效, 1-无效 0 - Valid, 1 - Invalid
3	伺服运行 Servo operation	1-有效, 0-无效 1 - Valid, 0 - Invalid
4~6	特定运行模式 Operation mode specific	与各伺服运行模式相关 Mode dependent
7	故障复位 Fault reset	Bit7: 上升沿有效 Active on rising edge
8	停止 Halt	0: 默认值 (Default value 0) 1: 使用停止选项代码 (0x605D) 停止移动 (Stop movement using halt option code 0x605D)
9	特定运行模式 Operation mode specific	与各伺服运行模式相关 Related to each servo operation mode
10	保留 Reserved	未定义 Undefined
11~15	厂家自定义 Manufacturer specific	厂家设定 Defined by manufacturer

表 4-4 运行模式控制字

Table 4-4 Control Word by Operation Mode

Operation mode	Bit4	Bit5	Bit6	Bit8	Bit9	Bit11~ Bit15
PP	new set-point	change set immediately	0: absolute 1: relative	Halt	reserved	reserved
PV	reserved	reserved	reserved	Halt	reserved	reserved

PT	reserved	reserved	reserved	Halt	reserved	reserved
CSP	reserved	reserved	reserved	Halt	reserved	reserved
CSV	reserved	reserved	reserved	Halt	reserved	reserved
CST	reserved	reserved	reserved	Halt	reserved	reserved
HM	reserved	reserved	reserved	Halt	reserved	reserved
IP	Activate	reserved	reserved	Halt	reserved	reserved

4.5.2 状态字

Status Word

表 4-5 状态字

Table 4-5 Status Word

Bits	Name	Description
0	准备打开伺服使能 Ready to switch on	1-有效, 0-无效 1-valid, 0-invalid
1	伺服使能 Switched on	1-有效, 0-无效 1-valid, 0-invalid
2	伺服运行 Operation enabled	1-有效, 0-无效 1-valid, 0-invalid
3	故障 Fault	1-有效, 0-无效 1-valid, 0-invalid
4	接通主回路电 Voltage enabled	1-有效, 0-无效 1-valid, 0-invalid
5	快速停机 Quick stop	0-有效, 1-无效 0-valid, 1-invalid
6	伺服无故障 Switch on disabled	1-有效, 0-无效 1-valid, 0-invalid
7	警告 Warning	1-有效, 0-无效 1-valid, 0-invalid

8	厂家自定义 Manufacturer-specific	零速度状态 Zero speed state
9	远程控制 Remote	1-有效（默认），0-无效 1-valid(Defaulted), 0-invalid
10	目标到达 Target reach	1-有效，0-无效 1-valid, 0-invalid
11	软件内部位置超限 Internal limit active	1-有效，0-无效 1-valid, 0-invalid
12	特定的运行模式 Operation mode specific	与各伺服运行模式相关 Related to each servo operation mode
13	跟随错误 Follow the wrong path	1-有效，0-无效 1-valid, 0-invalid
14~15	厂家自定义 Manufacturer-specific	未定义 No define

表 4-6 运行模式状态字

Table 4-6 Status Word by Operation Mode

Mode	Bit8	Bit10	Bit12	Bit13
PP	Zero speed status	Target reached	New set-point capability	Following error
PV	Zero speed status	Target reached	Reserved	Reserved
PT	Zero speed status	Target reached	Reserved	Reserved
CSP	Zero speed status	Reserved	Set-point acknowledge	Following error
CSV	Zero speed status	Reserved	Set-point acknowledge	Following error
CST	Zero speed status	Reserved	Set-point acknowledge	Reserved
HM	Reserved	Reserved	Reserved	Reserved

IP	Reserved	Reserved	Reserved	Reserved
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4.6 循环同步操作模式

Cyclic Synchronous Operation Mode

循环同步操作模式是高性能伺服驱动器中用于实现精确同步运动控制的一组高级模式。这些模式严格依赖于网络通信系统的同步时钟（由周期性的同步报文，如 CANopen 中的 SYNC 或 EtherCAT 中的 SYNC 信号，来维持）。所有参与同步网络的设备共享一个统一的时间基准，使得控制周期在驱动器间精确对齐，从而实现多轴之间严格的相位同步和低抖动控制。

Cyclic synchronous operation modes are a set of advanced modes used in high-performance servo drives to achieve precise synchronized motion control. These modes rely strictly on the synchronized clock of the network communication system, which is maintained by periodic synchronization messages, such as SYNC signals in CANopen or EtherCAT. All devices participating in the synchronization network share a unified time reference, ensuring that control cycles are accurately aligned among drives, thereby achieving strict phase synchronization and low jitter control between multiple axes.

该类模式的核心特征是：控制器在每个预设的循环周期内，向驱动器发送新的设定值（目标位置、速度或转矩），同时驱动器在同一个周期内反馈实际值（实际位置、速度等）。这种确定性通信机制为复杂的多轴协调应用奠定了基础。

The core feature of these modes is that the controller sends new set values (target position, speed, or torque) to the drive during each preset cycle, while the drive simultaneously provides feedback of the actual values (actual position, speed, etc.) within the same cycle. This deterministic communication mechanism lays the foundation for complex multi-axis coordinated applications.

4.6.1 循环同步位置模式(CSP)

Cyclic Synchronous Position Mode (CSP)

将对象字典 0x6060 的值设置为 8，即可使关节模组运行于循环同步位置模式。

Set the value of Object Dictionary 0x6060 to 8 to enable the joint module to operate in Cyclic Synchronous Position Mode (CSP).

在此模式下，主站控制器承担轨迹规划功能，并于每个 EtherCAT/CAN 通信周期将目标位置指令发送至关节模组；关节则根据接收到的指令，在内部完成位置、速度与转矩的三闭环控制。

In this mode, the master controller takes on the trajectory planning function and sends target position instructions to the joint module during each EtherCAT/CAN communication cycle. The joint module then completes position, speed, and torque three-loop control internally based on the received instructions.

如图 4-4 所示，驱动器控制功能的输入包括由控制器提供的目标位置，以及可选的速度前馈和转矩前馈量，后者用于改善系统响应。位置限制功能可有效防止越位。目标位置被视为绝对位置。实际位置值作为强制数据反馈至控制器，实际速度与实际转矩值则为可选反馈项。位置跟踪误差可作为附加监控参数使用。

As shown in Figure 4-4, the input to the drive control function includes the target position provided by the controller, as well as optional speed feedforward and torque feedforward, which are used to improve system response. The position limit function effectively prevents overshoot. The target position is treated as an absolute position. The actual position is forced feedback to the controller, while the actual speed and actual torque values are optional feedback items. Position tracking error can be used as an additional monitoring parameter.

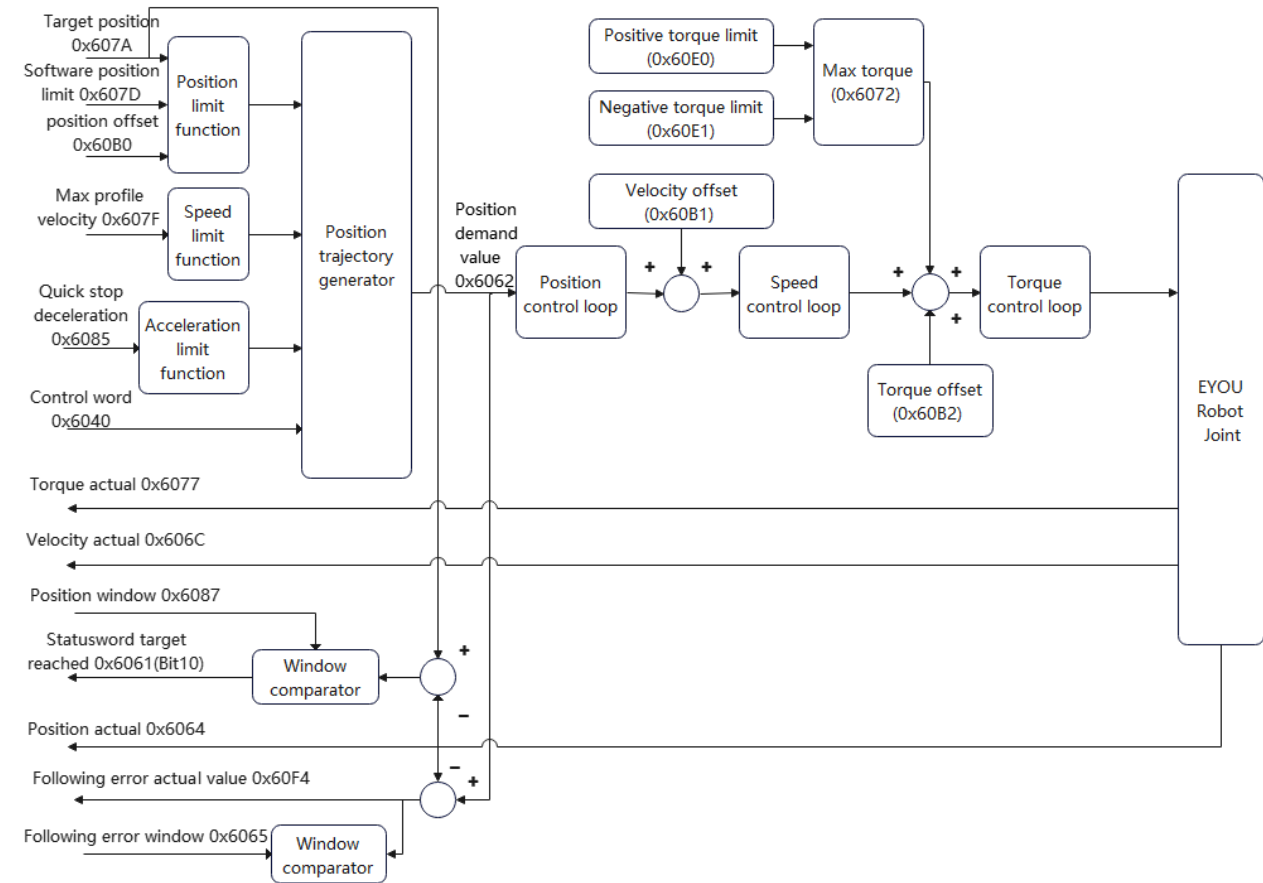


图 4-5 CSP 模式功能

Figure 4-5 CSP Mode Features

CSP 模式相关的对象字典如下表所示：

Object Dictionary for CSP (Cyclic Synchronous Position) Mode:

表 4-7 CSP 模式相关字典

Table 4-7 CSP Mode Related Dictionary

Index	Sub Index	Name	Unit	Data type	Access	PDO mapping
0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO
0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO
0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x6062	00h	Position demand value	plus	INT	RO	NO
0x6064	00h	Position actual value	plus	INT	RO	TxPDO

0x6065	00h	Following error window	plus	UINT	RW	NO
0x6067	00h	Position window	plus	UINT	RW	NO
0x6068	00h	Position window time	0.05ms	UINT	RW	NO
0x6081	00h	Profile velocity	plus/s	UINT	RW	TxPDO
0x6083	00h	Profile acceleration	plus/s ²	UINT	RW	TxPDO
0x6084	00h	Profile deceleration	plus/s ²	UINT	RW	TxPDO
0x607A	00h	Target position	plus	INT	RW	RxPDO
0x607D	01h	Software position limit: Min position limit	plus	INT	RW	NO
	02h	Software position limit: Max position limit	plus	INT	RW	NO
0x60F4	00h	Following error actual value	plus	INT	RO	TxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 8 (0x6060=8)，循环同步位置模式；

Set the operation mode to 8 (0x6060=8), Cyclic Synchronous Position mode.

- ② 读取实际位置 0x6064，设置目标位置 0x607A 等于当前实际位置值；

Read the actual position (0x6064) and set the target position (0x607A) equal to the current actual position value.

- ③ 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态；

Set the Control Word (0x6040) with the specific sequence (0x06 -> 0x07 -> 0x0F) to transition the servo drive into the enabled state.

- ④ 主站控制器将规划好的目标位置点通过 0x607A 这个对象字典周期性地发送给关节模组。

The master controller cyclically sends the planned target position points to the joint module via object 0x607A.

表 4-8 CSP 状态字相关位

Table 4-8 CSP Status Word Related Bits

状态字定义 Status Word Bit	描述 Description
Bit10	目标到达: 指示电机是否已达到目标位置 (0= 未达到目标位置, 1= 达到目标位置) Target Reached: Indicates whether the motor has reached the target position (0= Not reached, 1= Reached).
Bit11	内部限制生效: 指示软件限制是否生效 (最大电机速度 0x6080 限制速度需求值 0x606B 和轮廓速度 0x6081, 软件位置限制值 0x607D 限制位置需求值 0x6062) Internal Limit Active: Indicates whether software limits are active (e.g., Max motor speed 0x6080 limits velocity demand 0x606B and profile velocity 0x6081; software position limit 0x607D limits position demand 0x6062).
Bit12	目标位置确认: 0: 驱动器准备就绪, 可接收新的目标位置指令。 1: 驱动器已接收并开始处理新指令。 Set-point Acknowledge: 0: Drive is ready to accept a new target position command. 1: Drive has accepted and started processing a new command.
Bit13~15	保留 Reserved

4.6.2 循环同步速度模式(CSV)

Cyclic Synchronous Velocity Mode (CSV)

将对象字典 0x6060 的值设为 9, 即可激活关节模组的循环同步速度模式。

Set the value of object dictionary 0x6060 to 9 to activate the Cyclic Synchronous Velocity mode in the joint module.

在此模式下，主站控制器负责进行速度轨迹规划，并周期性地发送目标速度指令；关节模组则接收指令，并执行内部的速度环与转矩环控制。此外，还可通过速度前馈和转矩前馈来优化动态控制效果。需要注意的是，轮廓加速度与轮廓减速度参数仅在停止或快速停止功能被激活时才会起作用。

In this mode, the master controller is responsible for velocity trajectory planning and cyclically sends the target velocity command; the joint module receives the command and executes internal velocity loop and torque loop control. Furthermore, velocity feedforward and torque feedforward can be used to optimize dynamic control performance. Note that the Profile Acceleration and Profile Deceleration parameters only take effect when the Halt or Quick Stop function is activated.

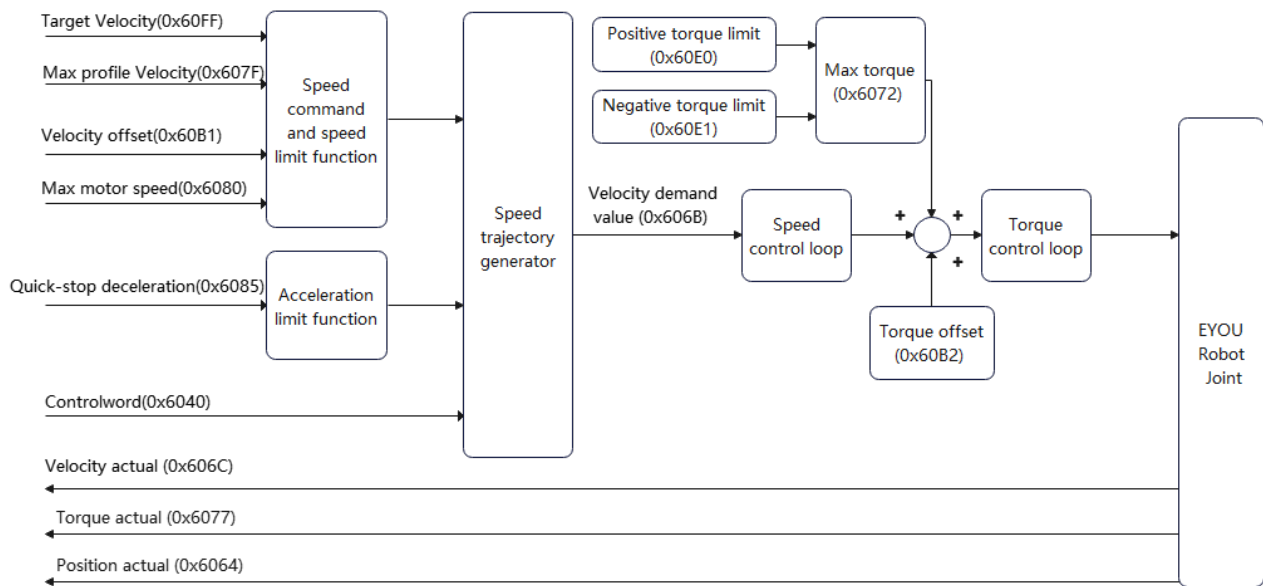


图 4-6 CSV 模式功能

Figure 4-6 CSV Mode Functionality

CSV 相关的对象字典如下表所示：

The object dictionaries related to CSV mode are shown in the table below:

表 4-9 CSV 模式相关字典

Table 4-9 CSV Mode Related Object Dictionary

Index	Sub - Index	Name	Unit	Data type	Access	PDO mapping
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0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO
0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO
0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x606C	00h	Velocity actual value	plus/s	INT	RW	RxPDO
0x6078	00h	Current actual value	per thousand of rated current	INT	RO	TxPDO
0x607D	01h	Software position limit: Min position limit	plus	INT	RW	NO
	02h	Software position limit: Max position limit	plus	INT	RW	NO
0x607F	00h	Max profile velocity	plus/s	UINT	RW	RxPDO
0x60FF	00h	Target velocity	plus/s	INT	RW	RxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 9 (0x6060=9)，循环同步速度模式；

Set the operation mode to 9 (0x6060=9), Cyclic Synchronous Velocity mode.

- ② 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态；

Set the Control Word (0x6040) with the specific sequence (0x06 -> 0x07 -> 0x0F) to transition the servo drive into the enabled state.

- ③ 设置目标速度 0x60FF。

Set the Target Velocity (0x60FF).

表 4-10 CSV 状态字相关位

Table 4-10 CSV Status Word Related Bits

状态字定义 Status Word Bit	描述 Description
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Bit10	目标到达： 实际速度在“速度窗口时间”内持续保持在（目标速度±速度窗口）的范围内。（0：未到达，1：已到达） Target Reached: The actual velocity remains within (Target Velocity ± Velocity Window) for the duration of the "velocity window time" (0: Not reached, 1: Reached).
Bit11	内部限制生效： 指示软件限制是否生效（最大电机速度 0x6080 限制速度需求值 0x60FF 和速度偏移量 0x60B1） Internal Limit Active: Indicates whether software limits are active (e.g., Max motor speed 0x6080 limits velocity demand 0x60FF and velocity offset 0x60B1).
Bit12	目标速度确认： 0：驱动器准备就绪，可接收新的目标速度指令。 1：驱动器已接收并开始处理新指令。 Set-point Acknowledge: 0: Drive is ready to accept a new target velocity command. 1: Drive has accepted and started processing a new command.
Bit13~15	保留 Reserved

4.6.3 循环同步转矩模式(CST)

Cyclic Synchronous Torque Mode (CST)

将对象字典 0x6060 的值设为 10，即可使关节模组运行于循环同步转矩模式。

Set the value of Object Dictionary 0x6060 to 10 to enable the joint module to operate in Cyclic Synchronous Torque Mode (CST).

在此模式下，主站控制器负责生成目标转矩指令，而伺服驱动器则接收并执行该指令。

主站在每个通信周期发送的 PDO 报文中，包含目标转矩和控制字。转矩偏移值可作为前馈量输入，以提升系统动态响应。

In this mode, the master controller is responsible for generating target torque commands, while the servo drive receives and executes those commands. Each PDO message sent by the master in every communication cycle contains the target torque and control word. Torque offset values can be used as feedforward inputs to improve the system's dynamic response.

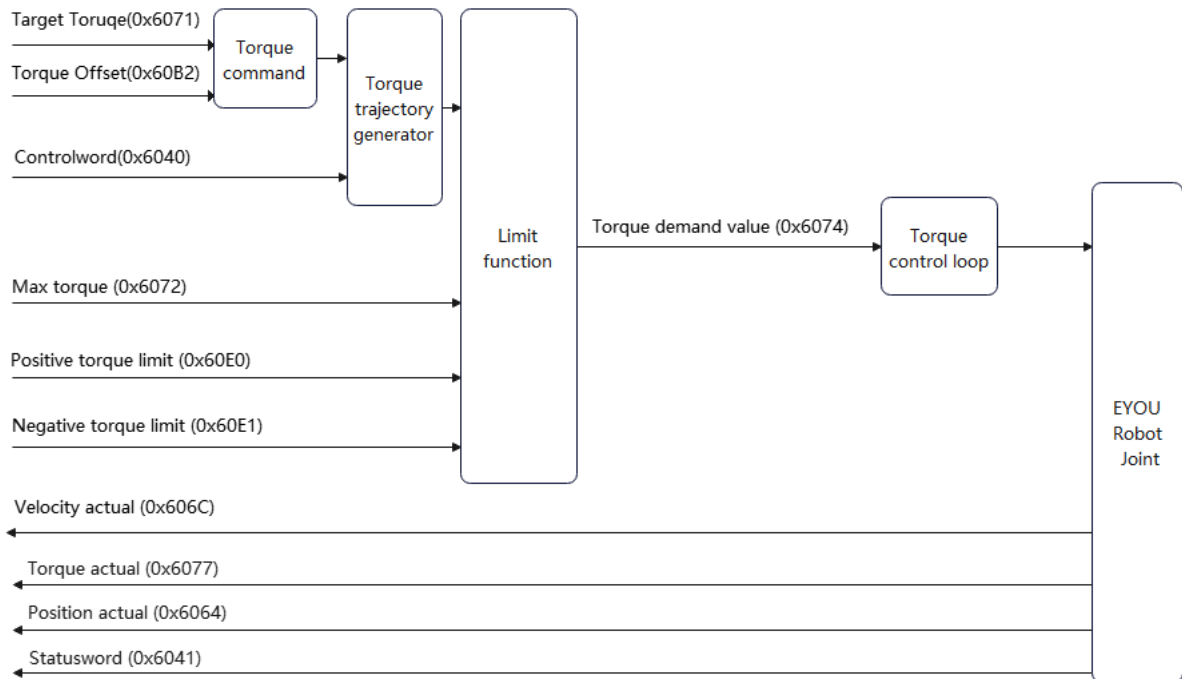


图 4-7 CST 模式功能

Figure 4-7 CST Mode Features

相关的对象字典如下表所示：

The related object dictionary is shown in the following table:

表 4-11 CST 模式相关字典

Table 4-11 CST Mode Related Dictionary

Index	Sub - Index	Name	Unit	Data type	Access	PDO mapping
0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO
0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO

0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x6071	00h	Target torque	per thousand of rated current	INT	RW	RxPDO
0x6072	00h	Max torque	per thousand of rated current	UINT	RW	NO
0x6073	00h	Max current	per thousand of rated current	INT	RW	NO
0x6074	00h	Torque demand value	per thousand of rated current	INT	RO	NO
0x6075	00h	Motor rated current	mA	UINT	RW	NO
0x6076	00h	Motor rated torque	mNm	UINT	RW	NO
0x6077	00h	Motor actual torque	per thousand of rated current	INT	RO	TxPDO
0x6078	00h	Motor actual current	per thousand of rated current	INT	RO	TxPDO
0x6087	00h	Torque slop	per thousand of rated current	UINT	RW	NO
0x60B2	00h	Torque offset	per thousand of rated current	INT	RW	RxPDO
0x60E0	00h	Positive torque limit value	mA	UINT	RW	RxPDO
0x60E0	00h	Negative torque limit value	mA	UINT	RW	RxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 10 (0x6060=10)，循环同步转矩模式;

Set the operation mode to 10 (0x6060=10), Cyclic Synchronous Torque mode.

- ② 设定目标扭矩，0x6071 = 0。由于扭矩模式下，一旦使能，伺服目标扭矩即作用，因此先设定为 0，以确保安全；

Set the target torque, 0x6071 = 0. Since in torque mode the target torque takes effect immediately upon enable, setting it to 0 first ensures safety.

- ③ 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态；

Set the Control Word 0x6040 (0x06 -> 0x07 -> 0x0F) to transition the servo into the enabled state.

- ④ 设置目标扭矩 0x6071。

Set the Target Torque 0x6071.

表 4-12 CST 状态字相关位

Table 4-12 CST Status Word Related Bits

状态字定义 Status Word Bit	描述 Description
Bit10	目标到达： 实际扭矩在“扭矩窗口时间”内持续保持在（目标扭矩±扭矩窗口）的范围内。（0：未到达，1：已到达） Target Reached: The actual torque remains within (Target Torque ± Torque Window) for the duration of the "torque window time" (0: Not reached, 1: Reached).
Bit11	内部限制生效： 指示软件限制是否生效（最大电机扭矩 0x6072 限制扭矩需求值 0x6071 和扭矩偏移 0x60B2） Internal Limit Active: Indicates whether software limits are active (Max motor torque 0x6072 limits torque demand value 0x6071 and torque offset 0x60B2).
Bit12	目标扭矩被忽略： 0：驱动器准备就绪，可接收新的目标扭矩指令。

	1: 驱动器已接收并开始处理新指令。 Set-point Acknowledge: 0: Drive is ready to accept a new target torque command. 1: Drive has accepted and started processing a new command.
Bit13~15	保留 Reserved

4.6.4 循环同步力控模式(CSF) (*力控关节特有)

Cyclic Synchronous Cyclic Force Control Mode (CSF)*Unique to force-controlled joints

将对象字典 0x6060 的值设为 13，即可使关节模组运行于循环同步力控模式。

Set the value of Object Dictionary 0x6060 to 13 to enable the joint module to operate in Cyclic Synchronous T Cyclic Force Control Mode (CSF).

在此模式下，主站控制器负责生成目标转矩指令，而伺服驱动器则接收并执行该指令。主站在每个通信周期发送的 PDO 报文中，包含目标转矩和控制字。转矩偏移值可作为前馈量输入，以提升系统动态响应。

In this mode, the master controller is responsible for generating target torque commands, while the servo drive receives and executes those commands. Each PDO message sent by the master in every communication cycle contains the target torque and control word. Torque offset values can be used as feedforward inputs to improve the system's dynamic response.

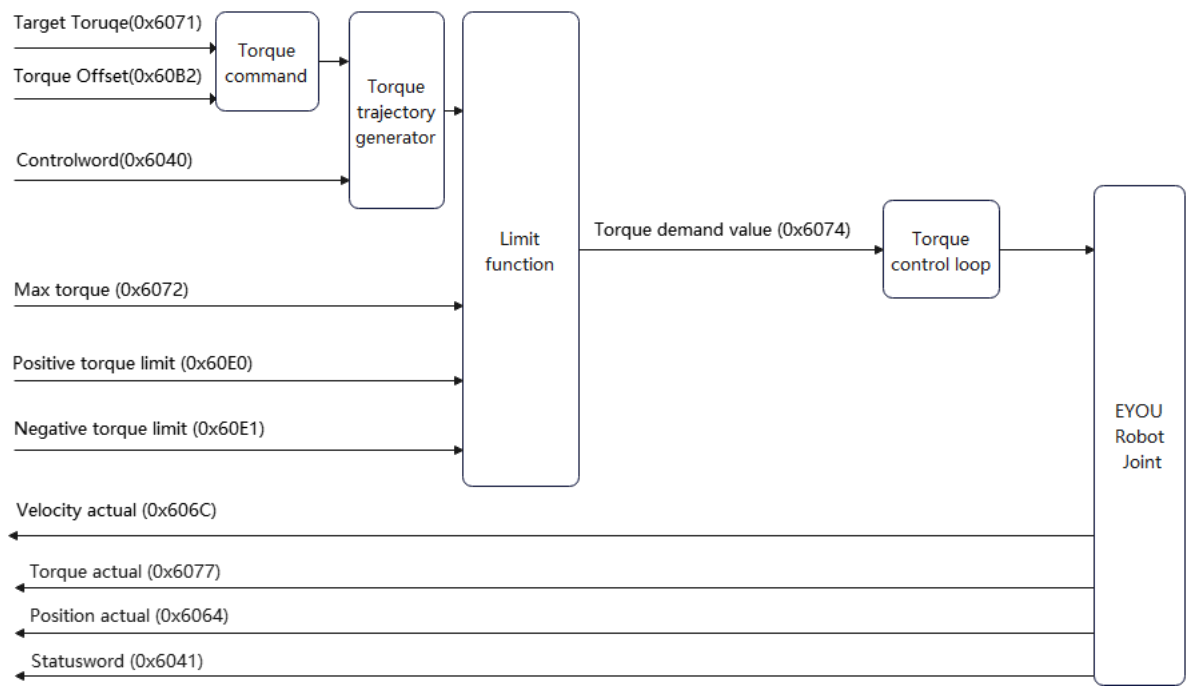


图 4-7 CSF 模式功能

Figure 4-7 CST Mode Features

相关的对象字典如下表所示：

The related object dictionary is shown in the following table:

表 4-11 CST 模式相关字典

Table 4-11 CST Mode Related Dictionary

Index	Sub - Index	Name	Unit	Data type	Access	PDO mapping
0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO
0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO
0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x6071	00h	Target torque	per thousand of Rated Torque	INT	RW	RxPDO
0x6072	00h	Max torque	per thousand of Rated Torque	UINT	RW	NO

0x6073	00h	Max current	per thousand of rated current	INT	RW	NO
0x6074	00h	Torque demand value	per thousand of Rated Torque	INT	RO	NO
0x6075	00h	Motor rated current	mA	UINT	RW	NO
0x6076	00h	Motor rated torque	mNm	UINT	RW	NO
0x6077	00h	Motor actual torque	per thousand of rated current	INT	RO	TxPDO
0x6078	00h	Motor actual current	per thousand of rated current	INT	RO	TxPDO
0x6087	00h	Torque slop	per thousand of rated current	UINT	RW	NO
0x60B2	00h	Torque offset	per thousand of rated current	INT	RW	RxPDO
0x60E0	00h	Positive torque limit value	mA	UINT	RW	RxPDO
0x60E0	00h	Negative torque limit value	mA	UINT	RW	RxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 13 (0x6060=13)，循环同步力控模式；

Set the operation mode to 13 (0x6060=13), Cyclic Synchronous Force Control Mode (CSF).

- ② 设定目标扭矩，0x6071 = 0。由于扭矩模式下，一旦使能，伺服目标扭矩即作用，因此先设定为 0，以确保安全；

Set the target torque, 0x6071 = 0. Since in torque mode the target torque takes effect immediately upon enable, setting it to 0 first ensures safety.

- ③ 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态；

Set the Control Word 0x6040 (0x06 -> 0x07 -> 0x0F) to transition the servo into the enabled state.

④ 设置目标扭矩 0x6071。

Set the Target Torque 0x6071.

表 4-12 CST 状态字相关位

Table 4-12 CST Status Word Related Bits

状态字定义 Status Word Bit	描述 Description
Bit10	目标到达: 实际扭矩在“扭矩窗口时间”内持续保持在（目标扭矩±扭矩窗口）的范围内。（0：未到达，1：已到达） Target Reached: The actual torque remains within (Target Torque ± Torque Window) for the duration of the "torque window time" (0: Not reached, 1: Reached).
Bit11	内部限制生效: 指示软件限制是否生效（最大电机扭矩 0x6072 限制扭矩需求值 0x6071 和扭矩偏移 0x60B2） Internal Limit Active: Indicates whether software limits are active (Max motor torque 0x6072 limits torque demand value 0x6071 and torque offset 0x60B2).
Bit12	目标扭矩被忽略: 0: 驱动器准备就绪，可接收新的目标扭矩指令。 1: 驱动器已接收并开始处理新指令。 Set-point Acknowledge: 0: Drive is ready to accept a new target torque command. 1: Drive has accepted and started processing a new command.
Bit13~15	保留 Reserved

4.7 轮廓操作模式

Profile Operation Mode

轮廓操作模式是一组基于“目标点”的运动控制模式。与循环同步模式需要实时发送设定值不同，在该类模式下，主站控制器通过对象字典设定目标位置、目标速度或目标转矩，以及相关的轮廓参数（如加速度、减速度等），然后通过控制字触发运动。驱动器在接收到触发信号后，将自动、独立地完成整个点到点的运动轮廓。这种模式降低了对通信实时性的要求，简化了上位机的控制逻辑。

Profile operation modes are a set of motion control modes based on "target points". Unlike cyclic synchronous modes that require real-time set values to be sent, in these modes, the master controller sets the target position, target speed, or target torque, along with related profile parameters (such as acceleration, deceleration, etc.) through the object dictionary, and then triggers the movement through a control word. Once the drive receives the trigger signal, it will independently complete the entire point-to-point motion profile. This mode reduces the real-time communication requirements and simplifies the control logic of the upper-level machine.

4.7.1 轮廓位置模式(PP)

Profile Position Mode (PP)

将对象字典 0x6060 的值设为 1，即可使关节模组运行于轮廓位置模式。

Set the value of Object Dictionary 0x6060 to 1 to enable the joint module to operate in Profile Position Mode (PP).

该模式下，主站控制器设定目标位置与轮廓参数，而驱动器则自主规划并执行完整的点到点运动轨迹，无需控制器进行实时插补。

In this mode, the master controller sets the target position and profile parameters, while the drive autonomously plans and executes the full point-to-point motion trajectory without requiring real-time interpolation from the controller.

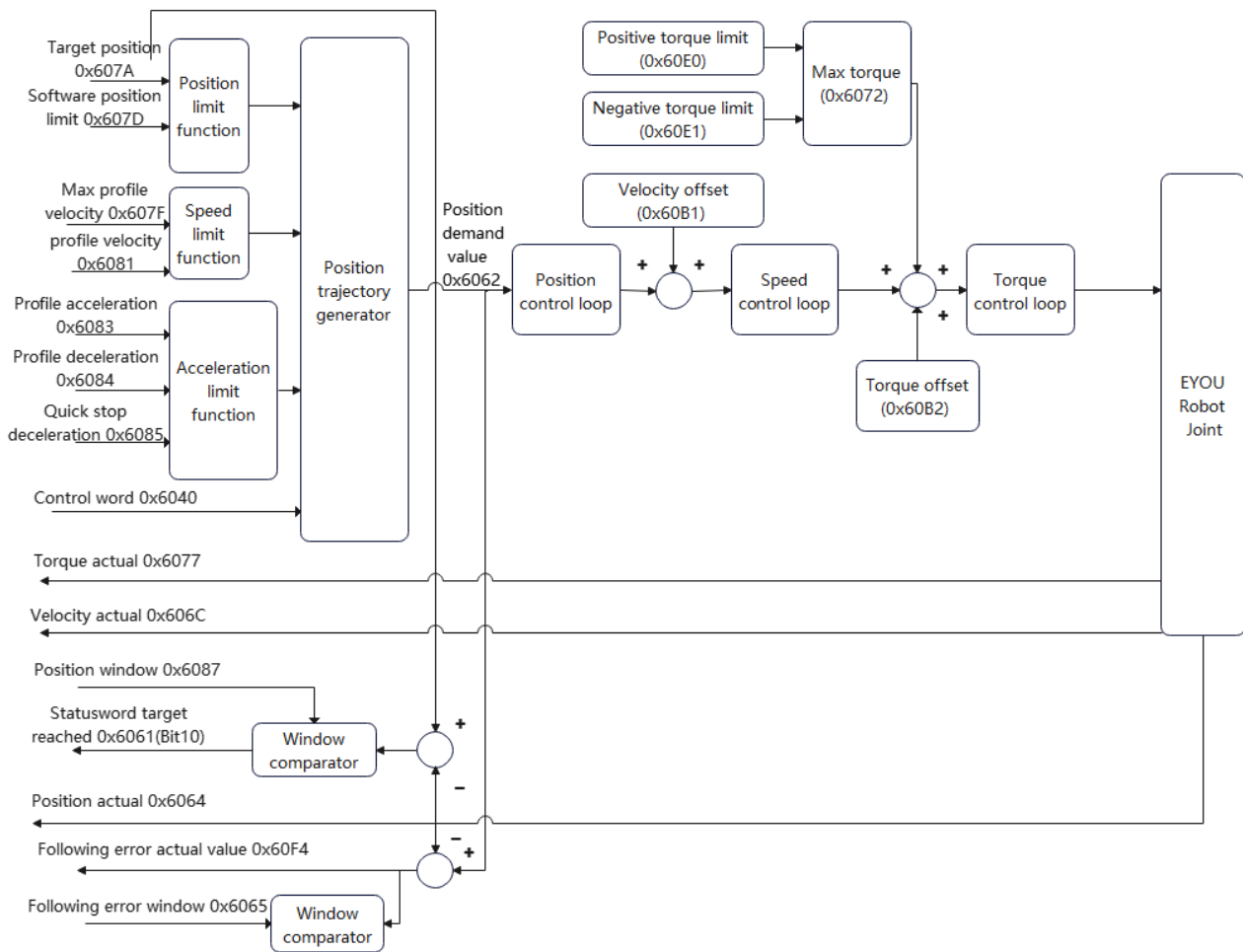


图 4-8 PP 模式功能

Figure 4-8 PP Mode Features

PP 模式相关的对象字典如下表所示：

The object dictionary related to the PP mode is shown in the table below:

表 4-13 PP 模式相关字典

Table 4-13 PP Mode Related Dictionary

Index	Sub - Index	Name	Unit	Data type	Access	PDO mapping
0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO
0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO
0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x6062	00h	Position demand value	plus	INT	RO	NO

0x6064	00h	Position actual value	plus	INT	RO	TxPDO
0x6065	00h	Following error window	plus	UINT	RW	NO
0x6067	00h	Position window	plus	UINT	RW	NO
0x6068	00h	Position window time	0.05ms	UINT	RW	NO
0x6081	00h	Profile velocity	plus/s	UINT	RW	TxPDO
0x6083	00h	Profile acceleration	plus/s ²	UINT	RW	TxPDO
0x6084	00h	Profile deceleration	plus/s ²	UINT	RW	TxPDO
0x607A	00h	Target position	plus	INT	RW	RxPDO
0x607D	01h	Software position limit: Min position limit	plus	INT	RW	NO
	02h	Software position limit: Max position limit	plus	INT	RW	NO
0x60F4	00h	Following error actual value	plus	INT	RO	TxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 1 (0x6060=1)，轮廓位置模式；

Set the operation mode to 1 (0x6060=1), Profile Position mode.

- ② 设置目标位置 (0x607A)、轮廓速度 (0x6081)、轮廓加速度 (0x6083)、轮廓减速度 (0x6084)；

Set the Target Position (0x607A), Profile Velocity (0x6081), Profile Acceleration (0x6083), and Profile Deceleration (0x6084).

- ③ 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态；

Set the Control Word (0x6040) with the specific sequence (0x06 -> 0x07 -> 0x0F) to transition the servo drive into the enabled state.

- ④ 设置控制指令 0x6040 (Bit4 从 0 到 1)，命令触发，由于控制命令触发为上升沿触发，因此必须将控制字 bit4 值切换为 off 再切至 on，伺服才会再次运动。

Set Bit4 (New set-point) of the Control Word 0x6040 to generate a rising edge (from 0 to

1) to trigger the movement. Since this bit is rising-edge triggered, it must be toggled from 0 to 1 again to trigger a subsequent movement.

表 4-14 PP 模式控制位与状态位

Table 4-14 PP Mode Control and Status Bits

字定义 Control Word Bits			描述 Description
Bit6	Bit5	Bit4	
0: 绝对运动 Absolute movement 1: 相对运动 Relative movement	0:不立即更新 Not immediate	0->1	开始向目标位置移动。 如果未启用立即生效指令，当前的运动命令正在执行时（尚未完成），即使接收到新的触发命令（Bit4:0->1），伺服也会继续执行当前的运动命令，只有在当前运动令完成后(在当前目标位置停止)，才会确认并执行新的运动命令。 Starts a movement to a target position. If the command is not enabled to take immediate effect, when the current motion command is in execution (not yet complete), the servo continues to execute the current motion command even if a new command is triggered (Bit4:0=>1) . The new command is acknowledged and executed only after the current command is complete(The movement is stopped at the current target position) .
	1:立即更新 Immediate	0->1	开始向目标位置移动。 如果启用立即生效指令，当前的运动命令 正在执行时（尚未完成），伺服一旦接收 到新的触发命令（Bit4:0->1），就会立即 中断当前运动指令并执行新的运动命令。 If the command is enabled to take immediate effect, when the current motion command is in execution (not yet complete), the servo immediately interrupts the current command and executes the new command once receiving the new triggered command (Bit4:0=>1) .

表 4-15 PP 模式状态字相关位

Table 4-15 PP Mode Status Word Related Bits

状态字定义	描述
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Status Word Bit	Description
Bit10	目标到达: 0: 未到达, 1: 已到达 Target Reached: 0: Not reached, 1: reached
Bit11	内部限制生效: 指示软件限制是否生效 (最大电机速度 0x6080 限制速度需求值 0x606B 和轮廓速度 0x6081。软件位置限制值 0x607D 限制位置需求值 0x6062。) Internal Limit Active: Indicates whether software limits are active (e.g., Max motor speed 0x6080 limits velocity demand 0x606B and profile velocity 0x6081; software position limit 0x607D limits position demand 0x6062).
Bit12	目标位置被忽略: 0: 驱动器准备就绪, 可接收新的目标位置指令。 1: 驱动器已接收并开始处理新指令。 New set-point capability: 0: Drive is ready to accept a new target position command. 1: Drive has accepted and started processing a new command and is temporarily unable to accept the next command.
Bit13~15	保留 Reserved

4.7.2 轮廓速度模式(PV)

Profile Velocity Mode (PV)

将对象字典 0x6060 的值设为 3, 即可使关节模组运行于轮廓速度模式。

Set the value of Object Dictionary 0x6060 to 3 to enable the joint module to operate in Profile Velocity Mode (PV).

该模式下, 主站控制器设定目标速度与加减速度参数, 模组则根据这些参数内部规划并生成平滑的速度变化曲线。

In this mode, the master controller sets the target speed and acceleration/deceleration parameters, and the module internally plans and generates smooth speed change curves based on

these parameters.

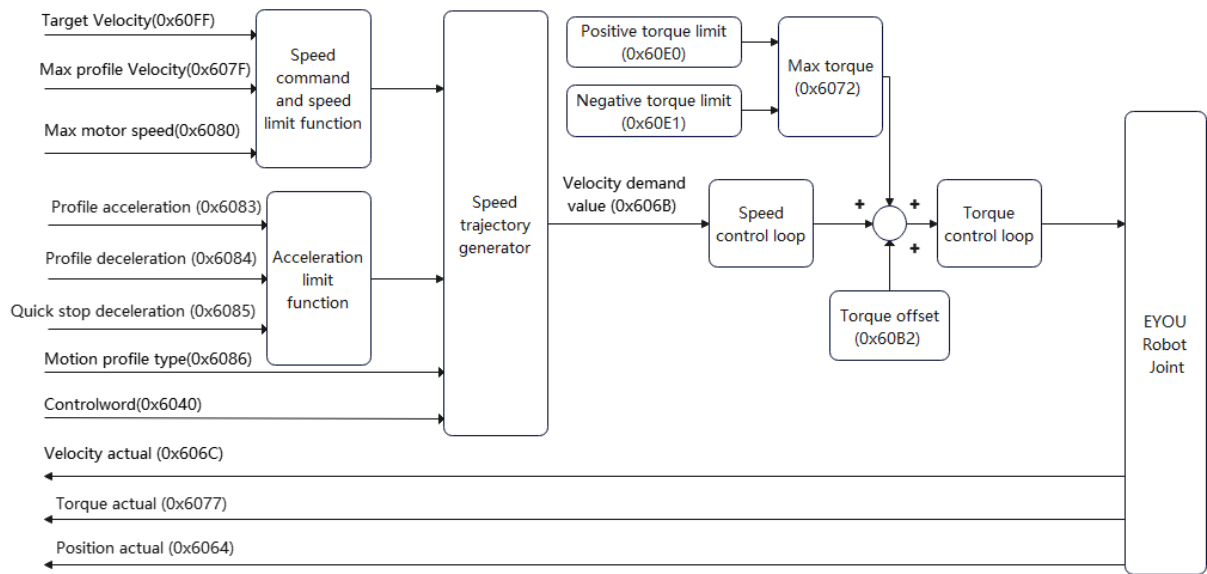


图 4-9 PV 模式功能

Figure 4-9 PV Mode Features

PV 模式相关的对象字典如下表所示：

The object dictionary related to PV mode is shown in the following table:

表 4-16 PV 模式相关字典

Table 4-16 PV Mode Related Dictionary

Index	Sub - Index	Name	Unit	Data type	Access	PDO mapping
0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO
0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO
0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x606C	00h	Velocity actual value	plus/s	INT	RW	RxPDO
0x6078	00h	Current actual value	per thousand of rated current	INT	RO	TxPDO

0x607D	01h	Software position limit: Min position limit	plus	INT	RW	NO
	02h	Software position limit: Max position limit	plus	INT	RW	NO
0x607F	00h	Max profile velocity	plus/s	UINT	RW	RxPDO
0x60FF	00h	Target velocity	plus/s	INT	RW	RxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 3 (0x6060=3)，轮廓速度模式;

Set the operation mode to 3 (0x6060=3), Profile Velocity mode.

- ② 设置轮廓加速度 (0x6083)、轮廓减速度 (0x6084)、目标速度 (0x60FF);

Set the Profile Acceleration (0x6083), Profile Deceleration (0x6084), and Target Velocity (0x60FF).

- ③ 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态。

Set the Control Word 0x6040 (0x06 -> 0x07 -> 0x0F) to transition the servo into the enabled state.

表 4-17 PV 模式控制字相关位

Table 4-17 PV Mode Control Word Related Bits

字定义 Control Word Bit	描述 Description
Bit8	控制运动停止: Controls movement execution: 值 0: 执行运动, 驱动器加速 (使用指定的轮廓加速度加速), 直到达到速度或停止位设置为 1。 Execute movement. The drive accelerates (using the specified Profile Acceleration) until the target velocity is reached or the Halt bit is set to 1. 值 1: 停止运动, 驱动器减速 (使用指定的轮廓减速度减速), 直到速度 = 0 或停止位重置为 0。 Halt movement. The drive decelerates (using th

	e specified Profile Deceleration) until the velocity reaches zero or the Halt bit is reset to 0.
--	--

表 4-18 PV 模式状态字相关位

Table 4-18 PV Mode Status Word Related Bits

状态字定义 Status Word Bit	描述 Description
Bit10	目标到达： 实际速度在“速度窗口时间”内持续保持在（目标速度±速度窗口）的范围内。（0：未到达，1：已到达） Target Reached: The actual velocity remains within (Target Velocity ± Velocity Window) for the duration of the "velocity window time" (0: Not reached, 1: Reached).
Bit11	内部限制生效： 指示软件限制是否生效（最大电机速度 0x6080 限制速度需求值 0x60FF 和速度偏移量 0x60B1） Internal Limit Active: Indicates whether software limits are active (Max motor speed 0x6080 limits velocity demand 0x60FF and velocity offset 0x60B1).
Bit12	目标速度被忽略： 0：驱动器准备就绪，可接收新的目标速度指令。 1：驱动器已接收并开始处理新指令。 Set-point Acknowledge: 0: Drive is ready to accept a new target velocity command. 1: Drive has accepted and started processing a new command.
Bit13~15	保留 Reserved

4.7.3 轮廓转矩模式(PT)

Profile Torque Mode (PT)

将对象字典 0x6060 的值设为 4，即可使关节模组运行于轮廓转矩模式。

Set the value of Object Dictionary 0x6060 to 4 to enable the joint module to operate in Profile Torque Mode (PT).

该模式下，主站控制器设定目标转矩，模组将维持该转矩输出直至收到新指令。此模式通常需要设置速度限制作为安全保护。

In this mode, the master controller sets the target torque, and the module maintains the output of this torque until new instructions are received. This mode typically requires setting speed limits for safety protection.

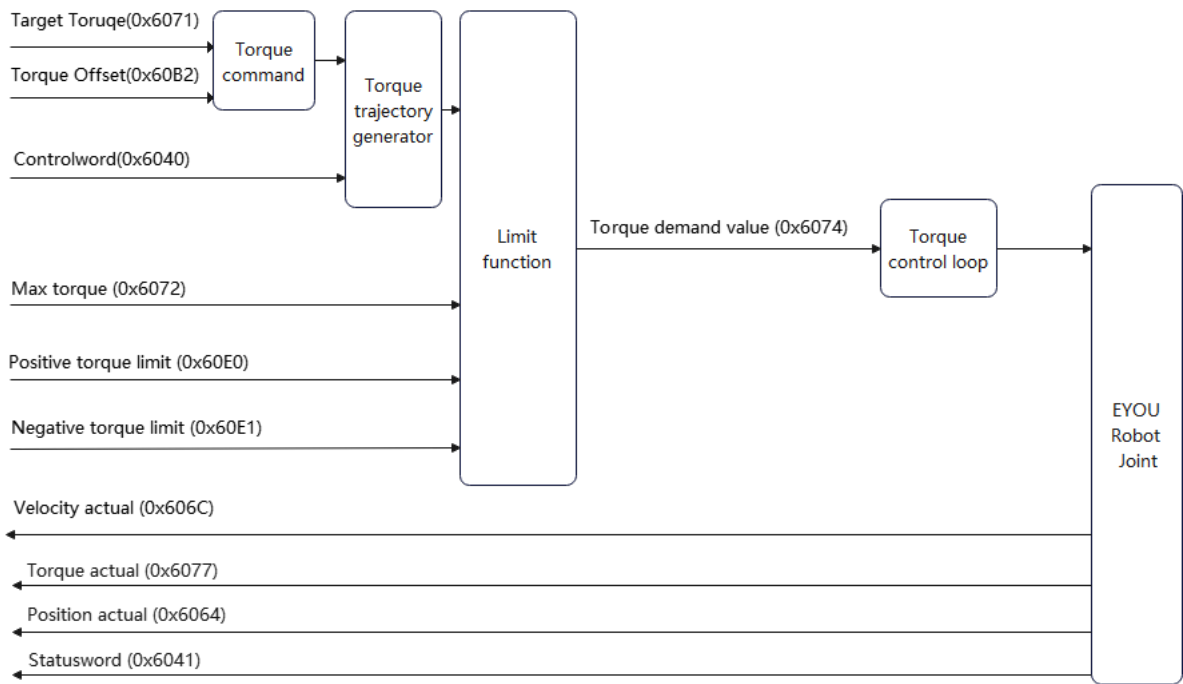


图 4-10 PT 模式功能

Figure 4-10 PT Mode Features

PT 模式相关的对象字典如下表所示：

The object dictionary related to PT mode is shown in the following table:

表 4-19 PT 模式相关字典

Table 4-19 PT Mode Related Dictionary

Index	Sub - Index	Name	Unit	Data type	Access	PDO mapping
0x603F	00h	Error Code	-	UINT	RO	TxPDO
0x6040	00h	Control word	-	UINT	RW	RxPDO

0x6041	00h	Status word	-	UINT	RO	TxPDO
0x6060	00h	Modes of operation	-	INT	RW	RxPDO
0x6061	00h	Modes of operation display	-	INT	RO	TxPDO
0x6071	00h	Target torque	per thousand of rated current	INT	RW	RxPDO
0x6072	00h	Max torque	per thousand of rated current	UINT	RW	NO
			per thousand rated current			
0x6074	00h	Torque demand value	per thousand of rated current	INT	RO	NO
0x6075	00h	Motor rated current	mA	UINT	RW	NO
0x6076	00h	Motor rated torque	mNm	UINT	RW	NO
0x6077	00h	Motor actual torque	per thousand of rated current	INT	RO	TxPDO
0x6078	00h	Motor actual current	per thousand of rated current	INT	RO	TxPDO
0x6087	00h	Torque slop	per thousand of rated current	UINT	RW	NO
0x60B2	00h	Torque offset	per thousand of rated current	INT	RW	RxPDO
0x60E0	00h	Positive torque limit value	mA	UINT	RW	RxPDO
0x60E1	00h	Negative torque limit value	mA	UINT	RW	RxPDO

基本操作步骤:

Basic Operational Steps:

- ① 设定模式为 4 (0x6060=4)，轮廓转矩模式；

Set the operation mode to 4 (0x6060=4), Profile Torque mode.

- ② 设置目标扭矩 (0x6071)；

Set the Target Torque (0x6071).

- ③ 设置控制命令 0x6040 (0x06-0x07-0x0F)，伺服进入使能状态。

Set the Control Word 0x6040 (0x06 -> 0x07 -> 0x0F) to transition the servo into the enabled state.

表 4-20 PT 模式控制字相关位

Table 4-20 PT Mode Control Word Related Bits

字定义 Control Word Bit	描述 Description
Bit8	控制扭矩输出： 启用停止位或将目标扭矩设置为零都将根据扭矩斜率对象 (0x6087) 逐渐降低施加到电机的扭矩。在斜坡的尽头，不会对电机施加扭矩，从而使轴自由移动。 Controls torque output: Enabling the Halt bit or setting the target torque to zero will gradually reduce the torque applied to the motor according to the Torque Slope object (0x6087). At the end of the ramp-down, no torque is applied to the motor, allowing the shaft to rotate freely.

表 4-21 PT 模式状态字相关位

Table 4-21 PT Mode Status Word Related Bits

状态字定义 Status Word Bit	描述 Description
Bit10	目标到达： 实际扭矩在“扭矩窗口时间”内持续保持在（目标扭矩±扭矩窗口）的范围内。（0：未到达，1：已到达） Target Reached: The actual torque remains within (Target Torque ± Torque Window) for

	the duration of the "torque window time" (0: Not reached, 1: Reached).
Bit11	内部限制生效： 指示软件限制是否生效（最大扭矩 0x6072 限制扭矩需求值 0x6074、目标扭矩 0x6071 和扭矩偏移 0x60B2。） Internal Limit Active: Indicates whether software limits are active (Max Torque 0x6072 limits the Torque Demand Value 0x6074, Target Torque 0x6071, and Torque Offset 0x60B2).
Bit12	目标扭矩确认： 0：驱动器准备就绪，可接收新的目标扭矩指令。 1：驱动器已接收并开始处理新指令。 Set-point Acknowledge: 0: Drive is ready to accept a new target torque command. 1: Drive has accepted and started processing a new command.
Bit13~15	保留 Reserved

4.7.4 回零模式(HM)

Homing Mode (HM)

目前仅支持回零方式 35（0x6098），以当前位置为机械零点。

设置模式 0x6060=6，0x6040=0x10，然后当前位置就是 0 点了，保存指令 0x2130=1。

Currently, only the homing method 35 (0x6098) is supported, using the current position as the mechanical zero point. Set mode 0x6060=6, 0x6040=0x10, then the current position becomes zero, and save the command 0x2130=1.

五、错误诊断与处理

Error Diagnosis and Handling

5.1 CANopen 通信错误

CANopen Communication Errors

表 5-1 CANopen 通讯错误表 (Abort code)

Table 5-1 CANopen Communication Error Codes (Abort code)

中止码 (Abort code)	名称 Name	解释 Explanation
0x00000000	无错误 No Error	通信成功 Communication successful.
0x05030000	切换错误 Toggle Bit Error	触发位没有切换 Toggle bit was not alternated.
0x05040000	SDO 超时 SDO Protocol Timeout	SDO 协议超时 SDO protocol timed out.
0x05040001	未知命令 Unknown Command Specifier	非法或未知的客户端 / 服务器命令字 Invalid or unknown client/server command specifier.
0x05040004	CRC 校验错误 CRC Error	CRC 校验失败 CRC calculation error.
0x06010000	访问错误 Access Violation	对象不支持访问 Object does not support the requested access type
0x06010001	只读错误 Read-Only Error	试图写只读对象 Attempt to write a read-only object.
0x06010002	只写错误 Write-Only Error	试图读只写对象 Attempt to read a write-only object.
0x06010003	子索引不能写入	无法写入子索引，子索引必须为“0”时才能写

	Sub-index Cannot Be Written	入 Cannot write to sub-index, often because the sub-index must be '0' to be writable.
0x06010004	不支持 SDO 访问 SDO Access Unsupported	不能通过完全访问来访问该对象 Object cannot be accessed via SDO; it may be PDO mapped only.
0x06020000	访问对象不存在 Object Does Not Exist	对象字典中对象不存在 Object does not exist in the object dictionary.
0x06040041	PDO 映射错误 PDO Mapping Error	对象不能映射到 PDO Object cannot be mapped to a PDO
0x06040042	PDO 长度错误 PDO Length Exceeded	映射的对象的数目和长度超出 PDO 长度 Total length of mapped objects exceeds the maximum PDO data field length.
0x06040043	一般性参数错误 General Parameter Incompatibility	一般性参数不兼容 General parameter incompatibility
0x06040047	一般性设备内部错误 General Device Incompatibility	一般性设备内部不兼容 General device internal incompatibility
0x06060000	硬件错误 Hardware Error	硬件错误导致对象访问失败 Access failed due to a hardware error.
0x06070010	服务参数错误 Service Parameter Mismatch	数据类型不匹配，服务参数长度不匹配 Data type mismatch or incorrect service parameter length.
0x06070013	服务参数太短导致错误 Service Parameter Too Short	服务参数长度太短 Service parameter too short.

0x06090011	子索引错误 sub-index error	子索引不存在 sub-index does not exist
0x06090030	参数数值范围错误 Parameter value out of range	超出参数数值的值范围 Parameter value exceeds the allowed range.
0x08000000	一般性错误 General Error	未指定的常规错误 Unspecified general error.
0x08000020	数据无法传输/保存 Data Transfer or Storage Error	数据不能发送或保存到应用 Data cannot be transferred or stored to the application
0x08000022	设备状态错误 Device State Error	当前设备状态导致数据无法发送或保存。 Current device state prevents data transfer or storage
0x0F00FFBE	密码错误 Password Error	密码错误 Password Error
0x0F00FFBF	非法指令代码 Illegal Command Code	非法的（不存在的）指令代码。 Illegal (non-existent) command code
0x0F00FFC0	NMT 状态错误 Invalid NMT State	设备处于错误的 NMT 状态，无法执行请求的操作 Device is in an invalid NMT state to perform the requested operation

5.2 设备报错

Device Errors

表 5-2 设备报错表

Table 5-2 Device Error Codes

Code	Fieldbus Fault Code (0x603F)	Fault Name	Fault Type
------	---------------------------------	------------	------------

E103	0x5210	电流传感器异常 Current Sensor Error	驱动器故障 Drive Fault
E105	0x5211	使能时电流传感器异常 Current Sensor Error at Enable	驱动器故障 Drive Fault
E107	0x6321	写 EEPROM 失败 EEPROM Write Failure	驱动器故障 Drive Fault
E120	0x2222	硬件过流 Hardware Over-Current	驱动器故障 Drive Fault
E121	0x2221	软件过流 Software Over-Current	驱动器故障 Drive Fault
E123	0x4210	电机过温 Motor Over-Temperature	驱动器故障 Drive Fault
E124	0x4310	驱动 MOS 过温 Drive MOSFET Over-Temperature	驱动器故障 Drive Fault
E125	0x2350	驱动过载 Drive Overload	驱动器故障 Drive Fault
E126	0x7121	堵转故障 Motor Stall	驱动器故障 Drive Fault
E127	0x2351	电机过载 Motor Overload	驱动器故障 Drive Fault
E129	0x7122	电机缺相 Motor Phase Loss	驱动器故障 Drive Fault
E130	0x3210	直流母线过压 DC Bus Over-Voltage	驱动器故障 Drive Fault
E131	0x3220	直流母线欠压 DC Bus Under-Voltage	驱动器故障 Drive Fault
E139	0xFF04	内部错误	驱动器故障

		Internal Error	Drive Fault
E140	0xFF10	驱动器参数初始化出错 Drive Parameter Initialization Error	驱动器故障 Drive Fault
E141	0x6322	MCU 参数初始化校验错误 MCU Parameter Verification Error	驱动器故障 Drive Fault
E157	0x6323	EEPROM 版本信息错误 EEPROM Version Error	驱动器故障 Drive Fault
E158	0x6320	参数 EEPROM 错误 Parameter EEPROM Error	驱动器故障 Drive Fault
E160	0xFF24	请执行保存和断电重启动作 Please Save Parameters and Power Cycle	驱动器故障 Drive Fault
E161	0xFF03	请执行配置动作 Please Perform Configuration	驱动器故障 Drive Fault
E203	0x7510	第一编码器通讯断线 Primary Encoder Communication Loss	电机编码器故障 Motor/Encoder Fault
E204	0x7511	第二编码器通讯断线 Secondary Encoder Communication Loss	电机编码器故障 Motor/Encoder Fault
E206	0x7521	编码器型号初始化失败 Encoder Model Initialization Failure	电机编码器故障 Motor/Encoder Fault
E209	0x7515	第一编码器 CRC 异常 Primary Encoder CRC Error	电机编码器故障 Motor/Encoder Fault

E210	0x7513	第二编码器 CRC 异常 Secondary Encoder CRC Error	电机编码器故障 Motor/Encoder Fault
E212	0x7514	双编码器位置偏差过大 Dual Encoder Position Mismatch	电机编码器故障 Motor/Encoder Fault
E230	0xFF11	加载电机参数出错 Motor Parameter Loading Error	电机编码器故障 Motor/Encoder Fault
E301	0x5454	驱动禁止输入保护 (STO) Drive Safe Torque Off (STO)	应用故障 Application Fault
E302	0x8611	位置偏差过大 Position Error Excess	应用故障 Application Fault
E303	0x8400	速度偏差过大 Velocity Error Excess	应用故障 Application Fault
E304	0x8401	超速故障 Over-Speed Fault	应用故障 Application Fault
E308	0xFF35	电子齿轮比计算溢出 Electronic Gear Ratio Calculation Overflow	应用故障 Application Fault
E309	0xFF36	电子齿轮比超范围 Electronic Gear Ratio Out of Range	应用故障 Application Fault
E323	0xFF20	紧急停机 Emergency Stop	应用故障 Application Fault
E326	0x8613	回零失败 Homing Failure	应用故障 Application Fault

E401	0xFF31	EtherCAT 丢包 EtherCAT Packet Loss	现场总线故障 Fieldbus Fault
E402	0xFF32	EtherCAT 通讯状态未进 OP EtherCAT State Not Operational (OP)	现场总线故障 Fieldbus Fault
E403	0xFF30	EtherCAT 网线未接 EtherCAT Cable Disconnected	现场总线故障 Fieldbus Fault
E404	0xFF34	指令插补周期不支持 Command Interpolation Cycle Not Supported	现场总线故障 Fieldbus Fault
E405	0xFF33	PDO 配置超出数量限制 PDO Configuration Count Exceeded	现场总线故障 Fieldbus Fault

0x5210 (E-103) : 电流传感器异常 (Current Sensor Anomaly)

报警代码 Alarm Code	提示 Hint	内容 Content
0x5210	产生机理 Mechanism	电流采样异常 Abnormal current sampling
	可能原因 Possible Causes	① 硬件故障：电流传感器损坏、传感器供电异常； Hardware fault: Current sensor damaged, sensor power supply abnormal. ② 环境干扰：强电磁干扰导致传感器信号失真； Environmental interference: Strong EMI causing sensor signal distortion. ③ 驱动器内部损坏：负责处理传感器信号的运算放大器或 AD 转换芯片损坏； Internal drive damage: Op-amp or ADC chip processing sensor signals is damaged.

		④ 驱动器上电自检过程中，电机处于非静止状态。 Motor was not stationary during drive power-on self-test.
	确认方法 Verification Method	① 检查现场是否有大型设备产生电磁干扰； Check for large equipment causing EMI on site. ② 检查机柜中是否存在多种电源变频设备等干扰源 Check for interference sources like variable frequency drives in the cabinet. ③ 确认驱动器上电过程或使能时，电机是否有被拖动进而有实际转速。 Confirm if the motor was being rotated (had actual speed) during drive power-on or enable.
	建议处理措施 Recommended Actions	① 检查驱动器和电机接地、屏蔽等抗干扰措施是否良好； Check drive and motor grounding, shielding, and other anti-interference measures. ② 确保驱动器上电或使能时，电机不要转动或降低电机转速至非常低（<30rpm）； Ensure the motor is not rotating or rotate at very low speed (<30rpm) during drive power-on/enable. ③ 更换驱动器。 Replace the drive.

0x5211（E105）：使能时电流传感器异常（Current Sensor Anomaly at Enable）

报警代码 Alarm Code	提示 Hint	内容 Content
0x5211	产生机理 Mechanism	电流采样异常 Abnormal current sampling.
	可能原因	① 硬件故障：电流传感器损坏、传感器供电异

	Possible Causes	常； Hardware fault: Current sensor damaged, sensor power supply abnormal. ② 环境干扰：强电磁干扰导致传感器信号失真； Environmental interference: Strong EMI causing sensor signal distortion. ③ 驱动器内部损坏：负责处理传感器信号的运算放大器或 AD 转换芯片损坏； Internal drive damage: Op-amp or ADC chip processing sensor signals is damaged. ④ 驱动器上电自检过程中，电机处于非静止状态。 Motor was not stationary during drive power-on self-test.
	确认方法 Verification Method	① 检查现场是否有大型设备产生电磁干扰； Check for large equipment causing EMI on site. ② 检查机柜中是否存在多种电源变频设备等干扰源； Check for interference sources like variable frequency drives in the cabinet. ③ 确认驱动器上电过程或使能时，电机是否有被拖动进而有实际转速。 Confirm if the motor was being rotated (had actual speed) during drive power-on or enable.
	建议处理措施 Recommended Actions	① 检查驱动器和电机接地、屏蔽等抗干扰措施是否良好； Check drive and motor grounding, shielding, and

		other anti-interference measures. ② 确保驱动器上电或使能时，电机不要转动或降低电机转速至非常低（<30rpm）； Ensure the motor is not rotating or rotate at very low speed (<30rpm) during drive power-on/enable. ③ 更换驱动器。 Replace the drive.
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0x6321（E107）：写 EEPROM 失败（EEPROM Write Failure）

报警代码 Alarm Code	提示 Hint	内容 Content
0x6321	产生机理 Mechanism	驱动器的微控制器（MCU）尝试向存储参数的 EEPROM 芯片写入数据时失败。 Drive's MCU failed when attempting to write data to the parameter storage EEPROM chip.
	可能原因 Possible Causes	① 硬件故障：写入过程中发生断电； Hardware fault: Power loss during write operation. ② 环境干扰：强电磁干扰导致传感器信号失真； Environmental interference: Strong EMI causing signal distortion. ③ 驱动器内部损坏：EEPROM 存储芯片物理损坏或达到读写寿命。 Internal drive damage: EEPROM memory chip physically damaged or reached read/write endurance limit.
	确认方法 Verification Method	① 尝试修改一个参数并保存，看是否再次报警； Try modifying a parameter and saving, check if

		alarm recurs. ② 重启驱动器后观察故障是否重现。 Observe if fault reoccurs after drive restart.
	建议处理措施 Recommended Actions	① 确保电源稳定，重新上电后操作； Ensure stable power supply, then operate after repowering. ② 若故障持续，尝试恢复驱动器出厂设置（注意备份参数）； If fault persists, try restoring drive factory settings (note: back up parameters). ③ 更换驱动器。 Replace the drive.

0x2222 (E120)：硬件过流（Hardware Overcurrent）

报警代码 Alarm Code	提示 Hint	内容 Content
0x2222	产生机理 Mechanism	通过硬件电路（如采样电阻和比较器）直接检测到逆变回路电流瞬间超过硬件设定的安全阈值，响应速度极快，旨在保护功率管免于击穿。 Direct detection by hardware circuitry (e.g., shunt resistor and comparator) that the current in the inverter circuit instantaneously exceeds the hardware-set safety threshold. Responds extremely fast to protect the power transistors from breakdown.
	可能原因 Possible Causes	① 电机相线短路或对地短路； Motor phase short-circuit or ground fault. ② 电机绝缘损坏； Motor insulation damage. ③ 驱动器功率模块本身短路损坏；

		Short-circuit damage in the drive's power module itself. ④ 负载突然严重卡死。 Load suddenly and severely jammed.
	确认方法 Verification Method	① 断电，用万用表测量电机三相间电阻及对地绝缘电阻； Power off, measure phase-to-phase resistance and insulation resistance to ground of the motor with a multimeter. ② 脱开电机与负载，手动转动负载检查是否卡死。 Disconnect motor from load, manually rotate the load to check for jamming.
	建议处理措施 Recommended Actions	① 排除电机短路或接地故障； Eliminate motor short-circuit or ground faults. ② 检查机械负载，消除卡死点； Check the mechanical load, remove jam points. ③ 若电机和线路正常，则驱动器功率模块损坏可能性极大，需维修。 If motor and wiring are normal, the drive power module is likely damaged and requires repair.

0x2221 (E121)：软件过流 (Software Overcurrent)

报警代码 Alarm Code	提示 Hint	内容 Content
0x2221	产生机理 Mechanism	通过软件计算电流采样值的有效值，判断其持续超过驱动器额定电流的允许值。 The RMS value of the sampled current is calculated by software, and an alarm is triggered when it

		continuously exceeds the allowable limit of the drive's rated current.
	可能原因 Possible Causes	① 负载过大或加减速过于频繁; Excessive load or overly frequent acceleration/deceleration. ② 电机参数（如电阻、电感）设置错误; Incorrect motor parameter settings (e.g., resistance, inductance). ③ 增益设置过高，导致系统振荡引起电流过大; Gain set too high, causing system oscillation and excessive current. ④ 机械传动部件卡滞或润滑不良。 Mechanical transmission parts are jammed or poorly lubricated.
	确认方法 Verification Method	① 检查负载是否超出电机额定扭矩; Check if the load exceeds the motor's rated torque. ② 核对电机参数设置是否正确; Verify if motor parameters are set correctly. ③ 观察驱动器电流实时曲线是否振荡。 Observe the drive's real-time current curve for oscillation.
	建议处理措施 Recommended Actions	① 减轻负载，优化运行曲线（如延长加减速时间）; Reduce load, optimize motion profile (e.g., extend acceleration/deceleration time). ② 重新恢复电机默认参数; Restore the motor's default parameters.

		③ 适当降低 PID 增益。 Appropriately reduce PID gains.
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0x4210 (E123)：电机过温 (Motor Overtemperature)

报警代码 Alarm Code	提示 Hint	内容 Content
0x4210	产生机理 Mechanism	驱动器接收到电机内置温度传感器的反馈，显示电机绕组温度超过设定阈值。 The drive receives feedback from the motor's built-in temperature sensor, indicating the motor winding temperature has exceeded the set threshold.
	可能原因 Possible Causes	① 电机长时间过载运行； Motor operating under overload for an extended period. ② 电机冷却不良，无足够散热条件； Poor motor cooling, insufficient heat dissipation. ③ 环境温度过高； Ambient temperature too high. ④ 温度传感器或其线路故障。 Temperature sensor or its wiring fault.
	确认方法 Verification Method	① 触摸电机外壳感受温度（注意安全），建议用红外测温枪； Touch the motor casing to feel temperature (with caution), an infrared thermometer is recommended. ② 查看驱动器参数中的电机温度实时值。 Check the real-time motor temperature value in the drive parameters.
	建议处理措施	① 确保电机冷却系统正常工作；

	Recommended Actions	Ensure the motor cooling system is functioning properly. ② 减轻负载，避免长期过载运行； Reduce load, avoid prolonged overload operation. ③ 检查电机温度传感器线路。 Check the motor temperature sensor wiring.
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0x4310 (E124)：驱动 MOS 过温 (Drive MOSFET Overtemperature)

报警代码 Alarm Code	提示 Hint	内容 Content
0x4310	产生机理 Mechanism	驱动器检测到内部功率 MOSFET（金属-氧化物半导体场效应晶体管）的温度过高。 The drive detects that the temperature of its internal power MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistors) is too high.
	可能原因 Possible Causes	① 环境温度过高，通风不畅； Ambient temperature too high, poor ventilation. ② 过载运行导致管内耗散功率过大。 Overload operation causes excessive power dissipation in the transistors.
	确认方法 Verification Method	查看驱动器内部温度实时值。 Check the real-time internal temperature value of the drive.
	建议处理措施 Recommended Actions	① 降低负载或改善工作周期； Reduce load or improve the duty cycle. ② 增加风扇等散热措施。 Add cooling measures such as fans.

0x2350 (E125)：驱动过载 (Drive Overload)

报警代码	提示	内容
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Alarm Code	Hint	Content
0x2350	产生机理 Mechanism	驱动器基于电流和时间的积分计算 (I^2t 算法), 模拟驱动器的热积累效应, 当计算出的“热量”超过预设水平时报警。 The drive calculates thermal accumulation based on the integral of current squared over time (I^2t algorithm). An alarm is triggered when the calculated "heat" exceeds the preset level.
	可能原因 Possible Causes	① 长期负载超过驱动器额定容量; Sustained load exceeding the drive's rated capacity. ② 过载保护参数设置过小。 Overload protection parameters set too low.
	确认方法 Verification Method	监控驱动器的负载率或热容量参数。 Monitor the drive's load rate or thermal capacity parameters.
	建议处理措施 Recommended Actions	① 减轻负载, 优化运行曲线 (如延长加减速时间); Reduce load, optimize motion profile (e.g., extend acceleration/deceleration time). ② 确认过载保护参数设置合理。 Confirm the overload protection parameters are set appropriately.

0x7121 (E126) : 堵转故障 (Stall Fault)

报警代码 Alarm Code	提示 Hint	内容 Content
0x7121	产生机理 Mechanism	驱动器检测到电机指令位置与实际位置偏差 (位置误差) 超过设定允许值并持续一定时间, 判断

		电机处于堵转状态。 The drive detects that the deviation between the commanded position and the actual position (position error) exceeds the set allowable value and persists for a certain duration, determining the motor is in a stall condition.
	可能原因 Possible Causes	① 机械负载卡死； Mechanical load jam. ② 扭矩不足（驱动器输出限制过低或负载惯性过大）； Insufficient torque (drive output limit set too low or load inertia too high). ③ 使能时电机处于异常位置被机械限位卡住。 Motor was at an abnormal position and jammed against a mechanical limit when enabled.
	确认方法 Verification Method	① 脱开负载，检查机械结构是否顺畅； Disconnect the load, check if the mechanical structure moves smoothly. ② 检查驱动器扭矩限制参数是否设置过小。 Check if the drive's torque limit parameters are set too low.
	建议处理措施 Recommended Actions	① 排除机械卡死故障； Eliminate mechanical jamming fault. ② 适当提高扭矩限制值（在机械安全允许范围内）； Appropriately increase the torque limit value (within safe mechanical limits).

		③ 提高负载惯量比。 Increase the load inertia ratio setting.
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0x2351 (E127)：电机过载 (Motor Overload)

报警代码 Alarm Code	提示 Hint	内容 Content
0x2351	产生机理 Mechanism	类似 E125，但保护对象是电机。驱动器根据电机电流和模型计算电机温升，超过设定值后报警。 Similar to E125, but the protected object is the motor. The drive calculates motor temperature rise based on motor current and a model, triggering an alarm when it exceeds the set value.
	可能原因 Possible Causes	同 E123（电机过温），但此报警是基于计算模型，而非直接温度传感器。 Same as E123 (Motor Overtemperature), but this alarm is based on a calculation model, not a direct temperature sensor.
	确认方法 Verification Method	监控驱动器的电机负载率或热容量参数。 Monitor the drive's motor load rate or thermal capacity parameters.
	建议处理措施 Recommended Actions	① 减轻负载，避免过载运行； Reduce load, avoid overload operation. ② 核对电机过载保护参数设置； Verify the motor overload protection parameter settings. ③ 确保电机冷却良好。 Ensure good motor cooling.

0x7122 (E129)：电机缺相 (Motor Phase Loss)

报警代码	提示	内容
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Alarm Code	Hint	Content
0x7122	产生机理 Mechanism	驱动器检测输出到电机的三相电流中有一相或两相没有电流。 The drive detects that one or two phases of the three-phase current output to the motor have no current.
	可能原因 Possible Causes	① 电机动力线有一相断路或连接器接触不良； Motor power line has an open circuit in one phase or poor connector contact. ② 驱动器内部逆变桥有一相桥臂损坏（如 MOSFET 开路）。 One phase leg of the drive's internal inverter bridge is damaged (e.g., MOSFET open circuit).
	确认方法 Verification Method	① 断电，检查电机三相接线； Power off, check the motor's three-phase wiring. ② 用万用表测量电机三相线间的导通性。 Measure the continuity between motor phases with a multimeter.
	建议处理措施 Recommended Actions	① 检查并紧固所有电机接线端子； Check and tighten all motor terminal connections. ② 若线路正常，则驱动器内部故障，需返厂维修。 If wiring is normal, the drive has an internal fault and requires factory repair.

0x3210 (E130)：直流母线过压 (DC Bus Overvoltage)

报警代码 Alarm Code	提示 Hint	内容 Content
0x3210	产生机理 Mechanism	驱动器内部直流母线电容上的电压超过安全阈值。

		The voltage on the drive's internal DC bus capacitor exceeds the safety threshold.
	可能原因 Possible Causes	① 输入电源电压过高； Input power supply voltage is too high. ② 电机减速过快，再生能量无法及时释放（制动电阻未接、损坏或容量不足）； Motor decelerates too rapidly, regenerative energy cannot be dissipated in time (braking resistor not connected, damaged, or insufficient capacity). ③ 制动电阻回路断路。 Open circuit in the braking resistor loop.
	确认方法 Verification Method	查看驱动器参数中的母线电压实时值。 Check the real-time DC bus voltage value in the drive parameters.
	建议处理措施 Recommended Actions	① 检查输入电源电压； Check the input power supply voltage. ② 延长减速时间； Extend the deceleration time. ③ 增加泄放装置，检查、安装或更换合适的制动电阻。 Add a braking unit, check, install, or replace a suitable braking resistor.

0x3220 (E131)：直流母线欠压 (DC Bus Undervoltage)

报警代码 Alarm Code	提示 Hint	内容 Content
0x3220	产生机理 Mechanism	驱动器内部直流母线电容上的电压低于正常工作所需的最低阈值。 The voltage on the drive's internal DC bus capacitor

		falls below the minimum threshold required for normal operation.
	可能原因 Possible Causes	① 输入电源电压过低; Input power supply voltage is too low. ② 瞬时停电; Momentary power loss. ③ 电源容量不足, 导致大电流启动时电压骤降; Insufficient power supply capacity, causing a voltage dip during high current startup. ④ 重负载下启动加速度过大, 瞬间启动电流大; Excessive starting acceleration under heavy load, causing high inrush current. ⑤ 过载或结构卡滞, 导致瞬间启动电流过大。 Overload or mechanical jamming causing excessive inrush starting current.
	确认方法 Verification Method	用万用表测量驱动器输入端子电压。 Measure the voltage at the drive input terminals with a multimeter.
	建议处理措施 Recommended Actions	① 检查电源电压; Check the power supply voltage. ② 增大电源容量。 Increase the power supply capacity.

0xFF04 (E139) : 内部错误 (Internal Error)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF04	产生机理 Mechanism	驱动器 CPU 自检时发现内部程序运行、逻辑或硬件状态出现严重异常。这是一个综合性的严重故障码。

		The drive's CPU detected a severe anomaly in internal program execution, logic, or hardware state during self-test. This is a comprehensive, serious fault code.
	可能原因 Possible Causes	驱动器内部硬件故障，如主控芯片、存储器、电源电路等关键元件异常。 Internal drive hardware failure, e.g., anomalies in key components like the main control chip, memory, or power circuit.
	确认方法 Verification Method	断电后重新上电，若故障立即或频繁出现，可基本判定。 Cycle power. If the fault appears immediately or frequently upon restart, it can be preliminarily determined.
	建议处理措施 Recommended Actions	① 断电重启； Power cycle. ② 返厂维修。 Return to factory for repair.

0xFF10 (E140)：驱动器参数初始化出错 (Drive Parameter Initialization Error)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF10	产生机理 Mechanism	驱动器上电时，无法从存储器中正确读取参数进行初始化。 When powering on, the drive cannot correctly read parameters from memory for initialization.
	可能原因 Possible Causes	① 参数存储器（如 EEPROM）损坏； Parameter memory (e.g., EEPROM) damaged. ② 参数因干扰等原因被破坏。 Parameters corrupted due to interference or other

		reasons.
	确认方法 Verification Method	重启后观察，尝试能否进入参数设置界面。 Restart and observe, try to see if you can enter the parameter setting interface.
	建议处理措施 Recommended Actions	① 尝试恢复出厂设置； Try restoring factory settings. ② 若无效，需送修。 If unsuccessful, the drive needs to be sent for repair.

0x6322 (E141) : MCU 参数初始化校验错误 (MCU Parameter Initialization Check Error)

报警代码 Alarm Code	提示 Hint	内容 Content
0x6322	产生机理 Mechanism	驱动器主控芯片 (MCU) 在初始化后，对自身内存或相关参数进行校验时发现错误。 After initialization, the drive's main control chip (MCU) found an error when checking its own memory or related parameters.
	可能原因 Possible Causes	与 E140 类似，可能指向更核心的 MCU 或固件问题。 Similar to E140, may indicate a more core MCU or firmware issue.
	确认方法 Verification Method	重启后观察，尝试能否进入参数设置界面。 Restart and observe, try to see if you can enter the parameter setting interface.
	建议处理措施 Recommended Actions	① 尝试恢复出厂设置； Try restoring factory settings. ② 若无效，需送修。 If unsuccessful, the drive needs to be sent for

repair.

0x6323 (E157) : EEPROM 版本信息错误 (EEPROM Version Information Error)

报警代码 Alarm Code	提示 Hint	内容 Content
0x6323	产生机理 Mechanism	驱动器检测到内部存储的固件版本信息、驱动器型号信息等关键标识数据与当前硬件或软件版本不匹配或校验失败。 The drive detects that the key identification data (e.g., firmware version, drive model) stored internally in the EEPROM does not match the current hardware/software version, or the data check failed.
	可能原因 Possible Causes	① 更换了不兼容的固件或进行了不当的固件升级； Incompatible firmware was installed or an improper firmware upgrade was performed. ② EEPROM 中存储版本信息的区域数据损坏； Data corruption in the EEPROM area storing version information. ③ 更换了驱动器的核心控制板但未正确配置。 The drive's core control board was replaced but not correctly configured.
	确认方法 Verification Method	查看驱动器型号代码和固件版本号，与预期值进行比对。 Check the drive model code and firmware version, compare with expected values.
	建议处理措施 Recommended Actions	① 重新进行正确的固件升级； Perform a correct firmware upgrade again. ② 联系设备制造商，确认硬件和软件的兼容性；

		Contact the equipment manufacturer to confirm hardware/software compatibility. ③ 若数据损坏，可能需要厂家专用工具修复或更换控制板。 If data is corrupted, factory-specific tools may be needed for repair, or the control board may need replacement.
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0x6320 (E158)：参数 EEPROM 错误 (Parameter EEPROM Error)

报警代码 Alarm Code	提示 Hint	内容 Content
0x6320	产生机理 Mechanism	驱动器无法正确访问或识别存储参数的 EEPROM 存储器。此故障比“写入失败”更底层，指向存储器本身的存取功能异常。 The drive cannot correctly access or recognize the EEPROM memory storing parameters. This fault is lower-level than a "write failure" and points to an access function abnormality of the memory itself.
	可能原因 Possible Causes	① EEPROM 存储器芯片彻底损坏或与 MCU 的通信中断； EEPROM memory chip completely damaged or communication with the MCU is interrupted. ② 存储器供电电路异常。 Abnormality in the memory's power supply circuit.
	确认方法 Verification Method	任何对参数的操作（读取、写入）都可能失败或引发此报警。 Any parameter operation (read, write) may fail or trigger this alarm.

	建议处理措施 Recommended Actions	① 断电重启； Power cycle. ② 若故障持续，需送修驱动器，更换 EEPROM 芯片或控制板。 If the fault persists, the drive needs repair, possibly requiring replacement of the EEPROM chip or control board.
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0xFF24 (E160)：请执行保存和断电重启动作 (Please Save Parameters and Power Cycle)

报警代码 Alarm Code	提示 Hint	内容 Content
0x FF24	产生机理 Mechanism	这是一个操作提示性报警，而非故障。通常在执行了某些关键参数修改后，驱动器提示用户必须进行保存和重启才能使新参数生效。 This is an operational reminder alarm, not a fault. It typically appears after modifying certain critical parameters, prompting the user to save and restart for the changes to take effect.
	可能原因 Possible Causes	① 修改了某些需要重启才能生效的参数（如电机型号、编码器类型等）； Modified parameters that require a restart to take effect (e.g., motor type, encoder type). ② 驱动器正常的工作流程提示。 It is a normal workflow prompt from the drive.
	确认方法 Verification Method	确认近期是否修改过关键参数。 Confirm if any critical parameters have been modified recently.
	建议处理措施 Recommended	① 保存参数：在驱动器操作界面上执行“参数保存”或“写入 EEPROM”操作；

	Actions	Save parameters: Execute the "Save Parameters" or "Write to EEPROM" operation on the drive's interface. ② 断电重启：将驱动器完全断电，等待数秒后重新上电，报警即可清除。 Power cycle: Completely power off the drive, wait a few seconds, then power it back on. The alarm will clear.
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0xFF03 (E161)：请执行配置动作 (Please Perform Configuration)

报警代码 Alarm Code	提示 Hint	内容 Content
0x FF03	产生机理 Mechanism	这是一个初始化设置提示。表明驱动器尚未完成必要的配置，无法正常启动运行。 This is an initialization setup prompt. It indicates that the drive has not completed the necessary configuration and cannot start operating normally.
	可能原因 Possible Causes	① 驱动器参数被初始化（恢复出厂设置）后； After the drive parameters have been initialized (factory reset). ② 驱动器检测到电机或编码器型号等关键参数未设置。 The drive has detected that key parameters such as the motor or encoder type are not set.
	确认方法 Verification Method	查看电机型号、编码器类型等基本参数是否为 0 或空白。 Check if basic parameters like motor model, encoder type, etc., are set to 0 or are blank.
	建议处理措施	① 执行配置：进入驱动器的配置向导（或快速调

	Recommended Actions	试功能) ; Perform configuration: Enter the drive's configuration wizard (or quick setup function). ② 输入参数: 正确设置电机参数 (型号、额定电流、转速等)、编码器类型、控制模式等; Enter parameters: Correctly set motor parameters (model, rated current, speed, etc.), encoder type, control mode, etc. ③ 保存重启: 完成后保存参数并断电重启。 Save and restart: After completion, save the parameters and power cycle.
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0x7510 (E203) : 第一编码器通讯断线 (Primary Encoder Communication Break)

报警代码 Alarm Code	提示 Hint	内容 Content
0x7510	产生机理 Mechanism	驱动器与电机内置的第一编码器之间的通讯信号完全中断, 无法收到任何反馈数据。 The communication signal between the drive and the primary (first) encoder is completely interrupted, and no feedback data is received.
	可能原因 Possible Causes	① 编码器反馈电缆断路、短路或连接器松动、损坏; Encoder feedback cable open circuit, short circuit, or loose/damaged connector. ② 编码器供电电源异常 (如 5V 或 VCC 线断路); Abnormal encoder power supply (e.g., 5V or VCC line open circuit). ③ 编码器本身损坏;

		Encoder itself is damaged. ④ 驱动器编码器接口电路故障。 Encoder interface circuit fault in the drive.
	确认方法 Verification Method	断电重启后依然存在。 The alarm persists after a power cycle.
	建议处理措施 Recommended Actions	返厂维修。 Return to factory for repair.

0x7511 (E204)：第二编码器通讯断线 (Secondary Encoder Communication Break)

报警代码 Alarm Code	提示 Hint	内容 Content
0x7511	产生机理 Mechanism	驱动器与电机内置的第二编码器之间的通讯信号完全中断，无法收到任何反馈数据。 The communication signal between the drive and the secondary encoder is completely interrupted, and no feedback data is received.
	可能原因 Possible Causes	编码器损坏。 Encoder damage.
	确认方法 Verification Method	断电重启后依然存在。 The alarm persists after a power cycle.
	建议处理措施 Recommended Actions	返厂维修。 Return to factory for repair.

0x7521 (E206)：编码器型号初始化失败 (Encoder Type Initialization Failure)

报警代码 Alarm Code	提示 Hint	内容 Content
0x7521	产生机理 Mechanism	编码器识别异常。 Encoder identification anomaly.

	可能原因 Possible Causes	编码器损坏。 Encoder damage.
	确认方法 Verification Method	断电重启后依然存在。 The alarm persists after a power cycle.
	建议处理措施 Recommended Actions	返厂维修。 Return to factory for repair.

0x7515 (E209)：第一编码器 CRC 异常 (Primary Encoder CRC Error)

报警代码 Alarm Code	提示 Hint	内容 Content
0x7515	产生机理 Mechanism	驱动器能收到编码器数据，但循环冗余校验（CRC）错误，表明数据传输过程中受到干扰，数据包内容不正确。 The drive receives encoder data, but a Cyclic Redundancy Check (CRC) error occurs, indicating data corruption during transmission.
	可能原因 Possible Causes	① 强电磁干扰； Strong electromagnetic interference. ② 编码器或驱动器接口电路不稳定。 Unstable encoder or drive interface circuit.
	确认方法 Verification Method	确保环境无强电磁干扰，重启。 Ensure the environment is free of strong EMI, then restart.
	建议处理措施 Recommended Actions	若异常，返厂维修。 If the alarm persists, return to factory for repair.

0x7513 (E210)：第二编码器 CRC 异常 (Secondary Encoder CRC Error)

报警代码	提示	内容
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Alarm Code	Hint	Content
0x7513	产生机理 Mechanism	驱动器能收到编码器数据，但循环冗余校验（CRC）错误，表明数据传输过程中受到干扰，数据包内容不正确。 The drive receives encoder data, but a Cyclic Redundancy Check (CRC) error occurs, indicating data corruption during transmission.
	可能原因 Possible Causes	① 强电磁干扰； Strong electromagnetic interference. ② 编码器或驱动器接口电路不稳定。 Unstable encoder or drive interface circuit.
	确认方法 Verification Method	确保环境无强电磁干扰，重启。 Ensure the environment is free of strong EMI, then restart.
	建议处理措施 Recommended Actions	若异常，返厂维修。 If the alarm persists, return to factory for repair.

0x7514（E212）：双编码器位置偏差过大（Dual Encoder Position Deviation Excessive）

报警代码 Alarm Code	提示 Hint	内容 Content
0x7514	产生机理 Mechanism	在双编码器系统（如电机端编码器+负载端光栅尺）中，驱动器检测到两个编码器反馈的位置差值超过了允许的公差范围。 In a dual-encoder system (e.g., motor encoder + load-side linear encoder), the drive detects that the difference between the two encoder feedback positions exceeds the allowable tolerance.
	可能原因	① 机械传动存在背隙或弹性变形；

	Possible Causes	Mechanical transmission has backlash or elastic deformation. ② 其中一个编码器零点偏移或损坏; One encoder's zero offset is incorrect or the encoder is damaged. ③ 位置偏差过大报警阈值设置过小。 Position deviation alarm threshold is set too small.
	确认方法 Verification Method	分别观察两个编码器的位置反馈值。 Observe the position feedback values of both encoders separately.
	建议处理措施 Recommended Actions	① 重新校准编码器零点; Recalibrate the encoder zeros. ② 根据实际机械精度, 适当调整“双编码器位置偏差限制”参数。 Adjust the "Dual Encoder Position Deviation Limit" parameter based on the actual mechanical accuracy.

0xFF11 (E230) : 加载电机参数出错

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF11	产生机理 Mechanism	驱动器尝试从内部存储器或外部配置中加载电机参数（如电阻、电感、惯量等）时失败，参数无效或不存。 The drive failed to load motor parameters (e.g., resistance, inductance, inertia) from internal memory or external configuration; the parameters are invalid or do not exist.
	可能原因	电机参数文件损坏或丢失。

	Possible Causes	Motor parameter file is corrupted or missing.
	确认方法 Verification Method	重启查看电机型号等参数。 Check the motor model and other parameters after restarting.
	建议处理措施 Recommended Actions	返厂维修。 Return to factory for repair.

0x5454 (E301)：驱动禁止输入保护 (STO) Drive Safe Torque Off (STO)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF11	产生机理 Mechanism	当监控电路检测到两路输入信号状态不一致（一路为有效高电平，另一路为无效低电平），或两路均为无效电平时，即判定为“STO 激活”条件满足。 When the monitoring circuit detects that the two input signals are inconsistent (one at a valid high level and the other at an invalid low level) or that both are at an invalid low level, the "STO activated" condition is determined to be met.
	可能原因 Possible Causes	① 安全设备动作：急停按钮按下； Safety Device Actuation: The emergency stop button is pressed; ② 电源或线路问题：供给 STO 回路的外部 24V 安全电源丢失或电压过低，信号线缆接触不良； Power Supply or Wiring Issues: Loss or undervoltage of the external 24V safety power supply for the STO circuit; poor contact in the

		signal cable. ③ 配置与接线错误：单路接线错误。 Configuration or Wiring Error: Incorrect single-channel wiring.
	确认方法 Verification Method	① 查看状态：测试 STO1/2 引脚电平； Check Status: Test the voltage levels at the STO1/STO2 pins. ② 排查外部回路：检查所有急停按钮是否复位。 Inspect External Circuit: Check if all emergency stop buttons are reset.
	建议处理措施 Recommended Actions	① 复位安全设备：无安全隐患的情况下，复位； Reset Safety Devices: Reset them after confirming no safety hazards exist. ② 驱动器复位； Reset the drive. ③ 检查与修复：更换线缆与按钮。 Inspect and Repair: Check and replace cables or buttons if necessary.

0x8611 (E302)：位置偏差过大 (Position Error Excessive)

报警代码 Alarm Code	提示 Hint	内容 Content
0x8611	产生机理 Mechanism	驱动器的位置控制环检测到“指令位置”与编码器反馈的“实际位置”之间的差值（即位置误差）超过了预设的“位置偏差超差”限制值。 The drive's position control loop detects that the difference between the commanded position and the actual position feedback (position error) exceeds the preset "position error excessive" limit.

	可能原因 Possible Causes	① 负载过大或阻力突变：电机扭矩不足，无法跟上指令位置； Excessive load or sudden change in resistance: Motor torque is insufficient to follow the command. ② 伺服增益过低：位置环或速度环 PID 增益设置太低，系统响应慢； Servo gains too low: Position or speed loop PID gains are set too low, causing slow system response. ③ 机械卡死：导致电机完全无法转动； Mechanical jam: Motor is completely unable to rotate. ④ 指令位置变化过快：过高的位置指令斜率或速度； Commanded position changes too fast: Excessive position command slope or speed. ⑤ 编码器反馈异常：反馈信号错误导致驱动器误判。 Encoder feedback anomaly: Incorrect feedback signal causing drive misjudgment.
	确认方法 Verification Method	① 检查机械负载是否顺畅，有无卡滞； Check if the mechanical load moves smoothly, and for any jamming. ② 监控实时位置误差值，观察其变化趋势； Monitor the real-time position error value and observe its trend.

		③ 检查位置偏差限制参数设置是否合理。 Check if the position error limit parameter is set appropriately.
	建议处理措施 Recommended Actions	① 排除机械故障：解决卡死、润滑不良等问题； Eliminate mechanical faults: Resolve jams, poor lubrication, etc. ② 优化伺服增益：适当提高位置环增益和速度环增益； Optimize servo gains: Appropriately increase the position and speed loop gains. ③ 调整运行参数：降低指令速度或加速度，使运动曲线更平滑； Adjust motion parameters: Reduce the command speed or acceleration to smooth the motion profile. ④ 核对参数：确保位置偏差限制值设置符合应用需求。 Verify parameters: Ensure the position error limit is set appropriately for the application.

0x8400 (E303)：速度偏差过大 (Velocity Error Excessive)

报警代码 Alarm Code	提示 Hint	内容 Content
0x8400	产生机理 Mechanism	驱动器的速度控制环检测到“指令速度”与编码器反馈的“实际速度”之间的差值超过了允许范围。 The drive's speed control loop detects that the difference between the commanded speed and the actual speed feedback exceeds the allowed range.
	可能原因	① 负载波动剧烈或过大：电机扭矩不足以维持设

	Possible Causes	定速度； Severe or excessive load fluctuations: Motor torque is insufficient to maintain the set speed. ② 速度环增益设置不当：增益过低导致响应慢，或过高引起震荡； Improper speed loop gain settings: Gains too low cause slow response; too high cause oscillation. ③ 加速度设置过大：启动/制动时需要的扭矩瞬间超过驱动器输出能力。 Acceleration set too high: The required torque during start/stop exceeds the drive's output capability.
	确认方法 Verification Method	① 观察速度指令和速度反馈的实时曲线； Observe the real-time curves of the speed command and speed feedback. ② 检查负载是否在运行中发生突变。 Check if the load changes abruptly during operation.
	建议处理措施 Recommended Actions	① 优化增益：重新进行速度环 PID 参数整定； Optimize gains: Re-tune the speed loop PID parameters. ② 减轻负载：检查并稳定负载； Reduce load: Check and stabilize the load. ③ 调整加减速时间：延长加速度和减速度时间。 Adjust acceleration/deceleration time: Increase the acceleration and deceleration times.

0x8401 (E304) : 超速故障 (Overspeed Fault)

报警代码 Alarm Code	提示 Hint	内容 Content
0x8401	产生机理 Mechanism	编码器反馈的实际转速超过了驱动器设定的“速度超差”限制值。这是一个严重的安全保护功能。 The actual speed measured from the encoder exceeds the drive's set "speed overshoot" limit. This is a critical safety protection function.
	可能原因 Possible Causes	① 位置环增益过高导致“飞车”：位置误差积累后，速度指令变得极大； Position loop gain too high causing "runaway": Accumulated position error leads to a very high speed command. ② 指令速度源异常：上位机发出了错误的速度指令； Commanded speed source is abnormal: The host PC sends an erroneous speed command. ③ 速度限制参数设置错误：设置值远低于实际可能达到的转； Speed limit parameter incorrectly set: The set value is much lower than the speed the motor can actually achieve. ④ 编码器反馈错误：反馈信号异常导致驱动器误读转速。 Encoder feedback error: Anomalous feedback signal causes the drive to misread speed.
	确认方法 Verification Method	① 检查速度限制相关参数； Check the speed limit related parameters.

		② 检查上位机指令是否正常; Check if the host PC commands are normal. ③ 检查编码器线路。 Check the encoder wiring.
	建议处理措施 Recommended Actions	① 检查参数: 确认速度限制值设置正确; Check parameters: Confirm the speed limit is set correctly. ② 稳定控制信号: 确保上位机指令正确无误; Stabilize the control signal: Ensure host PC commands are correct. ③ 调整增益: 避免位置环过冲和震荡。 Adjust gains: Avoid position loop overshoot and oscillation.

0xFF35 (E308) : 电子齿轮比计算溢出 (Electronic Gear Ratio Calculation Overflow)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF35	产生机理 Mechanism	在设置电子齿轮比分子和分母时, 计算得到的脉冲当量超出了驱动器的内部数据处理范围 (通常是 32 位寄存器无法表示)。 When setting the electronic gear ratio numerator and denominator, the calculated pulse equivalent exceeds the drive's internal data processing range (typically a 32-bit register overflow).
	可能原因 Possible Causes	① 电子齿轮比的分子或分母数值设置得过大; The numerator or denominator of the electronic gear ratio is set too large. ② 分子和分母的比值是一个极大或极小的无理数, 无法用设定值有效近似。

		The ratio is an extremely large or small irrational number that cannot be effectively approximated with the set values.
	确认方法 Verification Method	检查电子齿轮比参数的设置值 Check the settings of the electronic gear ratio parameters.
	建议处理措施 Recommended Actions	① 简化比值：尽量将电子齿轮比（分子/分母）化简为不可再约分的整数比； Simplify the ratio: Reduce the electronic gear ratio (numerator/denominator) to an irreducible fraction of integers. ② 调整数值：在满足精度要求的前提下，适当减小分子和分母的数值，避免使用极大的数。 Adjust values: Appropriately reduce the numerator and denominator values while meeting precision requirements, avoid using extremely large numbers.

0xFF36 (E309)：电子齿轮比超范围 (Electronic Gear Ratio Out of Range)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF36	产生机理 Mechanism	在设置后的电子齿轮比导致电机每转所需指令脉冲数超过了驱动器允许的最小值或最大值。 The set electronic gear ratio results in a commanded pulses per revolution (PPR) value that exceeds the minimum or maximum limit allowed by the drive.
	可能原因 Possible Causes	① 电子齿轮比设置不当，使得等效脉冲数过低（导致转速分辨率不足）或过高（导致速度上限过低）；

		Improper electronic gear ratio setting, causing equivalent PPR to be too low (insufficient speed resolution) or too high (low speed limit). ② 参数设置错误。 Incorrect parameter setting.
	确认方法 Verification Method	计算等效脉冲数 (=编码器线数 × 电子齿轮比)，看是否在驱动器规格范围内； Calculate the equivalent PPR (= encoder lines × electronic gear ratio) and check if it's within the drive's specification range.
	建议处理措施 Recommended Actions	重新计算：根据机械传动比和需要的精度，重新计算并设置合理的电子齿轮比，确保结果在驱动器允许范围内。 Recalculate: Based on the mechanical gear ratio and required precision, recalculate and set a reasonable electronic gear ratio, ensuring it's within the drive's allowable range.

0xFF20 (E323)：紧急停机 (Emergency Stop)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF20	产生机理 Mechanism	驱动器的紧急停机 (E-Stop) 安全输入信号被触发。这是一个最高优先级的安全功能。 The Emergency Stop (E-Stop) safety input signal of the drive is triggered. This is the highest priority safety function.
	可能原因 Possible Causes	① 设备上的急停按钮被按下； The emergency stop button on the equipment is pressed.

		② 安全回路被触发。 The safety circuit is triggered.
	确认方法 Verification Method	检查急停回路； Check the emergency stop circuit.
	建议处理措施 Recommended Actions	清除报警：在安全条件满足后，清除驱动器报警。 Clear alarm: After safety conditions are met, clear the drive alarm.

0xFF31 (E401) : EtherCAT 丢包 (EtherCAT Packet Loss)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF31	产生机理 Mechanism	EtherCAT 主站检测到在通讯过程中有数据帧丢失，导致通讯可靠性下降。 The EtherCAT master detects lost data frames during communication, reducing communication reliability.
	可能原因 Possible Causes	① 网络物理连接不良：网线接头松动、网线损坏； Poor physical network connection: Loose network cable connectors, damaged cable. ② 电磁干扰：网线未使用屏蔽线或屏蔽层未接地，受干扰导致数据错误； EMI: Unshielded network cable or improper shield grounding, causing data errors. ③ 网络负载过重：周期设置过短，或网络中从站数量过多。 Excessive network load: Communication cycle time is too short, or too many slaves in the network.

	确认方法 Verification Method	① 使用 EtherCAT 主站软件查看通讯错误计数； Use the EtherCAT master software to check communication error counters. ② 检查网线连接和质量。 Check network cable connection and quality.
	建议处理措施 Recommended Actions	① 检查物理连接：重新插拔网线，确保插紧。使用高质量的标准网线； Check physical connections: Re-seat network cables, ensure they are tight. Use high-quality standard cables. ② 抗干扰：使用屏蔽双绞线（STP）并确保屏蔽层良好接地； Reduce interference: Use shielded twisted pair (STP) cables and ensure the shield is properly grounded. ③ 优化网络：适当延长通讯周期，或优化网络拓扑。 Optimize network: Increase the communication cycle time appropriately, or optimize the network topology.

0xFF32（E402）：EtherCAT 通讯状态未进（OP EtherCAT Communication State Not Operational）

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF32	产生机理 Mechanism	EtherCAT 网络未能成功进入“操作”（OP）状态。 OP 状态是进行过程数据交换（PDO）的正常工作状态。 The EtherCAT network failed to successfully enter the

		"Operational" (OP) state. The OP state is the normal working state for Process Data Object (PDO) exchange.
	可能原因 Possible Causes	① 从站配置错误：从站 ESI 文件不匹配或配置参数有误； Slave configuration error: Slave ESI file mismatch or incorrect configuration parameters. ② 从站未准备就绪：某个从站存在故障或未初始化完成； Slave not ready: A slave device has a fault or is not initialized. ③ 网络接线错误：端口接反或环路。 Network wiring error: Ports reversed or loop formed.
	确认方法 Verification Method	在主站配置软件中查看所有从站的状态，找到停留在“初始化”或“预操作”状态的从站。 In the master configuration software, check the state of all slaves and identify any stuck in "Init" or "Pre-Operational" state.

	建议处理措施 Recommended Actions	① 检查配置：核对从站型号、固件版本与配置文件是否一致； Check configuration: Verify slave model, firmware version, and configuration file compatibility. ② 检查从站：排查故障从站，确认其自身工作正常； Check slave device: Troubleshoot the faulty slave, confirm it is functioning correctly. ③ 检查接线：确保网络是菊花链式拓扑，无环路。 Check wiring: Ensure the network uses a daisy-chain topology without loops.
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0xFF30 (E403) : EtherCAT 通讯状态未进 (OP EtherCAT Communication State Not OP)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF30	产生机理 Mechanism	EtherCAT 主站检测到与第一个从站之间的物理连接断开。 The EtherCAT master detects a physical disconnection from the first slave device.
	可能原因 Possible Causes	① 主站端口到第一个从站端口的网线未连接； The network cable from the master's port to the first slave's IN port is not connected. ② 网线断路； Open circuit in the network cable. ③ 主站或第一个从站的网络端口物理损坏。 Physical damage to the network port on the master

		or the first slave.
	确认方法 Verification Method	检查主站“OUT”端口到第一个从站“IN”端口的网线是否接好。 Check if the cable from the master's "OUT" port to the first slave's "IN" port is properly connected.
	建议处理措施 Recommended Actions	① 连接网线：确保网线牢固插入主站和第一个从站的端口中； Connect cable: Ensure the cable is firmly plugged into the master and the first slave's ports. ② 更换网线：使用已知良好的网线替换测试。 Replace cable: Test with a known-good network cable.

0xFF34 (E404)：指令插补周期不支持

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF34	产生机理 Mechanism	上位机发送的指令周期与驱动器内部设定的循环周期不匹配或不被支持。 The command cycle sent by the host PC does not match or is not supported by the drive's internal cycle time setting.
	可能原因 Possible Causes	① 上位机设置的指令周期过短，超过了驱动器的处理能力； The command cycle set by the host is too short, exceeding the drive's processing capability. ② 驱动器与主站的周期同步模式设置错误。 Incorrect cycle synchronization mode setting between the drive and the master.

	确认方法 Verification Method	对比主站设置指令周期和驱动器支持的周期范围。 Compare the host's command cycle with the drive's supported cycle time range.
	建议处理措施 Recommended Actions	① 调整周期：将主站的指令周期设置为驱动器支持的范围之内； Adjust the cycle: Set the host's command cycle within the drive's supported range. ② 核对同步模式：确保驱动器的同步模式（如 DC 模式）设置与主站一致。 Check sync mode: Ensure the drive's synchronization mode (e.g., DC mode) is consistent with the master's setting.

0xFF33 (E405) : PDO 配置超出数量限制 (PDO Configuration Exceeds Quantity Limit)

报警代码 Alarm Code	提示 Hint	内容 Content
0xFF33	产生机理 Mechanism	在 EtherCAT 网络组态时，为驱动器分配的过程数据对象（PDO）数量或总数据量超过了驱动器内部缓存的能力。 During EtherCAT network configuration, the number or total data size of Process Data Objects (PDO) assigned to the drive exceeds its internal buffer capacity.
	可能原因 Possible Causes	① 在主站软件中勾选了过多不必要的 PDO 映射条目； Too many unnecessary PDO mapping entries are selected in the master software. ② 驱动器支持的 PDO 数量有限。

		The drive supports a limited number of PDOs.
	确认方法 Verification Method	在主站配置软件中查看为驱动器分配的 PDO 列表和大小。 View the list and size of PDOs assigned to the drive in the master configuration software.
	建议处理措施 Recommended Actions	优化 PDO 映射：只勾选应用所必需的 PDO 条目，移除不必要的条目以节省资源。 Optimize PDO mapping: Select only the PDO entries essential for the application, and remove unnecessary ones to save resources.

六、TwinCAT 主站控制

TwinCAT Master Control

6.1 软件安装

Software Installation

请从 Beckhoff 官网下载最新版 TwinCAT3 软件（如 TC31-FULL-Setup.3.1.4024.35），并按照安装向导完成安装。

Please download the latest version of TwinCAT3 software (such as TC31-FULL-Setup.3.1.4024.35) from the Beckhoff official website and follow the installation wizard to complete the installation.

6.2 ESI 文件放置

ESI File Placement

PHU&RHU 的 EtherCAT 从站配置文件为 XML 格式（即 ESI 文件），文件名如下：

The PHU&RHU EtherCAT slave configuration file is in XML format (i.e., ESI file), and the file name is as follows:

EYOU_ServoModule.xml

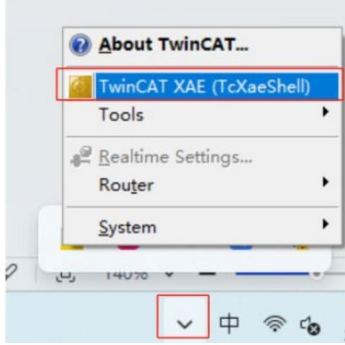
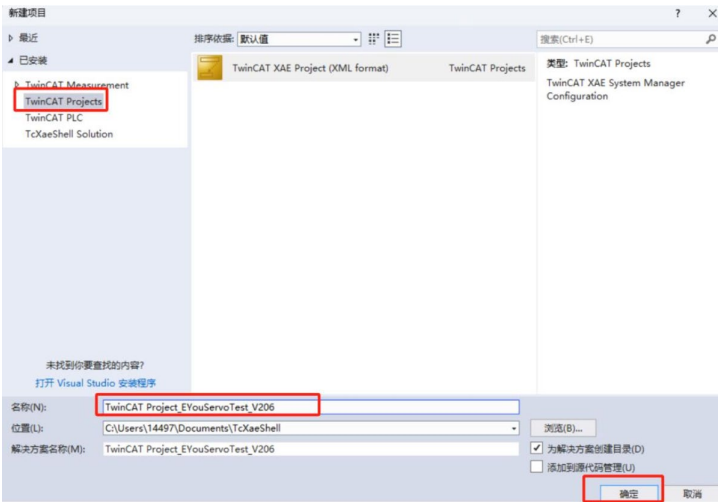
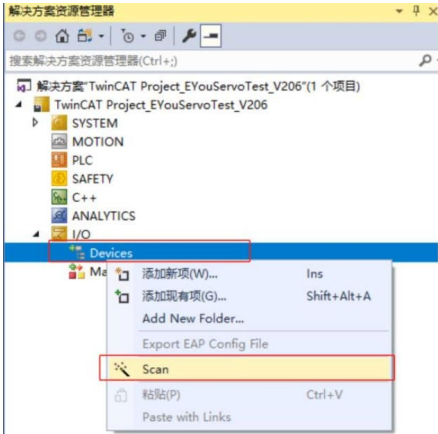
请将该文件放置于 Beckhoff TwinCAT3 指定的 ESI 文件路径下：

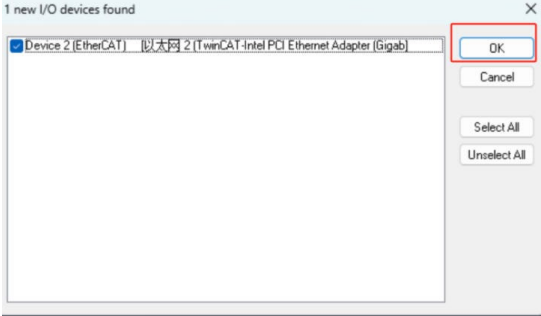
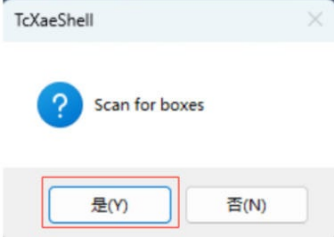
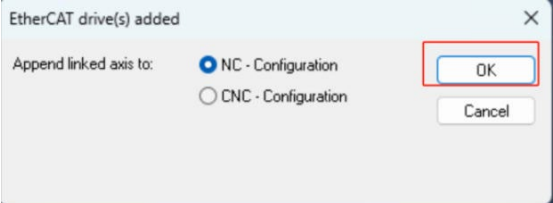
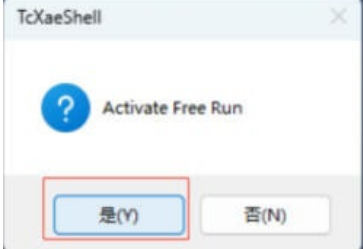
Please place this file in the ESI file path specified by Beckhoff TwinCAT3:

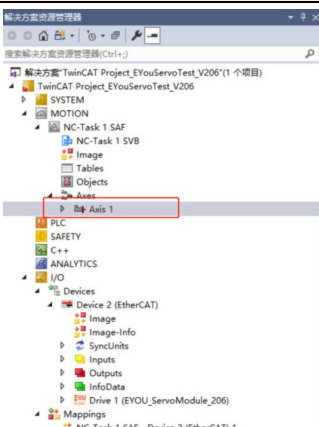
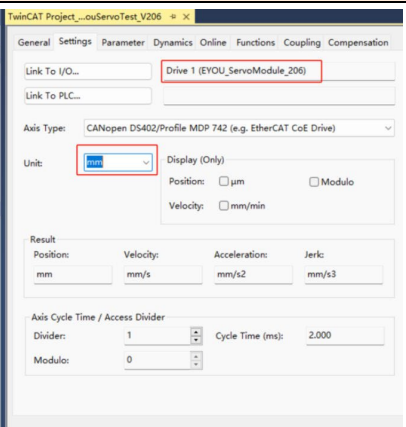
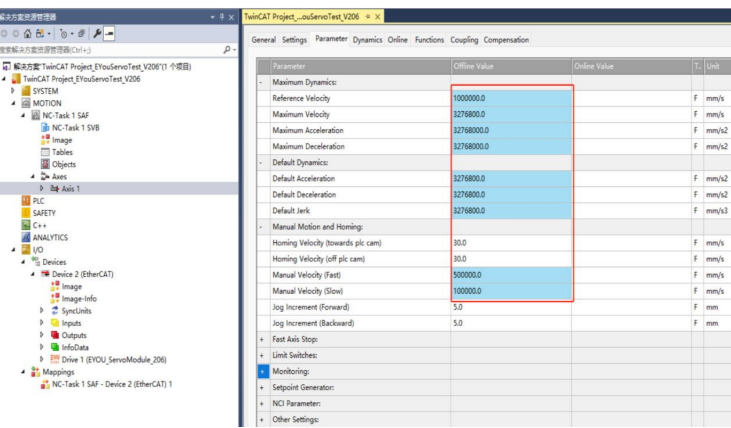
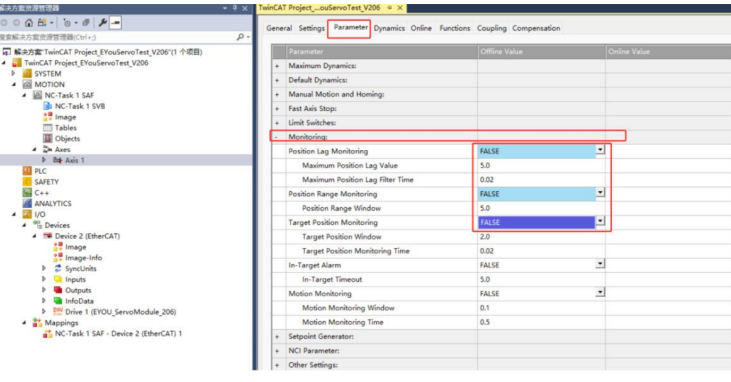
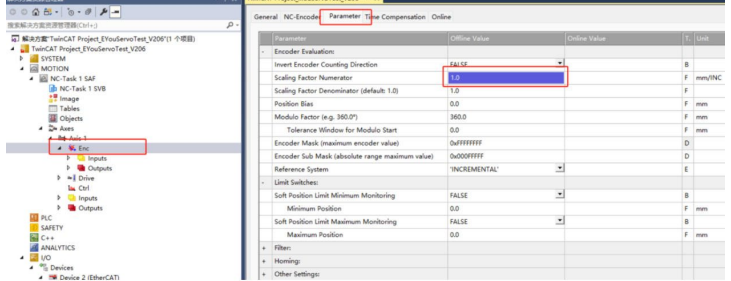
C:\TwinCAT\3.1\Config\Io\EtherCAT

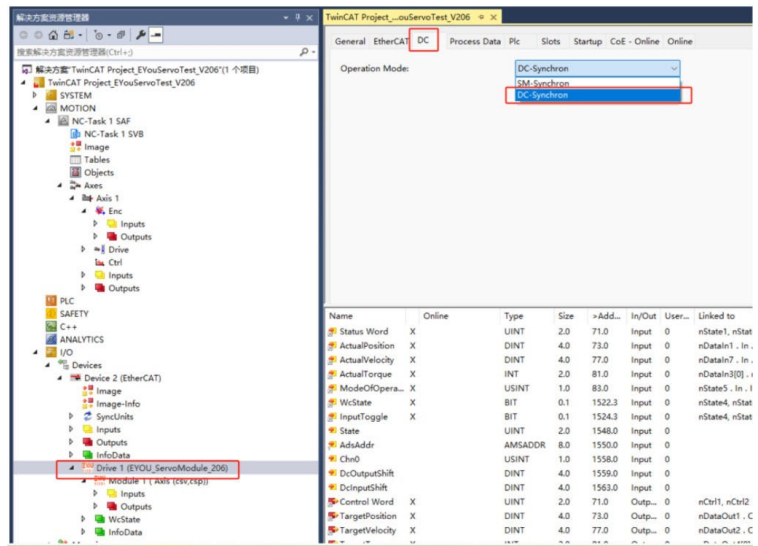
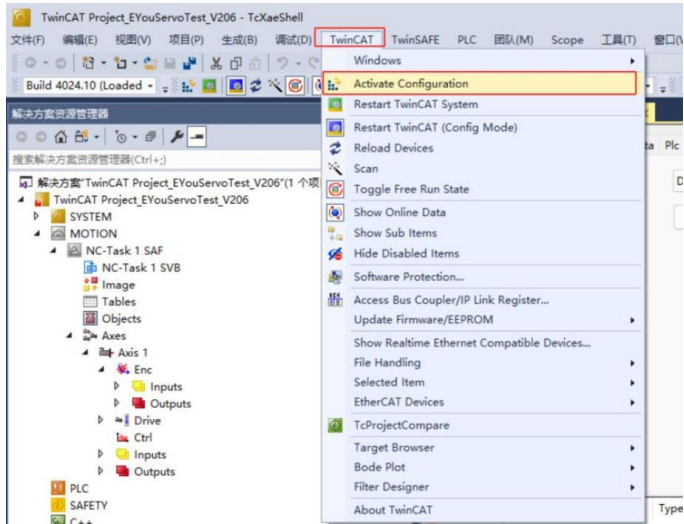
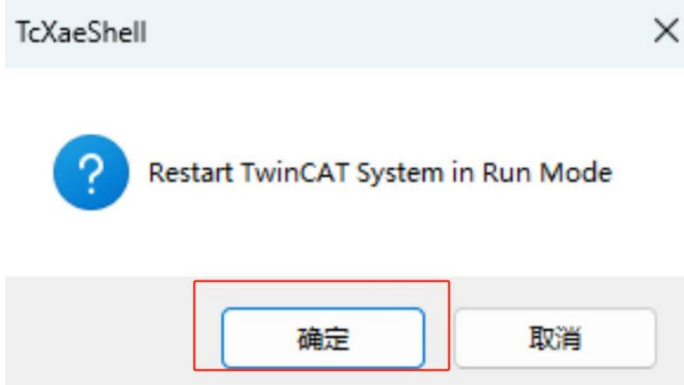
6.3 新建工程

Creating a New Project

步骤 Step	操作 Operation	图例 Illustration
1	新建 TwinCAT 工程 Create a new TwinCAT project	
	新建 TwinCAT 工程 Create a new TwinCAT project	
2	扫描从站设备 Scan for slave devices	

步骤 Step	操作 Operation	图例 Illustration
		
		
		
		
		

步骤 Step	操作 Operation	图例 Illustration
3	从站配置 Slave device configuration	 
		
		
		

步骤 Step	操作 Operation	图例 Illustration
	DC 模式，周期默认 2ms Distributed Clock (DC) mode, cycle time (default: 2ms)	
4	激活 Activate the configuration	
		

6.4 PDO 配置

PDO Configuration

本章节基于 Beckhoff TwinCAT3 主站对 PDO 动态配置具体操作步骤如下：

This chapter outlines the specific operational steps for PDO dynamic configuration using the Beckhoff TwinCAT3 master station as follows:

双击 Drive 1 (EYOU_ServoModule)，在右侧找到 Process Data，默认配置使用的映射参数在 PDO List 中。

Double-click Drive 1 (EYOU_ServoModule), locate Process Data on the right side, and the default mapping parameters used in the PDO List.

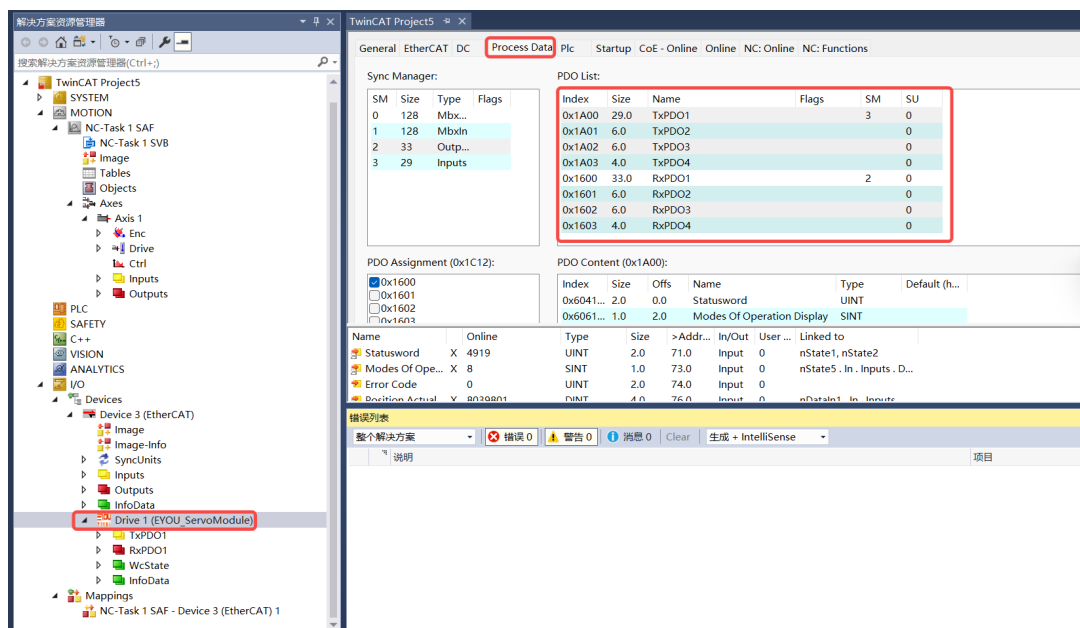


图 6-1 PDO List 的位置

Figure 6-1 Position of PDO List

选择 0x1A00(TxPDO)，以 0x1A00 为例，在 PDO Content 中添加或删除参数来改变映射对象。新映射对象可以直接插入也可以附加到末尾，添加好的参数可以在 PDO content 中看到。

select 0x1A00 (TxPDO). For example, with 0x1A00, add or remove parameters in PDO Content to modify the mapped object. The new mapped object can be inserted directly or appended to the end.

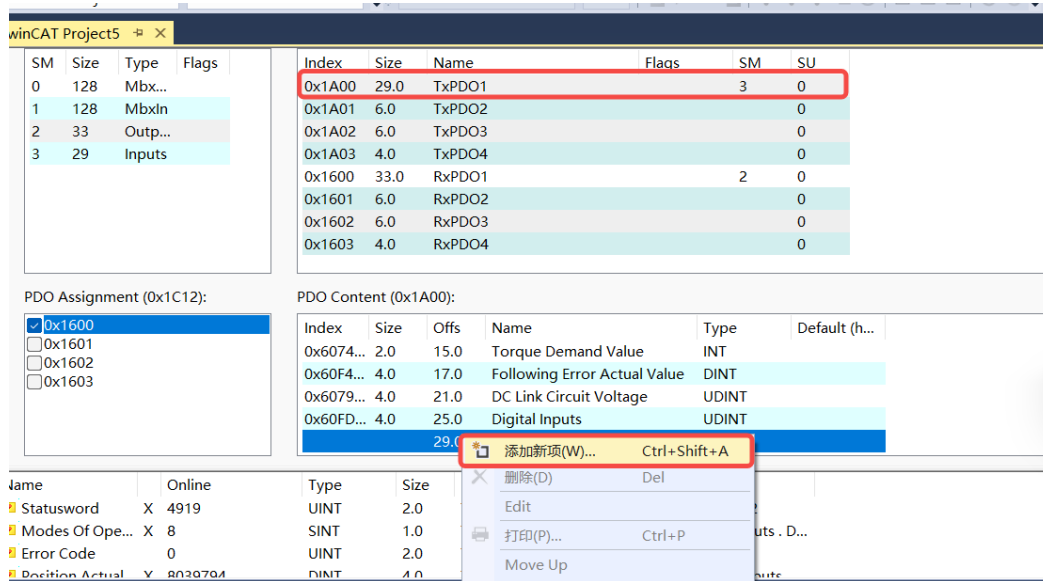


图 6-2 插入新映射对象

Figure 6-2 Insert new mapping object

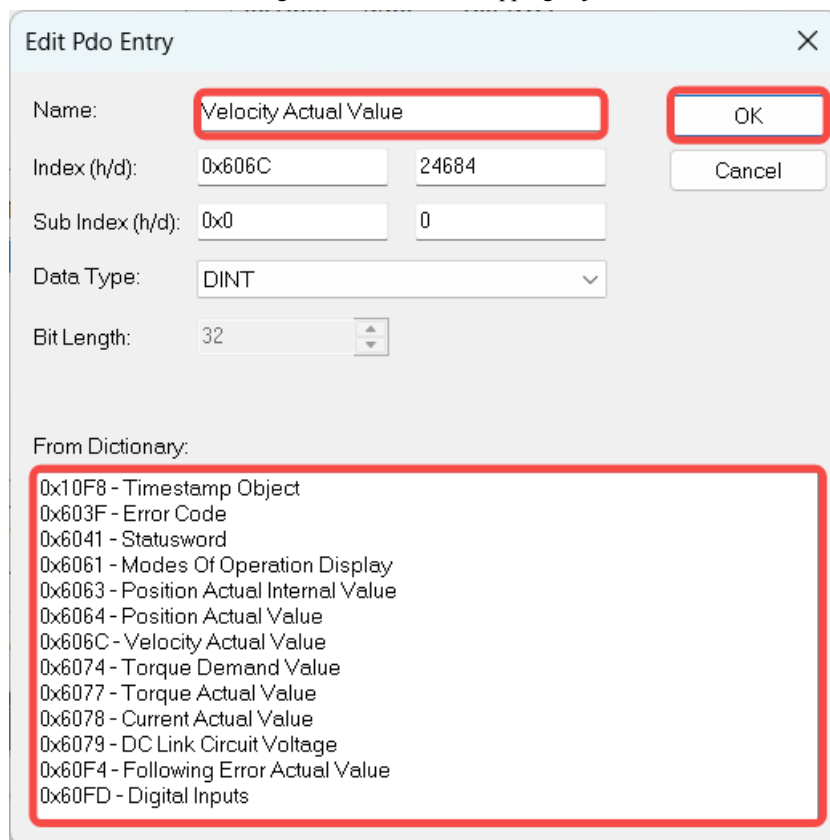


图 6-3 可插入对象列表

Figure 6-3 Insertable Object List

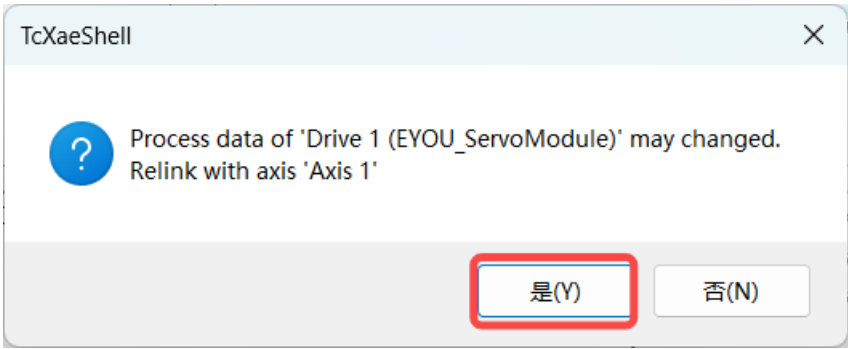


图 6-4 确认修改

Figure 6-4 Confirm modification

选择 0x1600(TxPDO), 以 0x1600 为例, 在 PDO Content 中添加或删除参数来改变映射对象。新映射对象可以直接插入也可以附加到末尾, 添加好的参数可以在 PDO content 中看到。

select 0x1A00 (TxPDO). For example, with 0x1A00, add or remove parameters in PDO Content to modify the mapped object. The new mapped object can be inserted directly or appended to the end.

PDO Content (0x1A00):

Index	Size	Offs	Name	Type	Default (h...
0x6064...	4.0	5.0	Position Actual Value	DINT	
0x606C...	4.0	9.0	Velocity Actual Value	DINT	
0x6077...	2.0	13.0	Torque Actual Value	INT	
0x6074...	2.0	15.0	Torque Demand Value	INT	
0x60F4...	4.0	17.0	Following Error Actual Value	DINT	

图 6-5 成功插入新映射对象

Figure 6-5 Successful insertion of new mapping object

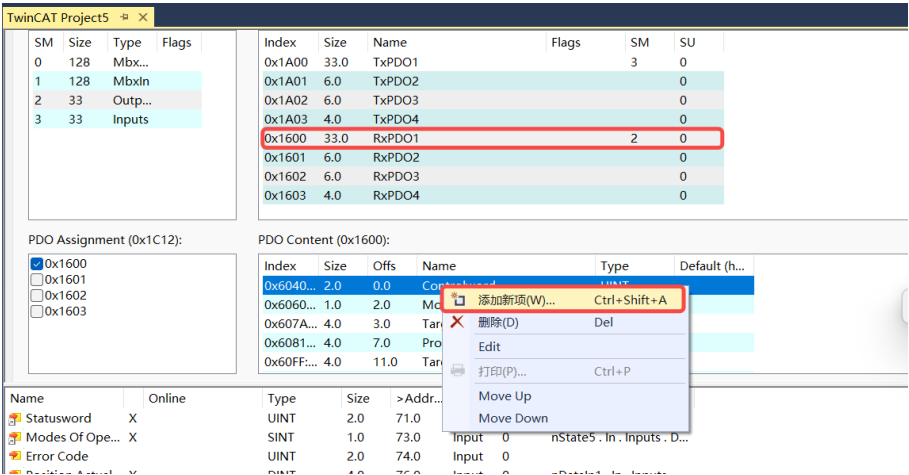


图 6-6 插入新映射对象

Figure 6-6 Insert new mapping object

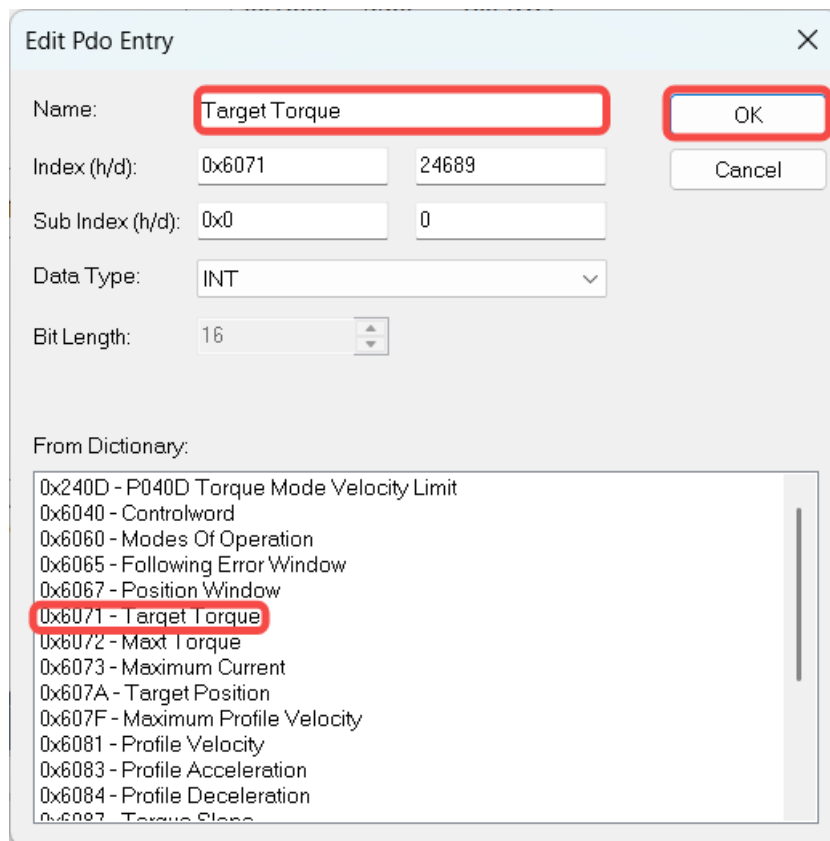


图 6-7 可插入对象列表

Figure 6-7 Insertable object list

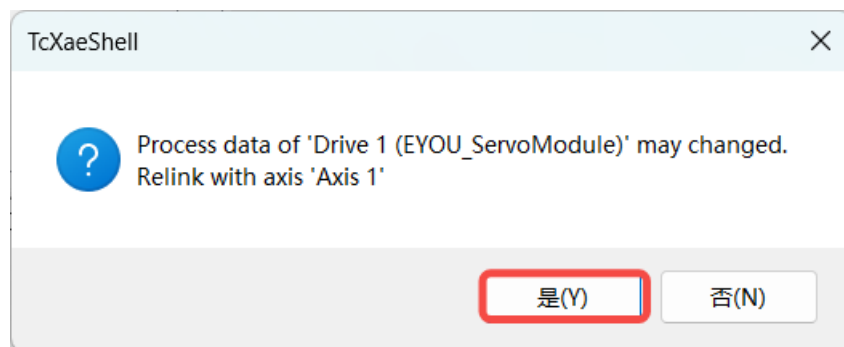


图 6-8 确认修改

Figure 6-8 Confirm modification

当 PDO 映射被更改时，TwinCAT 会自动更新启动脚本，以便在 PREOP=>OP 时发送到从站驱动器。按照 DSP402 标准协议，映射对象自动链接到使用标准对象的轴。其他映射对象需要手动连接 PDO。

When the PDO mapping is modified, TwinCAT automatically updates the startup script to send commands to slave drives during the PREOP=>OP phase. In accordance with the DSP402 standard protocol, the mapped objects are automatically linked to the axes using standard objects. Other mapping objects require manual PDO connection.

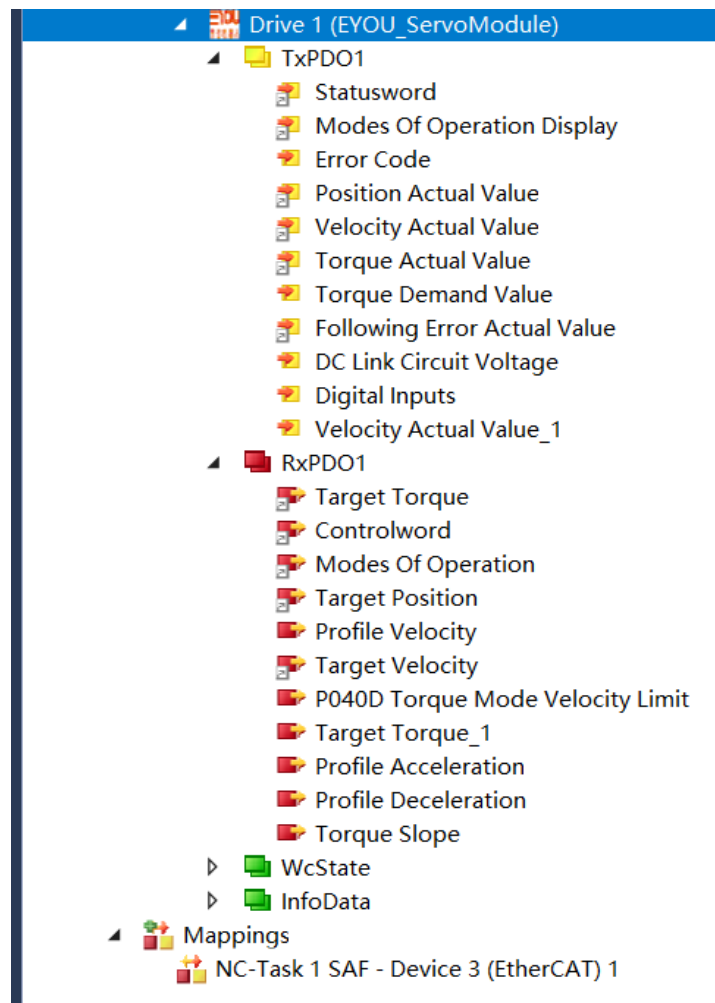


图 6-9 脚本更新

Figure 6-9 Script Update

6.5 运动控制

Motion Control

步骤 Step	操作 Operation	图例 Illustration
1	电机上使能 Enable the motor servo	
	电机点动 Jog the motor	

七、附录

Appendix

7.1 对象字典详解

Object Dictionary Detailed Explanation

7.1.1 对象数据存储与类型

Object Data Storage and Types

表 7-1 对象字典索引区域划分概览

Table 7-1 Overview of Object Dictionary Index Areas

Index Range	Description
0000h	Reserved
0001h~ 025Fh	数据类型 Data Types
0260h ~ 0FFFh	Reserved
1000h~1FFFh	通讯对象子协议区 Communication Profile Area
2000h ~5FFFh	制造商特定子协议区 Manufacturer-Specific Profile Area
6000h ~9FFFh	标准化设备子协议区 Standardized Device Profile Area
A000h~AFFFh	网络变量（符合 IEC61131-3） Network Variables (compliant with IEC 61131-3)
B000h ~ BFFFh	用于路由网关的系统变量 System Variables for Routing Gateways
C000h ~ FFFFh	Reserved

表 7-2 数据类型

Table 7-2 Data Types

Index	Name	Type	Description	Bits	Range
0x0001	BOOLEAN	BOOL	False/True	1	0,1
0x0002	INTEGER8	SINT	Short integer	8	$-2^7 \sim 2^7 - 1$
0x0003	INTEGER16	INT	Integer	16	$-2^{15} \sim 2^{15} - 1$
0x0004	INTEGER32	DINT	Double integer	32	$-2^{31} \sim 2^{31} - 1$
0x0015	INTEGER64	LINT	Long integer	64	$-2^{63} \sim 2^{63} - 1$
0x0005	UNSIGNED8	USINT	Unsigned Short integer	8	$0 \sim 2^8 - 1$
0x0006	UNSIGNED16	UINT	Unsigned Integer		$0 \sim 2^{16} - 1$
0x0007	UNSIGNED32	UDINT	Unsigned Double integer	32	$0 \sim 2^{32} - 1$
0x001B	UNSIGNED64	ULINT	Unsigned Long integer		$0 \sim 2^{64} - 1$
0x0009	VISIBLE_STRING	STRING (n)	Visible String (octet per character)	8*n	-
0x000A	OCTET_STRING	ARRAY [0...n] of USINT	Sequence of octets (data type USINT)	8*(n+1)	-
0x0021	PDO_MAPPING	-	PDO Mapping Parameter Record	-	-
0x0023	IDENTITY	-	Identity Parameter Record	-	-

表 7-3 对象字典目录

Table 7-3 Access Type and Object Code

Access type	Description
RW	Read and write access
RO	Read only access
WO	Write only access
CONST	Read only access value is constant
Object code	Object name
0x0007	VAR
0x0008	ARRAY
0x0009	RECORD

表 7-4 对象字典目录

Table 7-4 Object Dictionary

NO.	Index	Name	Object code	CANopen	EtherCAT
1	0x1000	Device type	VAR	√	√
2	0x1001	Error register	VAR	√	√
3	0x1003	Pre-Defined error field	ARRAY	√	×
4	0x1005	COB-ID SYNC message	VAR	√	×
5	0x1006	Communication cycle period	VAR	√	×
6	0x1007	Synchronous window Length	VAR	√	×
7	0x1008	Manufacturer device name	VAR	√	√
8	0x1009	Manufacturer hardware version	VAR	√	√
9	0x100A	Manufacturer software version	VAR	√	√
10	0x100B	Node-ID	VAR	√	×
11	0x100C	Guard Time	VAR	√	×
12	0x100D	Life Time Factor	VAR	√	×
13	0x1010	Save parameters	ARRAY	√	×
14	0x1014	COB-ID EMCY	VAR	√	×

NO.	Index	Name	Object code	CANopen	EtherCAT
15	0x1016	Consumer heartbeat time	ARRAY	√	×
16	0x1017	Producer heartbeat time	VAR	√	×
17	0x1018	Identity object	RECORD	√	√
18	0x1200	SDO server parameter	RECORD	√	×
19	0x1400	Receive PDO 1 parameter	RECORD	√	×
20	0x1401	Receive PDO 2 parameter	RECORD	√	×
21	0x1402	Receive PDO 3 parameter	RECORD	√	×
22	0x1403	Receive PDO 4 parameter	RECORD	√	×
23	0x1600	Receive PDO 1 mapping	RECORD	√	√
24	0x1601	Receive PDO 2 mapping	RECORD	√	√
25	0x1602	Receive PDO 3 mapping	RECORD	√	√
26	0x1603	Receive PDO 4 mapping	RECORD	√	√
27	0x1800	Transmit PDO 1 parameter	RECORD	√	×
28	0x1801	Transmit PDO 2 parameter	RECORD	√	×
29	0x1802	Transmit PDO 3 parameter	RECORD	√	×
30	0x1803	Transmit PDO 4 parameter	RECORD	√	×
31	0x1A00	Transmit PDO 1 mapping	RECORD	√	√
32	0x1A01	Transmit PDO 2 mapping	RECORD	√	√
33	0x1A02	Transmit PDO 3 mapping	RECORD	√	√
34	0x1A03	Transmit PDO 4 mapping	RECORD	√	√
35	0x1C00	SYNC manager communication type	ARRAY	×	√
36	0x1C12	SYNC manager 2 PDO assignment	ARRAY	×	√
37	0x1C13	SYNC manager 3 PDO assignment	ARRAY	×	√
38	0x1C32	SYNC manager 2 parameter	RECORD	×	√
39	0x1C33	SYNC manager 3 parameter	RECORD	×	√
40	0x2000	Motor Type	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
41	0x2002	Motor Name	VAR	√	√
42	0x2005	Motor Power	VAR	√	√
43	0x2006	Motor Rate Speed	VAR	√	√
44	0x2007	Motor Rated Torque	VAR	√	√
45	0x2008	Motor Rated Current	VAR	√	√
46	0x2009	Motor Max Speed	VAR	√	√
47	0x200A	Motor Max Torque	VAR	√	√
48	0x200B	Motor Peak Current	VAR	√	√
49	0x200C	Motor Inertia	VAR	√	√
50	0x200F	Load To Motor Inertia Ratio	VAR	√	√
51	0x2011	Motor Poles	VAR	√	√
52	0x2012	Motor Inductance	VAR	√	√
53	0x2013	Motor Resistance	VAR	√	√
54	0x2014	Motor Back EMF Coefficient	VAR	√	√
55	0x2015	Motor Torque Coefficient	VAR	√	√
56	0x2018	Motor Rated Voltage	VAR	√	√
57	0x2022	Encoder Type Backup	VAR	√	√
58	0x2023	Motor Encoder Resolution	VAR	√	√
59	0x2025	Encoder Single Turn Resolution	VAR	√	√
60	0x2026	Motor Initial Angle	VAR	√	√
61	0x2028	Motor Acceleration	VAR	√	√
62	0x2029	Motor Deceleration	VAR	√	√
63	0x202A	Acceleration	VAR	√	√
64	0x202B	Deceleration	VAR	√	√
65	0x202C	Maximum Acceleration	VAR	√	√
66	0x202D	Maximum Deceleration	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
67	0x2040	Motor Foldback Disable	VAR	√	√
68	0x2042	Motor Foldback Fault Threshold	VAR	√	√
69	0x2043	Motor Foldback Warning Threshold	VAR	√	√
70	0x2044	Motor Foldback Delay Time	VAR	√	√
71	0x2045	Motor Foldback Time Constant	VAR	√	√
72	0x2046	Motor Foldback Recovery Time	VAR	√	√
73	0x2047	Motor Foldback Factor	VAR	√	√
74	0x204A	Drive Type	VAR	√	√
75	0x204C	Addr	VAR	√	√
76	0x2055	PWM Frequency	VAR	√	√
77	0x205A	Bus Control Lpf Frequency	VAR	√	√
78	0x205B	Bus Feedback Lpf Frequency	VAR	√	√
79	0x205C	Over Voltage Threshold	VAR	√	√
80	0x205D	Under Voltage Threshold	VAR	√	√
81	0x205E	Under Voltage Mode	VAR	√	√
82	0x205F	Under Voltage Recovery Mode	VAR	√	√
83	0x2060	Under Voltage Time	VAR	√	√
84	0x2061	Over Current Threshold	VAR	√	√
85	0x2062	Over Current Time	VAR	√	√
86	0x2063	Current Sensor Correction Coefficient	VAR	√	√
87	0x2064	Current Sensor Zero Offset Threshold	VAR	√	√
88	0x2065	Current Sensor Velocity Threshold	VAR	√	√
89	0x2066	Temperature Correction Coefficient	VAR	√	√
90	0x2067	Drive Over Temperature Threshold	VAR	√	√
91	0x2068	Drive IPM Temperature Filter Length	VAR	√	√
92	0x2069	Drive Temperature Filter Length	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
93	0x206A	Drive Foldback Fault Threshold	VAR	√	√
94	0x206B	Drive Foldback Warning Threshold	VAR	√	√
95	0x206D	Drive Foldback Current Lpf	VAR	√	√
96	0x206E	Drive Foldback Delay Time	VAR	√	√
97	0x206F	Drive Foldback Stall Slope	VAR	√	√
98	0x2070	Drive Foldback Delay Stall Start Temperature	VAR	√	√
99	0x2071	Drive Foldback Delay Stall End Temperature	VAR	√	√
100	0x2072	Drive Foldback Stall Current Threshold	VAR	√	√
101	0x2073	Drive Foldback Stall Start Temperature	VAR	√	√
102	0x2074	Drive Foldback Stall End Temperature	VAR	√	√
103	0x2075	Drive Foldback Constant Time	VAR	√	√
104	0x2076	Drive Foldback Coefficient	VAR	√	√
105	0x2082	Serial Number	VAR	√	√
106	0x2083	Hardware Version	VAR	√	√
107	0x2084	MCU Version	VAR	√	√
108	0x2087	Module Rated Torque Nm	VAR	√	√
109	0x2100	Drive Communication Mode	VAR	√	√
110	0x2101	Drive Operation Mode	VAR	√	√
111	0x2102	Rotary Direction	VAR	√	√
112	0x2103	Disable Mode	VAR	√	√
113	0x2104	Active Disable Speed Threshold	VAR	√	√
114	0x2105	Active Disable Delay	VAR	√	√
115	0x2106	Active Disable Time	VAR	√	√
116	0x2107	Active Disable Deceleration	VAR	√	√
117	0x2108	Active Disable Deceleration Time	VAR	√	√
118	0x2110	Manual Brake By Output Mode	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
119	0x2110	Brake forced output control	VAR	√	√
120	0x2113	Out Brake Release Time	VAR	√	√
121	0x2114	Out Brake Engage Time	VAR	√	√
122	0x2115	Out Brake Safe Speed	VAR	√	√
123	0x212D	Password	VAR	√	√
124	0x212E	Restore Drive Parameter	VAR	√	√
125	0x212F	Config Drive	VAR	√	√
126	0x2130	Save Drive Parameter To EEPROM	VAR	√	√
127	0x2201	Position Command Moving Average Filter	VAR	√	√
128	0x2215	Feed	VAR	√	√
129	0x2216	Shaft Revolution	VAR	√	√
130	0x2217	Electric Gear Denominator	VAR	√	√
131	0x2218	Electric Gear Numerator	VAR	√	√
132	0x221B	Position Interpolation Type	VAR	√	√
133	0x221C	Position Interpolation Delay	VAR	√	√
134	0x221E	Position Command Compensation Gain	VAR	√	√
135	0x221F	Position Command Compensation Lpf	VAR	√	√
136	0x2220	Position Loop Control Mode	VAR	√	√
137	0x2221	Internal Velocity Feedforward Smooth Type	VAR	√	√
138	0x2222	Velocity Feedforward Source	VAR	√	√
139	0x2223	External Input Velocity Feedforward	VAR	√	√
140	0x2228	Rigid	VAR	√	√
141	0x2229	First Group Position Loop Bandwidth	VAR	√	√
142	0x222A	First Group Position Loop Gain	VAR	√	√
143	0x222B	First Group Position Loop Velocity Feedforward Gain	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
144	0x222C	First Group Position Loop Velocity Feedforward Filter Frequency	VAR	√	√
145	0x222D	First Group Torque Feedforward Gain	VAR	√	√
146	0x222E	First Group Torque Feedforward Filter Frequency	VAR	√	√
147	0x222F	Acceleration Feedforward Gain	VAR	√	√
148	0x2230	Acceleration Feedforward Mode	VAR	√	√
149	0x2231	Acceleration Feedforward Velocity Threshold	VAR	√	√
150	0x2232	Acceleration Feedforward Filter Frequency	VAR	√	√
151	0x2233	Position Error To Current Feedforward Gain	VAR	√	√
152	0x2234	Position Error To Current Feedforward Lpf	VAR	√	√
153	0x2238	Gain Switch Rigid	VAR	√	√
154	0x223A	Second Group Position Loop Bandwidth	VAR	√	√
155	0x223B	Gain Switch Second Group Velocity Feedforward Gain	VAR	√	√
156	0x223C	Gain Switch Second Group Velocity Feedforward Filter Frequency	VAR	√	√
157	0x223D	Gain Switch Second Group Torque Feedforward Gain	VAR	√	√
158	0x223E	Gain Switch Second Group Torque Feedforward Filter Frequency	VAR	√	√
159	0x2248	Position Offset	VAR	√	√
160	0x2249	Position Feedback Source	VAR	√	√
161	0x224A	Position Error Threshold	VAR	√	√
162	0x224B	Position Error Time	VAR	√	√
163	0x224D	In Position Mode	VAR	√	√
164	0x224E	In Position Hysteresis	VAR	√	√
165	0x2250	In Position Threshold	VAR	√	√
166	0x2251	In Position Time	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
167	0x2260	Homing Error Check Mode	VAR	√	√
168	0x2262	Homing Type	VAR	√	√
169	0x2264	Homing Acceleration	VAR	√	√
170	0x2265	Homing Velocity 1	VAR	√	√
171	0x2266	Homing Velocity 2	VAR	√	√
172	0x2267	Homing Offset	VAR	√	√
173	0x2268	Home Offset Move	VAR	√	√
174	0x2269	Homing Max Run Time	VAR	√	√
175	0x226A	Homing Penetrate Detect Enable	VAR	√	√
176	0x226B	Homing Complete Wait Time	VAR	√	√
177	0x2301	Maximum Velocity	VAR	√	√
178	0x2303	First Group Velocity Loop Bandwidth	VAR	√	√
179	0x2304	First Group Velocity Proportional Gain	VAR	√	√
180	0x2305	First Velocity Loop Integral Time Constant	VAR	√	√
181	0x2306	First Group Velocity Integral Gain	VAR	√	√
182	0x2307	First Group Velocity Feedforward Gain	VAR	√	√
183	0x2308	First Group Velocity To Current Feedforward Gain	VAR	√	√
184	0x2309	First Group Velocity To Current Feedforward Lpf	VAR	√	√
185	0x230A	Torque Feedforward Source	VAR	√	√
186	0x230B	External Input Torque Feedforward	VAR	√	√
187	0x230C	Velocity Loop Control Mode	VAR	√	√
188	0x230D	Velocity Filter Mode	VAR	√	√
189	0x230E	First Group Velocity Filter Frequency	VAR	√	√
190	0x2310	Velocity Feedback Filter Mode	VAR	√	√
191	0x2313	Gain Switch Second Group Velocity Loop Bandwidth	VAR	√	√
192	0x2314	Second Group Velocity Loop Bandwidth	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
193	0x2315	Second Group Velocity Loop Integral Time Constant	VAR	√	√
194	0x2316	Gain Switch Second Group Velocity Integral Gain	VAR	√	√
195	0x2317	Gain Switch Second Group Velocity Feedforward Gain	VAR	√	√
196	0x2318	Gain Switch Second Group Velocity To Current Feedforward Gain	VAR	√	√
197	0x2319	0 Gain Switch Second Group Velocity To Current Feedforward Lpf	VAR	√	√
198	0x231E	Second Group Velocity Filter Frequency	VAR	√	√
199	0x2327	Jog Enable	VAR	√	√
200	0x2328	Jog Velocity	VAR	√	√
201	0x2329	Jog Direction	VAR	√	√
202	0x232C	Velocity Reached Threshold	VAR	√	√
203	0x232F	Zero Velocity Threshold	VAR	√	√
204	0x2330	Zero Velocity Time	VAR	√	√
205	0x2331	Velocity Reach Threshold	VAR	√	√
206	0x2332	Velocity Reach Time	VAR	√	√
207	0x2333	Velocity Error Threshold	VAR	√	√
208	0x2334	Velocity Error Time	VAR	√	√
209	0x2335	Dither Frequency	VAR	√	√
210	0x2404	Torque Slope	VAR	√	√
211	0x2408	Maximum Current	VAR	√	√
212	0x2409	Maximum Positive Current	VAR	√	√
213	0x240A	Maximum Negative Current	VAR	√	√
214	0x240D	Torque Mode Velocity Limit	VAR	√	√
215	0x240E	Velocity Limit Unit Selection	VAR	√	√
216	0x240F	Velocity Limit Coefficient In Current Mode	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
217	0x2410	Current Loop Bandwidth	VAR	√	√
218	0x2412	Current Loop Proportional Gain	VAR	√	√
219	0x2413	Current Loop Integral Gain	VAR	√	√
220	0x2415	Current Loop Anti Saturation Gain	VAR	√	√
221	0x241B	Current Loop Voltage Feedforward Coefficient	VAR	√	√
222	0x241D	Torque Command First Filter	VAR	√	√
223	0x241E	Torque Command Second Filter	VAR	√	√
224	0x2420	Adaptive Filter Enable	VAR	√	√
225	0x2421	Adaptive Filter Minimum Frequency	VAR	√	√
226	0x2422	Adaptive Filter Magnitude Threshold	VAR	√	√
227	0x2423	Adaptive Filter Save Mode	VAR	√	√
228	0x2426	Low Notch Center Frequency Flag	VAR	√	√
229	0x2428	First Notch Filter Center Frequency	VAR	√	√
230	0x2429	First Notch Filter Bandwidth	VAR	√	√
231	0x242A	First Notch Filter Depth	VAR	√	√
232	0x242B	First Notch Filter Enable	VAR	√	√
233	0x242C	Second Notch Filter Center Frequency	VAR	√	√
234	0x242D	Second Notch Filter Bandwidth	VAR	√	√
235	0x242E	Second Notch Filter Depth	VAR	√	√
236	0x242F	Second Notch Filter Enable	VAR	√	√
237	0x2440	Flux Weakening Enable	VAR	√	√
238	0x2444	Vbus Utilization Rate	VAR	√	√
239	0x2450	Torque Loop Kp	VAR	√	√
240	0x2451	Torque Loop Ki	VAR	√	√
241	0x2452	Torque Offset	VAR	√	√
242	0x2453	Torque Feedback Low-Pass Filter Frequency	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
243	0x250B	Over Velocity Threshold	VAR	√	√
244	0x250C	Over Velocity Time	VAR	√	√
245	0x2516	Stall Time	VAR	√	√
246	0x2517	Stall Velocity	VAR	√	√
247	0x2518	Stall Current	VAR	√	√
248	0x251B	Encoder Communication Crc Fault Value	VAR	√	√
249	0x251C	Encoder Communication Timeout Fault Value	VAR	√	√
250	0x251D	Encoder Communication Fault Threshold	VAR	√	√
251	0x252A	Gravity Compensation Enable	VAR	√	√
252	0x252B	Gravity Compensation Value	VAR	√	√
253	0x252C	Gravity Compensation Coefficient	VAR	√	√
254	0x252D	Gravity Compensation Off Time	VAR	√	√
255	0x252E	Gravity Compensation Mode	VAR	√	√
256	0x252F	Gravity Compensation Actual Value	VAR	√	√
257	0x2532	Position Limiting Mode	VAR	√	√
258	0x2533	Software Position Limit Hysteresis	VAR	√	√
259	0x2534	Software Position Limit Maximum	VAR	√	√
260	0x2535	Software Position Limit Minimum	VAR	√	√
261	0x2536	Hardware Position Limit Hysteresis	VAR	√	√
262	0x2537	Hardware Position Limit Mode	VAR	√	√
263	0x253B	STO Mode	VAR	√	√
264	0x253C	STO Recover Mode	VAR	√	√
265	0x2540	Drive Latched Warning	VAR	√	√
266	0x2541	Drive Latched Fault	VAR	√	√
267	0x2543	Fault History Save Delay Time	VAR	√	√
268	0x2601	MCU Realtime Overload Check Enable	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
269	0x2602	Drive Realtime Load	VAR	√	√
270	0x2603	Drive Maximum Realtime Load	VAR	√	√
271	0x2604	Drive Motion Realtime Load	VAR	√	√
272	0x2605	Drive Realtime Overload Type	VAR	√	√
273	0x2620	Gain Switch Enable	VAR	√	√
274	0x2621	Gain Switch Mode	VAR	√	√
275	0x2622	Gain Switch Delay	VAR	√	√
276	0x2623	Gain Switch Level	VAR	√	√
277	0x2624	Gain Switch Hysteresis	VAR	√	√
278	0x2625	Gain Switch Time	VAR	√	√
279	0x2626	Gain Switch Filter Enable	VAR	√	√
280	0x2627	Gain Switch Parameter Dump	VAR	√	√
281	0x2628	Gain Switch Position Command Threshold	VAR	√	√
282	0x2629	Gain Switch Acceleration	VAR	√	√
283	0x263A	Positive Friction Compensation	VAR	√	√
284	0x263B	Negative Friction Compensation	VAR	√	√
285	0x263C	Positive Friction Compensation Hysteresis	VAR	√	√
286	0x263D	Negative Friction Compensation Hysteresis	VAR	√	√
287	0x2642	Unit Of Rotary Acceleration	VAR	√	√
288	0x2643	Unit Of Rotary Position	VAR	√	√
289	0x2644	Unit Of Rotary Velocity	VAR	√	√
290	0x2649	Serial Buffered Position Command 1	VAR	√	√
291	0x264A	Serial Buffered Position Command 2	VAR	√	√
292	0x264B	Serial Buffered Velocity Command 1	VAR	√	√
293	0x264C	Serial Buffered Velocity Command 2	VAR	√	√
294	0x264D	Serial Buffered Position Move Times	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
295	0x264E	Serial Buffered Position Move Delay Time	VAR	√	√
296	0x264F	Serial Buffered Position Move Mode	VAR	√	√
297	0x266C	Interpolation Time Index	VAR	√	√
298	0x266D	Interpolation Time Period Value	VAR	√	√
299	0x2670	Ecat Communication State	VAR	×	√
300	0x2672	AL Code	VAR	√	√
301	0x2675	EtherCAT Position Command Compensation Delay	VAR	×	√
302	0x2676	EtherCAT Position Command Compensation Mode	VAR	×	√
303	0x2677	EtherCAT Redundancy Enable	VAR	×	√
304	0x2678	EtherCAT Mainloop Run Mode	VAR	×	√
305	0x2679	EtherCAT Eeprom Modify Mode	VAR	×	√
306	0x267A	A Enable Object 0x6076	VAR	√	√
307	0x26A0	Node-ID	VAR	√	√
308	0x26A1	CAN Buadrate	VAR	√	√
309	0x26A2	Reduction Ratio Numerator	VAR	√	√
310	0x26A3	Reduction Ratio Denominator	VAR	√	√
311	0x2706	Drive Enable Status	VAR	√	√
312	0x2707	Position Motion Ended	VAR	√	√
313	0x2708	Control Mode	VAR	√	√
314	0x2709	System State Machine State	VAR	√	√
315	0x270A	Motor Run Loop State	VAR	√	√
316	0x270B	Application State Machine State	VAR	√	√
317	0x270C	System Run Time	VAR	√	√
318	0x270D	Initial Position Identification Status	VAR	√	√
319	0x2710	Drive Sync0 Task Realtime Load	VAR	√	√
320	0x2711	Drive 1ms Task Realtime Load	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
321	0x2712	Drive 10ms Task Realtime Load	VAR	√	√
322	0x2735	Positive Current Limit Actual Value	VAR	√	√
323	#x2736	Negative Current Limit Actual Value	VAR	√	√
324	0x276F	Encoder Single Turn Position	VAR	√	√
325	0x2770	Encoder Multi Turn Position	VAR	√	√
326	0x2771	Encoder Multi-Turn Original Value	VAR	√	√
327	0x2777	Vbus	VAR	√	√
328	0x2779	Drive Temperature	VAR	√	√
329	0x277A	Power Module Temperature	VAR	√	√
330	0x27B0	Position Loop Gain Actual Value	VAR	√	√
331	0x27B1	Position Loop Velocity Feedforward Gain Actual Value	VAR	√	√
332	0x27B2	Position Loop Velocity Feedforward Filter Frequency Actual Value	VAR	√	√
333	0x27B3	Torque Feedforward Gain Actual Value	VAR	√	√
334	0x27B4	Torque Feedforward Filter Frequency Actual Value	VAR	√	√
335	0x27B5	Velocity Proportional Gain Actual Value	VAR	√	√
336	0x27B6	Velocity Integral Gain Actual Value	VAR	√	√
337	0x27B7	Velocity Feedforward Gain	VAR	√	√
338	0x27B8	Velocity To Current Feedforward Gain Actual Value	VAR	√	√
339	0x27B9	Velocity To Current Feedforward Lpf Actual Value	VAR	√	√
340	0x27BA	Torque Command First Filter Actual Value	VAR	√	√
341	0x27BB	Velocity Filter Frequency Actual Value	VAR	√	√
342	0x27BC	Torque Reference Cmd	VAR	√	√
343	0x27BD	Torque Value	VAR	√	√
344	0x5000	Parameter Read And Write	VAR	√	√
345	0x5001	Parameter Dump Access	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
346	0x27BB	Velocity Filter Frequency Actual Value	VAR	√	√
347	0x603F	Error code	VAR	√	√
348	0x6040	Control word	VAR	√	√
349	0x6041	Status word	VAR	√	√
350	0x605A	Quick stop option code	VAR	√	√
351	0x605B	Shutdown option code	VAR	√	√
352	0x605C	Disable operation option code	VAR	√	√
353	0x605D	Halt option code	VAR	√	√
354	0x605E	Fault reaction option code	VAR	√	√
355	0x6060	Modes of operation	VAR	√	√
356	0x6061	Modes of operation display	VAR	√	√
357	0x6062	Position demand value	VAR	√	√
358	0x6064	Position actual value	VAR	√	√
359	0x6065	Following error window	VAR	√	√
360	0x6066	Following error time out	VAR	√	√
361	0x6067	Position window	VAR	√	√
362	0x6068	Position window time	VAR	√	√
363	0x606B	Velocity demand value	VAR	√	√
364	0x606C	Velocity actual value	VAR	√	√
365	0x606D	Velocity window	VAR	√	√
366	0x606E	Velocity window time	VAR	√	√
367	0x606F	Velocity threshold	VAR	√	√
368	0x6070	Velocity threshold time	VAR	√	√
369	0x6071	Target torque	VAR	√	√
370	0x6072	Max torque	VAR	√	√
371	0x6073	Max current	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
372	0x6074	Torque demand value	VAR	√	√
373	0x6075	Motor rated current	VAR	√	√
374	0x6076	Motor rated torque	VAR	√	√
375	0x6077	Torque actual value	VAR	√	√
376	0x6078	Current Actual Value	VAR	√	√
377	0x6079	DC link circuit voltage	VAR	√	√
378	0x607A	Target position	VAR	√	√
379	0x607C	Home offset	ARRAY	√	√
380	0x607D	Software position limit	ARRAY	√	√
381	0x607E	Polarity	ARRAY	√	√
382	0x607F	Max profile velocity	VAR	√	√
383	0x6080	Max motor speed	VAR	√	√
384	0x6081	Profile velocity	VAR	√	√
385	0x6083	Profile acceleration	VAR	√	√
386	0x6084	Profile deceleration	VAR	√	√
387	0x6085	Quick stop deceleration	VAR	√	√
388	0x6087	Torque slope	VAR	√	√
389	0x608F	Position Encoder Resolution	VAR	√	√
390	0x6091	Gear Ratio	VAR	√	√
391	0x6092	Feed Constant	VAR	√	√
392	0x6098	Homing method	VAR	√	√
393	0x6099	Home velocity	VAR	√	√
394	0x609A	Homing acceleration	VAR	√	√
395	0x60B0	Position offset	VAR	√	√
396	0x60B1	Velocity offset	VAR	√	√
397	0x60B2	Torque offset	VAR	√	√

NO.	Index	Name	Object code	CANopen	EtherCAT
398	0x60C0	Interpolation Type	VAR	√	√
399	0x60C2	Interpolation Time Period	VAR	√	√
400	0x60C5	Max acceleration	VAR	√	√
401	0x60C6	Max deceleration	VAR	√	√
402	0x60E0	Positive torque limit value	VAR	√	√
403	0x60E1	Negative torque limit value	VAR	√	√
404	0x60F4	Following error actual value	VAR	√	√
405	0x60FC	Position demand value	VAR	√	√
406	0x60FD	Digital inputs	VAR	√	√
407	0x60FE	Digital outputs	VAR	√	√
408	0x60FF	Target velocity	VAR	√	√
409	0x6502	Supported drive modes	VAR	√	√

7.1.2 通信基础参数

Communication Basic Parameters

0x1000:00h-设备参数 (Device type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x00000000	-	RO	NO	-	NO
Byte4		Byte3		Byte2			Byte1	
Additional information				Device profile number				
说明： 包含有关设备类型和功能信息。它由一个 16 字段设备描述的配置文件编号和另一个 16 位字段的附加说明组成，该对象提供有关设备可选功能的其他信息。 Description : Contains information about the device type and functions. It consists of a 16-bit device profile number and another 16-bit field for additional information, providing extra details about the device's optional features.								

0x1001:00h-错误寄存器 (Error register)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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USINT	0x00	0xFF	0x00	-	RO	NO	-	NO
Bit7	Bit6	Bit5	Bit4		Bit3	Bit2	Bit1	Bit0
Manufacturer specific	Reserved	Device profile specific	Communication error(overflow\error state)		Temperature	Voltage	Current	Generic error
说明：定义了一个 8 位的错误寄存器，寄存器的每个位都定义一种特定的错误类型，如果某一位置 1，则表示发生了相应错误。 Description : Defines an 8-bit error register. Each bit of the register defines a specific error type. If a bit is set to 1, it indicates the corresponding error has occurred.								

0x1003:00h-预定义错误字段（Pre-Defined error field）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RO	NO	-	NO
Bit24~31			Bit16~23			Bit15~0		
Manufacturer specific error code			Error register			Error code		
说明：保存设备中发生的错误，并通过紧急事件对象发出信号。 Description : Stores errors that occur in the device and signals them via the Emergency object.								

0x1005:00h-同步报文 COB-ID（COB-ID SYNC message）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000080	0xFFFFFFFF	0x00000001	-	RW	NO	-	NO
Bits			Value	Meaning				
Bit31			-	-				
Bit30			0	Device does not generate SYNC message				
			1	Device generates SYNC message				
Bit29			0	11-bit ID (CAN-2.0A)				
			1	29-bit ID (CAN-2.0B)				
Bit28~11			0	If bit 29=0				
			x	If bit 29=1, bit 28-11 of 29-bit SYNC COB-ID				

Bit10~0	x	Bit 10-0 of SYNC COB-ID
说明：YNC 报文的通信标识符。SYNC 报文用于网络同步，所有节点在收到 SYNC 信号后同时执行任务。此参数配置发送 SYNC 报文的 COB-ID。 Description : Communication identifier for the SYNC message. The SYNC message is used for network synchronization; all nodes execute tasks simultaneously upon receiving the SYNC signal. This parameter configures the COB-ID for transmitting SYNC messages.		

0x1006:00h-同步循环周期（Communication cycle period）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	us	RW	NO	-	NO
说明：这个对象仅与 SYNC 生产者相关，定义了以微秒为单位的同步周期时间间隔，如果设置为 0，则禁用 SYNC 功能。 Description : This object is relevant only to the SYNC producer. It defines the synchronous cycle time interval in microseconds. If set to 0, the SYNC function is disabled.								

0x1007:00h-同步窗口长度（Synchronous window Length）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	us	RW	NO	-	NO
说明：定义了同步周期时间窗口的长度。 Description : Defines the length of the synchronous window time.								

0x1008:00h-制造商设备名称（Manufacturer device name）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
STRING	EYou	-	-	-	RO	NO	-	NO
说明：此对象包含由制造商分配的设备名称，例如“EYou”。 Description : This object contains the device name assigned by the manufacturer, for example, "EYou".								

0x1009:00h-制造商硬件版本（Manufacturer hardware version）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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STRING	-	-	-	-	RO	NO	-	NO
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说明： 此对象包含由制造商指定的硬件版本号。

Description : This object contains the hardware version number specified by the manufacturer.

0x100A:00h-制造商软件版本 (Manufacturer software version)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
STRING	-	-	-	-	RO	NO	-	NO

说明： 此对象包含由制造商指定的软件版本号。

Description : This object contains the software version number specified by the manufacturer.

0x100B:00h-节点 ID 设置 (Node-ID)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x01	0x7F	0x00	-	RW	NO	Power Restart	NO

说明： 此对象包含了 Node ID，如果 Node ID 被修改，只有在发送了重置通信和开始通信的 NMT 报文后，对象才会返回更新的值。

Description : This object contains the Node ID. If the Node ID is modified, the object will return the updated value only after the Reset Communication and Start Communication NMT messages have been sent.

0x100C:00h-节点保护时间 (Guard Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0000	0xFF	0x0000	ms	RW	NO	-	NO

说明： 此对象提供从网络主机发送到伺服的节点保护请求的时间。伺服将通过调整伺服内部状态来响应节点保护报文的每个请求。如果未使用，则该值设置为 0。

Description : This object provides the time interval between node guard requests sent from the network host to the servo drive. The drive will respond to each guard request by adjusting its internal state. If unused, this value should be set to 0.

0x100D:00h-寿命因子 (Life Time Factor)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x00	0xFF	0x00	ms	RW	NO	-	NO

说明：此对象提供节点保护时间的倍数。伺服在保护时间和寿命因子的乘积定义的时间段内 收到节点保护请求。如果伺服在此时间段内未收到节点保护请求，则会将此情况视为错误。 如果未使用，则该值设置为 0。

Description : This object provides a multiplier for the guard time. Life Time = Guard Time * Life Time Factor. The drive must receive a node guard request within the time window defined by this product. Failure to receive a request within this period is considered an error. If unused, this value is set to 0.

0x1010:01h-保存参数（Save parameters）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RW	YES	Immediately	NO

说明：此对象用于将参数保存到非易失性内存中。写入值：0x65766173("save"指令)时保存生效并返回值为 1，等待 3s 后保存完成并返回值为 2，写入其他值无效（返回值为 0）。

注意：保存过程中请勿断电，否则将会导致保存失败甚至参数丢失。

Description : This object is used to save the current parameters to non-volatile memory. When the value 0x65766173 (ASCII for "save") is written, the save operation initiates and the status immediately returns 1. After approximately 3 seconds, when the save is complete, the return value changes to 2. Writing any other value is invalid (returns 0).

Note: Do not power off during the save process, as this may cause the save to fail or result in parameter loss.

0x1014:00h-紧急状态对象（COB-ID EMCY）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0x65766173	0x00000000	-	RW	YES	Immediately	NO
Bit number		Value		Meaning				
Bit31		0		EMCY exists / is valid				
		1		EMCY does not exist / is invalid				
Bit30		0		Reserved (always 0)				
Bit29		0		11-bit ID (CAN 2.0A)				
		1		29-bit ID (CAN 2.0B)				

Bit28~11	0	If bit 29 = 0
	x	If bit 29 = 1: bits 28~11 of 29-bit EMCY COB-ID
Bit10~0	x	Bits 10~0 of EMCY COB-ID
说明：定义紧急状态对象（EMCY）的 COB-ID。 Description： Defines the Communication Object Identifier (COB-ID) for the Emergency (EMCY) object.		

0x1016:00h-子索引个数（Number of subindexes）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x01	0x7F	0x01	-	RO	YES	-	NO
说明：此参数包含受监控的节点 ID 和设置的心跳时间两个部分，消费者心跳时间必须大于相应节点的生产者心跳时间（毫秒），一个节点不能设置两个不同的消费者心跳时间，建议消费者心跳时间至少比生产者心跳时间大 2 倍。在收到第一条心跳报文后开始监视。如果消费者心跳时间为0，则禁用此功能。 Description： This parameter contains two parts: the monitored node ID and the set heartbeat time. The consumer heartbeat time (in milliseconds) must be greater than the producer heartbeat time of the corresponding node. A node can not have two different consumer heartbeat times. It is recommended that the consumer heartbeat time be at least twice the producer heartbeat time. Monitoring begins after receiving the first heartbeat message. If the consumer heartbeat time is 0, this function is disabled.								

0x1016:01h-消费者心跳时间（Consumer heartbeat time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	ms	RW	YES	-	NO
说明：此参数包含受监控的节点 ID 和设置的心跳时间两个部分，消费者心跳时间必须大于相应节点的生产者心跳时间（毫秒），一个节点不能设置两个不同的消费者心跳时间，建议消费者心跳时间至少比生产者心跳时间大 2 倍。在收到第一条心跳报文后开始监视。如果消费者心跳时间为0，则禁用此功能。 Description： This parameter (located at sub-index 1) contains two pieces of information: the monitored node ID and the set heartbeat timeout (consumer time, in milliseconds). The consumer time must be greater than the producer heartbeat time of the corresponding node. A node cannot be configured with two different consumer times. It is recommended								

ended that the consumer time be at least twice the producer time. Monitoring begins after receiving the first heartbeat message from that node. If the consumer time is set to 0, the heartbeat monitoring function for that node is disabled.

0x1017:00h-生产者心跳时间 (Producer heartbeat time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x03E8	0xFFFF	0x0000	ms	RW	YES	-	NO

说明：定义心跳的周期时间，它必须是 1ms 的倍数。如果不使用，则为 0。

Description : Defines the period (in milliseconds) for sending heartbeat messages when this device acts as a heartbeat producer. The value must be a multiple of 1 ms. If the heartbeat function is not used, set it to 0.

0x1018:01h-厂商 ID (Vendor ID)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RO	NO	-	NO

说明：包含分配给每个制造商的唯一值。

Description : Contains the unique identifier assigned to the device manufacturer.

0x1018:02h-产品代码 (Product code)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RO	NO	-	NO

说明：标识制造商特定的产品代码（设备版本）。

Description : Identifies the manufacturer-specific product code (device version).

0x1018:03h-修订号 (Revision)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RO	NO	-	NO

说明：包含产品的硬件/固件修订号。

Description : Contains the hardware/firmware revision number of the product.

0x1018:04h-序列号 (Serial number)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RO	NO	-	NO
说明： 制造商特定的序列号。 Description : Unique serial number assigned to the device by the manufacturer.								

0x1200-服务器 SDO 参数 (SDO server parameter)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	-	-	-	RO	NO	-	NO
说明： 包含该设备作为服务器的 SDO 的参数。 Description : This object contains the communication parameter configuration for this device when acting as an SDO server.								

0x1400~0x1403:00h - RxPDO 映射数量 (the number of Receive PDO parameters)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x03	0x05	0x02	-	RO	YES	ESM Changed	NO
说明： 定义映射到该接收PDO (RxPDO) 中的对象字典条目的数量。 Description : Defines the number of object dictionary entries mapped to this Receive PDO (RxPDO).								

0x1400~0x1403:01h - RxPDO 使用的 COB-ID (COB-ID used by PDO)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000200	0xFFFFFFFF	0x00000001	-	RO	YES	ESM Changed	NO
说明： 定义 COB-ID。如果设置了第 31 位，则禁用 PDO。 Description : Defines the Communication Object Identifier (COB-ID) used by this Receive PDO (RxPDO). If the most significant bit (bit 31) is set to 1, the PDO is disabled.								

0x1400~0x1403:02h - RxPDO 传输类型 (Transmission type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0xFF	0xFF	0x00	-	RO	YES	ESM Changed	NO
Code		Behavior						

0~240	Received PDO data is stored until the next SYNC cycle. When a SYNC message is received, the previously received PDO data is applied.
241~253	Reserved
254~255	Received PDO data is immediately applied to its mapped objects.
说明：此对象控制在接收到新 PDO 的行为。 Description : This object controls how the data of a newly received PDO message is applied.	

0x1400~0x1403:03h - RxPDO 停止时间 (Inhibit time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0000	0xFFFF	0x0000	100us	RO	YES	ESM Changed	NO
说明：对于传输类型 253, PDO 仅在远程传输请求 (RTR) 时进行传输。对于传输类型 255, 如果数据改变, 则传输 PDO。因此, 停止时间定义了一个最小的时间间隔。 Description: For transmission type 253, the PDO is transmitted only upon a Remote Transmission Request (RTR). For transmission type 255, the PDO is transmitted if the data changes. Therefore, the inhibit time defines a minimum time interval between transmissions.								

0x1600~0x1603:00h - RxPDO 映射数量 (the number of PDO parameters)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x02	0x06	0x00	-	RO	YES	-	NO
说明：定义映射字典中的有效映射的数量。这个映射的数量也是通过相应的 PDO 接收到的应用程序变量的数量。 Description: Defines the number of valid mapping entries in the mapping dictionary. This number also represents the number of application variables received via the corresponding PDO.								

0x1600~0x1603:01h - 对象字典映射条目 1 (Mapping entry1)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x60400010	0xFFFFFFFF	0x00000000	-	RO	YES	ESM Changed	NO
说明：包含有关已映射的变量的信息。这些条目通过其索引(16 位)、子索引 (8 位) 和数据长度 (8 位) 来描述 PDO 内容。 Description: Contains information about the mapped variable. These entries describe the PDO content via its index (16 bits), sub-index (8 bits), and data length in bits (8 bits).								

0x1600~0x1603:02h - 对象字典映射条目 2 (Mapping entry2)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UDINT	0x60600010	0xFFFFFFFF	0x00000000	-	RO	YES	ESM Changed	NO
说明: 包含有关已映射的变量的信息。这些条目通过其索引(16 位)、子索引(8 位)和数据长度(8 位)来描述 PDO 内容。 Description: Contains information about the mapped variable. These entries describe the PDO content via its index (16 bits), sub-index (8 bits), and data length in bits (8 bits).								

0x1600~0x1603:03~6h - 对象字典映射条目 3~6 (Mapping entry 3~6)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RO	YES	ESM Changed	NO
说明: 包含有关已映射的变量的信息。这些条目通过其索引(16 位)、子索引(8 位)和数据长度(8 位)来描述 PDO 内容。 Description: Contains information about the mapped variable. These entries describe the PDO content via its index (16 bits), sub-index (8 bits), and data length in bits (8 bits).								

0x1800~0x1803:00h - TxPDO 映射数量 (the number of Transmit PDO parameters)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x03	0x10	0x02	-	RO	YES	ESM Changed	NO
说明: 定义 PDO 映射数量。 Description: Defines the number of PDO mapping entries.								

0x1800~0x1803:01h - TxPDO 使用的 COB-ID (COB-ID used by PDO)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x80000180	0xFFFFFFFF	0x00000001	-	RO	YES	ESM Changed	NO
说明: 定义 COB-ID。如果设置了第 31 位, 则禁用 PDO。 Description: Defines the COB-ID. If bit 31 is set, the PDO is disabled.								

0x1800~0x1803:02h - TxPDO 传输类型 (Transmission type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x01	0xFF	0x00	-	RW	YES	ESM Changed	NO
Code		Behavior						
0~240		Received PDO data is stored until the next SYNC cycle; upon receiving a SYNC messa						

	ge, the previously received PDO data is applied.
241~253	Reserved
254~255	Received PDO data is immediately applied to its mapped objects.
说明：此对象控制在接收到新 PDO 的行为。 Description: This object controls the behavior upon receiving a new PDO.	

0x1800~0x1803:03h - TxPDO 停止时间 (Inhibit time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x03E8	0xFFFF	0x0000	100us	RO	YES	ESM Changed	NO
说明：对于传输类型 253, PDO 仅在远程传输请求 (RTR) 时进行传输。对于传输类型 255, 如果数据改变, 则传输 PDO。因此, 停止时间定义了一个最小的时间间隔。 Description: For transmission type 253, the PDO is transmitted only upon a Remote Transmission Request (RTR). For transmission type 255, the PDO is transmitted if the data changes. Therefore, the inhibit time defines a minimum time interval.								

0x1800~0x1803:04h – 保留 (reserved)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x00	0xFF	0x00	-	RW	YES	ESM Changed	NO
说明：此子索引没有功能, 仅出于兼容性原因而存在。 Description: This sub-index has no function and exists only for compatibility reasons.								

0x1800~0x1803:05h - 事件定时器 (Event timer)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0001	0xFFFF	0x0000	ms	RW	YES	ESM Changed	NO
说明：此时间 (以毫秒为单位) 可用于触发处理数据复制和 PDO 发送的事件。 Description: This time (in milliseconds) can be used to trigger an event for processing data copying and PDO transmission.								

0x1A00~0x1A03:00h -TxPDO 映射数量 (the number of PDO parameters)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x03	0x06	0x00	-	RO	YES	-	NO

说明： 定义映射对象中有效条目的数量。这个条目的数量也是相应的 PDO 发送到应用程序变量的数量。

Description: Defines the number of valid entries in the mapping object. This number of entries also corresponds to the number of application variables sent via the corresponding PDO.

0x1A00~0x1A03:01h - 对象字典映射条目 1 (Mapping entry1)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x60410010	0xFFFFFFFF	0x00000000	-	RO	YES	ESM Changed	NO

说明： 包含有关已映射的变量的信息。这些条目通过其索引(16 位)、子索引 (8 位)和数据长度 (8 位)来描述 PDO 内容。

Description: Contains information about the mapped variable. These entries describe the PDO content via its index (16 bits), sub-index (8 bits), and data length in bits (8 bits).

0x1A00~0x1A03: 02~4h - 对象字典映射条目 2~4 (Mapping entry2~4)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x60600010	0xFFFFFFFF	0x00000000	-	RO	YES	ESM Changed	NO

说明： 包含有关已映射的变量的信息。这些条目通过其索引(16 位)、子索引 (8 位)和数据长度 (8 位)来描述 PDO 内容。

Description: Contains information about the mapped variable. These entries describe the PDO content via its index (16 bits), sub-index (8 bits), and data length in bits (8 bits).

0x1C00:00h - SYNC 通信类型 (SYNC manager communication type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x04	0x12	0x00	-	RO	NO	-	NO

Value	default configuration
1	邮箱接收 (Mailbox receive)
2	邮箱发送 (Mailbox send)
3	过程数据输出 (Process data output)
4	过程数据输入 (Process data input)

说明： SYNC通信类型。

Description: SYNC communication type.

0x1C12:00h - SM2 PDO 分配 (SYNC manager 2 PDO assignment)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REC	0x04	0x04	0x00	-	RW	YES	ESM Changed	NO
说明：当收到 PDO 报文时，通过 PDO 报文传递的数据（最多 8 个字节）用于更新映射到 PDO 的对象。 Description: When a PDO message is received, the data (up to 8 bytes) transmitted via the PDO message is used to update the objects mapped to the PDO.								

0x1C13:00h – SM3 PDO 分配 (SYNC manager 2 PDO assignment)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REC	0x04	0x04	0x00	-	RW	YES	ESM Changed	NO
说明：当收到 PDO 报文时，通过 PDO 报文传递的数据（最多 8 个字节）用于更新映射到 PDO 的对象。 Description: When a PDO message is received, the data (up to 8 bytes) transmitted via the PDO message is used to update the objects mapped to the PDO.								

0x1C32 – SM2 参数 (SYNC manager 2 parameter)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REC	0x04	0x04	0x00	-	RW	YES	ESM Changed	NO
说明：DC同步模式设置对象。 Description: DC Synchronous Mode Setting Object.								

0x1C33– SM3 参数 (SYNC manager 3 parameter)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REC	0x04	0x04	0x00	-	RW	YES	ESM Changed	NO
说明：DC同步模式设置对象。 Description: DC Synchronous Mode Setting Object.								

7.1.3 P0 组伺服电机参数

P0 Group Servo Motor Parameters

0x2000:00h-电机型号选择 (Motor Type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x0	0x16	0x-1	-	RW	YES	immediately	Rx/Tx

说明：用于在驱动器数据库中识别并匹配特定电机型号的参数组。

Description: A parameter group used to identify and match a specific motor model in the drive's database.

0x2002:00h-电机名称 (Motor Name)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
STRING	0x0	0xFFFFFFFF	0x0	-	RW	YES	immediately	Rx/Tx

说明：为用户定义的电机设置一个易于识别的别名。

Description: Sets a user-friendly alias for the motor.

0x2005:00h-电机额定功率 (Motor Power)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3F	0x7D0	0x0	W	RW	YES	immediately	Rx/Tx

说明：电机在持续工作状态下能够安全输出的最大机械功率。

Description: Maximum mechanical power the motor can safely output under continuous operation.

0x2006:00h-电机额定转速 (Motor Rate Speed)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0xBB8	0x1770	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：电机在额定功率和额定转矩下可以长期稳定运行的转速。

Description: Speed at which the motor can operate stably for extended periods at rated power and torque.

0x2007:00h-电机额定转矩 (Motor Rated Torque)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.2	0x64	0x0	Nm	RW	YES	immediately	Rx/Tx

说明：电机在额定转速下能够持续输出而不过热的转矩值。

Description: Continuous torque the motor can output at rated speed without overheating.

0x2008:00h-电机额定电流 (Motor Rated Current)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	2.97	0x96	0x0	Apeak	RW	YES	immediately	Rx/Tx

说明：对应电机额定转矩，电机可连续运行的安全电流值。

Description: Continuous safe current corresponding to the motor's rated torque.

0x2009:00h-电机最高转速 (Motor Max Speed)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x1770	0x2328	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：电机在机械结构上允许达到的最大安全转速极限。

Description: Maximum safe speed limit allowed by the motor's mechanical structure.

0x200A:00h-电机最大转矩 (Motor Max Torque)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.5	0x64	0x0	Nm	RW	YES	immediately	Rx/Tx

说明：电机在短时间内能够提供的最大输出转矩（过载能力）。

Description: Maximum output torque the motor can provide for a short duration (overload capability).

0x200B:00h-电机最大电流 (Motor Peak Current)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	7.92	0x12C	0.1	Apeak	RW	YES	immediately	Rx/Tx

说明：对应电机最大转矩，驱动器允许输出的瞬时电流上限。

Description: Instantaneous current limit the drive is allowed to output, corresponding to the motor's maximum torque.

0x200C:00h-电机转动惯量 (Motor Inertia)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.49	0x1E8480	0x0	kg*cm^2	RW	YES	immediately	Rx/Tx

说明：电机转子自身惯性大小的量度，影响电机的加速能力。

Description: A measure of the motor rotor's inertia, affecting its acceleration capability.

0x200F:00h-负载转动惯量比（ Load To Motor Inertia Ratio）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	0x258	0x0	0.001 倍	RW	YES	immediately	Rx/Tx

说明：负载转动惯量与电机转子惯量的比值，用于评估系统动态响应。

Description: Ratio of load inertia to motor rotor inertia, used to evaluate system dynamic response.

0x2011:00h-电机极对数（Motor Poles）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0xA	0x1E	0x1	-	RW	YES	-	Rx/Tx

说明：决定电机同步转速与供电频率关系的关键电磁设计参数。

Description: Key electromagnetic design parameter determining the relationship between synchronous speed and supply frequency.

0x2012:00h-电机线电感（Motor Inductance）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.358	0x3E8	0x0	mH	RW	YES	immediately	Rx/Tx

说明：电机绕组对电流变化的阻碍特性，影响电流环响应和 PWM 谐波。

Description: Characteristic of motor windings opposing current change, affecting current loop response and PWM harmonics.

0x2013:00h-电机线电阻（Motor Resistance）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	11.8	0x4B	0x0	Ω	RW	YES	immediately	Rx/Tx

说明：电机绕组的直流电阻，是产生铜损和温升的主要原因。

Description: DC resistance of motor windings, primary cause of copper losses and temperature rise.

0x2014:00h-电机反电势系数（Motor Back EMF Coefficient）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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DINT	6.8	0x1F4	0x0	Vrms/krpm(线)	RW	YES	immediately	Rx/Tx
说明：电机单位转速下产生的反电动势电压值。 Description: Generated back EMF voltage per unit of motor speed.								

0x2015:00h-电机转矩系数 (Motor Torque Coefficient)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.06734	0x1E	0x1	Nm/Apeak	RW	YES	immediately	Rx/Tx
说明：电机单位电流所能产生的输出转矩值。 Description: Output torque generated per unit of input current.								

0x2018:00h-电机额定电压 (Motor Rated Voltage)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x30	0x190	0x0	Vrms	RW	YES	immediately	Rx/Tx
说明：电机设计的最佳工作电压，通常与反电势和转速相关。 Description: Optimal operating voltage for motor design, typically related to back EMF and speed.								

0x2022:00h-编码器类型备份 (Encoder Type Backup)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：将当前电机编码器的关键配置参数（如型号、分辨率、零点位置等）保存到驱动器非易失性存储器中的功能，用于快速恢复或更换电机后的参数重建。 Description: Function to save key configuration parameters (model, resolution, zero position, etc.) of the current motor encoder to drive's non-volatile memory, for quick recovery or parameter rebuilding after motor replacement.								

0x2023:00h-编码器分辨率(LPR) (Motor Encoder Resolution)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x8000	0x77359400	0x1	lpr	RW	YES	-	Rx/Tx
说明：编码器每转所输出的绝对位置值数量。 Description: Number of absolute position values the encoder outputs per revolution.								

0x2025:00h-编码器单圈分辨率 (Encoder Single Turn Resolution)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x20000	0x7FFFFFFF	0x0	Count	RO	YES	-	Tx

说明：编码器在一圈内能够识别的最小位置变化量。

Description: Minimum resolvable position change within one revolution of the encoder.

0x2026:00h-编码器初始角（Motor Initial Angle）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x167	0x0	°	RW	YES	immediately	Rx/Tx

说明：电机电角度零点与编码器机械零位之间的偏移角，用于矢量控制对齐。

Description: Offset angle between the motor's electrical zero and the encoder's mechanical zero, used for vector control alignment.

0x2028:00h-电机加速时间设定（Motor Acceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3E8	0xF4240	0x0	rpm/s	RW	YES	immediately	Rx/Tx

说明：电机从零速加速到额定转速所需的时间。

Description: Time required for the motor to accelerate from zero speed to rated speed.

0x2029:00h-电机减速时间设定（Motor Deceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3E8	0xF4240	0x1	rpm/s	RW	YES	immediately	Rx/Tx

说明：电机从额定转速减速到零速所需的时间。

Description: Time required for the motor to decelerate from rated speed to zero speed.

0x202A:00h-加速时间设定（Acceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3E8	0xF4240	0x0	rpm/s	RW	YES	immediately	Rx/Tx

说明：用于 S-曲线规划中，速度上升段的斜坡时间。

Description: Used for S-curve planning: ramp time for the acceleration segment.

0x202B:00h-减速时间设定 (Deceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3E8	0xF4240	0x0	rpm/s	RW	YES	immediately	Rx/Tx

说明：用于 S-曲线规划中，速度下降段的斜坡时间。

Description: Used for S-curve planning: ramp time for the deceleration segment.

0x202C:00h-最大加速时间设定 (Maximum Acceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xF4240	0xF4240	0x0	rpm/s	RW	YES	immediately	Rx/Tx

说明：系统允许的最长加速时间限制，作为安全保护。

Description: Maximum allowable acceleration time limit for the system, serving as a safety protection.

0x202D:00h-最大减速时间设定 (Maximum Deceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xF4240	0xF4240	0x1	rpm/s	RW	YES	immediately	Rx/Tx

说明：系统允许的最长减速时间限制，作为安全保护。

Description: Maximum allowable deceleration time limit for the system, serving as a safety protection.

0x2040:00h-电机过载保护检测使能 (Motor Foldback Disable)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：开关量，用于启用或禁用电机的热过载保护功能。

Description: Switch to enable or disable the motor's thermal overload protection function.

0x2042:00h-电机过载保护故障阈值 (Motor Foldback Fault Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x12C	0x0	A	RW	YES	immediately	Rx/Tx

说明：电机热模型温度达到此值后触发故障并停机。

Description: Triggers a fault and shutdown when the motor's thermal model temperature reaches this value.

0x2043:00h-电机过载保护报警阈值（ Motor Foldback Warning Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x12C	0x0	A	RW	YES	immediately	Rx/Tx

说明：电机热模型温度达到此值后触发预警，但不停机。

Description: Triggers a warning (without shutdown) when the motor's thermal model temperature reaches this value.

0x2044:00h-电机过载保护恢复延迟时间（ Motor Foldback Delay Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3	0x960	0x0	s	RW	YES	immediately	Rx/Tx

说明：故障发生后，系统等待多长时间才开始计算温度冷却。

Description: After a fault occurs, the time the system waits before beginning to calculate temperature cooldown.

0x2045:00h-电机过载保护恢复时间常数（Motor Foldback Time Constant）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3	0x4B0	0x0	s	RW	YES	immediately	Rx/Tx

说明：定义电机在停止运行后的冷却速度快慢。

Description: Defines the motor's cooling rate after operation stops.

0x2046:00h-电机过载保护恢复时间（ Motor Foldback Recovery Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x3E8	0x0	s	RW	YES	-	Rx/Tx

说明：从故障状态恢复到可运行状态所需的总时间。

Description: Total time required to recover from a fault state to an operational state.

0x2047:00h-电机过载保护因数（Motor Foldback Factor）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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DINT	0x1	0x2	0x1	-	RW	YES	immediately	Rx/Tx
说明：调整电机热过载保护模型灵敏度的系数。 Description: Coefficient for adjusting the sensitivity of the motor's thermal overload protection model.								

0x204A:00h-驱动器型号选择 (Drive Type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	基于硬件	0x10	0x0	Arms	RW	YES	-	Rx/Tx
说明：用于识别驱动器自身功率和功能版本的参数。 Description: Parameter used to identify the drive's own power rating and functional version.								

0x204C:00h-驱动器通信轴地址 (Addr)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0xFFFF	0x1	-	RW	YES	immediately	Rx/Tx
说明：在多轴总线网络中，用于区分不同驱动器的唯一标识。 Description: Unique identifier for distinguishing different drives in a multi-axis bus network.								

0x2055:00h-PWM 开关频率 (PWM Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x8	0x10	0x8	kHz	RW	YES	immediately	Rx/Tx
说明：驱动器逆变桥臂功率管的开关频率，影响电流纹波和噪音。 Description: Switching frequency of the drive's inverter power transistors, affecting current ripple and noise.								

0x205A:00h-直流母线电压滤波频率(控制) (Bus Control Lpf Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x7D0	0x2710	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：用于控制算法的母线电压反馈值滤波强度。 Description: Filtering strength for the bus voltage feedback value used in the control algorithm.								

0x205B:00h-直流母线电压滤波频率(反馈) (Bus Feedback Lpf Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x1F4	0x2710	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：用于显示和保护母线电压反馈值滤波强度。 Description: Filtering strength for the bus voltage feedback value used for display and protection.								

0x205C:00h-直流母线过压保护值（Over Voltage Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3C	0x64	0xA	Vdc	RW	YES	immediately	Rx/Tx
说明：当母线电压超过此设定值时触发过压故障。 Description: Triggers an overvoltage fault when the bus voltage exceeds this set value.								

0x205D:00h-直流母线欠压保护值（Under Voltage Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x14	0x64	0xA	Vdc	RW	YES	immediately	Rx/Tx
说明：当母线电压低于此设定值时触发欠压故障。 Description: Triggers an undervoltage fault when the bus voltage falls below this set value.								

0x205E:00h-直流母线欠压保护模式（Under Voltage Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x3	0x3	0x0	-	RW	YES	immediately	Rx/Tx
说明：定义欠压时是报警还是立即停机等行为。 Description: Defines the behavior during undervoltage, e.g., alarm or immediate shutdown.								

0x205F:00h-直流母线欠压恢复模式（Under Voltage Recovery Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：定义欠压故障消除后是自动恢复还是手动复位。 Description: Defines whether the system recovers automatically or requires manual reset after an undervoltage fault is cleared.								

0x2060:00h-直流母线欠压保护检测延时 (Under Voltage Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x28	0x2710	0x0	ms	RW	YES	immediately	Rx/Tx

说明：电压低于阈值后，持续多久才判定为欠压故障。

Description: Duration the voltage must remain below the threshold to be considered an undervoltage fault.

0x2061:00h-驱动器过流保护值 (Over Current Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xA	0xC8	0.1	A	RW	YES	immediately	Rx/Tx

说明：硬件检测到输出电流超过此值时立即封锁输出。

Description: Hardware-immediate output shutdown when the output current exceeds this value.

0x2062:00h-驱动器过流保护时间 (Over Current Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x10	0x64	0x1	125us	RW	YES	immediately	Rx/Tx

说明：电流超过过流保护值后，到驱动器采取动作的最大延时。

Description: Maximum delay between the current exceeding the overcurrent threshold and the drive taking action.

0x2063:00h-电流传感器校正系数 (Current Sensor Correction Coefficient)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：用于校准电流采样通道的增益和零偏。

Description: Used to calibrate the gain and offset of the current sampling channels.

0x2064:00h-电流传感器零偏阈值 (Current Sensor Zero Offset Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1F4	0x3E8	0x1	mA	RW	YES	immediately	Rx/Tx

说明：判断电流传感器零偏误差是否过大的阈值。

Description: Threshold to determine if the current sensor's zero offset error is excessive.

0x2065:00h-电流传感器零偏速度阈值（Current Sensor Velocity Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x5	0x1F4	0.001	Hz	RW	YES	immediately	Rx/Tx

说明：进行电流传感器零偏自动校准时的电机转速条件。

Description: Motor speed condition for performing automatic zero offset calibration of the current sensor.

0x2066:00h-温度传感器校正系数（Temperature Correction Coefficient）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	1.02	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：用于校准温度（电机或驱动器）采样值的系数。

Description: Coefficient for calibrating the temperature (motor or drive) sampling value.

0x2067:00h-电机过温保护值（Motor Over Temperature Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x56	0xC8	0x0	°C	RW	YES	immediately	Rx/Tx

说明：当电机温度传感器读数超过此值时触发过热保护。

Description: Triggers overtemperature protection when the motor temperature sensor reading exceeds this value.

0x2068:00h-驱动器功率模块温度滤波长度（Drive IPM Temperature Filter Length）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x10	0x40	0x0	-	RW	YES	immediately	Rx/Tx

说明：对功率模块温度采样值进行平滑滤波的窗口大小。

Description: Smoothing filter window size for the IPM (Intelligent Power Module) temperature samples.

0x2069:00h-电机温度滤波长度（Motor Temperature Filter Length）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UINT	0x10	0x40	0x0	-	RW	YES	immediately	Rx/Tx
说明：对电机温度采样值进行平滑滤波的窗口大小。 Description: Smoothing filter window size for the motor temperature samples.								

0x206A:00h-驱动器过载保护值（Drive Foldback Fault Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	基于硬件	0x12C	0x0	A	RW	YES	immediately	Rx/Tx
说明：基于驱动器自身热模型的过热保护故障阈值。 Description: Over-temperature protection fault threshold based on the drive's own thermal model.								

0x206B:00h-驱动器过载报警值（Drive Foldback Warning Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	11.879	0x12C	0x0	A	RW	YES	immediately	Rx/Tx
说明：基于驱动器自身热模型的过热预警阈值。 Description: Over-temperature warning threshold based on the drive's own thermal model.								

0x206D:00h-驱动器过载保护电流滤波频率（Drive Foldback Current Lpf）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x32	0x1F40	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：对驱动器过载检测电流进行滤波的截止频率。 Description: Cutoff frequency of the low-pass filter applied to the current used for drive overload detection.								

0x206E:00h-驱动器过载延时时间（Drive Foldback Delay Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x2	0x12C	0x0	s	RW	YES	immediately	Rx/Tx
说明：过载电流持续作用于此时间后，热模型温度开始显著上升。 Description: Time the overload current must persist before the thermal model's temperature begins to rise significantly.								

0x206F:00h-驱动器过载堵转斜率（Drive Foldback Stall Slope）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-0.05	-0.001	0x-1	s/°C	RW	YES	immediately	Rx/Tx

说明：定义在电机堵转等极端情况下驱动器热模型的温升速率。

Description: Defines the temperature rise rate in the drive's thermal model under extreme conditions like motor stall.

0x2070:00h-驱动器过载堵转延时起始温度 (Drive Foldback Delay Stall Start Temperature)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.6	0x78	0x0	°C	RW	YES	immediately	Rx/Tx

说明：启动“堵转斜率”快速温升模型的起始温度点。

Description: Start temperature point for the "stall slope" rapid temperature rise model.

0x2071:00h-驱动器过载堵转延时结束温度 (Drive Foldback Delay Stall End Temperature)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.1	0x78	0x0	°C	RW	YES	immediately	Rx/Tx

说明：启动“堵转斜率”快速温升模型的结束温度点。

Description: End temperature point for the "stall slope" rapid temperature rise model.

0x2072:00h-驱动器过载堵转电流 (Drive Foldback Stall Current Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	4.454	0x1E	0x0	A	RW	YES	immediately	Rx/Tx

说明：用于计算堵转情况下驱动器热模型的电流值。

Description: Current value used in the drive's thermal model calculation for stall conditions.

0x2073:00h-驱动器过载堵转起始温度 (Drive Foldback Stall Start Temperature)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3F	0xC8	0x0	°C	RW	YES	immediately	Rx/Tx

说明：在堵转模式下，热模型计算的起始温度。

Description: Initial temperature for thermal model calculation in stall mode.

0x2074:00h-驱动器过载堵转结束温度 (Drive Foldback Stall End Temperature)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x49	0xC8	0x0	°C	RW	YES	immediately	Rx/Tx

说明：在堵转模式下，热模型计算的结束温度。

Description: The end temperature point for the thermal model calculation in stall mode.

0x2075:00h-驱动器过载时间常数 (Drive Foldback Constant Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	2.5	0x12C	0x0	s	RW	YES	immediately	Rx/Tx

说明：定义驱动器自身热模型的加热和冷却时间常数。

Description: Defines the heating and cooling time constants for the drive's thermal model.

0x2076:00h-驱动器过载调节系数 (Drive Foldback Coefficient)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	0x4	0x1	-	RO	YES	immediately	Tx

说明：手动调节驱动器过载保护模型灵敏度的系数。

Description: A coefficient for manually adjusting the sensitivity of the drive's overload protection model.

0x2082:00h-序列号 (Serial Number)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
STRING	-	-	-	-	RO	NO	-	Tx

说明：产品的唯一身份识别码，用于追溯。

Description: The product's unique identification code, used for traceability.

0x2083:00h-硬件版本 (Hardware Version)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
STRING	-	-	-	-	RO	NO	-	Tx

说明：驱动器电路板及硬件的版本号。

Description: Version number of the drive's circuit board and hardware.

0x2084:00h-MCU 固件版本 (MCU Version)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
STRING	-	-	-	-	RO	NO	-	Tx

说明：驱动器主控芯片中运行的软件程序版本号。

Description: Version number of the software program running on the drive's main controller chip (MCU).

0x2087:00h-模组额定扭矩 (Module Rated Torque)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REAL	-	-	-	-	RO	NO	-	Tx

说明：带力控传感器参数，力控关节额定扭矩。

Description: With force control sensor parameters, rated torque of force-controlled joints.

7.1.4 P1 组基本控制参数

P1 Group Basic Control Parameters

0x2100:00h-控制权 (Drive Communication Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：决定当前控制权限的来源，0 是 UART，1 是 EtherCAT，2 是 CANopen。

Description: Determines the source of the current control authority, 0 is UART, 1 is EtherCAT, 2 is CANopen.

0x2101:00h-控制模式设定 (Drive Operation Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x8	0xB	0x0	-	RW	YES	immediately	Rx/Tx

说明：设定伺服运行的控制模式，如位置/速度/转矩模式。

Description: Sets the servo's control mode, e.g., Position, Velocity, or Torque mode.

0x2102:00h-旋转正方向选择（Rotary Direction）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x3	0x0	-	RW	YES	immediately	Rx/Tx

说明：设定电机正方向为顺时针或逆时针。

Description: Sets the motor's positive direction as clockwise (CW) or counterclockwise (CCW).

0x2103:00h-停机模式（Disable Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x5	0x0	-	RW	YES	immediately	Rx/Tx

说明：设定停机时电机的制动方式，如减速停或自由停。

Description: Sets the motor's stopping/braking mode, e.g., deceleration stop or coast stop.

0x2104:00h-预禁止速度阈值（Active Disable Speed Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0xA	0xC8	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：速度低于此值时允许进入禁止状态。

Description: Allows the drive to enter the disable state when speed is below this threshold.

0x2105:00h-预禁止延迟时间（Active Disable Delay）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0x4E20	0x0	ms	RW	YES	immediately	Rx/Tx

说明：进入禁止状态前的等待时间。

Description: Wait time before entering the disable state.

0x2106:00h-伺服使能 OFF 至电机不通电总延时（Active Disable Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UINT	0x64	0x1964	0x0	ms	RW	YES	immediately	Rx/Tx
说明：伺服下使能后到电机完全断电的延时。 Description: Total delay from servo disable command to motor power being completely cut off.								

0x2107:00h-控制减速减速度（Active Disable Deceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x186A0	MAXDEC	0x0	rpm/s	RW	YES	immediately	Rx/Tx
说明：停机或切换模式时的控制减速度。 Description: Controlled deceleration used for stopping or mode switching.								

0x2108:00h-控制减速时间（Active Disable Deceleration Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0xC8	0x1964	0x0	ms	RW	YES	immediately	Rx/Tx
说明：执行控制减速的时间设定。 Description: Time setting for executing the controlled deceleration.								

0x2110:00h-抱闸输出控制模式（Manual Brake By Output Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：设定抱闸输出的动作模式。0 代表手动控制抱闸模式，1 默认自动跟随使能指令。 Description: Set the action mode for the brake output. 0 represents manual control mode for the brake, 1 by default automatically follows the enable instruction.								

0x2111:00h-抱闸输出控制模式（Brake forced output control）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：手动控制方法：写入 1（手动控制电机抱闸闭合），写入 0（手动控制电机抱闸松开） Description: Manual control method: Write 1 (to manually close the motor brake), write 0 (to manually release the motor brake).								

0x2113:00h-抱闸输出 ON 至指令接收延时 (Out Brake Release Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1F4	0x2710	0x0	ms	RW	YES	immediately	Rx/Tx

说明：抱闸打开到开始执行指令之间的延时。

Description: Delay between brake release and command execution.

0x2114:00h-抱闸输出 OFF 至电机不通电延时 (Out Brake Engage Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x12C	0x1964	0x0	ms	RW	YES	immediately	Rx/Tx

说明：抱闸关闭后到电机断电之间的延时。

Description: Delay between brake engagement and motor power-off.

0x2115:00h-抱闸输出 OFF 时电机转速阈值 (Out Brake Safe Speed)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0xA	0xC8	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：抱闸关闭时允许的最大电机转速。

Description: Maximum allowable motor speed when the brake is closed.

0x212D:00h-厂家密码 (Password)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x4D2	0xFFFF	0x0	-	RW	YES	immediately	Rx/Tx

说明：厂家级参数修改的密码。

Description: Password for modifying manufacturer-level parameters.

0x212E:00h-恢复出厂设置 (Restore Drive Parameter)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x0	0x2	0x-1	-	RW	YES	immediately	Rx/Tx

说明：恢复所有参数到出厂默认值。

Description: Restores all parameters to their factory default values.

0x212F:00h-配置生效 (Config Drive)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	-	Rx/Tx

说明：使已修改的配置立即生效。

Description: Applies/modifies the configuration immediately.

0x2130:00h-参数保存至 EEPROM (Save Drive Parameter To Eeprom)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	-	-	-	RW	NO	-	Rx/Tx

说明：将当前参数永久写入 EEPROM。

Description: Permanently saves the current parameters to EEPROM.

7.1.5 P2 组位置控制参数

P2 Group Position Control Parameters

0x2201:00h-指令 FIR 滤波器 (Position Command Moving Average Filter)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x4	0x80	0x0	ms	RW	YES	immediately	Rx/Tx

说明：对运动指令进行有限长单位冲激响应滤波，以平滑轨迹。

Description: Applies a Finite Impulse Response (FIR) filter to the motion command to smooth the trajectory.

0x2215:00h-机械齿轮比分子 (Feed)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x80000	0xFFFFFFFF	0x1	-	RW	YES	immediately	Rx/Tx

说明：机械传动比分母表示中的分子部分。

Description: Numerator of the mechanical gear ratio expressed as a fraction.

0x2216:00h-机械齿轮比分母（Shaft Revolution）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x1	0xFFFFFFFF	0x1	-	RW	YES	immediately	Rx/Tx

说明：机械传动比分母表示中的分母部分。

Description: Denominator of the mechanical gear ratio expressed as a fraction.

0x2217:00h-EtherCAT 通信电子齿轮分母（Electric Gear Denominator）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x1	0xFFFFFFFF	0x1	-	RW	YES	immediately	Rx/Tx

说明：EtherCAT 位置指令电子齿轮比的分母。

Description: Denominator of the electronic gear ratio for EtherCAT position commands.

0x2218:00h-EtherCAT 通信电子齿轮分子（Electric Gear Numerator）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x1	0xFFFFFFFF	0x1	-	RW	YES	immediately	Rx/Tx

说明：EtherCAT 位置指令电子齿轮比的分子。

Description: Numerator of the electronic gear ratio for EtherCAT position commands.

0x221B:00h-位置插值类型（Position Interpolation Type）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x0	0x3	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择位置指令的插值方式（线性/样条等）。

Description: Selects the interpolation method for position commands (e.g., linear, spline).

0x221C:00h-位置插补延迟（Position Interpolation Delay）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx
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说明： 从上位机（如 CNC、运动控制器）发出位置指令，到伺服驱动器实际开始执行该指令所需的时间。它本质上是轨迹指令在控制系统中的处理与传输耗时。

Description: The time delay from when a position command is issued from the master device (e.g., CNC, motion controller) to when the servo drive actually starts executing that command. Essentially, it's the command processing and transmission latency within the control system.

0x221E:00h-位置指令补偿增益（Position Command Compensation Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x2710	0x0	-	RW	YES	immediately	Rx/Tx

说明： 位置指令补偿控制器的增益系数。

Description: Gain coefficient for the position command compensation controller.

0x221F:00h-位置指令补偿低通滤波截止频率（Position Command Compensation Lpf）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x3E8	0x2710	0x-1	Hz	RW	YES	immediately	Rx/Tx

说明： 位置指令补偿器的低通滤波截止频率。

Description: Low-pass filter cutoff frequency for the position command compensator.

0x2220:00h-位置环控制模式（Position Loop Control Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx

说明： 位置环控制器为消除位置误差而计算速度指令的不同算法策略。它决定了系统如何响应和修正位置偏差，直接影响系统的动态特性、刚性及抗干扰能力。

Description: Different algorithmic strategies used by the position loop controller to calculate velocity commands for eliminating position error. It determines how the system responds to and corrects position deviation, directly impacting dynamic performance, stiffness, and disturbance rejection.

0x2221:00h-位置指令速度内部平滑类型（Internal Velocity Feedforward Smooth Type）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明： 选择位置指令生成内部速度的平滑算法。

Description: Selects the smoothing algorithm for generating internal velocity from the position command.

0x2222:00h-速度控制前馈选择 (Velocity Feedforward Source)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择速度前馈信号的来源。

Description: Selects the source of the velocity feedforward signal.

0x2223:00h-外部输入速度前馈 (External Input Velocity Feedforward)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2710	0x-2710	rpm	RW	YES	immediately	Rx/Tx

说明：从外部接口输入的速度前馈量。

Description: The velocity feedforward value input from an external interface.

0x2228:00h-刚性等级选择 (Rigid)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0xD	0x1F	0x0	-	RW	YES	immediately	Rx/Tx

说明：通过选择预设等级来快速设置位置环增益。

Description: Quickly sets the position loop gain by selecting a preset level.

0x2229:00h-位置环带宽 (First Group Position Loop Bandwidth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x30	0xBB8	0x0	1/s	RW	YES	immediately	Rx/Tx

说明：表征位置环动态响应速度的频率特性指标。

Description: A frequency domain characteristic that represents the dynamic response speed of the position loop.

0x222A:00h-位置环位置增益 (First Group Position Loop Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x30	0xBB8	0x0	-	RW	YES	immediately	Rx/Tx

说明：位置环比例控制器的增益系数。

Description: Proportional gain coefficient for the position loop controller.

0x222B:00h-位置环速度前馈增益（First Group Position Loop Velocity Feedforward Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：位置环中速度前馈的增益系数。

Description: Velocity feedforward gain coefficient within the position loop.

0x222C:00h-位置环速度前馈滤波频率（First Group Position Loop Velocity Feedforward Filter Frequency）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx

说明：位置环速度前馈信号的滤波频率。

Description: Filter frequency for the position loop velocity feedforward signal.

0x222D:00h-位置环转矩前馈增益（First Group Torque Feedforward Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：位置环中转矩前馈的增益系数。

Description: Torque feedforward gain coefficient within the position loop.

0x222E:00h-位置环转矩前馈滤波频率（First Group Torque Feedforward Filter Frequency）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx

说明：位置环转矩前馈信号的滤波频率。

Description: Filter frequency for the position loop torque feedforward signal.

0x222F:00h-位置环加速度前馈增益（Acceleration Feedforward Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xC8	0x-14	-	RW	YES	immediately	Rx/Tx
说明：位置环中加速度前馈的增益系数。 Description: Acceleration feedforward gain coefficient within the position loop.								

0x2230:00h-位置环加速度前馈模式选择 (Acceleration Feedforward Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x2	0x2	0x0	-	RW	YES	immediately	Rx/Tx
说明：选择加速度前馈的工作模式。 Description: Selects the operating mode for the acceleration feedforward.								

0x2231:00h-位置环加速度前馈速度阈值 (Acceleration Feedforward Velocity Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x2710	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：启用加速度前馈的速度门槛值。 Description: Velocity threshold for enabling acceleration feedforward.								

0x2232:00h-位置环加速度前馈滤波频率 (Acceleration Feedforward Filter Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx
说明：位置环加速度前馈信号的滤波频率。 Description: Filter frequency for the acceleration feedforward signal in the position loop.								

0x2233:00h-位置环位置误差电流前馈增益 (Position Error To Current Feedforward Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x4E20	0x-4E20	-	RW	YES	immediately	Rx/Tx
说明：根据位置误差直接前馈电流的增益。 Description: Gain for directly feeding forward current based on the position error.								

0x2234:00h-位置环位置误差电流前馈滤波频率(Position Error To Current Feedforward Lpf)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx

说明：位置误差电流前馈的滤波频率。

Description: Low-pass filter cutoff frequency for the position error to current feedforward.

0x2238:00h-第 2 刚性等级选择 (Gain Switch Rigid)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0xD	0x1F	0x0	-	RW	YES	immediately	Rx/Tx

说明：第二套位置环参数的刚性等级选择。

Description: Rigidity level selection for the second set of position loop parameters.

0x223A:00h-第 2 位置环位置增益 (Second Group Position Loop Bandwidth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x30	0xBB8	0x0	1/s	RW	YES	immediately	Rx/Tx

说明：第二套位置环的位置增益值。

Description: Bandwidth value for the second set of position loop parameters.

0x223B:00h-第 2 位置环速度前馈增益 (Gain Switch Second Group Velocity Feedforward Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：第二套位置环的速度前馈增益。

Description: Velocity feedforward gain for the second set of position loop parameters.

0x223C:00h-第 2 位置环速度前馈滤波频率 (Gain Switch Second Group Velocity Feedforward Filter Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx

说明：第二套位置环的速度前馈滤波频率。

Description: Velocity feedforward filter frequency for the second set of position loop parameters.

0x223D:00h-第 2 位置环转矩前馈增益 (Gain Switch Second Group Torque Feedforward Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：第二套位置环的转矩前馈增益。

Description: Torque feedforward gain for the second set of position loop parameters.

0x223E:00h-第 2 位置环转矩前馈滤波频率 (Gain Switch Second Group Torque Feedforward Filter Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx

说明：第二套位置环的转矩前馈滤波频率。

Description: Torque feedforward filter frequency for the second set of position loop parameters.

0x2248:00h-机械原点偏移量 (Position Offset)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xFFFFFFFF	0x-FFFFFFFF	Count	RW	YES	immediately	Rx/Tx

说明：机械原点与程序原点之间的位置偏移量。

Description: Position offset between the mechanical origin and the program origin.

0x2249:00h-位置环位置反馈来源 (Position Feedback Source)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择位置环反馈信号来源（编码器/外部等）。

Description: Selects the source of the position feedback signal (e.g., encoder, external).

0x224A:00h-位置偏差过大阈值 (Position Error Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x400000	0xFFFFFFFF	0x0	Count	RW	YES	immediately	Rx/Tx

说明：触发位置偏差过大故障的误差阈值。

Description: Error threshold for triggering a "Position Error Excessive" fault.

0x224B:00h-位置偏差过大时间 (Position Error Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1	0x3E8	0x0	ms	RW	YES	immediately	Rx/Tx

说明：位置偏差超过阈值后触发故障的延迟时间。

Description: Delay time after the position error exceeds the threshold before a fault is triggered.

0x224D:00h-定位完成判断模式 (In Position Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择判断定位完成的逻辑条件。

Description: Selects the logical conditions for determining when positioning is complete.

0x224E:00h-定位完成阈值迟滞 (In Position Hysteresis)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0x7D0	0x0	Count	RW	YES	immediately	Rx/Tx

说明：定位完成判断的迟滞区间防止信号抖动。

Description: Hysteresis window for the in-position judgment, preventing signal jitter.

0x2250:00h-定位完成阈值 (In Position Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x64	0xFFFFFFFF	0x0	Count	RW	YES	immediately	Rx/Tx

说明：判定定位完成的最终位置误差阈值。

Description: Final position error threshold for determining that positioning is complete.

0x2251:00h-定位完成窗口（In Position Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1	0x3E8	0x0	ms	RW	YES	immediately	Rx/Tx

说明：判定定位完成的位置容差窗口大小。

Description: Size of the position tolerance window for determining positioning completion.

0x2260:00h-回零错误检测模式（Homing Error Check Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择回零过程中错误检测的方式。

Description: Selects the error detection method during the homing process.

0x2262:00h-回零模式（Homing Type）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x23	0x23	0x23	-	RW	YES	immediately	Rx/Tx

说明：选择机械原点的寻找方式。

Description: Selects the method for finding the mechanical home (origin) position.

0x2264:00h-回零加速度（Homeing Acceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xFA0	0xF4240	0x0	rpm/s	RW	YES	immediately	Rx/Tx

说明：回零过程中使用的加速度值。

Description: Acceleration used during the homing process.

0x2265:00h-回零速度 1（Homing Velocity 1）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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DINT	0x64	0x1770	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：回零第一阶段（高速搜索）的运行速度。 Description: Velocity for the first stage (high-speed search) of homing.								

0x2266:00h-回零速度 2（Homing Velocity 2）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x14	0x1770	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：回零第二阶段（低速精确定位）的运行速度。 Description: Velocity for the second stage (low-speed precise positioning) of homing.								

0x2267:00h-机械偏移量（Homing Offset）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x7FFFFFFF	0x-80000000	Count	RW	YES	immediately	Rx/Tx
说明：回零后需要偏移的机械距离。 Description: Mechanical offset to apply after homing is complete.								

0x2268:00h-机械偏移量移动模式（Home Offset Move）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：执行机械偏移量的运动方式。 Description: Motion mode for executing the home offset move.								

0x2269:00h-回零运行最大时间限制（Homing Max Run Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0x2DC6C0	0x0	ms	RW	YES	immediately	Rx/Tx
说明：回零操作允许的最长运行时间。 Description: Maximum allowable runtime for the homing operation.								

0x226A:00h-回零穿越检测使能（Homing Penetrate Detect Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：用于启用或禁用回零过程中对“原点信号”进行有效性验证的功能。该功能旨在检测电机是否意外越过了原点传感器，从而提高回零操作的可靠性。 Description: Enables or disables validity verification of the "home signal" during homing. This function detects if the motor has accidentally passed the home sensor, improving the reliability of the homing operation.								

0x226B:00h-回零完成等待时间（Homing Complete Wait Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x3E8	0x2710	0x64	ms	RW	YES	immediately	Rx/Tx
说明：回零动作完成后系统确认的等待时间。 Description: Wait time for the system to confirm completion of the homing action.								

7.1.6 P3 组速度控制参数

P3 Group Velocity Control Parameters

0x2301:00h-用户速度限制（Maximum Velocity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x2328	0x2328	0x0	rpm	RW	YES	-	Rx/Tx
说明：由用户设定的、应用于特定模式的速度运行上限值。 Description: User-set upper speed limit applicable in specific modes.								

0x2303:00h-速度环带宽（First Group Velocity Loop Bandwidth）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1B	0xBB8	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：表征速度环动态响应速度的频率特性指标。 Description: Frequency characteristic indicating the dynamic response speed of the velocity loop.								

0x2304:00h-速度环比例增益（First Group Velocity Proportional Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.008	0xF4240	0x0	-	RW	YES	immediately	Rx/Tx

说明：速度环比例控制环节的放大倍数，影响系统刚度。

Description: Amplification factor of the velocity loop's proportional controller, affecting system stiffness.

0x2305:00h-速度环积分时间常数（First Velocity Loop Integral Time Constant）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x15	0x7D0	0x0	ms	RW	YES	immediately	Rx/Tx

说明：速度环积分器的作用时间常数，影响消除静差的速度。

Description: Time constant of the velocity loop's integrator, affecting the speed of steady-state error elimination.

0x2306:00h-速度环积分增益（First Group Velocity Integral Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.005	0x30D40	0x0	-	RW	YES	immediately	Rx/Tx

说明：速度环积分控制环节的放大系数。

Description: Amplification coefficient of the velocity loop's integral controller.

0x2307:00h-速度环前馈增益（First Group Velocity Feedforward Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	1.2	0x0	-	RW	YES	immediately	Rx/Tx

说明：为提高跟踪性能而引入的速度前馈控制系数。

Description: Velocity feedforward coefficient introduced to improve tracking performance.

0x2308:00h-速度环电流前馈增益（First Group Velocity To Current Feedforward Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：在速度环内引入的电流前馈补偿系数。

Description: Current feedforward compensation coefficient introduced in the velocity loop.

0x2309:00h-速度环电流前馈滤波频率（First Group Velocity To Current Feedforward Lpf）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx
说明：对速度环电流前馈信号进行滤波的截止频率。 Description: Cutoff frequency of the filter applied to the velocity loop's current feedforward signal.								

0x230A:00h-转矩前馈控制选择 (Torque Feedforward Source)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：选择转矩前馈的来源和启用方式。 Description: Selects the source and enabling method for torque feedforward.								

0x230B:00h-外部输入转矩前馈 (External Input Torque Feedforward)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0x64	0x-64	A	RW	NO	immediately	Rx/Tx
说明：从外部接口（如模拟量）输入的转矩前馈量。 Description: Torque feedforward value input from an external interface (e.g., analog).								

0x230C:00h-速度环控制模式 (Velocity Loop Control Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x1	-	RW	YES	immediately	Rx/Tx
说明：选择速度环的控制策略，如纯 P 控制、PI 控制等。 Description: Selects the control strategy for the velocity loop, e.g., P-only, PI control, etc.								

0x230D:00h-速度反馈来源选择 (Velocity Filter Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x6	0x0	-	RW	YES	immediately	Rx/Tx
说明：选择速度反馈信号的来源，如编码器微分、外部传感器等。 Description: Selects the source of the velocity feedback signal, e.g., encoder differentiation, external sensor, etc.								

0x230E:00h-速度反馈低通滤波频率 (First Group Velocity Filter Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x320	0xDAC	0x1	Hz	RW	YES	immediately	Rx/Tx

说明：对速度反馈信号进行低通滤波的截止频率。

Description: Cutoff frequency of the low-pass filter applied to the velocity feedback signal.

0x2310:00h-速度反馈滤波模式 (Velocity Feedback Filter Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x6	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择速度反馈滤波器的类型或模式。

Description: Selects the type or mode of the velocity feedback filter.

0x2313:00h-第 2 速度环带宽 (Gain Switch Second Group Velocity Loop Bandwidth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1B	0xBB8	0x0	Hz	RW	YES	immediately	Rx/Tx

说明：第二套速度环参数的带宽指标（用于增益切换）。

Description: Bandwidth index for the second set of velocity loop parameters (used for gain switching).

0x2314:00h-第 2 速度环增益 (Second Group Velocity Loop Bandwidth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x8	0xBB8	0x0	Hz	RW	YES	immediately	Rx/Tx

说明：第二套速度环的比例增益值。

Description: Proportional gain value for the second set of velocity loop parameters.

0x2315:00h-第 2 速度环积分时间常数 (Second Group Velocity Loop Intergral Time Constant)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x5	0x7D0	0x0	ms	RW	YES	immediately	Rx/Tx

说明：第二套速度环的积分时间常数。

Description: Integral time constant for the second set of velocity loop parameters.

0x2316:00h-第 2 速度环积分 (Gain Switch Second Group Velocity Integral Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.005	0x30D40	0x0	-	RW	YES	immediately	Rx/Tx

说明：第二套速度环的积分增益值。

Description: Integral gain value for the second set of velocity loop parameters.

0x2317:00h-第 2 速度环前馈增益 (Gain Switch Second Group Velocity Feedforward Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	1.1	0x0	-	RW	YES	immediately	Rx/Tx

说明：第二套速度环的前馈增益值。

Description: Feedforward gain value for the second set of velocity loop parameters.

0x2318:00h-第 2 速度环电流前馈增益 (Gain Switch Second Group Velocity To Current Feedforward Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：第二套速度环的电流前馈增益值。

Description: Current feedforward gain value for the second set of velocity loop parameters.

0x2319:00h-第 2 速度环电流前馈滤波频率 (Gain Switch Second Group Velocity To Current Feedforward Lpf)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RW	YES	immediately	Rx/Tx

说明：第二套速度环的电流前馈滤波频率。

Description: Filter frequency for the current feedforward of the second set of velocity loop parameters.

0x231E:00h-第 2 速度反馈低通滤波频率 (Second Group Velocity Filter Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x1B8	0xDAC	0x1	Hz	RW	YES	immediately	Rx/Tx

说明：用于第二套速度环的速度反馈滤波频率。

Description: Velocity feedback filter frequency for the second set of velocity loop parameters.

0x2327:00h-点动使能（Jog Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：启用或禁用手动点动运行功能的信号。

Description: Signal to enable or disable the manual jogging function.

0x2328:00h-点动速度（Jog Velocity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x64	0x1770	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：点动操作时电机的运行速度。

Description: Motor speed during jogging operation.

0x2329:00h-点动方向（Jog Direction）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0x1	0x-1	-	RW	YES	immediately	Rx/Tx

说明：点动操作时电机的运行方向。

Description: Direction of motor movement during jogging operation.

0x232C:00h-速度到达信号阈值（Velocity Reached Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x1	0x0	rpm	RW	YES	-	Rx/Tx

说明：判定实际速度已达到指令速度的允许误差范围。

Description: Allowed error range for determining that the actual velocity has reached the commanded velocity.

0x232F:00h-零速到达阈值（Zero Velocity Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UDINT	0xA	0xBB8	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：判定电机已处于停止状态的最高速度门槛。 Description: Maximum speed threshold for determining that the motor is at a standstill (zero speed).								

0x2330:00h-零速到达时间（Zero Velocity Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x5	0x3E8	0x0	ms	RW	YES	immediately	Rx/Tx
说明：实际速度低于零速阈值后，持续多久才发出零速信号。 Description: Duration for which the actual velocity must remain below the zero-velocity threshold before the zero-speed signal is generated.								

0x2331:00h-速度到达阈值（Velocity Reach Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x32	0xBB8	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：用于产生"速度到达"信号的容差窗口大小。 Description: Tolerance window size for generating the "Velocity Reached" signal.								

0x2332:00h-速度到达时间（Velocity Reach Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x5	0x3E8	0x0	ms	RW	YES	immediately	Rx/Tx
说明：速度进入到达阈值范围内后，需持续多久才发出到达信号。 Description: Time the velocity must remain within the reached threshold before the "Velocity Reached" signal is asserted.								

0x2333:00h-速度超差阈值（Velocity Error Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0x1770	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：触发速度超差报警或故障的速度误差极限值。 Description: Velocity error limit that triggers an overspeed alarm or fault.								

0x2334:00h-速度超差时间（Velocity Error Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x64	0xBB8	0x0	ms	RW	YES	immediately	Rx/Tx
说明：速度误差超过阈值后，持续多久才触发超差报警。 Description: Duration the velocity error must exceed the threshold before triggering an overspeed alarm.								

0x2335:00h-速度噪声滤波频率（Dither Frequency）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xDAC	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：用于抑制速度反馈信号中高频噪声的滤波器截止频率。 Description: Filter cutoff frequency for suppressing high-frequency noise in the velocity feedback signal.								

7.1.7 P4 组电流控制参数

P4 Group Current/Torque Control Parameters

0x2404:00h-转矩指令变化斜率（Torque Slope）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x3E8	0x0	mNm/s	RW	YES	immediately	Rx/Tx
说明：限制转矩指令单位时间内最大变化率的参数。 Description: Parameter that limits the maximum rate of change of the torque command per unit time.								

0x2408:00h-转矩限制（Maximum Current）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xC8	0xBB8	0x0	A	RW	YES	immediately	Rx/Tx
说明：系统允许输出的综合转矩上限绝对值。 Description: Absolute maximum torque/current the system is allowed to output.								

0x2409:00h-正向转矩限制（Maximum Positive Current）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x64	0xBB8	0x0	A	RW	YES	immediately	Rx/Tx

说明：电机正转方向允许输出的最大转矩值。

Description: Maximum torque/current allowed in the positive (forward) direction.

0x240A:00h-负向转矩限制 (Maximum Negative Current)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x64	0xBB8	0x0	A	RW	YES	immediately	Rx/Tx

说明：电机反转方向允许输出的最大转矩值。

Description: Maximum torque/current allowed in the negative (reverse) direction.

0x240D:00h-转矩模式下的速度限制 (Torque Mode Velocity Limit)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xBB8	0x2328	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：在转矩控制模式中，为防止飞车而设定的速度保护上限。

Description: Speed protection limit set in torque control mode to prevent runaway.

0x240E:00h-速度限制单位选择 (Velocity Limit Unit Selection)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：设定速度限制值所使用的物理单位。

Description: Selects the physical unit used for setting the speed limit value.

0x240F:00h-电流模式下的速度限制系数 (Velocity Limit Coefficient In Current Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：在转矩控制模式下，用于设定电机最高允许转速的一个比例参数。它通常以电机额定转速或最高转速的百分比形式表示。

Description: In torque control mode, a scaling parameter used to set the motor's maximum allowable speed, typically expressed as a percentage of the motor's rated or maximum speed.

0x2410:00h-电流环带宽 (Current Loop Bandwidth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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DINT	0x4B0	0x1388	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：表征电流环动态响应速度的频率特性指标。 Description: Frequency characteristic indicating the dynamic response speed of the current loop.								

0x2412:00h-电流环比例增益（Current Loop Proportional Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x32	0x3E8	0x0	V/A	RW	YES	immediately	Rx/Tx
说明：电流环比例控制环节的放大倍数，决定系统的响应刚度。 Description: Amplification factor of the current loop's proportional controller, determining system response stiffness.								

0x2413:00h-电流环积分增益（Current Loop Integral Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	32.5	0x46	0x0	V/A*ΔT	RW	YES	immediately	Rx/Tx
说明：电流环积分控制环节的放大系数，用于消除静态误差。 Description: Amplification coefficient of the current loop's integral controller, used to eliminate steady-state error.								

0x2415:00h-电流环抗饱和增益（Current Loop Anti Saturation Gain）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.02	0x64	0x0	-	RW	YES	immediately	Rx/Tx
说明：防止电流环积分器饱和并改善动态特性的补偿增益。 Description: Compensation gain to prevent integrator windup in the current loop and improve dynamic performance.								

0x241B:00h-电流环电压前馈系数（Current Loop Voltage Feedforward Coefficient）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.7	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：为补偿反电势而引入的电压前馈控制系数。 Description: Voltage feedforward control coefficient introduced to compensate for back-EMF.								

0x241D:00h-转矩指令滤波频率（Torque Command First Filter）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x320	0xFA0	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：对转矩指令进行低通滤波的截止频率。 Description: Cutoff frequency of the low-pass filter applied to the torque command.								

0x241E:00h-第 2 转矩指令滤波频率 (Torque Command Second Filter)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0xC8	0xFA0	0x0	Hz	RW	YES	immediately	Rx/Tx
说明：第二级转矩指令滤波器的截止频率（若存在）。 Description: Cutoff frequency of the second-stage torque command filter (if applicable).								

0x2420:00h-自适应陷波器模式选择 (Adaptive Filter Enable)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：选择自适应陷波器的工作模式（如学习、锁定等）。 Description: Enables or disables the adaptive notch filter.								

0x2421:00h-自适应陷波最小频率 (Adaptive Filter Minmum Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x30D40	0x7D0	0x2	Hz	RW	YES	immediately	Rx/Tx
说明：自适应陷波器能够调节的最低中心频率。 Description: Minimum center frequency to which the adaptive notch filter can be adjusted.								

0x2422:00h-振动阈值设定 (Adaptive Filter Magnitude Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.12	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：触发自适应陷波器开始学习的机械振动幅度门槛。 Description: Mechanical vibration amplitude threshold that triggers the adaptive notch filter to start learning.								

0x2423:00h-自适应陷波自动保存模式 (Adaptive Filter Save Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：陷波器参数在学习完成后是否自动保存。

Description: Determines whether notch filter parameters are automatically saved after learning is complete.

0x2426:00h-陷波中心频率过低标志 (Low Notch Center Frequency Flag)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0xFF	0x0	Hz	RW	YES	immediately	Rx/Tx

说明：标识当前陷波器中心频率是否低于安全范围。

Description: Indicates whether the current notch filter center frequency is below the safe range.

0x2428:00h-第 1 陷波频率 (First Notch Filter Center Frequency)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xFA0	0xFA0	0x32	Hz	RW	YES	immediately	Rx/Tx

说明：第一个固定陷波滤波器的中心频率。

Description: Center frequency of the first fixed notch filter.

0x2429:00h-第 1 陷波宽度选择 (First Notch Filter Bandwidth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x50	0x1F4	0x14	Hz	RW	YES	immediately	Rx/Tx

说明：第一个固定陷波滤波器的频带宽度（品质因数 Q 值）。

Description: Bandwidth of the first fixed notch filter (related to quality factor Q).

0x242A:00h-第 1 陷波深度选择 (First Notch Filter Depth)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x28	0x64	0x0	%	RW	YES	immediately	Rx/Tx

说明：第一个固定陷波滤波器对共振频率的抑制深度。

Description: Attenuation depth of the first fixed notch filter at the resonance frequency.

0x242B:00h-第 1 陷波器使能（First Notch Filter Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：启用或禁用第一个固定陷波滤波器。

Description: Enables or disables the first fixed notch filter.

0x242C:00h-第 2 陷波频率（Second Notch Filter Center Frequency）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xFA0	0xFA0	0x32	Hz	RW	YES	immediately	Rx/Tx

说明：第二个固定陷波滤波器的中心频率。

Description: Center frequency of the second fixed notch filter.

0x242D:00h-第 2 陷波宽度选择（Second Notch Filter Bandwidth）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x50	0x1F4	0x14	Hz	RW	YES	immediately	Rx/Tx

说明：第二个固定陷波滤波器的频带宽度。

Description: Bandwidth of the second fixed notch filter.

0x242E:00h-第 2 陷波深度选择（Second Notch Filter Deepth）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x28	0x64	0x0	%	RW	YES	immediately	Rx/Tx

说明：第二个固定陷波滤波器对共振频率的抑制深度。

Description: Attenuation depth of the second fixed notch filter at the resonance frequency.

0x242F:00h-第 2 陷波器使能（Second Notch Filter Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明： 启用或禁用第二个固定陷波滤波器。 Description: Enables or disables the second fixed notch filter.								

0x2440:00h-磁通削弱使能（Flux Weakening Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	-	RW	NO	immediately	Rx/Tx
说明： 用于启用或禁用“磁场削弱控制”算法的开关。该功能通过主动降低电机内部的磁场强度，来扩展电机在额定电压下的恒功率调速范围，使其能运行在基速以上。 Description: Switch to enable or disable the flux-weakening control algorithm. This function actively reduces the motor's internal magnetic field strength to extend the constant power speed range beyond the base speed under rated voltage.								

0x2444:00h-直流母线电压利用率（Vbus Utilization Rate）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.935	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明： 实际输出电压与最大可能输出电压（与母线电压相关）的比值。 Description: Ratio of actual output voltage to the maximum possible output voltage (related to bus voltage).								

0x2450:00h-扭矩环比例增益（Torque Loop Kp）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REAL	-	-	-	-	RW	YES	immediately	Rx/Tx
说明： 力控关节参数，力矩环控制参数。 Description: Force-controlled joint parameters, torque loop control parameters.								

0x2451:00h-扭矩环积分增益（Torque Loop Ki）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REAL	-	-	-	-	RW	YES	immediately	Rx/Tx
说明： 力控关节参数，力矩环控制参数。 Description: Force-controlled joint parameters, torque loop control parameters.								

0x2452:00h-扭矩偏移量（Torque Offset）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REAL	-	-	-	Nm	RW	YES	immediately	Rx/Tx
说明：力控关节参数，力矩环控制参数。 Description: Force-controlled joint parameters, torque loop control parameters.								

0x2453:00h-扭矩反馈低通滤波器频率（Torque Feedback Low-Pass Filter Frequency）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	-	-	HZ	RW	YES	immediately	Rx/Tx
说明：力控关节参数，力矩环控制参数。 Description: Force-controlled joint parameters, torque loop control parameters.								

7.1.8 P5 组故障与保护参数

P5 Group Fault and Protection Parameters

0x250B:00h-过速故障阈值（Over Velocity Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0xC350	0xEA60	0x1	rpm	RW	YES	immediately	Rx/Tx
说明：触发过速故障保护的实际控制速度上限值。 Description: Actual speed upper limit that triggers an overspeed fault protection.								

0x250C:00h-过速故障时间（Over Velocity Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1	0x3E8	0x1	ms	RW	YES	immediately	Rx/Tx
说明：实际速度超过阈值后，持续多久才触发过速故障。 Description: Duration the speed must exceed the threshold before an overspeed fault is triggered.								

0x2516:00h-堵转保护时间阈值（Stall Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x3E8	0x3E8	0x0	ms	RW	YES	immediately	Rx/Tx

说明：电机处于堵转状态持续超过此时间将触发保护。

Description: If the motor remains in a stall condition beyond this time, protection is triggered.

0x2517:00h-堵转判定速度阈值 (Stall Velocity)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3C	0x1F4	0x0	rpm	RW	YES	immediately	Rx/Tx

说明：低于此速度即判定为可能发生堵转的速度阈值。

Description: Speed threshold below which the motor is considered potentially stalled.

0x2518:00h-堵转保护电流阈值 (Stall Current)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x-1	0x64	0x-1	A	RW	YES	immediately	Rx/Tx

说明：用于辅助判定堵转的电流阈值。

Description: Current threshold used as an auxiliary criterion for stall detection.

0x251B:00h-编码器通信 CRC 错误计数值 (Encoder Communication Crc Fault Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0xFFFF	0x0	-	RW	YES	-	Rx/Tx

说明：编码器通信数据 CRC 校验错误的累计次数。

Description: Cumulative count of CRC errors in encoder communication data.

0x251C:00h-编码器通信超时错误计数值 (Encoder Communication Timeout Fault Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0xFFFF	0x0	-	RW	YES	-	Rx/Tx

说明：编码器通信响应超时的累计次数。

Description: Cumulative count of encoder communication timeout errors.

0x251D:00h-编码器错误阈值设置寄存器 (Encoder Communication Fault Threshold)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UINT	0x505	0xFFFF	0x101	-	RW	YES	immediately	Rx/Tx
说明： 设置编码器各类错误计数的报警或故障阈值。 Description: Sets alarm or fault thresholds for various encoder error counts.								

0x252A:00h-重力补偿自适应使能（Gravity Compensation Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明： 启用或禁用电机能根据位置自动调整重力补偿值的功能。 Description: Enables or disables the function that automatically adjusts gravity compensation based on motor position.								

0x252B:00h-重力补偿值（Gravity Compensation Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x64	0x-64	A	RW	YES	immediately	Rx/Tx
说明： 为平衡垂直轴重力而预设的恒定转矩补偿量。 Description: Preset constant torque compensation value to counteract gravity on a vertical axis.								

0x252C:00h-重力补偿系数（Gravity Compensation Coefficient）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xA	0x3E8	0x0	-	RW	YES	immediately	Rx/Tx
说明： 将重力换算为所需补偿转矩的比例系数。 Description: Scaling coefficient to convert gravity into the required compensation torque.								

0x252D:00h-重力补偿退出时间（Gravity Compensation Off Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1F4	0x2710	0x1	-	RW	YES	immediately	Rx/Tx
说明： 使能信号无效后，重力补偿转矩衰减到零所需的时间。 Description: Time required for gravity compensation torque to decay to zero after the enable signal becomes inactive.								

0x252E:00h-重力补偿模式选择（Gravity Compensation Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择重力补偿的工作模式，如恒定、正弦等。

Description: Selects the operating mode for gravity compensation, e.g., constant, sinusoidal, etc.

0x252F:00h-重力补偿实际值（Gravity Compensation Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x64	0x-64	A	RO	YES	-	Tx

说明：当前实际生效的重力补偿转矩值。

Description: Currently active gravity compensation torque value.

0x2532:00h-软件限位设置选择（Position Limiting Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择使用哪一组软件限位参数。

Description: Selects which set of software position limit parameters to use.

0x2533:00h-软限位检测滞环阈值（Software Position Limit Hysteresis）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x7FFFFFFF	0x0	Count	RW	YES	immediately	Rx/Tx

说明：为防止在限位边界抖动而设置的迟滞区间。

Description: Hysteresis window set to prevent chattering near the limit boundary.

0x2534:00h-软件限位正向位置（Software Position Limit Maximum）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0xFFFFFFFF	0xFFFFFFFF	0x0	Count	RW	YES	immediately	Rx/Tx

说明：正方向的软件限位边界位置。

Description: Positive direction software position limit boundary.

0x2535:00h-软件限位反向位置 (Software Position Limit Minimum)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xFFFFFFFF	0x0	Count	RW	YES	immediately	Rx/Tx

说明：负方向的软件限位边界位置。

Description: Negative direction software position limit boundary.

0x2536:00h-硬件位置限位回差 (Hardware Position Limit Hysteresis)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：为防止硬件限位开关在触发边界因机械振动或信号抖动而导致状态频繁切换，而专门设置的位置迟滞区间。

Description: Position hysteresis window specifically set to prevent frequent state changes of the hardware limit switch at the trigger boundary due to mechanical vibration or signal bounce.

0x2537:00h-硬件位置限位模式 (Hardware Position Limit Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：定义了当外部硬件限位开关被触发时，伺服驱动器所采取的具体安全响应策略，其最高优先级是防止机械损坏。

Description: Defines the specific safety response strategy taken by the servo drive when an external hardware limit switch is triggered, with the highest priority being to prevent mechanical damage.

0x253B:00h-STO 故障模式 (STO Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1	0x3	0x0	-	RW	YES	immediately	Rx/Tx

说明：定义 STO 安全输入被触发（断开）时，驱动器的响应行为：

Defines the drive's response behavior when the STO safety input is triggered (open):

0: 关闭 -STO 功能失效，不产生任何提示。（仅用于调试，禁止用于运行）

Disabled - The STO function is deactivated, and no prompt is generated. (For debugging only, prohibited during operation)

1: 智能响应-STO 触发时，若驱动器未使能则产生报警；若已使能则报故障并紧急停机。

Smart Response - When STO is triggered, an alarm is generated if the drive is not enabled; if enabled, a fault is reported, and an emergency stop is initiated.

2: 仅报警-STO 触发时，产生报警，恢复 STO 信号即正常。

Alarm Only - When STO is triggered, an alarm is generated; normal operation resumes once the STO signal is restored.

3: 仅故障-STO 触发时, 立即报故障并紧急停机。

Fault Only - When STO is triggered, a fault is reported immediately, and an emergency stop is initiated.

0x253C:00h-STO 故障恢复模式 (STO Recover Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明: 定义 STO 安全输入恢复 (闭合) 后, 驱动器的恢复方式:

Defines the drive's recovery method after the STO safety input is restored (closed):

0: 手动恢复-STO 故障/报警需手动清除 (复位) 后才能继续运行。

Manual Recovery - The STO fault/alarm must be cleared manually (reset) before operation can continue.

1: 自动恢复-STO 信号恢复后, 故障/报警自动清除, 驱动器可根据使能信号继续或恢复运行。

Auto Recovery - After the STO signal is restored, the fault/alarm is cleared automatically, and the drive can continue or resume operation based on the enable signal.

0x2540:00h-警告信息查询 (Latched Warning)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT2540	0x0	0x100000000	0x0	-	RW	YES	immediately	Rx/Tx

说明: 用于读取当前处于激活状态的警告代码列表。

Description: Used to read the list of currently active warning codes.

0x2541:00h-故障信息查询 (Drive Latched Fault)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT2541	0x0	0xFFFF	0x0	-	RW	YES	immediately	Rx/Tx

说明: 用于读取当前处于激活状态的故障代码列表。

Description: Used to read the list of currently active fault codes.

0x2543:00h-故障记录保存延时时间 (Fault History Save Delay Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1E	0x258	0x0	s	RW	YES	immediately	Rx/Tx

说明: 从故障发生到被存入历史记录前的延迟时间, 用于防抖和过滤瞬时故障。

Description: Delay time from fault occurrence to being saved in the history, used for debouncing and filtering transient faults.

7.1.9 P6 组辅助功能参数

P6 Group Auxiliary Function Parameters

0x2601:00h-CPU 计算过载检测使能 (MCU Realtime Overload Check Enable)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明：启用或禁用对 CPU 运算负载过高的检测功能。 Description: Enables or disables the detection function for excessive CPU load.								

0x2602:00h-驱动器运算总负载 (Drive Realtime Load)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xF4240	0x0	0.01us	RO	YES	-	Tx
说明：驱动器所有任务实时占用 CPU 资源的百分比。 Description: Percentage of CPU resources occupied in real-time by all drive tasks.								

0x2603:00h-驱动器运算总负载最大值 (Drive Maximum Realtime Load)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xF4240	0x0	0.01us	RO	YES	-	Tx
说明：自驱动器运行以来，CPU 总负载达到过的峰值。 Description: The peak value of the total CPU load since the drive started running.								

0x2604:00h-驱动器运算运动负载 (Drive Motion Realtime Load)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xF4240	0x0	0.01us	RO	YES	-	Tx
说明：运动控制相关任务（如位置环、速度环）所占用的 CPU 负载。 Description: CPU load occupied by motion control tasks (e.g., position loop, speed loop).								

0x2605:00h-驱动器运算过载类型 (Drive Realtime Overload Type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UDINT	0x0	0x6	0x0	-	RO	YES	-	Tx
说明： 指示导致 CPU 过载的具体任务或原因。 Description: Indicates the specific task or cause that led to the CPU overload.								

0x2620:00h-增益切换使能（Gain Switch Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx
说明： 启用或禁用根据条件自动切换控制环增益的功能。 Description: Enables or disables the function to automatically switch control loop gains based on conditions.								

0x2621:00h-增益切换模式（Gain Switch Mode）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0xA	0x0	-	RW	YES	immediately	Rx/Tx
说明： 选择增益切换的触发条件（如根据位置误差、转矩等）。 Description: Selects the trigger condition for gain switching (e.g., based on position error, torque, etc.).								

0x2622:00h-增益切换延迟时间（Gain Switch Delay）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x2	0x2710	0x0	ms	RW	YES	immediately	Rx/Tx
说明： 从触发条件满足到实际切换增益之间的延迟时间。 Description: Delay time between the trigger condition being met and the actual gain switch.								

0x2623:00h-增益切换等级（Gain Switch Level）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xF4240	0x0	-	RW	YES	immediately	Rx/Tx
说明： 选择切换到哪一组预设的增益参数。 Description: Selects which preset set of gain parameters to switch to.								

0x2624:00h-增益切换滞环（Gain Switch Hysteresis）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0xF4240	0x0	-	RW	YES	immediately	Rx/Tx

说明：为防止增益在切换点附近频繁跳动而设置的迟滞区间。

Description: Hysteresis window set to prevent frequent gain switching near the switch point.

0x2625:00h-位置增益切换时间（Gain Switch Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x64	0x3E8	0x0	ms	RW	YES	immediately	Rx/Tx

说明：切换位置环增益时，过渡过程的平滑时间常数。

Description: Smoothing time constant for the transition when switching position loop gains.

0x2626:00h-增益切换滤波器设定（Gain Switch Filter Enable）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：对增益切换触发信号进行滤波的参数。

Description: Enables filtering of the gain switch trigger signal.

0x2627:00h-增益切换参数批量复制（Gain Switch Parameter Dump）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	-	-	-	RW	NO	immediately	Rx/Tx

说明：将一组增益参数复制到另一组的批量操作指令。

Description: Batch operation command to copy a set of gain parameters to another group.

0x2628:00h-增益切换位置指令阈值（Gain Switch Position Command Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x2	0x7FFFFFFF	0x0	Count	RW	YES	immediately	Rx/Tx

说明：当位置指令变化超过此阈值时触发增益切换。

Description: Triggers gain switching when the position command variation exceeds this threshold.

0x2629:00h-增益切换加速度 (Gain Switch Acceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x3E8	0xF4240	0x1	rpm/s	RW	YES	immediately	Rx/Tx

说明：当实际加速度超过此值时触发增益切换。

Description: Triggers gain switching when the actual acceleration exceeds this value.

0x263A:00h-正向摩擦补偿 (Positive Friction Compensation)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x64	0x-64	A	RW	YES	immediately	Rx/Tx

说明：在正转方向为克服摩擦力而额外叠加的转矩补偿量。

Description: Additional torque compensation in the positive (forward) direction to overcome friction.

0x263B:00h-反向摩擦补偿 (Negative Friction Compensation)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x64	0x-64	A	RW	YES	immediately	Rx/Tx

说明：在反转方向为克服摩擦力而额外叠加的转矩补偿量。

Description: Additional torque compensation in the negative (reverse) direction to overcome friction.

0x263C:00h-正向摩擦补偿速度滞环 (Positive Friction Compensation Hysteresis)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x0	0x3E8	0x-3E8	rpm	RW	YES	immediately	Rx/Tx

说明：正转摩擦补偿生效与取消的速度迟滞区间。

Description: Speed hysteresis window for enabling/disabling positive friction compensation.

0x263D:00h-反向摩擦补偿速度滞环 (Negative Friction Compensation Hysteresis)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x0	0x3E8	0x-3E8	rpm	RW	YES	immediately	Rx/Tx

说明：反转摩擦补偿生效与取消的速度迟滞区间。

Description: Speed hysteresis window for enabling/disabling negative friction compensation.

0x2642:00h-旋转加速度单位（Unit Of Rotary Acceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x1	-	RW	YES	immediately	Rx/Tx

说明：定义旋转运动加速度的参数单位（如 rad/s², rpm/s）。

Description: Defines the parameter unit for rotary acceleration (e.g., rad/s², rpm/s).

0x2643:00h-旋转位置单位（Unit Of Rotary Position）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x1	-	RW	YES	immediately	Rx/Tx

说明：定义旋转运动位置的参数单位（如 pulse, rev, rad, deg）。

Description: Defines the parameter unit for rotary position (e.g., pulse, rev, rad, deg).

0x2644:00h-旋转速度单位（Unit Of Rotary Velocity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x1	-	RW	YES	immediately	Rx/Tx

说明：定义旋转运动速度的参数单位（如 rpm, rad/s）。

Description: Defines the parameter unit for rotary velocity (e.g., rpm, rad/s).

0x2649:00h-位置缓冲式点动移动距离 1（Serial Buffered Position Command 1）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x7FFFFFFF	0x-80000000	Count	RW	YES	immediately	Rx/Tx

说明：缓冲式点动中第一段移动的距离。

Description: Target position for the first segment in buffered jogging/positioning.

0x264A:00h-位置缓冲式点动移动距离 2（Serial Buffered Position Command 2）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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DINT	0x0	0x7FFFFFFF	0x-80000000	Count	RW	YES	immediately	Rx/Tx
说明：缓冲式点动中第二段移动的距离。 Description: Target position for the second segment in buffered jogging/positioning.								

0x264B:00h-位置缓冲式点动移动速度 1 (Serial Buffered Velocity Command 1)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0xA	0x1F40	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：缓冲式点动中第一段移动的速度。 Description: Velocity for the first segment in buffered jogging/positioning.								

0x264C:00h-位置缓冲式点动移动速度 2 (Serial Buffered Velocity Command 2)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0xA	0x1F40	0x0	rpm	RW	YES	immediately	Rx/Tx
说明：缓冲式点动中第二段移动的速度。 Description: Velocity for the second segment in buffered jogging/positioning.								

0x264D:00h-位置缓冲式点动移动次数 (Serial Buffered Position Move Times)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1	0xFFFF	0x0	-	RW	YES	immediately	Rx/Tx
说明：缓冲式点动循环执行的总次数。 Description: Total number of cycles to execute for buffered jogging.								

0x264E:00h-位置缓冲式点动移动间等待时间 (Serial Buffered Position Move Delay Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0x186A0	0x0	ms	RW	YES	immediately	Rx/Tx
说明：缓冲式点动中各次移动之间的暂停时间。 Description: Pause time between consecutive moves in buffered jogging.								

0x264F:00h-位置缓冲式点动模式 (Serial Buffered Position Move Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择缓冲式点动的运行模式（如单次、循环）。

Description: Selects the operating mode for buffered jogging/positioning (e.g., single, cyclic).

0x266C:00h-EtherCAT 通信指令周期计算指数 (Interpolation Time Index)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x-3	0x-2	0x-5	-	RW	YES	immediately	Rx/Tx

说明：用于计算 EtherCAT 指令周期的指数值。

Description: Exponent used to calculate the EtherCAT command cycle. Period = 1ms * 2^{index}.

0x266D:00h-EtherCAT 通信指令周期 (Interpolation Time Period Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0xFA	0x1	-	RW	YES	immediately	Rx/Tx

说明：EtherCAT 主站发送指令的同步周期时间。

Description: Synchronous cycle time of EtherCAT master command transmission (calculated value).

0x2670:00h-EtherCAT 状态机状态与端口连接状态 (Ecat Communication State)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x-1	0x8	0x-1	-	RO	YES	-	Tx

说明：显示 EtherCAT 从站状态机及各物理端口的连接状态。

Description: Displays the EtherCAT slave state machine and the connection status of each physical port.

0x2672:00h-AL 故障码 (AL Code)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0xFFFF	0x0	-	RO	YES	-	Tx

说明：EtherCAT 从站应用层 (Application Layer) 报告的故障代码。

Description: Status/Error code reported by the EtherCAT slave Application Layer (AL).

0x2675:00h-EtherCAT 位置补偿延时(EtherCAT Position Command Compensation Delay)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x2	0xC8	0x0	125us	RW	YES	immediately	Rx/Tx

说明：补偿 EtherCAT 通信延迟所引入的位置指令延时量。

Description: Amount of position command delay introduced to compensate for EtherCAT communication latency.

0x2676:00h-EtherCAT 位置补偿模式(EtherCAT Position Command Compensation Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：选择 EtherCAT 位置延迟补偿的策略。

Description: Selects the strategy for EtherCAT position delay compensation.

0x2677:00h-EtherCAT 冗余使能(EtherCAT Redundancy Enable)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：用于启用或禁用 EtherCAT 通信线缆冗余功能的开关。启用后，系统通过构建一个物理环形网络，在单一线路故障时能够自动切换，保证通信不中断。

Description: Switch to enable or disable the EtherCAT cable redundancy function. When enabled, the system can automatically switch to a backup link in case of a single line failure by forming a physical ring network, ensuring communication continuity.

0x2678:00h-EtherCAT ML 运行模式(EtherCAT Mainloop Run Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x2	0x0	-	RW	YES	immediately	Rx/Tx

说明：EtherCAT Mailbox Logic（邮箱逻辑）运行模式。

Description: Sets the operating mode of the EtherCAT mailbox logic processing loop.

0x2679:00h-EtherCAT EEPROM 修改模式(EtherCAT Eeprom Modify Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x0	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：设置 EtherCAT 从站 EEPROM 的读写权限模式。

Description: Sets the read/write permission mode for the EtherCAT slave EEPROM.

0x267A:00h-H6076 启用（Enable Object 0x6076）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x1	0x0	-	RW	YES	immediately	Rx/Tx

说明：启用或禁用对象字典索引 0x6076（位置偏移）的相关功能。

Description: Enables or disables the functionality associated with Object Dictionary index 0x6076 (Position Offset).

0x26A0:00h- Node ID（Node-ID）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x1	0x7F	0x1	kbps	RW	YES	-	Rx/Tx

说明：定义本设备在 CAN 总线上的唯一节点地址，修改此参数后，通常需要重启设备或重新上电才能使新的节点 ID 生效。必须确保同一 CAN 网络上所有节点的 ID 唯一，否则会导致通信冲突。

Description: Defines the unique node address of this device on the CAN bus. After modifying this parameter, it usually requires restarting the device or power cycling it for the new node ID to take effect. It is essential to ensure that all node IDs on the same CAN network are unique; otherwise, it may cause communication conflicts.

0x26A1:00h- CAN 通信波特率（CAN Baudrate）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0xF4240	0xF4240	0x0	bps	RO	YES	-	Rx/Tx

说明：设置 CAN 总线的通信速率，默认 1000000bps。分别支持 500kbps、250 kbps、125 kbps、100 kbps、50 kbps、20 kbps，可通过设置更改。

Description: Set the communication baud rate for the CAN bus. The default is 1,000,000 bps. Supported rates include 500 kbps, 250 kbps, 125 kbps, 100 kbps, 50 kbps, and 20 kbps, and can be changed via configuration.

0x26A2:00h- 减速器减速比分子（Reduction Ratio Numerator）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x65	0xA1	0x1	-	RO	YES	-	Rx/Tx

说明：减速器减速比分子。

Description: The reducer's reduction ratio is fractional.

0x26A3:00h- 减速器减速比分母（Reduction Ratio Denominator）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x1	0xA1	0x1	-	RO	YES	-	Rx/Tx
说明： 减速器减速比分母。 Description: The reducer's reduction ratio denominator.								

7.1.10 P7 组监控参数

P7 Group Monitoring Parameters

0x2706:00h-伺服使能状态 (Drive Enable Status)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0x1	0x0	-	RO	YES	-	Tx
说明： 综合了软硬件使能信号后，驱动器最终的功率输出状态。 Description: The final power output status of the drive, considering all software and hardware enable signals.								

0x2707:00h-电机停止 (Position Motion Ended)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0x1	0x0	-	RO	YES	-	Tx
说明： 指示电机当前处于零速状态。 Description: Indicates that the motor is currently at zero speed / in position.								

0x2708:00h-控制模式 (Control Mode)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	0x8	0x8	0x0	-	RO	YES	-	Tx
说明： 显示驱动器当前生效的工作模式，如位置、速度或转矩模式。 Description: Shows the currently active operating mode of the drive, e.g., Position, Velocity, or Torque mode.								

0x2709:00h-系统状态 (System State Machine State)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0x9	0x0	-	RO	YES	-	Tx

说明：驱动器整体的运行状态机，如初始化、就绪、运行、故障等。

Description: System state machine state, e.g., Initializing, Ready, Operational, Fault, etc.

0x270A:00h-电机运行环路（Motor Run Loop State）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x1	0x8	0x0	-	RO	YES	-	Tx

说明：指示电机当前正在执行的闭环控制类型，如电流环、速度环或位置环。

Description: Indicates which level of the motor control loop is currently active (e.g., Current Loop, Velocity Loop, Position Loop).

0x270B:00h-应用状态机（Application State Machine State）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x1	0x5	0x0	-	RO	YES	-	Tx

说明：针对特定应用工艺（如回零、点动）的内部流程状态。

Description: The internal process state for specific application sequences (e.g., homing, jogging).

0x270C:00h-运行时间（System Run Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xFFFFFFFF	0x0	h:m:s	RO	YES	-	Tx

说明：驱动器累计上电运行的时间。

Description: The cumulative powered-on runtime of the drive.

0x270D:00h-LED 显示内容（Initial Position Identification Status）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	0x0	0xF	0x0	-	RO	YES	-	Tx

说明：驱动器面板指示灯所代表的当前状态或故障代码。

Description: Content indicated by the LED display (status code or fault code).

0x2710:00h-驱动器 Sync0 运算负载（Drive Sync0 Task Realtime Load）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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UDINT	0x0	0xFFFFFFFF	0x0	0.01us	RO	YES	-	Tx
说明：在 EtherCAT 同步周期内，驱动器核心任务所占用的 CPU 时间百分比。 Description: CPU time percentage occupied by the drive's core control tasks within the EtherCAT synchronous cycle (Sync0).								

0x2711:00h-驱动器 1ms 任务运算负载 (Drive 1ms Task Realtime Load)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xFFFFFFFF	0x0	0.01us	RO	YES	-	Tx
说明：1 毫秒周期任务的 CPU 占用率。 Description: CPU utilization of the 1ms periodic task.								

0x2712:00h-驱动器 10ms 任务运算负载 (Drive 10ms Task Realtime Load)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xFFFFFFFF	0x0	0.01us	RO	YES	-	Tx
说明：10 毫秒周期任务的 CPU 占用率。 Description: CPU utilization of the 10ms periodic task.								

0x2735:00h-正向实际转矩限制 (Positive Current Limit Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xBB8	0x-3E8	A	RO	YES	-	Tx
说明：当前生效的正方向输出转矩上限值。 Description: Currently active upper limit for the positive direction output current.								

0x2736:00h-负向实际转矩限制 (Negative Current Limit Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xBB8	0x-3E8	A	RO	YES	-	Tx
说明：当前生效的负方向输出转矩上限值。 Description: Currently active upper limit for the negative direction output current.								

0x276F:00h-第一编码器单圈值 (Encoder Single Turn Position)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x7FFFFFFF	0x-80000000	Count	RO	YES	-	Tx

说明：主编码器在一圈内的绝对位置值。

Description: Absolute position value of the encoder within one revolution.

0x2770:00h-编码器多圈值 (Encoder Multi Turn Position)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	2 ⁶³ -1	-2 ⁶³	Rev	RO	YES	-	Tx

说明：绝对值编码器记录的总圈数。

Description: Total number of revolutions recorded by the absolute encoder.

0x2771:00h-第二编码器单圈值 (Encoder Multi-Turn Original Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x7FFFFFFF	0x-80000000	Count	RO	YES	-	Tx

说明：辅助编码器在一圈内的绝对位置值。

Description: Absolute position value of the auxiliary (second) encoder within one revolution.

0x2777:00h-直流母线电压 (Vbus)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x352	0x0	V	RO	YES	-	Tx

说明：驱动器内部直流总线上的实时电压值。

Description: Real-time voltage value on the drive's internal DC bus.

0x2779:00h-电机温度 (Drive Temperature)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xC8	0x-64	°C	RO	YES	-	Tx

说明：通过传感器检测或模型估算的电机温度。

Description: Drive internal temperature measured by sensors.

0x277A:00h-驱动器功率模块温度（Power Module Temperature）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0xC8	0x-64	°C	RO	YES	-	Tx

说明：驱动器内部 IGBT 等功率器件的温度。

Description: Temperature of the power devices (e.g., IGBTs) inside the drive.

0x27B0:00h-位置环位置增益实际值（Position Loop Gain Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x30	0xBB8	0x0	-	RO	YES	-	Tx

说明：位置环比例增益的当前实际生效值。

Description: Currently active proportional gain value of the position loop.

0x27B1:00h-速度前馈增益实际值（Position Loop Velocity Feedforward Gain Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	0x1	0x0	-	RO	YES	-	Tx

说明：速度前馈控制的当前实际增益值。

Description: Currently active velocity feedforward gain in the position loop.

0x27B2:00h-速度前馈滤波频率实际值（Position Loop Velocity Feedforward Filter Frequency Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RO	YES	-	Tx

说明：速度前馈滤波器的当前实际截止频率。

Description: Currently active cutoff frequency of the position loop's velocity feedforward filter.

0x27B3:00h-转矩前馈增益实际值（Torque Feedforward Gain Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2	0x0	-	RO	YES	-	Tx

说明：转矩前馈控制的当前实际增益值。

Description: Currently active torque feedforward gain.

0x27B4:00h-转矩前馈滤波频率实际值 (Torque Feedforward Filter Frequency Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RO	YES	-	Tx

说明：转矩前馈滤波器的当前实际截止频率。

Description: Currently active cutoff frequency of the torque feedforward filter.

0x27B5:00h-速度环比例增益实际值 (Velocity Proportional Gain Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.8	0xF4240	0x0	-	RO	YES	-	Tx

说明：速度环比例控制的当前实际增益值。

Description: Currently active proportional gain of the velocity loop.

0x27B6:00h-速度环积分增益实际值 (Velocity Integral Gain Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0.5	0x30D40	0x0	-	RO	YES	-	Tx

说明：速度环积分控制的当前实际增益值。

Description: Currently active integral gain of the velocity loop.

0x27B7:00h-速度环前馈增益实际值 (Velocity Feedforward Gain)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x1	1.2	0x0	-	RO	YES	-	Tx

说明：速度环前馈控制的当前实际增益值。

Description: Currently active feedforward gain of the velocity loop.

0x27B8:00h-速度环电流前馈增益实际值 (Velocity To Current Feedforward Gain Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	0x0	0x2	0x0	-	RO	YES	-	Tx
说明：速度环内电流前馈控制的当前实际增益值。 Description: Currently active current feedforward gain within the velocity loop.								

0x27B9:00h-速度环电流前馈滤波频率实际值（Velocity To Current Feedforward Lpf Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x3E8	0x1F40	0x64	Hz	RO	YES	-	Tx
说明：速度环内电流前馈滤波器的当前实际截止频率。 Description: Currently active cutoff frequency of the current feedforward low-pass filter within the velocity loop.								

0x27BA:00h-转矩指令滤波频率实际值（Torque Command First Filter Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x0	0xFA0	0x0	Hz	RO	YES	-	Tx
说明：转矩指令滤波器的当前实际截止频率。 Description: Currently active cutoff frequency of the first-stage low-pass filter for the torque command.								

0x27BB:00h-速度反馈低通滤波频率实际值（Velocity Filter Frequency Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x320	0xDAC	0x1	Hz	RO	YES	-	Tx
说明：速度反馈滤波器的当前实际截止频率。 Description: Currently active cutoff frequency of the velocity feedback low-pass filter.								

0x27BC:00h-扭矩参考指令（Torque Reference Cmd）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REAL	-	-	-	Nm	RW	NO	-	Tx

说明：力控关节参数，力矩环控制参数。

Description: Force-controlled joint parameters, torque loop control parameters.

0x27BD:00h-扭矩值 (Torque Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
REAL	-	-	-	Nm	RO	NO	-	Tx

说明：力控关节参数，力矩环控制参数。

Description: Force-controlled joint parameters, torque loop control parameters.

0x5000:00h-参数读写 (Parameter Read And Write)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT5000	-	-	-	-	RW	NO	immediately	Rx/Tx

说明：参数的读取与写入。

Description: This object is used for reading and writing drive parameters.

0x5001:00h-参数导出/访问 (Parameter Dump Access)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT5001	-	-	-	-	RW	NO	immediately	Rx/Tx

说明：用于配置、备份和恢复参数设置。

Description: Used to configure, back up, and restore parameter settings.

7.1.11 标准化参数

Standardized Parameters

0x603F:00h-错误代码 (Error Code)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	-	RO	NO	immediately	Tx

说明：指示当前发生的故障代码，方便快速排查问题。

Description: Indicates the currently active fault code for quick troubleshooting.

0x6040:00h-控制字（Control word）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：用于向驱动器发送控制命令（如：启动、停止、使能、复位、故障确认等）。

Description: Used to send control commands to the drive (e.g., start, stop, enable, reset, fault acknowledge).

0x6041:00h-状态字（Status word）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	-	RO	NO	immediately	Tx

说明：实时反映驱动器的当前运行状态（如：准备就绪、故障、使能、已启动、报警等）。主站通过读取此寄存器来监控驱动器状态。

Description: Reflects the drive's current operational status in real-time (e.g., ready, fault, enabled, started, warning, etc.). The master monitors the drive state by reading this register.

0x605A:00h-快停选项代码（Quick Stop Option Code）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：定义驱动器在接收到快速停止指令时应采取的减速停止行为（例如：立即停止、减速停止、自由停车等）。

Description: Defines the deceleration behavior the drive should take upon receiving a quick stop command (e.g., stop immediately, decelerate to stop, coast to stop, etc.).

0x605B:00h-停机选项代码（Shutdown Option Code）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：定义驱动器在接收到停机指令时应采取的行为（例如：立即停止、减速停止、自由停车等）。

Description: Defines the action the drive should take upon receiving a shutdown command (e.g., stop immediately, decelerate to stop, coast to stop, etc.).

0x605C:00h-禁用操作选项代码（Disable Operation Option Code）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：定义驱动器在接收到禁用操作指令时应采取的行为（例如：立即停止、减速停止、自由停车等）。 Description: Defines the action the drive should take upon receiving a disable operation command (e.g., stop immediately, decelerate to stop, coast to stop, etc.).								

0x605D:00h-停止选项代码（Halt Option Code）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：定义驱动器在接收到暂停指令时应采取的行为（例如：立即停止、减速停止、自由停车等）。 Description: Defines the action the drive should take upon receiving a halt command (e.g., stop immediately, decelerate to stop, coast to stop, etc.).								

0x605E:00h-故障响应选项（Fault Response Options）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：设定当驱动器检测到故障时应执行的动作（如：快速停止、禁用输出、保持最后状态等）。 Description: Defines the action the drive should take upon detecting a fault (e.g., quick stop, disable output, keep last state, etc.).								

0x6060:00h-运行模式（Modes Of Operation）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：设定驱动器当前的工作模式，如位置模式(8)、速度模式(9)、转矩模式(10)等。 Description: Sets the current operating mode of the drive, e.g., Profile Position Mode (8), Profile Velocity Mode (9), Profile Torque Mode (10), etc.								

0x6061:00h-运行模式显示（Modes Of Operation Display）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	-	0xFF	0x0	-	RO	NO	immediately	Tx
说明：显示驱动器当前实际生效的工作模式。 Description: Displays the currently active operating mode of the drive.								

0x6062:00h-位置目标值（Position Demand Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus	RO	NO	immediately	Tx

说明：在每个控制周期中，由驱动器内部轨迹生成器（profile generator）计算出的、期望电机立即达到的目标位置。它是位置闭环的给定指令值。

Description: The target position, calculated by the drive's internal profile generator for each control cycle, that the motor is expected to reach immediately. It serves as the setpoint for the position closed-loop control.

0x6063:00h-实际内部位置值（Position Actual Internal Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus	RO	NO	immediately	Tx

说明：说明：位置测量装置的实际值，是闭环位置控制的两个输入值之一。数据单位被定义为增量。

Description: The actual value of the position measurement device is one of the two input values of the closed loop position control. The data unit is defined as increments.

0x6064:00h-实际位置值（Position Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus	RO	NO	immediately	Tx

说明：此对象表示输出端的位置实际值。对于半闭环系统是电机端编码

Description: This object represents the position actual value of the output encoder feedback. It returns the motor position feedback value.

0x6065:00h-跟随误差窗口（Following Error Window）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus	RW	NO	immediately	Rx/Tx

说明：位置跟随误差的报警阈值。当实际位置与目标位置的差值持续超过此窗口时，会触发“跟随误差超限”故障。

Description: Alarm threshold for the position following error. A "Following Error Exceeded" fault is triggered when the difference between the actual and target position persistently exceeds this window.

0x6066:00h-跟随误差超时（Following Error Time Out）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	ms	RW	NO	immediately	Rx/Tx

说明：在触发跟随误差故障前，允许跟随误差持续超过“跟随误差窗口”的最大时间。

Description: Maximum time the following error is allowed to persist outside the "Following Error Window" before triggering a following error fault.

0x6067:00h-位置窗口 (Position Window)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus	RW	NO	immediately	Rx/Tx

说明: 用于判定目标位置到达的允许误差范围。当实际位置与目标位置的偏差持续在此窗口内时, 位置到达信号有效。

Description: Allowable error range for determining "target reached". The "Target Reached" signal is valid when the deviation between the actual and target positions remains within this window.

0x6068:00h-位置窗口时间 (Position Window Time)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	ms	RW	NO	immediately	Rx/Tx

说明: 在发出“目标到达”信号前, 要求实际位置必须持续稳定在“位置窗口”范围内的最短时间。

Description: The minimum time the actual position must remain stable within the "Position Window" before the "Target Reached" signal is issued.

0x606B:00h-速度目标值 (Velocity Demand Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus/s	RO	NO	immediately	Tx

说明: 速度控制模式下, 由内部规划器计算出的目标速度指令值。它是速度环的给定值。

Description: In velocity control mode, the target velocity command calculated by the internal profiler. It is the setpoint for the velocity loop.

0x606C:00h-实际速度值 (Velocity Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus/s	RO	NO	immediately	Tx

说明: 电机侧当前的实际速度反馈值。

Description: Current actual velocity feedback value on the motor side.

0x606D:00h-速度窗口 (Velocity Window)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx

说明：用于判定目标速度到达的允许误差范围。当实际速度与目标速度的偏差持续在此窗口内时，速度到达信号有效。

Description: Allowable error range for determining "Velocity Target Reached". The "Velocity Target Reached" signal is valid when the deviation between the actual and target velocities remains within this window.

0x606E:00h-速度窗口时间（Velocity Window Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	ms	RW	NO	immediately	Rx/Tx

说明：在发出“速度到达”信号前，要求实际速度必须持续稳定在“速度窗口”范围内的最短时间。

Description: The minimum time the actual velocity must remain stable within the "Velocity Window" before the "Velocity Target Reached" signal is issued.

0x606F:00h-速度阈值（Velocity Threshold）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx

说明：一个预设的速度临界值，当电机的实际速度值跨越此临界值时，会触发特定的逻辑动作或状态判断（如零速检测）。

Description: A preset velocity threshold that, when crossed by the motor's actual velocity, triggers specific logic actions or status judgments (e.g., zero-speed detection).

0x6070:00h-速度阈值时间（Velocity Threshold Time）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	ms	RW	NO	immediately	Rx/Tx

说明：在切换由“速度阈值”触发的状态信号（如“零速”信号）前，要求实际速度值必须持续稳定在阈值之上或之下（例如，低于阈值）的最短时间。

Description: The minimum time the actual velocity must persist above or below (e.g., below) the "Velocity Threshold" before switching the corresponding status signal (e.g., "Zero Velocity").

0x6071:00h-目标力矩（Target Torque）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	per thousand of rated current	RW	NO	immediately	Rx/Tx

说明：转矩控制模式下，由上位控制器给定的目标转矩值。

Description: In torque control mode, the target torque value given by the master controller.

0x6072:00h-最大力矩（Max Torque）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	0.001	RW	NO	immediately	Rx/Tx

说明：电机在短时间内可以提供的最大转矩限制值，是设定瞬时目标转矩的绝对上限。

Description: The maximum torque limit the motor can provide for a short time, serving as the absolute upper limit for setting the instantaneous target torque.

0x6073:00h-最大电流（Maximum Current）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	0.001	RW	NO	immediately	Rx/Tx

说明：允许输出给电机的绝对最大峰值电流限值。

Description: The absolute maximum current limit allowed to be output to the motor.

0x6074:00h-力矩目标值（Torque Demand Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	per thousand of rated current	RO	NO	immediately	Tx

说明：驱动器内部为控制回路（如位置环、速度环）输出的、作为电流环给与的转矩指令值。

Description: The torque command value output by the drive's internal control loops (e.g., position loop, velocity loop) to the current loop.

0x6075:00h-电机额定电流（Motor Rated Current）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	mA	RO	NO	immediately	Tx

说明：伺服电机在连续运行状态下，能够安全、稳定地输出其额定转矩而不会因过热导致损坏的最大允许峰值电流值。

Description: The maximum allowable current for the servo motor to safely and stably output its rated torque under continuous operation without overheating damage.

0x6076:00h-电机额定力矩（Motor Rated Torque）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	mNm	RO	NO	immediately	Tx

说明： 伺服电机在额定电流下，能够连续、稳定输出而不会因过热损坏的最大转矩。

Description: The maximum torque the servo motor can continuously and stably output at rated current without overheating damage.

0x6077:00h-实际力矩值（Torque Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	‰	RO	NO	immediately	Tx

说明： 转矩实际值指驱动电机内部的瞬时扭矩，以额定扭矩的千分比（‰）为单位。具体公式如下：

实际扭矩（mNm）= (对象字典 0x6077 ÷ 1000) × 对象字典 0x6076。

其中，0x6075 表示额定电流，0x6078 表示实际电流的千分比值。

Description: The actual torque value refers to the instantaneous torque inside the drive motor, given in thousandths (‰) of the rated torque. The specific formula is as follows:

Actual Torque (mNm) = (Object Dictionary 0x6077 ÷ 1000) × Object Dictionary 0x6076.

Note: The description for the current parameters (0x6075 and 0x6078) seems to have been included here by mistake, as the context is about torque. For torque calculation, Object Dictionary 0x6076 represents the Rated Torque.

0x6078:00h-实际电流值（Current Actual Value）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	‰	RO	NO	immediately	Tx

说明： 电流实际值指驱动电机内部的瞬时电流，以额定电流的千分比（‰）为单位。该值通过实时采样电机三相电流的瞬时值，经合成计算得到，具体公式如下：实际电流（mA）= (对象字典 0x6078 ÷ 1000) × 对象字典 0x6075。

其中，0x6075 表示额定电流，0x6078 表示实际电流的千分比值。

Description: The actual current value refers to the instantaneous current inside the drive motor, expressed in thousandths (‰) of the rated current. This value is obtained by real-time sampling and synthesized calculation of the motor's three-phase instantaneous currents. The specific calculation formula is as follows:

Actual Current (mA) = (Object Dictionary 0x6078 ÷ 1000) × Object Dictionary 0x6075.

Note: 0x6075 represents the rated current. 0x6078 represents the actual current value expressed in thousandths of the rated current.

0x6079:00h-直流母线电压（DC Link Circuit Voltage）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	mV	RO	NO	immediately	Tx

说明： 驱动器内部直流总线的电压值。

Description: The voltage value of the drive's internal DC bus.

0x607A:00h-目标位置（Target Position）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
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DINT	-	0xFFFFFFFF	0x0	plus	RW	NO	immediately	Rx/Tx
说明：在轮廓位置模式（Profile Position Mode）下，由主站发送的最终目标位置。 Description: In Profile Position Mode, the final target position sent by the master.								

0x607C:00h-回零偏移（Home Offset）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus	RW	NO	immediately	Rx/Tx
说明：用户定义的偏置值，用于将伺服电机的机械原点与系统坐标系零点分离开来。它定义了从“机械零点”到“程序零点”的偏移距离。 Description: User-defined offset value used to separate the motor's mechanical home from the system coordinate zero. It defines the offset distance from the "mechanical zero" to the "program zero".								

0x607D:00h-软件位置限位（Software Position Limit）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT607D	-	-	-	-	RW	NO	immediately	Rx/Tx
说明：内部设定的、禁止电机轴进入的虚拟电子区域。它是一种软保护，用于防止机械结构运动到其物理极限之外而发生碰撞损坏。 Description: Internally set virtual electronic area that the motor shaft is prohibited from entering. It is a soft protection to prevent the mechanical structure from moving beyond its physical limits and causing collision damage.								

0x607E:00h-极性（Polarity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
USINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx
说明：用于定义伺服系统中信号或运动逻辑方向的参数。它决定了指令或反馈的“正”与“负”对应的物理意义。 Description: Parameter used to define the logical direction of signals or motion in the servo system. It determines the physical meaning of "positive" and "negative" for commands and feedback.								

0x607F:00h-最大轮廓速度（Maximum Profile Velocity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx
说明：在轮廓位置模式（Profile Position Mode）下，位置规划器所允许生成的运动轨迹的最大速度。 Description: In Profile Position Mode, the maximum velocity allowed for motion trajectories generated by the position profiler.								

0x6080:00h-电机最高速度（Motor Maximum Speed）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx

说明：电机在机械和电气设计上允许的最高安全转速，是防止电机损坏的硬性保护限制。

Description: The maximum safe rotational speed allowed by the motor's mechanical and electrical design. It is a hard protection limit to prevent motor damage.

0x6081:00h-轮廓速度（Profile Velocity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx

说明：在位置控制模式下，单次点位移动的目标运行速度，决定了电机移动的快慢。

Description: The target speed for a single point-to-point move in Position mode, determining how fast the motor moves.

0x6083:00h-轮廓加速度（Profile Acceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/s ²	RW	NO	immediately	Rx/Tx

说明：位置控制模式下，从零加速到轮廓速度所允许的最大速度变化率，决定了启动或加速的快慢。

Description: The maximum allowable rate of speed increase from zero to the profile speed in Position mode. It determines how quickly the motor starts or accelerates.

0x6084:00h-轮廓减速度（Profile Deceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/s ²	RW	NO	immediately	Rx/Tx

说明：位置控制模式下，从轮廓速度减速到零所允许的最大速度变化率，决定了停止或减速的快慢。

Description: The maximum allowable rate of speed decrease from the profile speed to zero in Position mode. It determines how quickly the motor stops or decelerates.

0x6085:00h-快停减速度（Quick Stop Deceleration）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/s ²	RW	NO	immediately	Rx/Tx

说明：紧急事件触发快速停止功能时，用于停止电机的紧急减速斜率，以实现最快安全制动。

Description: The emergency deceleration rate used to stop the motor when a Quick Stop is triggered, aiming for the fastest safe braking.

0x6087:00h-力矩斜率 (Torque Slope)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明： 转矩控制模式下，限制输出转矩变化率的参数，定义了力矩指令变化的允许快慢，相当于力矩柔化处理。

Description: In Torque control mode, a parameter that limits the rate of change of the output torque. It defines how fast the torque command is allowed to change, acting as a torque smoothing filter.

0x608F:00h-位置编码器分辨率 (Position Encoder Resolution)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT608F	-	-	-	-	RW	NO	immediately	Rx/Tx

说明： 伺服电机编码器能够检测到的最小位置变化量，决定了位置控制的理论精度上限。

Description: The smallest resolvable position change detectable by the servo motor's encoder. It determines the theoretical upper limit of the system's position control accuracy.

0x6091:00h-减速比 (Gear Ratio)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT6091	-	-	-	-	RW	NO	immediately	Rx/Tx

说明： 伺服电机（输入）与最终负载（输出）之间的转速转换比率。它定义了转速转换关系并按比例放大输出转矩。

Description: The speed conversion ratio between the servo motor (input) and the final load (output). It defines the speed relationship and proportionally amplifies the output torque.

0x6092:00h-反馈常数 (Feed Constant)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT6092	-	-	-	-	RW	NO	immediately	Rx/Tx

说明： 建立编码器脉冲数与负载侧物理位移之间换算关系的系数。定义了“多少个脉冲”等于“一个用户单位”。

Description: A scaling coefficient that establishes the mathematical relationship between encoder pulse counts and the actual physical displacement on the load side. It defines how many pulses equal one user-defined unit.

0x6098:00h-回零方式 (Homing Method)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
SINT	-	0xFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：预先设定的、指导伺服电机寻找并确立机械坐标系原点的标准化规则和流程。

Description: A pre-defined standardized procedure that guides the servo motor to find and establish a unique and stable mechanical coordinate system origin.

0x6099:00h-回零速度 (Homing Speeds)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT6099	-	-	-	-	RW	NO	immediately	Rx/Tx

说明：执行回零操作时，电机向原点位置移动的目标速度。通常分为高速搜索和低速精确定位两个阶段。

Description: The target speed at which the motor moves towards the home position during the homing operation. It is typically divided into two stages: high-speed search and low-speed precise positioning.

0x609A:00h-回零加速度 (Homing Acceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/ ²	RW	NO	immediately	Rx/Tx

说明：回零操作过程中，速度增加或减少的快慢程度，控制启动、停止和高低速切换的平稳性与响应速度。

Description: The rate of speed change during the homing operation. It controls the smoothness and responsiveness of starting, stopping, and switching between high and low speeds.

0x60B0:00h-位置偏移 (Position Offset)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus	RW	NO	immediately	Rx/Tx

说明：可动态加载的位置补偿值。在位置控制模式下，瞬时叠加到当前位置指令上，使电机实际位置立即产生微小的、受控的偏移。

Description: A dynamically loadable position compensation value. In Position mode, it is instantaneously added to the current position command, causing the motor's actual position to shift immediately in a controlled, small amount.

0x60B1:00h-速度偏移 (Velocity Offset)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx

说明：可动态加载的速度补偿值。在速度控制模式下，瞬时叠加到当前速度指令上，使电机实际转速立即产生微小的、受控的变化。

Description: A dynamically loadable velocity compensation value. In Velocity mode, it is instantaneously added to the current velocity command, causing the motor's actual speed to change immediately in a controlled, small amount.

0x60B2:00h-力矩偏移 (Torque Offset)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
					s	p		

INT	-	0xFFFF	0x0	per thousand of rated current	RW	NO	immediately	Rx/Tx
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说明：可动态加载的转矩补偿值。在转矩控制模式下，瞬时叠加到当前转矩指令上，使电机输出转矩立即产生微小的、受控的变化。

Description: A dynamically loadable torque compensation value. In Torque mode, it is instantaneously added to the current torque command, causing the motor's output torque to change immediately in a controlled, small amount.

0x60C0:00h-插值类型 (Interpolation Type)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	-	0xFFFF	0x0	-	RW	NO	immediately	Rx/Tx

说明：定义了伺服驱动器在接收密集微小位置指令时，如何在离散指令点之间生成平滑、连续运动轨迹的方法。

Description: Defines the method by which the servo drive generates a smooth, continuous motion trajectory between discrete command points when receiving dense, tiny position commands.

0x60C2:00h-插值周期 (Interpolation Time Period)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT60C2	-	0xFFFFFFFF	0x0	ms	RW	NO	immediately	Rx/Tx

说明：伺服驱动器两次执行插值计算并更新内部位置指令之间的固定时间间隔，决定了生成运动轨迹的细腻度和精度。

Description: The fixed time interval between two consecutive interpolation calculations and internal position command updates in the servo drive. It determines the smoothness and accuracy of the generated motion trajectory.

0x60C5:00h-最大加速度 (Max Acceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/ s^2	RW	NO	immediately	Rx/Tx

说明：系统在所有运行模式下允许的最大速度增加速率。它是一个拥有最高优先级的系统级安全极限参数，用于保护电机和机械结构。

Description: The maximum allowed rate of speed increase for the system in all operating modes. It is a system-level safety limit parameter with the highest priority, used to protect the motor and mechanical structure.

0x60C6:00h-最大减速度 (Max Deceleration)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	plus/ s^2	RW	NO	immediately	Rx/Tx

说明：系统在所有运行模式下允许的最大速度减少速率。它是一个拥有最高优先级的系统级安全极限参数，用于在紧急停止或快速减速时保护电机和机械结构。

Description: The maximum allowed rate of speed decrease for the system in all operating modes. It is a system-level safety limit parameter with the highest priority, used to protect the motor and mechanical structure during emergency stops or rapid decelerations.

0x60E0:00h-正向力矩限值 (Positive Torque Limit Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	mA	RW	NO	immediately	Rx/Tx

说明: 允许电机输出正向转矩的最大值。是正常操作中用于限制电机输出力、防止机械过载的软件保护门槛。

Description: The maximum allowable positive torque output of the motor. It is a software protection threshold used during normal operation to limit the motor's output force and prevent mechanical overload.

0x60E1:00h-负向力矩限值 (Negative Torque Limit Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFF	0x0	mA	RW	NO	immediately	Rx/Tx

说明: 允许电机输出负向转矩的最大值。是正常操作中用于限制电机在反向旋转时的输出力、防止机械过载的软件保护门槛。

Description: The maximum allowable negative torque output of the motor. It is a software protection threshold used during normal operation to limit the motor's output force in the reverse direction and prevent mechanical overload.

0x60F4:00h-实际跟随误差值 (Following Error Actual Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFFFFFF	0x0	plus	RO	NO	immediately	Tx

说明: 实时计算的「位置目标值」与「实际位置值」之间的瞬时差值。是评估伺服系统动态跟踪性能的最直接、最关键指标。

Description: The instantaneous difference between the "Position Demand Value" and the "Position Actual Value", calculated in real-time. It is the most direct and critical indicator for evaluating the dynamic tracking performance of a servo system.

0x60FC:00h-内部位置目标值 (Position Demand Internal Value)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	-	0xFFFFFFFF	0x0	plus	RO	NO	immediately	Tx

说明: 位置规划器在每个控制周期中生成的、电机在当前时刻应该到达的理想位置。它构成了位置控制环的瞬时给定轨迹。

Description: The ideal position that the motor should reach at the current moment, generated by the position profiler in each control cycle. It constitutes the instantaneous reference trajectory for the position control loop.

0x60FD:00h-数字量输入 (Digital Inputs)

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	-	RO	NO	immediately	Tx

说明：接收外部开关信号的物理接口。它将外部的“是/否”状态转换为驱动器内部可识别的逻辑信号，用于实现各种控制功能与安全联锁。

Description: Physical interface for receiving external switch signals. It converts external ON/OFF states into logical signals recognizable by the drive, used to implement various control functions and safety interlocks.

0x60FE:00h-数字量输出（Digital Outputs）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DT60FE	-	-	-	-	RW	NO	immediately	Rx/Tx

说明：用于向外部设备发送开关状态信号的物理接口。它将驱动器内部的状态和报警信息，转换为外部电路可识别的“通/断”信号，用于指示、控制和联锁。

Description: Physical interface for sending switch status signals to external devices. It converts the drive's internal status and alarm information into ON/OFF signals recognizable by external circuits, used for indication, control, and interlocking.

0x60FF:00h-目标速度（Target Velocity）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
DINT	-	0xFFFFFFFF	0x0	plus/s	RW	NO	immediately	Rx/Tx

说明：上位控制系统（如 PLC）直接发送给伺服驱动器的指令速度。它代表了在速度控制模式下，系统希望电机达到并维持的预期转速。

Description: The velocity command sent directly from the master controller (e.g., PLC) to the servo drive. In Velocity mode, it represents the desired speed that the system wants the motor to achieve and maintain.

0x6502:00h-支持的驱动模式（Supported Drive Modes）

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	-	0xFFFFFFFF	0x0	-	RO	NO	immediately	Tx

说明：指示伺服驱动器和电机组能够支持的不同控制模式。它定义了驱动器可以如何被控制。

Description: Indicates the different control modes supported by the servo drive and motor combination. It defines how the drive can be controlled.

7.2 CANopen 通信报文示例（PDO 配置示例）

CANopen Communication Message Examples (PDO Configuration Examples)

以关节 Node ID = 1 为例。

Take joint Node ID = 1 as an example.

7.2.1 循环同步位置模式（CSP）

Cyclic Synchronous Position Mode (CSP)

表 7-5 CSP 模式 PDO 配置

Table 7-5 CSP Mode PDO Configuration

CSP Mode Configuration	Step	COB-ID	Data
停止节点，配置相关参数 Stop Node, Configure Parameters	关闭远程节点 Stop Remote Node	00	02 01
	复位节点 Reset Node	00	82 01
		701	00
	设置为周期同步位置模式 Set to CSP Mode (0x08)	601	2F 60 60 00 08 00 00 00
		581	60 60 60 00 00 00 00 00
	核对运行模式为 CSP 模式 Verify CSP Mode	601	40 61 60 00 00 00 00 00
		581	4F 60 60 00 08 00 00 00
	关闭同步发生器 Disable SYNC Producer	601	23 05 10 00 80 00 00 00
		581	60 05 10 00 00 00 00 00
	通信周期设置为 1000us Set SYNC Period (1000 μ s)	601	23 06 10 00 E8 03 00 00
		581	60 06 10 00 00 00 00 00

PDO 映射配置 PDO Mapping Configuration	TxPDO1 配置流程 TxPDO1 Configuration	关闭 TxPDO1 Disable TxPDO1	601	23 00 18 01 81 01 00 80
			581	60 00 18 01 00 00 00 00
		设置传输类型 Set TxPDO1 Transmission Type (1)	601	2F 00 18 02 01 00 00 00
			581	60 00 18 02 00 00 00 00
		清除原有映射 Clear TxPDO1 Mappings	601	2F 00 1A 00 00 00 00 00
			581	60 00 1A 00 00 00 00 00
		0x1A00: 01h 映射 0x60410010 (状态字) 0x1A00: 01h Map 0x60410010 (Status Word)	601	23 00 1A 01 10 00 41 60
			581	60 00 1A 01 00 00 00 00
		0x1A00: 02h 映射 0x60640020 (实际位置) 0x1A00: 02h Map 0x60640020 (Actual Position)	601	23 00 1A 02 20 00 64 60
			581	60 00 1A 02 00 00 00 00
		0x1A00: 00h 写入映射 对象个数: 2 0x1A00: 00h Write Number of Mapped Objects: 2	601	2F 00 1A 00 02 00 00 00
			581	60 00 1A 00 00 00 00 00
		打开 TxPDO1 Enable TxPDO1	601	23 00 18 01 81 01 00 00
			581	60 00 18 01 00 00 00 00
	RxPDO1 配置流程	关闭 RxPDO1 Disable RxPDO1	601	23 00 14 01 01 02 00 80
			581	60 00 14 01 00 00 00 00

	RxPDO1 Configuration	设置传输类型 Set RxPDO1 Transmission Type (1)	601	2F 00 14 02 01 00 00 00
		清除原有映射 Clear RxPDO1 Mappings	581	60 00 14 02 00 00 00 00
		清除原有映射 Clear RxPDO1 Mappings	601	2F 00 16 00 00 00 00 00
		清除原有映射 Clear RxPDO1 Mappings	581	60 00 16 00 00 00 00 00
		0x1600: 01h 映射 0x60400010 (控制字) 0x1600: 01h Map 0x60400010 (Control word)	601	23 00 16 01 10 00 40 60
		0x1600: 01h 映射 0x60400010 (控制字) 0x1600: 01h Map 0x60400010 (Control word)	581	60 00 16 01 00 00 00 00
		0x1600: 02h 映射 0x607A0020 (目标位 置) 0x1600: 02h Map 0x607A0020 (Target Position)	601	23 00 16 02 20 00 7A 60
		0x1600: 02h 映射 0x607A0020 (目标位 置) 0x1600: 02h Map 0x607A0020 (Target Position)	581	60 00 16 02 00 00 00 00
		0x1600: 00h 写映射对 象个数: 2 0x1600: 00h Write Number of Mapped Objects: 2	601	2F 00 16 00 02 00 00 00
		0x1600: 00h 写映射对 象个数: 2 0x1600: 00h Write Number of Mapped Objects: 2	581	60 00 16 00 00 00 00 00
		打开 RxPDO1 Enable RxPDO1	601	23 00 14 01 01 02 00 00
		打开 RxPDO1 Enable RxPDO1	581	60 00 14 01 01 00 00 00
启动节点 Start Node	NMT 启动节点 NMT Start Node		0	01 01
	读 0x6064 获取当前实际位置 Read Actual Position (0x6064)		601	40 64 60 00 00 00 00 00
	读 0x6064 获取当前实际位置 Read Actual Position (0x6064)		581	43 64 60 00 00 00 00 00

	写 0x607A 等于当前实际位置 Write Target Position (0x607A) to Current		601	23 7A 60 00 00 00 00 00
			581	60 7A 60 00 00 00 00 00
周 期 发 送 RxPDO1 Cyclic Send RxPDO1	电机清除报错 Fault Reset	控制字设置为128，目标位置设置为0plus。 Control word set to 128, target position set to 0 plus.	201	80 00 00 00 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	40 12 00 00 00 00 00
	电机使能 Motor Enable	控制字设置为6，目标位置设置0plus。 Control word set to 6, target position set to 0 plus.	201	06 00 00 00 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	21 12 04 F8 4F 00
		控制字设置为 7 Control word set to 7	201	07 00 00 00 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	33 12 00 00 00 00 00
		控制字设置为 15，目标位置为 0 plus。 Control word set to 15, target position to 0 plus.	201	0F 00 00 00 00 00 00

		发送同步帧 Send Sync Frame	080	
			181	37 16 00 00 00 00

7.2.2 循环同步速度模式（CSV）

Cyclic Synchronous Velocity Mode (CSV)

表 7-6 CSV 模式 PDO 配置

Table 7-6 CSV Mode PDO Configuration

CSV Mode Configuration	Step	COB-ID	Data
停止节点，配置相关参数 Stop Node, Configure Related Parameters	关闭远程节点 Deactivate Remote Node	00	02 01
	复位节点 Reset Node	00	82 01
		701	00
	设置为周期同步速度模式 Set to Cyclic Synchronous Velocity Mode	601	2F 60 60 00 08 00 00 00
		581	60 60 60 00 00 00 00 00
	核对运行模式为 CSV 模式 Verify Operation Mode is CSV Mode	601	40 61 60 00 00 00 00 00
		581	4F 60 60 00 09 00 00 00
	轮廓加速度设置为 5000 plus/s ² Profile Acceleration Set to 5000 plus/s ²	601	23 83 60 00 88 13 00 00
		581	60 83 60 00 00 00 00 00
	轮廓减速度设置为 5000 plus/s ² Profile Deceleration Set to 5000 plus/s ²	601	23 84 60 00 88 13 00 00
		581	60 84 60 00 00 00 00 00
	关闭同步发生器 Disable SYNC Generator	601	23 05 10 00 80 00 00 00
		581	60 05 10 00 00 00 00 00
	通信周期设置为 1000us Communication Cycle Set to 1000us	601	23 06 10 00 E8 03 00 00
		581	60 06 10 00 00 00 00 00

PDO 映射配置 PDO Mapping Configuration	TxPDO1 配置 流程 TxPDO1 Configuration Process	关闭 TxPDO1 Disable TxPDO1	601	23 00 18 01 81 01 00 80
			581	60 00 18 01 00 00 00 00
		设置传输类型 Set Transmission	601	2F 00 18 02 01 00 00 00
		Type	581	60 00 18 02 00 00 00 00
		清除原有映射 Clear Existing Map	601	2F 00 1A 00 00 00 00 00
		ping	581	60 00 1A 00 00 00 00 00
		0x1A00: 01h 映射 0x60410010 (状态 字)	601	23 00 1A 01 10 00 41 60
		0x1A00: 01h Map 0x60410010 (Status Word)	581	60 00 1A 01 00 00 00 00
		0x1A00: 02h 映射 0x606C0020 (实际速度)	601	23 00 1A 02 20 00 6C 60
		0x1A00: 02h Map 0x606C0020 (Actual Velocity)	581	60 00 1A 02 00 00 00 00
		0x1A00: 00h 写入 映射对象个数: 2	601	2F 00 1A 00 02 00 00 00
		0x1A00: 00h Write Number of Mapped Objects: 2	581	60 00 1A 00 00 00 00 00
		打开 TxPDO1 Enable TxPDO1	601	23 00 18 01 81 01 00 00
			581	60 00 18 01 00 00 00 00
	RxDO1 配置	关闭 RxPDO1	601	23 00 14 01 01 02 00 80

	流程 RxPDO1 Configuration Process	Disable RxPDO1	581	60 00 14 01 00 00 00 00
		设置传输类型	601	2F 00 14 02 01 00 00 00
		Set Transmission	581	60 00 14 02 00 00 00 00
		Type		
		清除原有映射	601	2F 00 16 00 00 00 00 00
		Clear Existing	581	60 00 16 00 00 00 00 00
		Mapping		
		0x1600: 01h 映 0x60400010 (控制 字)	601	23 00 16 01 10 00 40 60
		0x1600: 01h Map 0x60400010 (Control Word)	581	60 00 16 01 00 00 00 00
		0x1600: 02h 映射 0x60FF0020 (目标 速度)	601	23 00 16 02 20 00 FF 60
		0x1600: 02h Map 0x60FF0020 (Target Velocity)	581	60 00 16 02 00 00 00 00
		0x1600: 00h 写映 射对象个数: 2	601	2F 00 16 00 02 00 00 00
		0x1600: 00h Write Number of Mapped Objects: 2	581	60 00 16 00 00 00 00 00
		打开 RxPDO1	601	23 00 14 01 01 02 00 00
		Enable RxPDO1	581	60 00 14 01 01 00 00 00
启动节点	NMT 启动节点		0	01 01

Start Node	NMT Start Node			
	获取实际速度		601	40 6C 60 00 00 00 00 00
	Get Actual Velocity		581	43 6C 60 00 00 00 00 00
周期发送 RxPDO1 Cyclic Send RxPDO1	电机清除 报错 Motor Fault Reset	控制字设置为 128, 目标位置设置为 0 plus。、Control word set to 128, target position set to 0 plus	201	80 00 00 00 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	40 12 00 00 00 00 00
	电机使能 Motor Enable	控制字设置为 6, 目标速度设置 0plus/s。 Control word set to 6, target velocity set to 0 plus/s	201	06 00 00 00 00 00 00
		发送同步帧	080	
		Send Sync Fram	181	21 02 00 00 00 00 00
		控制字设置为 7 Control word set to 7	201	07 00 00 00 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	33 02 00 00 00 00 00
		控制字设置为 15, 目标速度为 0 plus/s。 Control word set to 15, target velocity to 0 plus/s	201	0F 00 00 00 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	37 06 00 00 00 00 00

	目标速度 设置 Target Velocity Setting	控制字设置为 15，目标速度设置为 50000 plus/s。	201	0F 00 88 13 00 00
		发送同步帧 Send Sync Frame	080	
			181	37 06 AE 14 00 00

7.2.3 循环同步转矩模式（CST）

Cyclic Synchronous Torque Mode (CST)

表 7-7 CST 模式 PDO 配置

Table 7-7 CST Mode PDO Configuration

CST Mode Configuration	Step		COB-ID	Data
停止节点，配置相关参数 Stop Node, Configure Related Parameters	关闭远程节点 Deactivate Remote Node		00	02 01
	复位节点 Reset Node		00	82 01
			701	00
	设置为周期同步扭矩模式 Set to Cyclic Synchronous Torque Mode		601	2F 60 60 00 0A 00 00 00
			581	60 60 60 00 00 00 00 00
	核对运行模式为 CST 模式 Verify Operation Mode is CST Mode		601	40 61 60 00 00 00 00 00
			581	4F 60 60 00 0A 00 00 00
	关闭同步发生器 Disable SYNC Generator		601	23 05 10 00 80 00 00 00
			581	60 05 10 00 00 00 00 00
	通信周期设置为 1000us Communication Cycle Set to 1000us		601	23 06 10 00 E8 03 00 00
			581	60 06 10 00 00 00 00 00
PDO 映射配置 PDO Mapping	TxPDO1 配置流程	关闭 TxPDO1 Disable TxPDO1	601	23 00 18 01 81 01 00 80
			581	60 00 18 01 00 00 00 00
	TxPDO1	设置传输类型	601	2F 00 18 02 01 00 00 00

Configuration	Configuration Process	Set Transmission Type	581	60 00 18 02 00 00 00 00
		清除原有映射	601	2F 00 1A 00 00 00 00 00
		Clear Existing Mapping	581	60 00 1A 00 00 00 00 00
		0x1A00: 01h 映射	601	23 00 1A 01 10 00 41 60
		0x60410010 (状态字)	581	60 00 1A 01 00 00 00 00
		0x1A00: 01h Map		
		0x60410010 (Status Word)	601	23 00 1A 02 10 00 77 60
		0x1A00: 02h 映射		
		0x60770010 (实际扭矩值)	581	60 00 1A 02 00 00 00 00
		0x1A00: 02h Map		
		0x60770010 (Actual Torque Value)	601	2F 00 1A 00 02 00 00 00
		0x1A00: 00h 写入		
		映射对象个数: 2	581	60 00 1A 00 00 00 00 00
		0x1A00: 00h Write		
		Number of Mapped Objects: 2	601	23 00 18 01 81 01 00 00
		打开 TxPDO1		
	RxPDO1 配置流程	Enable TxPDO1	581	60 00 18 01 00 00 00 00
		关闭 RxPDO1	601	23 00 14 01 01 02 00 80
		Disable RxPDO1	581	60 00 14 01 00 00 00 00
		设置传输类型	601	2F 00 14 02 01 00 00 00
	RxPDO1 Configuration	Set Transmission	581	60 00 14 02 00 00 00 00

	n Process	Type		
		清除原有映射	601	2F 00 16 00 00 00 00 00
		Clear Existing Mapping	581	60 00 16 00 00 00 00 00
		0x1600: 01h 映射	601	23 00 16 01 10 00 40 60
		0x60400010 (控制字)	581	60 00 16 01 00 00 00 00
		0x1600: 01h Map 0x60400010 (Control Word)		
		0x1600: 02h 映射	601	23 00 16 02 10 00 71 60
		0x60710010 (目标扭矩)	581	60 00 16 02 00 00 00 00
		0x1600: 02h Map 0x60710010 (Target Torque)		
		0x1600: 00h 写映射对象个数: 2	601	2F 00 16 00 02 00 00 00
		0x1600: 00h Write Number of Mapped Objects: 2	581	60 00 16 00 00 00 00 00
		打开 RxPDO1	601	23 00 14 01 01 02 00 00
		Enable RxPDO1	581	60 00 14 01 01 00 00 00
启动节点 Start Node	NMT 启动节点 NMT Start Node		0	01 01
	获取实际扭矩		601	40 77 60 00 00 00 00 00
	Get Actual Torque		581	4B 77 60 00 00 00 00 00

周期发送 RxPDO1 Cyclic Send RxPDO1	电机清除报错 Motor Fault Reset	控制字设置为 128，目标扭矩设置为 0。 Control word set to 128, target torque set to 0	201	80 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	40 02 00 00 00 00
	电机使能 Motor Enable	控制字设置为 6，目标扭矩设置 0。 Control word set to 6, target torque set to 0	201	06 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	21 02 00 00 00 00
		控制字设置为 7 Control word set to 7	201	07 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	33 02 00 00 00 00
		控制字设置为 15，目标扭矩设置为 0。 Control word set to 15, target torque set to 0	201	0F 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	37 06 00 00 00 00
	目标扭矩设置 Target Torque Setting	控制字设置为 15，目标扭矩设置为 100。 Control word set to 15, target torque set to 100	201	0F 00 64 00
		发送同步帧	080	

		Send Sync Frame	181	37 06 63 00 00 00
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7.2.4 轮廓位置模式 (PP)

Profile Position Mode (PP)

表 7-8 PP 模式 PDO 配置

Table 7-8 PP Mode PDO Configuration

PP Mode Configuration	Step		COB-ID	Data
停止节点，配置相关参数 Stop Node, Configure Related Parameters	关闭远程节点 Deactivate Remote Node		00	02 01
	复位节点 Reset Node		00	82 01
			701	00
	设置为轮廓位置模式 Set to Profile Position Mode		601	2F 60 60 00 01 00 00 00
			581	60 60 60 00 00 00 00 00
	核对运行模式为 PP 模式 Verify Operation Mode is PP Mode		601	40 61 60 00 00 00 00 00
			581	4F 60 60 00 01 00 00 00
	轮廓速度设置为 5566 plus/s Profile Velocity Set to 5566 plus/s		601	23 81 60 00 BE 15 00 00
			581	60 81 60 00 00 00 00 00
	轮廓加速度设置为 5566 plus/s ² Profile Acceleration Set to 5566 plus/s ²		601	23 83 60 00 BE 15 00 00
			581	60 83 60 00 00 00 00 00
	轮廓减速度设置为 5566 plus/s ² Profile Deceleration Set to 5566 plus/s ²		601	23 84 60 00 BE 15 00 00
			581	60 84 60 00 00 00 00 00
	关闭同步发生器 Disable SYNC Generator		601	23 05 10 00 80 00 00 00
			581	60 05 10 00 00 00 00 00
	通信周期设置为 1000us Communication Cycle Set to 1000us		601	23 06 10 00 E8 03 00 00
			581	60 06 10 00 00 00 00 00
PDO 映射配置	TxPDO1 配置流程	关闭 TxPDO1 Disable TxPDO1	601	23 00 18 01 81 01 00 80
			581	60 00 18 01 00 00 00 00

PDO Mapping Configuration	TxPDO1 Configuration Process	设置传输类型	601	2F 00 18 02 01 00 00 00
		Set Transmission Type	581	60 00 18 02 00 00 00 00
		清除原有映射	601	2F 00 1A 00 00 00 00 00
		Clear Existing Mapping	581	60 00 1A 00 00 00 00 00
		0x1A00: 01h 映射	601	23 00 1A 01 10 00 41 60
		0x60410010 (状态字)	581	60 00 1A 01 00 00 00 00
		0x1A00: 01h Map		
		0x60410010 (Status Word)		
		0x1A00: 02h 映射	601	23 00 1A 02 20 00 64 60
		0x60640020 (实际位置)	581	60 00 1A 02 00 00 00 00
		0x1A00: 02h Map		
		0x60640020 (Actual Position)	601	2F 00 1A 00 02 00 00 00
		0x1A00: 00h 写入映射		
		对象个数: 2	581	60 00 1A 00 00 00 00 00
		0x1A00: 00h Write		
		Number of Mapped Objects: 2	601	23 00 18 01 81 01 00 00
		打开 TxPDO1	581	60 00 18 01 00 00 00 00
	RxPDO1 配置流程 RxPDO1 Configuration Process	关闭 RxPDO1	601	23 00 14 01 01 02 00 80
		Disable RxPDO1	581	60 00 14 01 00 00 00 00
		设置传输类型	601	2F 00 14 02 01 00 00 00
		Set Transmission Type	581	60 00 14 02 00 00 00 00
		清除原有映射	601	2F 00 16 00 00 00 00 00
		Clear Existing Mapping	581	60 00 16 00 00 00 00 00

		0x1600: 01h 映射 0x60400010 (控制字)	601	23 00 16 01 10 00 40 60
		0x1600: 01h Map 0x60400010 (Control Word)	581	60 00 16 01 00 00 00 00
		0x1600: 02h 映射 0x607A0020 (目标位置)	601	23 00 16 02 20 00 7A 60
		0x1600: 02h Map 0x607A0020 (Target Position)	581	60 00 16 02 00 00 00 00
		0x1600: 00h 写映射对象个数: 2 0x1600: 00h Write Number of Mapped Objects: 2	601	2F 00 16 00 02 00 00 00
			581	60 00 16 00 00 00 00 00
		打开 RxPDO1	601	23 00 14 01 01 02 00 00
		Enable RxPDO1	581	60 00 14 01 01 00 00 00
启动节点 Start Node	NMT 启动节点 NMT Start Node		0	01 01
	读 0x6064 获取当前实际位置 Read 0x6064 to Get Current Actual Position		601	40 64 60 00 00 00 00 00
			581	43 64 60 00 00 00 00 00
	写 0x607A 等于当前实际位置 Write 0x607A Equal to Current Actual Position		601	23 7A 60 00 00 00 00 00
			581	60 7A 60 00 00 00 00 00
周期发送 RxPDO1 Cyclic Send RxPDO1	电机清除报错 Motor Fault Reset	控制字设置为128, 目标位置设置为0plus。 Control word set to 128, target position set to 0 plus	201	80 00 00 00 00 00 00

		发送同步帧	080	
		Send Sync Frame	181	40 12 00 00 00 00
	电机使能 Motor Enable	控制字设置为6，目标位置设置0plus。 Control word set to 6, target position set to 0 plus	201	06 00 00 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	21 12 69 BA 50 00
		控制字设置为 7 Control word set to 7	201	07 00 00 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	33 12 67 BA 50 00
		控制字设置为 15，目标位置为 0 plus。 Control word set to 15, target position to 0 plus	201	0F 00 00 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	37 16 69 BA 50 00
	运动 Motion	控制字设置为 31； 目标位置设置为 1000 plus Control word set to 31; target position set to 1000 plus	201	1F 00 E8 03 00 00
		发送同步帧	080	
		Send Sync Frame	181	37 12 76 9B 50 00

7.2.5 轮廓速度模式 (PV)

Profile Velocity Mode (PV)

表 7-9 PV 模式 PDO 配置

Table 7-9 PV Mode PDO Configuration

PV Mode Configuration	Step		COB-ID	Data
停止节点，配置相关参数 Stop Node, Configure Related Parameters	关闭远程节点 Deactivate Remote Node		00	02 01
	复位节点 Reset Node		00	82 01
			701	00
	设置为轮廓速度模式 Set to Profile Velocity Mode		601	2F 60 60 00 03 00 00 00
			581	60 60 60 00 00 00 00 00
	核对运行模式为 PV 模式 Verify Operation Mode is PV Mode		601	40 61 60 00 00 00 00 00
			581	4F 60 60 00 03 00 00 00
	轮廓速度设置为 5566 plus/s Profile Velocity Set to 5566 plus/s		601	23 81 60 00 BE 15 00 00
			581	60 81 60 00 00 00 00 00
	轮廓加速度设置为 5566plus/s ² Profile Acceleration Set to 5566 plus/s ²		601	23 83 60 00 BE 15 00 00
			581	60 83 60 00 00 00 00 00
	轮廓减速度设置为 5566plus/s ² Profile Deceleration Set to 5566 plus/s ²		601	23 84 60 00 BE 15 00 00
			581	60 84 60 00 00 00 00 00
	关闭同步发生器 Disable SYNC Generator		601	23 05 10 00 80 00 00 00
			581	60 05 10 00 00 00 00 00
	通信周期设置为 1000us Communication Cycle Set to 1000us		601	23 06 10 00 E8 03 00 00
			581	60 06 10 00 00 00 00 00
PDO 映射配置 PDO Mapping Configuration	TxPDO1 配置流程 TxPDO1	关闭 TxPDO1 Disable TxPDO1	601	23 00 18 01 81 01 00 80
			581	60 00 18 01 00 00 00 00
	TxPDO1	设置传输类型	601	2F 00 18 02 01 00 00 00

	Configuration	Set Transmission Type	581	60 00 18 02 00 00 00 00
		清除原有映射	601	2F 00 1A 00 00 00 00 00
	Process	Clear Existing Mapping	581	60 00 1A 00 00 00 00 00
		0x1A00: 01h 映射	601	23 00 1A 01 10 00 41 60
		0x60410010 (状态字)	581	60 00 1A 01 00 00 00 00
		0x1A00: 01h Map		
		0x60410010 (Status Word)	601	23 00 1A 02 20 00 6C 60
		0x1A00: 02h 映射		
		0x606C0020 (实际速度)	581	60 00 1A 02 00 00 00 00
		0x1A00: 02h Map		
		0x606C0020 (Actual Velocity)	601	2F 00 1A 00 02 00 00 00
		0x1A00: 00h 写入映射对象个数: 2		
		0x1A00: 00h Write Number of Mapped Objects: 2	581	60 00 1A 00 00 00 00 00
		打开 TxPDO1	601	23 00 18 01 81 01 00 00
		Enable TxPDO1	581	60 00 18 01 00 00 00 00
	RxDO1 配置流程	关闭 RxPDO1	601	23 00 14 01 01 02 00 80
		Disable RxPDO1	581	60 00 14 01 00 00 00 00
		设置传输类型	601	2F 00 14 02 01 00 00 00
		Set Transmission Type	581	60 00 14 02 00 00 00 00
		清除原有映射	601	2F 00 16 00 00 00 00 00
	RxPDO1 Configuration			
	Process			

		Clear Existing Mapping	581	60 00 16 00 00 00 00 00
		0x1600: 01h 映射 0x60400010 (控制字)	601	23 00 16 01 10 00 40 60
		0x1600: 01h Map 0x60400010 (Control Word)	581	60 00 16 01 00 00 00 00
		0x1600: 02h 映射 0x60FF0020 (目标速度)	601	23 00 16 02 20 00 FF 60
		0x1600: 02h Map 0x60FF0020 (Target Velocity)	581	60 00 16 02 00 00 00 00
		0x1600: 00h 写映射 对象个数: 2	601	2F 00 16 00 02 00 00 00
		0x1600: 00h Write Number of Mapped Objects: 2	581	60 00 16 00 00 00 00 00
		打开 RxPDO1	601	23 00 14 01 01 02 00 00
		Enable RxPDO1	581	60 00 14 01 01 00 00 00
		启动节点 Start Node	NMT 启动节点 NMT Start Node	
读 0x606C 获取当前实际速度 Read 0x606C to Get Current Actual Velocity			601	40 64 60 00 00 00 00 00
			581	43 6C 60 00 00 00 00 00
周 期 发 送 RxPDO1	电机清除报 错	控制字设置为128，目 标速度设置为0plus/s	201	80 00 00 00 00 00

Cyclic Send RxPDO1	Motor Fault Reset	。		
		Control word set to 128, target velocity s et to 0 plus/s		
		发送同步帧 Send Sync Frame	080	
			181	40 12 00 00 00 00
	电机使能 Motor Enable	控制字设置为6，目标 位置设置0plus。		
		Control word set to 6, target position set to 0 plus	201	06 00 00 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	21 12 00 00 00 00
		控制字设置为 7		
		Control word set to 7	201	07 00 00 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	33 12 00 00 00 00
		控制字设置为 15，目 标位置为 0 plus。		
		Control word set to 15, target position to 0 plus	201	0F 00 00 00 00 00
		发送同步帧 Send Sync Frame	080	
			181	37 16 00 00 00 00
	运动 Motion	控制字设置为 15； 目标速度设置为 1000	201	0F 00 E8 03 00 00

		plus/s Control word set to 15; target velocity set to 1000 plus/s		
		发送同步帧 Send Sync Frame	080	
			181	37 16 58 02 00 00

7.2.6 轮廓转矩模式 (PT)

Profile Torque Mode (PT)

表 7-10 PT 模式 PDO 配置

Table 7-10 PT Mode PDO Configuration

PT Mode Configuration	Step		COB-ID	Data
停止节点，配置相关参数 Stop Node, Configure Related Parameters	关闭远程节点 Deactivate Remote Node		00	02 01
	复位节点 Reset Node		00	82 01
			701	00
	设置为轮廓转矩模式 Set to Profile Torque Mode		601	2F 60 60 00 04 00 00 00
			581	60 60 60 00 00 00 00 00
	核对运行模式为 PT 模式 Verify Operation Mode is PT Mode		601	40 61 60 00 00 00 00 00
			581	4F 60 60 00 04 00 00 00
	关闭同步发生器 Disable SYNC Generator		601	23 05 10 00 80 00 00 00
			581	60 05 10 00 00 00 00 00
	通信周期设置为 1000us Communication Cycle Set to 1000us		601	23 06 10 00 E8 03 00 00
			581	60 06 10 00 00 00 00 00
PDO 映射配置 PDO Mapping Configuration	TxPDO1 配置流程 TxPDO1 Configuration	关闭 TxPDO1 Disable TxPDO1	601	23 00 18 01 81 01 00 80
			581	60 00 18 01 00 00 00 00
		设置传输类型 Set Transmission	601	2F 00 18 02 01 00 00 00
			581	60 00 18 02 00 00 00 00

	Process	Type		
		清除原有映射	601	2F 00 1A 00 00 00 00 00
		Clear Existing Mapping	581	60 00 1A 00 00 00 00 00
		0x1A00: 01h 映射	601	23 00 1A 01 10 00 41 60
		0x60410010 (状态字)		
		0x1A00: 01h Map	581	60 00 1A 01 00 00 00 00
		0x60410010 (Status Word)		
		0x1A00: 02h 映射	601	23 00 1A 02 10 00 77 60
		0x60770010 (实际扭矩值)		
		0x1A00: 02h Map	581	60 00 1A 02 00 00 00 00
		0x60770010 (Actual Torque Value)		
		0x1A00: 00h 写入	601	2F 00 1A 00 02 00 00 00
		映射对象个数: 2		
		0x1A00: 00h Write	581	60 00 1A 00 00 00 00 00
		Number of Mapped Objects: 2		
		打开 TxPDO1	601	23 00 18 01 81 01 00 00
		Enable TxPDO1	581	60 00 18 01 00 00 00 00
	RxDO1 配置流程 RxPDO1 Configuration Process	关闭 RxPDO1	601	23 00 14 01 01 02 00 80
		Disable RxPDO1	581	60 00 14 01 00 00 00 00
		设置传输类型	601	2F 00 14 02 01 00 00 00
		Set Transmission Type	581	60 00 14 02 00 00 00 00
		清除原有映射	601	2F 00 16 00 00 00 00 00

		Clear Existing Mapping	581	60 00 16 00 00 00 00 00
		0x1600: 01h 映 0x60400010 (控制字)	601	23 00 16 01 10 00 40 60
		0x1600: 01h Map 0x60400010 (Control Word)	581	60 00 16 01 00 00 00 00
		0x1600: 02h 映射 0x60710010 (目标扭矩)	601	23 00 16 02 10 00 71 60
		0x1600: 02h Map 0x60710010 (Target Torque)	581	60 00 16 02 00 00 00 00
		0x1600: 00h 写映射 对象个数: 2	601	2F 00 16 00 02 00 00 00
		0x1600: 00h Write Number of Mapped Objects: 2	581	60 00 16 00 00 00 00 00
		打开 RxPDO1	601	23 00 14 01 01 02 00 00
		Enable RxPDO1	581	60 00 14 01 01 00 00 00
启动节点 Start Node	NMT 启动节点 NMT Start Node		0	01 01
	获取实际扭矩		601	40 77 60 00 00 00 00 00
	Get Actual Torque		581	4B 77 60 00 00 00 00 00
周期发送 RxPDO1 Cyclic Send	电机清除报 错 Motor Fault Reset	控制字设置为 128, 目 标扭矩设置为 0。 Control word set to 128,	201	80 00 00 00

RxPDO1		target torque set to 0		
		发送同步帧	080	
		Send Sync Frame	181	40 02 00 00 00 00
	电机使能 Motor Enable	控制字设置为 6，目标 扭矩设置 0。 Control word set to 6, target torque set to 0	201	06 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	21 02 00 00 00 00
		控制字设置为 7 Control word set to 7	201	07 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	33 02 00 00 00 00
		控制字设置为 15，目 标扭矩设置为 0。 Control word set to 15, target torque set to 0	201	0F 00 00 00
		发送同步帧	080	
		Send Sync Frame	181	37 06 00 00 00 00
	目标扭矩 设置 Target Tor que Settin g	控制字设置为 15，目 标扭矩设置为 100。 Control word set to 15, target torque set to 100	201	0F 00 64 00
		发送同步帧	080	
		Send Sync Frame	181	37 06 63 00