

RP Series Product User Manual



Version: V1.0

Date : 8 June 2026

Version Change Description

Version Change Description for the RP Joint User Manual				
NO	Version	Date	Revision content	Res.
1	V1.0	20260608	First Edition Released	--
				--
				--
				--

Security Warning and Important Notes

Please read this user manual and all appendices carefully before installing, operating, maintaining or inspecting this product. Incorrect operation of the joint module may result in personal injury or property damage. Therefore, operators must thoroughly read and fully understand the entire contents of this manual, and strictly adhere to all safety precautions listed therein..

The symbols shown below are used to define the hazard levels and corresponding instructions mentioned in this manual. Please take notice prior to use.

■ warning signs

	Warning : This refers to electrical usage practices that pose imminent hazards; Failure to avoid this may result in personal injury and severe equipment damage.
	Warning : This indicates an impending hazardous situation. Failure to take precautions may cause personal injury or severe equipment damage.
	Warning : This refers to potentially hazardous hot surfaces. Contact may cause personal injury.

■ Please strictly follow the below instructions to prevent damage to the module.

Warning Signs	Warning Description	Detailed Explanation
	1. Do not connect or disconnect the power cable while power is on.	Please confirm that the power indicator light has turned off prior to wiring and inspection work.

	2. Do not connect or disconnect the serial communication cable while power is on.	When the wiring is incomplete, the GND levels of the master controller and the joint may differ. A voltage difference between the two GND terminals at the moment of connection may damage the serial port interface..
--	---	--

	3. Connect the power terminals correctly and securely.	Ensure the power terminals are securely connected to prevent power issues caused by poor contact.
	4. Ensure proper grounding protection for the casing	Without proper grounding, the joint housing may accumulate electric charges and become live. Ensure the housing is adequately grounded.
	5. Do not exceed the permitted voltage and current values.	Verify the connection requirements in accordance with the selected product specifications. Exceeding the allowable voltage or current values may damage the motor, such as causing overheating.
	1. Set appropriate protective limits	When operating the torque mode of this product, incorrect target commands issued by the host computer may cause unexpected motor runaway. Please set proper protection limits on both the host controller and the product drive, including position limit, speed limit and current limit, to ensure equipment and personal safety.
	2. Perform no-load trial run	During the trial run, to prevent accidents, operate the joint module under no-load conditions (without connecting it to the drive shaft); otherwise, injuries may occur.

	3. Do not exceed the allowable torque/bending moment under load.	Do not apply a torque that exceeds the instantaneous maximum allowable torque. Otherwise, it may cause loosening of fastened screws, vibration, or damage, leading to product failure.
	4. Do not disassemble or replace the product assembly	This product is high-precision equipment that must be installed and calibrated by qualified professionals. Disassembly or reassembly of the assembled unit is strictly prohibited. Any abnormal performance resulting from improper use will void the warranty coverage.
	5. Please use in the specified environment	① Protection rating: IP54; ② Operating temperature: -10°C to 40°C; Storage temperature: -20°C to 60°C; ③ Operating and storage humidity: 10%~90%RH; ④ Free from dust, metal powder, corrosive gases, flammable gases, oil mist, etc.
	6. Please take care when handling and transporting the product.	① Do not strike the product with hard objects; ② Do not drop this product; ③ Maintain the original packaging during transportation to avoid compression or impact.
	1. Be cautious of	During operation, the motor surface

	high-temperature surfaces	may become extremely hot depending on its protection category. The surface temperature may exceed 85°C, posing a risk of mild burns. Measure the temperature and wait until the motor cools below 40°C before touching it.
	2. No-load operation	All joint modules undergo rigorous power consumption tests before delivery. Heat is generated during no-load operation due to friction, oil churning loss and power consumption of the holding brake. Thanks to its compact structure and smooth surface, the module cannot dissipate heat effectively when placed uninstalled, e.g. on a desktop, resulting in a rise in surface temperature. This may activate the thermal protection. Please beware of scald hazards from high temperatures.

Legal Notice

Before using this product, users must carefully read this manual and operate the product in accordance with its instructions. The Company shall not be liable for any property damage or personal injury resulting from improper use of the product. As the product consists of numerous components, children must not handle it to prevent accidents. To extend the product's service life, avoid using it in high-temperature or high-pressure environments.

There may be slight discrepancies in color, appearance and other aspects between the description in this manual and the actual product. Please refer to the actual product. This manual is published by Jiangsu EYou Robot Technology Co., Ltd. (hereinafter referred to as EYou). EYou reserves the right to make necessary improvements or updates to any inaccurate information in this manual, as well as enhance related programs and equipment at any time without prior notice.. Any changes to the information herein will not be notified separately, detailed updates are available in the Download Center (<https://www.eyoubot.com>). All figures are for functional illustration only. Please refer to the actual product for details.

Copyright Statement

This document is protected by copyright, and all rights are reserved. This document is protected by software copyright and EYou's agreements; any use, disclosure or retention is restricted accordingly. No part of this document may be photocopied, reproduced, or translated into another language without prior written permission from Jiangsu EYou Robotics Co., Ltd.

All graphics and information in this document are the property of Jiangsu EYou Robotics Co., Ltd. Unauthorized use and reproduction are strictly prohibited.

Table of Contents

Version Change Description	2
Security Warning and Important Notes	3
Legal Notice	8
Copyright Statement	8
1. Product Specification Parameters	12
1.1. Product Introduction	12
1.2. Appearance and Installation Dimensions	12
1.3. Product Technical Specifications	14
2. Driver Product Information	16
2.1. Driver Technical Specifications	16
2.2. Driver Interface Definition	16
2.3. Driver interface and recommended models	16
3. Host Computer Instructions	17
3.1. Hardware Connection	18
3.2. Software Usage Steps	18
3.2.1. Open the Software	18
3.2.2. Mode Selection	18
3.2.3. Scan for Motors	20
3.2.4. Interface Introduction	20
3.2.5. Motor Control	25
3.2.6. Waveform View	33
3.2.7. Parameter Modification	33
3.2.8. Communication Data	36
3.2.9. Summary of The Host Computer	36
4. Driver Protocol and Usage Instructions	37
4.1. Running Mode	37

4.2. Control Word and Status Word	37
4.2.1. control word	38
4.2.2. status word	38
4.3. Profile Operation Mode	39
4.3.1. Profile Position Mode (PP)	40
4.3.2. Profile Velocity Mode (PV)	40
4.3.3. Profile Torque Mode (PT)	40
4.4. Circular Synchronous Operation Mode	41
4.4.1. Cyclic Synchronous Position Mode (CSP)	41
4.4.2. Cyclic Synchronous Velocity Mode (CSV)	41
4.4.3. Circular Synchronous Torque Mode (CST)	42
4.5. Set zero point	42
4.6. Set up ID	43
4.7. Save parameter	43
5. Canopen Communication Protocol Type Description	45
5.1. Object Dictionary (OD)	45
5.2. NMT State Machine and Network Management	46
5.2.1. NMT State Machine	46
5.2.2. NMT Module Control Message	47
5.2.3. NMT Node Monitoring Message	48
5.3. Service Data Object (SDO)	48
5.3.1. Write SDO data	49
5.3.2. Read SDO data	50
5.4. Process Data Object (PDO)	51
5.4.1. PDO Transfer Type	52
5.4.2. PDO Configuration Parameters and Configuration Process	54
5.5. Sync Object (SYNC)	55

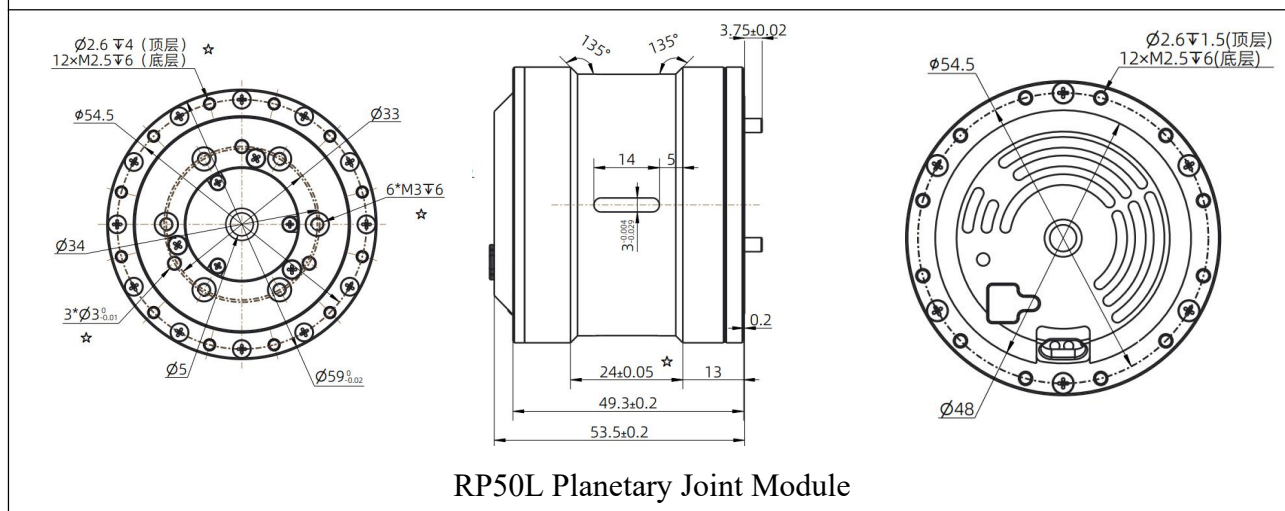
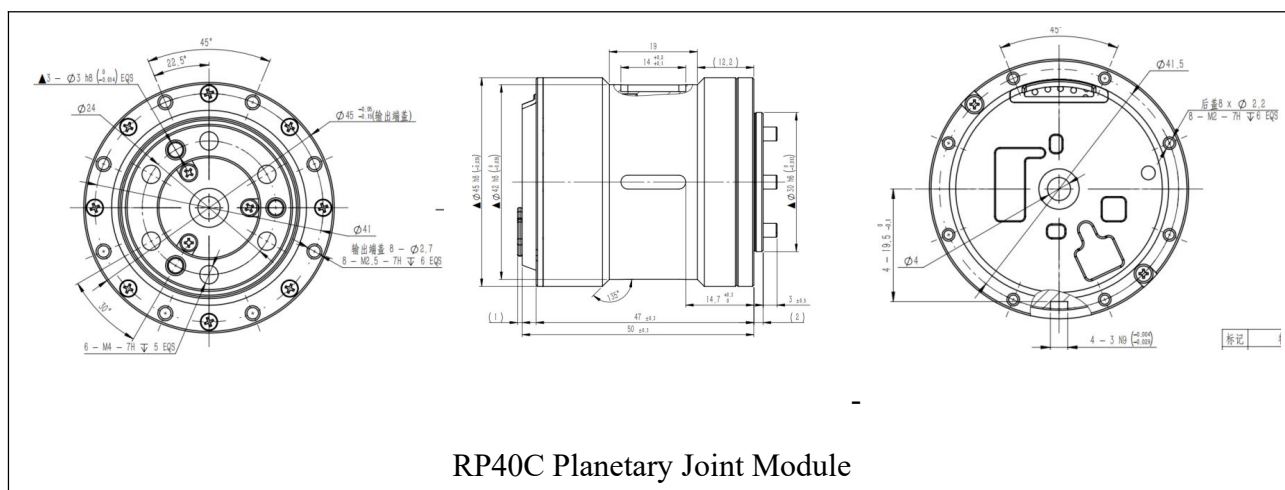
5.6. Emergency Medical Care Unit (EMCY)	56
5.7. Network Protection (Heartbeat and Node Protection)	57
5.7.1. Heartbeat Protection Mechanism	57
5.7.2. Node Protection Mechanism	59
6. MIT Communication Protocol Type Description	61
6.1. MIT Introduce	61
6.2. MIT Control Block Diagram	61
6.3. MIT Core Formula	61
6.4. MIT control protocol	61
7. Maintenance and Care	63
7.1. Daily Inspection Items	63
7.2. Maintenance Routine	64
7.3. Storage Conditions and Expiration Date	65
7.4. Maintenance and Replacement Recommendations	65
8. Fault Diagnosis and Resolution	67
8.1. CANopen communication error	67
8.2. Device Error Code	68
9. Appendix	71
9.1. Warranty Policy and Duration	71
9.2. Contact Information and Technical Support	74
9.3. Glossary	75

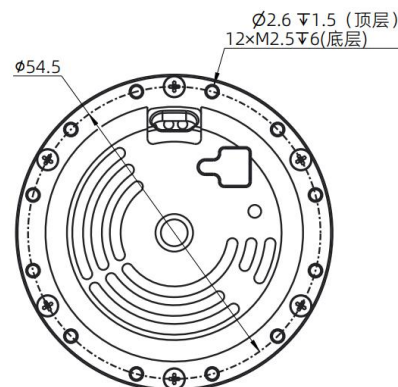
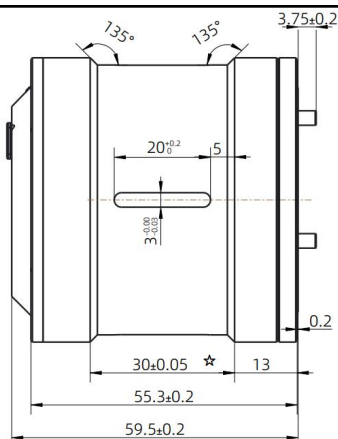
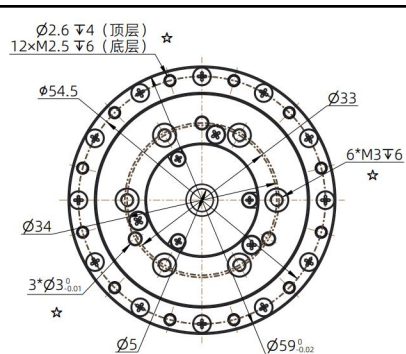
1. Product Specification Parameters

1.1. Product Introduction

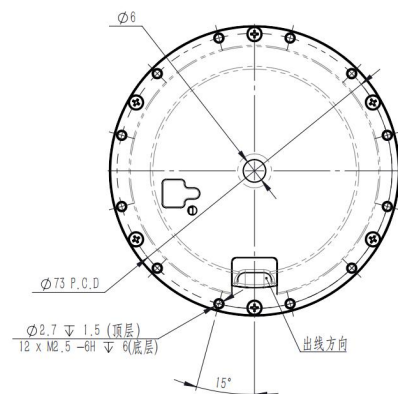
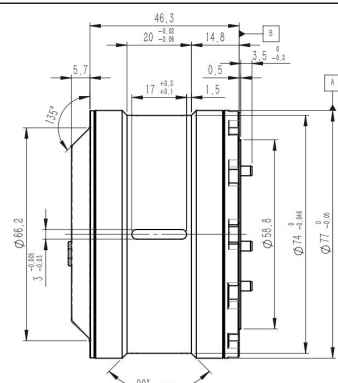
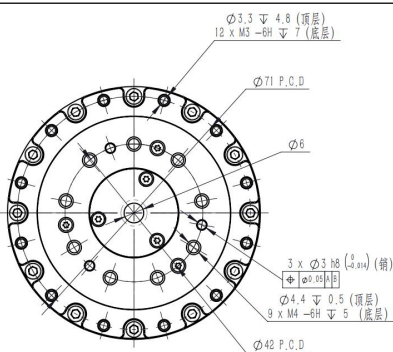
The RP series products are competition-grade planetary joint modules mainly used in humanoid robots. The hardware of the entire series of products uses FOC and FPGA to achieve high-precision dynamic control, integrates high-power motors, 19-bit dual encoders, and ISO6-level high-precision reducers, comes standard with CANOpen communication, and can be customized with CANFD communication and multiple control modes. It features high rigidity and a hollow anti-tangling wire design, meeting the joint adaptation requirements of different parts of the robot's body, and is the core power unit for semi-humanoid robots to achieve high-dynamic and highly reliable motion.

1.2. Appearance and Installation Dimensions

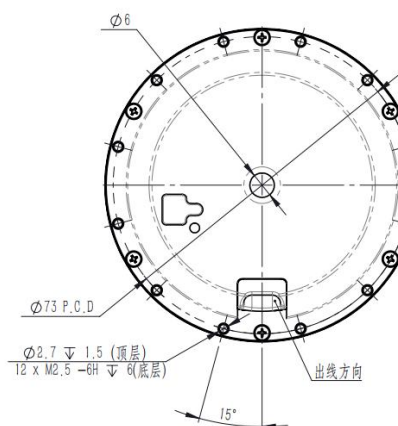
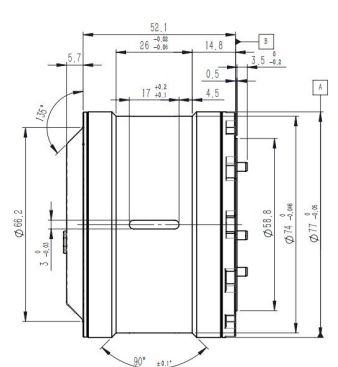
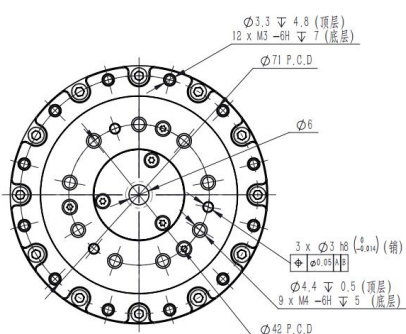




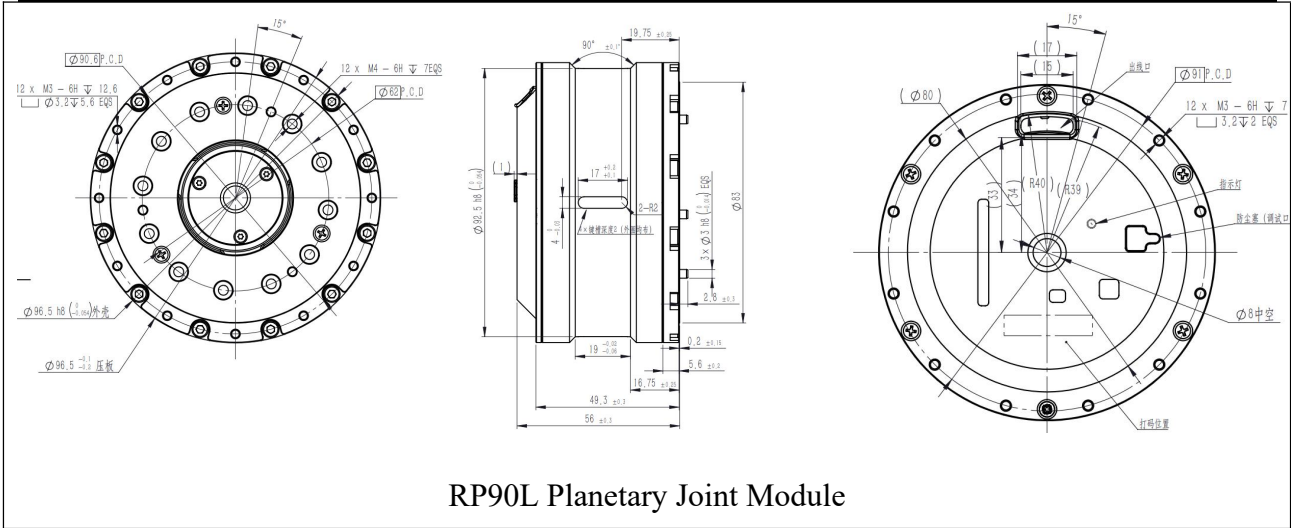
RP50H Planetary Joint Module



RP70L Planetary Joint Module



RP70H Planetary Joint Module



1.3. Product Technical Specifications

 意优科技	RP Series Motor Parameters					
	1	2	3	4	5	6
Model	RP40C	RP50H	RP50L	RP70H	RP70L	RP90L
Number of pole pairs	7	10	10	10	10	14
Rated Voltage (V)	48	48	48	48	48	48
Rated Output Power (W)	29.5	212	210	328	205	653
Rated Torque (N·m)	0.1	0.6	0.3	1.2	0.7	2.4
Rated Speed (rpm)	3100	3360	6700	2600	2800	2600
Rated Current (Arms)	0.95	4.6	5.1	7	4.6	15
Maximum Torque (N·m)	0.3	2.5	0.96	3.6	2.1	7.3
Maximum Current (Arms)	2.85	20.3	18	22.6	16.3	49
Phase Resistance (ohm)	4.2±8%	0.63±10%	0.51±10%	0.41±8%	0.58	0.2053±5%
Phase inductance (mH)	1.84±8%	0.56±20%	0.2±30%	0.38±8%	0.767	0.177±10%
Back EMF Constant (V/Krpm)	9.5	8.5	3.75±10%	10.6	14.25	15.2
Torque constant (N·m/A)	0.105	0.141	0.058	0.17	0.12	0.16

 意优科技		RP Series Specification Parameters					
No.		1	2	3	4	5	6
Module Model		RP40C	RP50L	RP50H	RP70L	RP70H	RP90L
Structure	Reducer Type	Planetary	Planetary	Planetary	Planetary	Planetary	Planetary
	Reduction Ratio	25.0000	19.5278	19.5278	20.0000	20.0000	21.9130
	Rated Torque (N·m)	2	5	10	12	17	35
	Peak Torque (N·m)	6	15	30	36	60	120
	Rated Joint Power (W)	25	79	157	163	223	421
	Backlash (Arcmin)	≤12	≤12	≤12	≤12	≤12	≤12
	Rated Output Speed (rpm)	120	150	150	130	125	115
	Peak Output Speed (rpm)	145	180	180	160	150	135
	Dimension (OD×Axial)(mm)	Φ45×52	Φ59×53.5	Φ59×59.5	Φ77×52.5	Φ77×58.3	Φ96.5×56
	Weight (g)(excl. cable)	225.00	410.00	465.00	670.00	760.00	1075.00
	Rated Joint Efficiency	70%	70%	78%	78%	78%	82%
	Hollow Shaft Diameter (mm)	4	5	5	6.0	6.0	8
	Housing Appearance (Color)	Matte Black Standard	Matte Black Standard	Matte Black Standard	Matte Black Standard	Matte Black Standard	Matte Black Standard
	Moment of Inertia (kg·mm ²)	8.18	26.15	28.66	72.97	93.21	269.40
	Radial Dynamic/Static Load Rating (N)	1170/980	2140/2740	2140/2740	2430/3490	2430/3490	2810/4680
	Axial Dynamic/Static Load Rating (N)	/	5100/18700	5100/18700	5500/2270	5500/2270	6440/30480
Hardware	Operating Voltage (VDC)	48±10%					
	Max Withstand Voltage (VDC)	90					
	Driver	Built-in					
	Bus Current (Arms)	1.2	2.6	4.5	5.5	7.5	12.5
	Encoder Resolution (bit)	Dual-channel: 17(input), 19(output)					
	Driver Interface	Power (DC in DC out), CAN FD (In, Out)					
Software	Communication Protocol	CANOpen / CANFD (Custom Development Available)					
	Control Mode	Current, Velocity, Position, MIT Control Mode					
Reliability & Service Life	Ambient Operating Temp. (°C)	-10~45					
	Max Housing Temp Rise (°C)	≤60					
	Noise Level (dB) @1m	≤60					
	IP Rating	IP54					
	Service Life (h)	>3000					

2. Driver Product Information

2.1. Driver Technical Specifications

Content	Representative value
Rated Operational Voltage	48V DC
Maximum allowed voltage	60V DC
Rated Operational Current	0.95-15Arms
Peak Point Current	2.85-55Arms
CAN Bus Bit Rate	1Mbps
Operating Ambient Temperature	-10°C-45°C
The Drive Allows a Maximum Temperature	85°C
Encoder Resolution	≥17bit

2.2. Driver Interface Definition



2.3. Driver interface and recommended models

Product	Wiring Harness Definition	End-of-line model	Brand Manufacturer	Mating model	Brand Manufacturer
RP40C	Red (VBAT+) Black (GND)	XT30U-M.G.Y	AMASS (Aimace)	XT30U-F.G.Y	AMASS (Aimace)
	White (CAN-L) Blue (CAN-H)	HX20006-2R	Kabus	HX20006-2Y	Kabus

RP50L/ H	Red (VBAT+) Black (GND)	XT30U-M.G.Y	AMASS (Aimace)	XT30U-F.G.Y	AMASS (Aimace)
	White (CAN-L) Blue (CAN-H)	HX20006-2R	Kabus	HX20006-2Y	Kabus
RP70L/ H	Red (VBAT+) Black (GND)	XT30U-M.G.Y	AMASS (Aimace)	XT30U-F.G.Y	AMASS (Aimace)
	White (CAN-L) Blue(CAN-H)	HX20006-2R	Kabus	HX20006-2Y	Kabus
RP90L	Red (VBAT+) Black (GND)	XT60U-M.G.Y /	AMASS (Aimace)	XT60U-F.G.Y	AMASS (Aimace)
	White (CAN-L) Blue (CAN-H)	HX20006-2R	Kabus	HX20006-2Y	Kabus

2.4. State Indicator Light

The RP series uses green lights to display the operational status of the products.

Product state	State indicator light activation
Enable	Lighting
Disable	Slow blink (1Hz)
Error	Quick blink (4Hz)

3. Host Computer Instructions

EYouCanOpenTool is a dedicated quick commissioning software for EYou joint modules with CANopen interface. It integrates standard CANopen functions including SDO, PDO and NMT,

and supports parameter read/write, waveform display and motion control for single joints.

3.1. Hardware Connection

- 1) Select the appropriate USBCAN interface. Currently, EYouCanOpenTool supports two USBCAN interfaces: the open-source canable (with Candlelight firmware type) and the Chuangxin CANalyst-II.
- 2) Connect the USBCAN cable to the joint terminals correctly. Ensure CAN_H and CAN_L are properly wired, and the terminating resistor between the two bus lines is 60 ohms.
- 3) For joint power supply, select the appropriate voltage according to the model. Carefully avoid reversing the polarity of the power supply, as this may damage the joint hardware.

Note 1: The USBCAN interface typically includes a 120Ω termination resistor, which must be activated by turning the digital switch.

3.2. Software Usage Steps

3.2.1. Open the Software

Locate the EYouCanOpenTool shortcut on the desktop and double-click to launch the software, as shown in Figure 3-1:



Figure 3-1 EYouCanOpenTool software icon

3.2.2. Mode Selection

To accommodate various scenarios, EYouCANopenTool offers multiple modes, as shown in Figure 3-2:

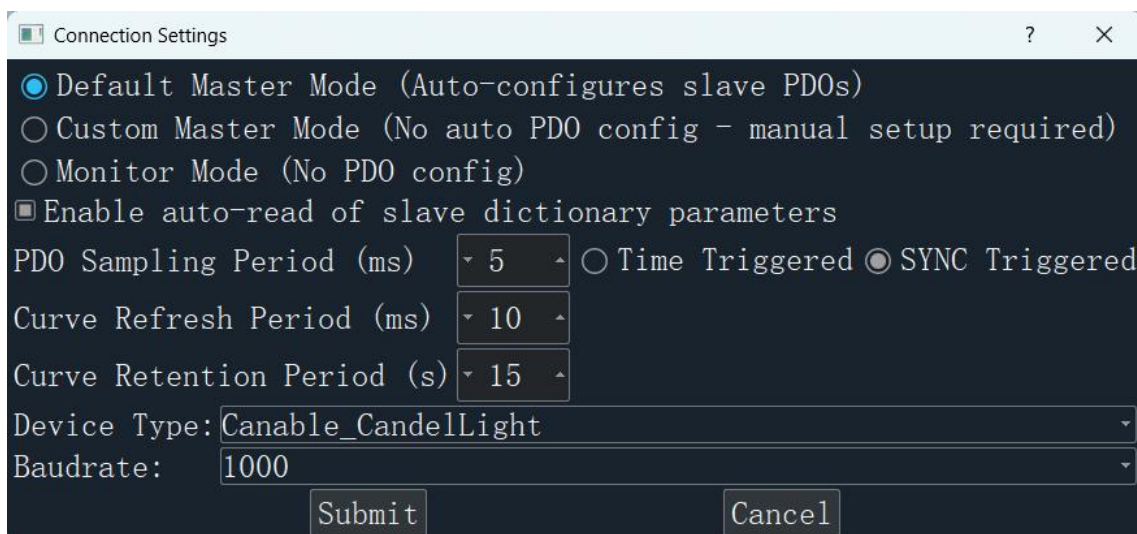


Figure 3-2 Pattern 1 Selection Interface Diagram

Default Master Station Mode: This mode is primarily used for independent motor testing and debugging, where the motor's TPDO parameters are configured using fixed data to upload and display waveform signals. If the system includes a master station controlling motors, this mode should not be activated. When enabled, the software functions as a basic CANopen master station, enabling data read/write operations, waveform display, and motion control of slave joints.

Custom Master Station Mode: Motor PDO are not auto-configured in this mode, configure data upload manually. This mode is unavailable when a master station exists

Monitoring Mode: This mode is primarily used for monitoring and modifying joint parameters. It cannot configure PDO or control motor movements, and is suitable only when the system already has a master station control.

Default Loading Parameter for The Slave Dictionary: When checked, it automatically scans joints and loads the parameters from the first scanned joint.

Curve refresh period (ms): The waveform refresh frequency, measured in milliseconds. Keep the default value unless otherwise specified.

Curve retention time (S): The waveform display buffer duration in seconds. Keep the default value unless otherwise specified.

Device type: Canable_CandellLight or USB CAN-2E-U, choose according to actual requirements;

other models are not supported.

Baud Rate: 1000K (Joint factory defaults. Choose as needed if settings have been changed.)

Summary: The EYouCANOpenTool functions primarily as a master station. If no active master station exists in the system, use the Default Master Mode directly. After configuration and commissioning, power cycle the joint system to restart it.

3.2.3. Scan for Motors

- 1) Upon first opening the software, it automatically scans the joints on the bus.
- 2) If the software is running and there are changes in the bus joints, manual scanning is required.

3.2.4. Interface Introduction

After opening the software, the normal joint connection interface appears as follows:

- 1) The <Waveform Display> interface is shown in Figure 3-3:

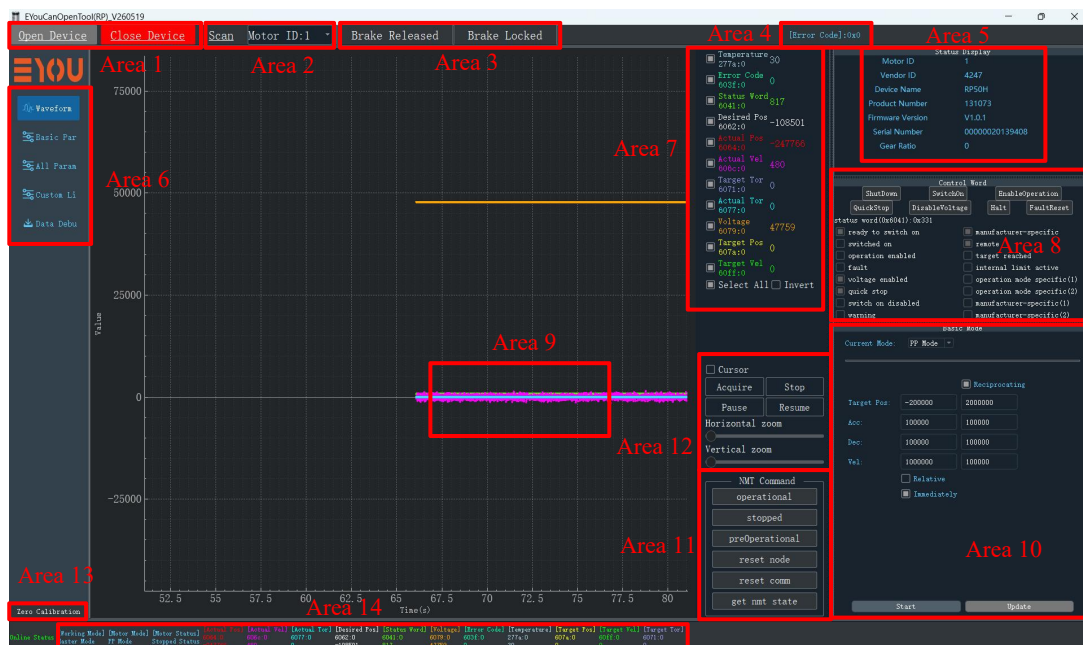


Figure 3-3 Waveform 2display interface diagram

Area 1: USBCAN Open/Close Area.

Area 2: Scan and Joint ID Selection Area. Click the Scan button to refresh detected joints, then select the target joint for commissioning from the drop-down list. Currently, EYouCanOpenTool only supports controlling one joint at a time.

Area 3: Manual brake control zone, effective for brakes with actuating joints. **Engage the brake:** Supply power to the brake, release the brake, and rotate the joint in the enabled position. **Close the brake:** Cut off the brake power supply, and lock the brake.

Note: During joint control, the joint automatically manages brake engagement and release based on its active state (up or down), eliminating the need for separate control. During joint control, the brake will automatically release and engage according to the enable status, requiring no separate operation.

Area 4: Common status displays, such as voltage, error codes, and temperature, etc.

Area 5: Joint information display, including product number, firmware version, serial number and other parameters.

Area 6: Functional Interface Switching.

Area 7: Waveform and real-time data display. Check the corresponding waveform items as required.

Area 8: Control word shortcut commands and status word display area. Control word commands can be issued and status word displays viewed via this area using the SDO method.

Area 9: Waveform display area. Zoom the waveform using the mouse wheel, and drag the waveform with the right mouse button.

Area 10: Motion Mode Control Area – allows selection of different modes to control the joints.

Area 11: NMT instruction region.

Area 12: Waveform Operation Area. Use pause, resume and zoom functions to view waveforms.

Area 13: Set the zero point with one click. This feature supports zero point configuration under various exceptional scenarios, allowing quick setup.

Area 14: Joint status and data display area.

2) The <Basic Parameters> interface is shown in Figure 3-4:

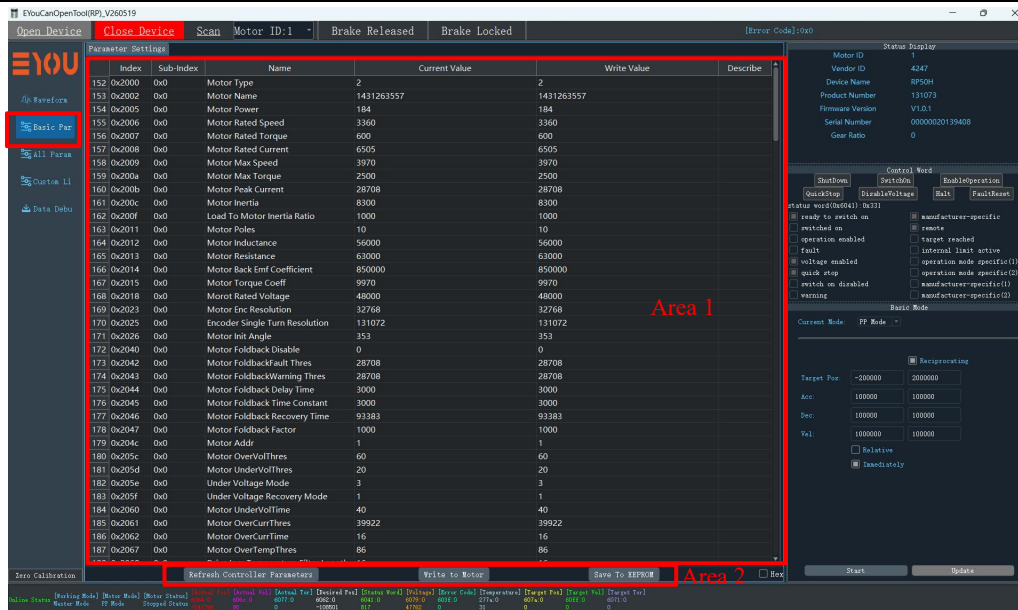


Figure 3-3 Basic Parameter Interface Diagram

Area 1: Basic Parameter Display & Editing Area. Parameters can be modified here.

Area 2: Area for refreshing, writing, and saving basic parameters.

3) The <All Parameters> interface is shown in Figure 3-5:

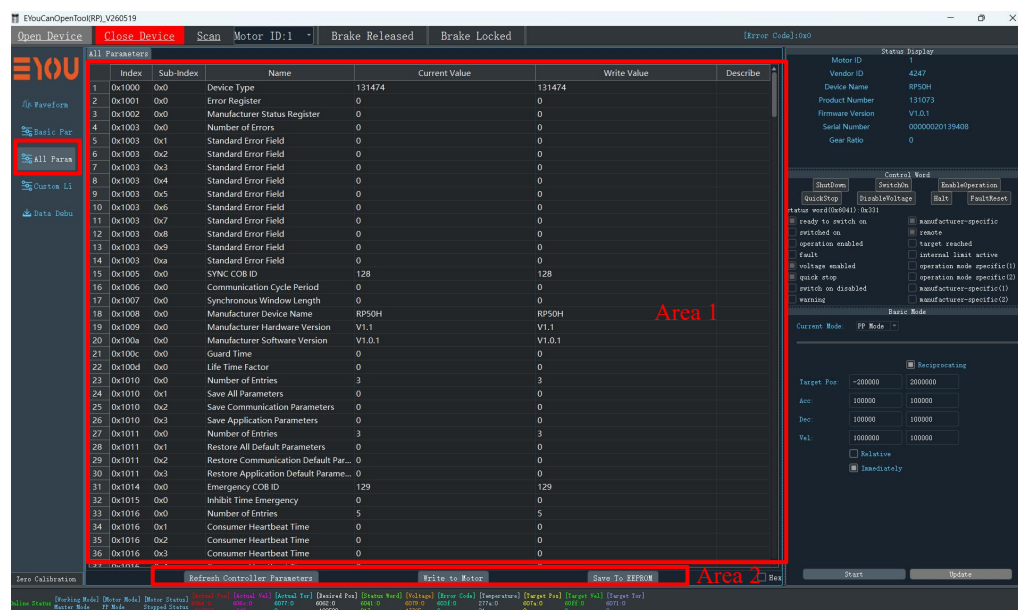


Figure 3-4: Full Parameter Interface Diagram

Area 1: All parameters display the modification area.

Area 2: The area for refreshing, writing, and saving all parameters.

4) The <Custom List> interface is displayed as shown in Figure 3-6:

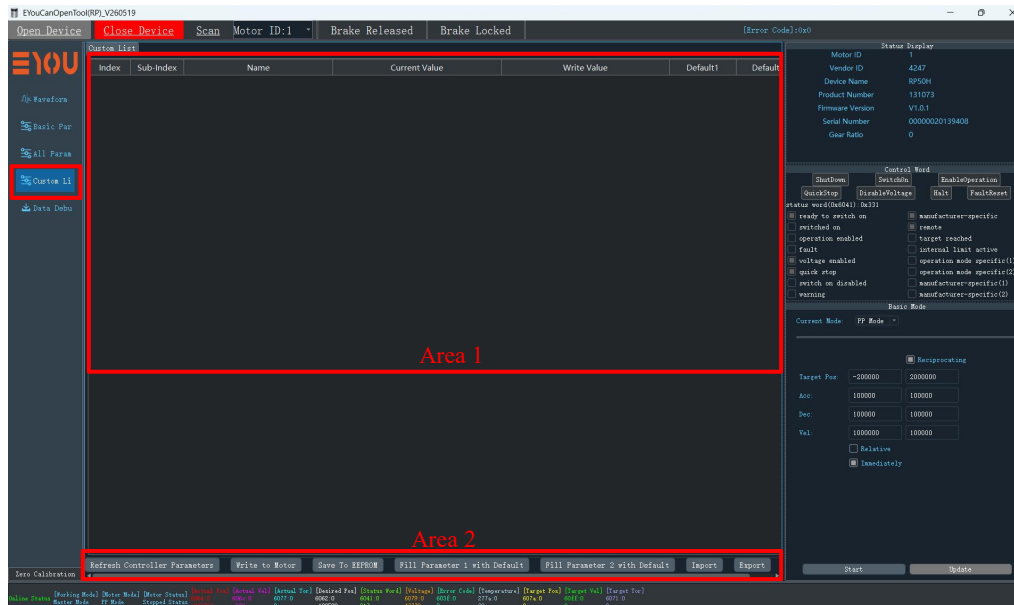


Figure 3-5 Custom Interface Diagram

This interface facilitates quick debugging of commonly used parameters, aggregating them here with two default value sets. A comprehensive parameter import/export feature will be added later.

Area 1: Display and modify custom parameter entries. In the All Parameters or Basic Parameters interface, right-click the desired entry and select Add to Custom List.

Area 2: Custom parameter refresh for reading, writing, and saving for custom parameters; update the default parameter group.

5) The <Data Transmission> interface is shown in Figure 3-7:

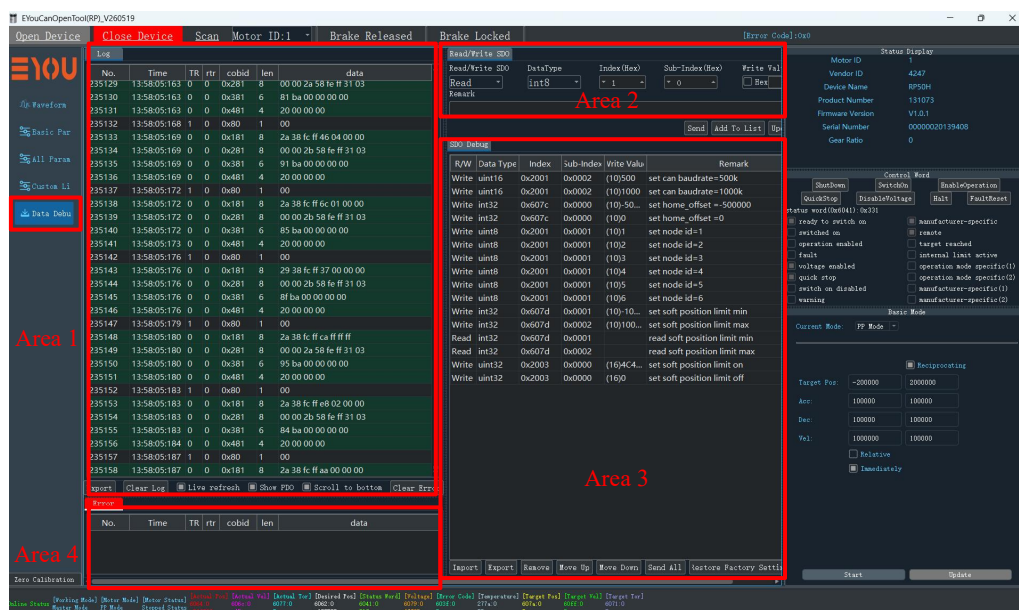


Figure 3-6 Data transmission and reception interface diagram

This interface is used for viewing communication data, SDO debugging, and sending/receiving shortcut SDO commands.

Area 1: The real-time data log on the CAN bus displays detailed communication data through this feature.

Export: Excel data can be exported.

Clear Log: Remove displayed data.

Real-time Refresh: Uncheck this option to pause data display updates, actual data continues to be transmitted.

Display PDO: Uncheck this option to filter out most high-speed PDO data, making it easier to view SDO data.

Scroll to Bottom: Uncheck this option for easy scrolling through historical data.

Area 2: Rapid SDO debugging read/write operations. Current data must be viewed in the Region 1 log interface, while subsequent SDO operation results will be displayed in this region.

Area 3: SDO instruction table. Instructions can be added to this table via SDO debugging in Region 2.

Import: The SDO instruction table can be imported for use.

Export: The SDO instruction table can be exported.

Delete: Remove the selected SDO instruction.

Move Up: Move the selected SDO instruction upward.

Move down: Move the selected SDO instruction downward.

Send All: Click this button to send all SDO commands in the command table sequentially.

Return Parameters to Factory Settings: Restore the device to its original factory configuration. The standard user settings will revert to their initial factory values. Do not click this button arbitrarily.

Save parameters: Save parameter command, issue an EEPROM save command.

Area 4: SDO communication error. The cause can be determined by the SDO error code. This error is not a motor error but solely an SDO communication error.

3.2.5. Motor Control

The recommended waveform display interface utilizes Region 10's basic mode control function. Select a different mode from the drop-down menu in the current mode for control, as shown in Figure 3-8:

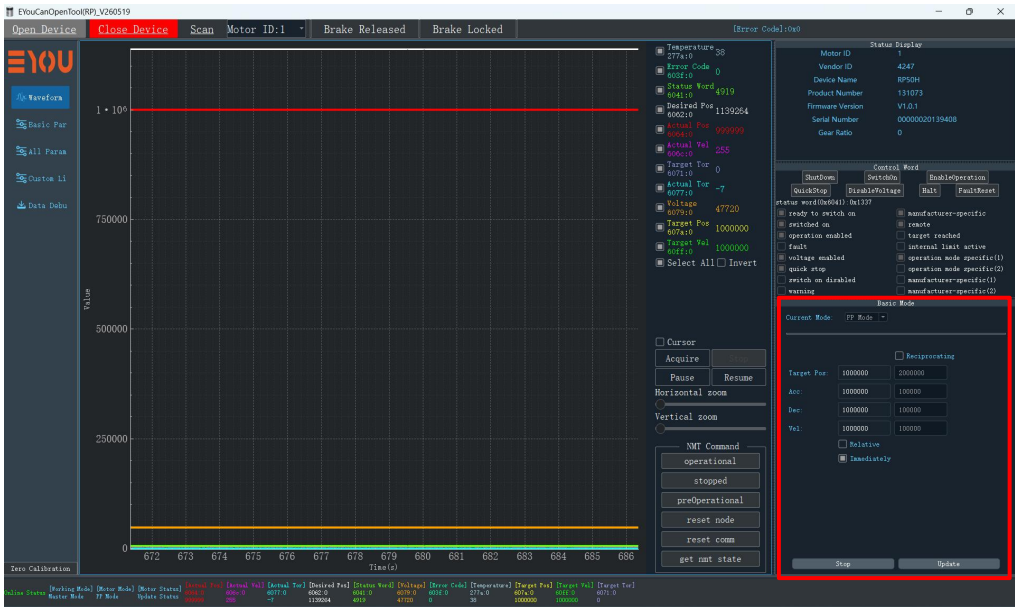


Figure 3-3 Operation Control Interface Diagram

1) Profile Position Mode:

In this mode, the joint automatically generates a trapezoidal velocity trajectory, requiring the specification of target position, acceleration/deceleration during movement, and constant-speed operation.

Target position: Unit: Pulse. This value can be found in the <Basic Parameters> dictionary entry 6091-02 (electronic gear ratio), which specifies the pulse resolution per full revolution of the joint output shaft. As shown in the figure below, 6091-02 = 6619136, indicating that one full revolution of the joint output shaft corresponds to 6619136 pulses. See Figure 3-9 for details.

0x6091	0x1	Gear Ratio Motor Revolutions	6619136	6619136
0x6091	0x2	Gear Ratio Shaft Revolutions	6619136	6619136

Figure 3-4: Interface diagram of contour position pattern data

Acceleration: Unit: pulses/(second·second); recommended rated voltage ≤ 10 times rated speed.

Deceleration: Unit: pulses/(second·second); recommended rated voltage ≤ 10 times rated speed.

Speed: Unit: pulses/second, constant speed during operation. The rated speed under default parameters is 3,276,800 pulses/second.

Start/Stop: Start Execution, including mode configuration, enabling and motion data transmission. The button will switch to Stop after activation.

Update: Running, update parameters by clicking this button.

Reciprocating motion: When this feature is selected, the joint can perform reciprocating movements according to two operational parameters.

Note: When the voltage is below rated value or the load-to-inertia ratio is excessively high, adjust the acceleration and deceleration rates during actual commissioning to ensure operational performance and stability.

As an example, at the rated voltage with no modification to the electronic gear ratio, the motion parameters correspond to approximately one-third of the rated speed, as shown in Figure 3-10:

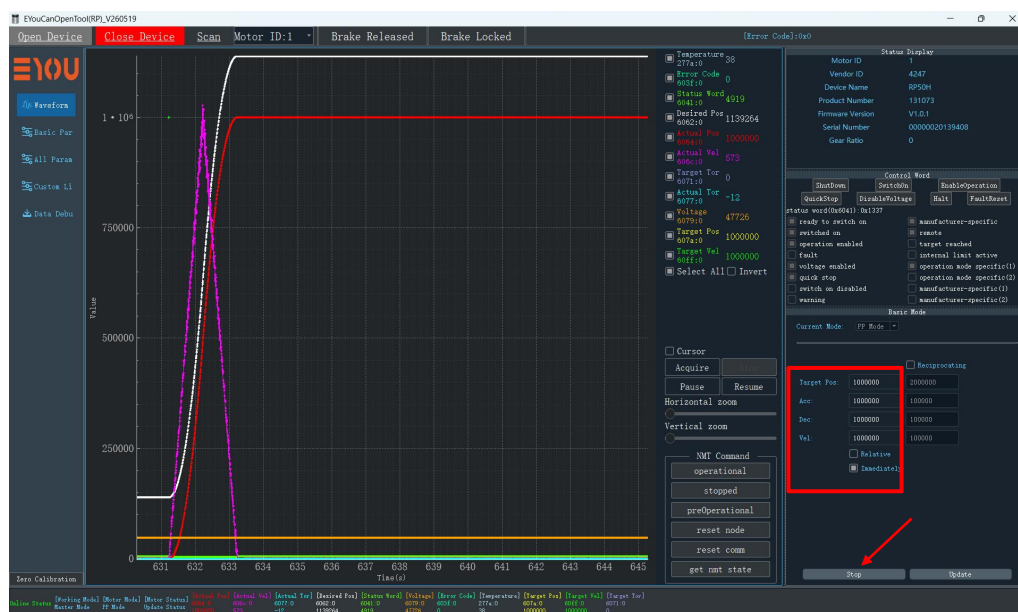


Figure 3-5 Waveform Diagram

2) Profile Velocity Mode:

In this mode, the joint automatically generates a trapezoidal velocity trajectory, requiring the specification of target speed and acceleration/deceleration values during operation.

Target speed: Unit: pulses/second. This value can be found in the <Basic Parameters> section of the 6091-02 dictionary (electronic gear ratio denominator), which specifies the pulse resolution

per full revolution of the joint output shaft. As shown in the figure below, 6091-02 = 6619136, indicating that one full rotation of the joint output shaft corresponds to 6619136 pulses. Under default parameters, the rated speed is 3,276,800 pulses/second. For initial testing or under constrained conditions, a lower target speed may be entered first, as illustrated in Figure 3-11.

0x6091	0x1	Gear Ratio Motor Revolutions	6619136	6619136
0x6091	0x2	Gear Ratio Shaft Revolutions	6619136	6619136

Figure 3-6: Interface diagram of contour velocity pattern data

- Target speed:** Unit: pulses/second, the target speed during operation.
- Acceleration:** Unit: pulses/(second·second); recommended rated voltage ≤ 10 times rated speed.
- Deceleration:** Unit: pulses/(second·second); recommended rated voltage ≤ 10 times rated speed.
- Start/Stop:** Start Execution, including pattern configuration, enabling, and motion data transmission, then the button changes to Stop.
- Update:** Running, update parameters by clicking this button.
- Repetition movement wait time:** When this feature is selected, the joint can perform actions in a repetitive manner based on the wait time among two operational parameters.
- Note: When the voltage is below rated value or the load inertia ratio is excessively high, adjust the acceleration and deceleration rates during actual debugging to ensure operational performance and stability.
- As an example, at the rated voltage with no modification to the electronic gear ratio, the motion parameters correspond to approximately one-third of the rated speed, as shown in Figure 3-12:

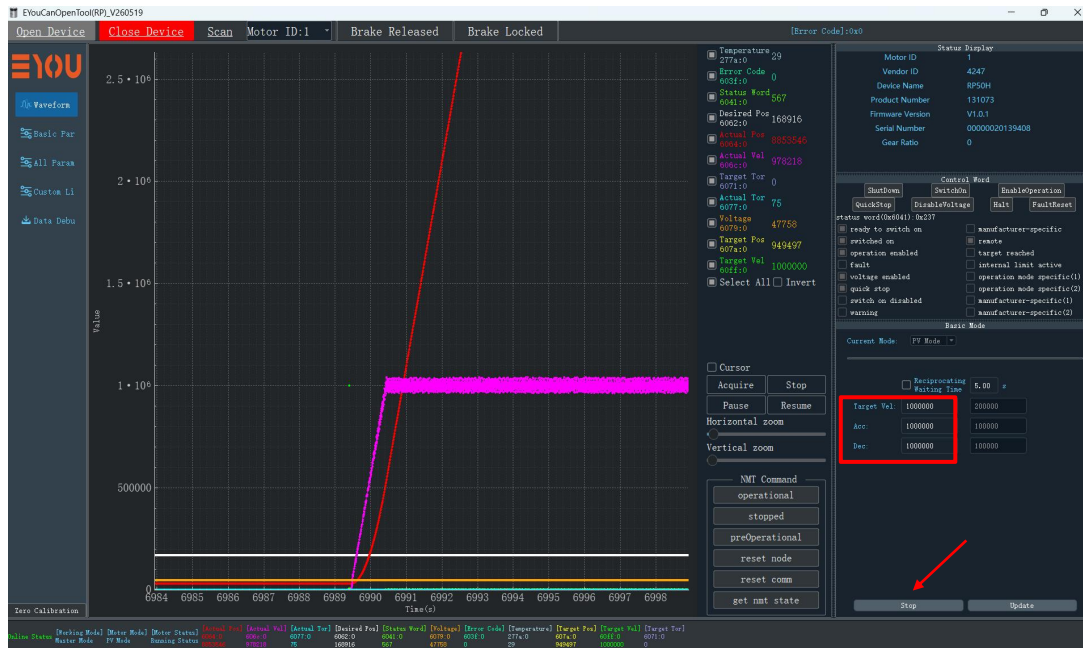


Figure 3-5 Waveform Diagram

3) Profile Torque Mode:

In this mode, the joint automatically generates a trapezoidal target torque trajectory, requiring the specification of both the target torque and its torque slope.

Target Torque: Unit: thousandths (%) of the rated torque. The torque input and output are calibrated proportionally to the rated torque. For example, a torque feedback value of +200 indicates an output of 0.2 times the rated torque in the positive direction, while a torque output value of -200 indicates an output of 0.2 times the rated torque in the negative direction.

Torque slope: Unit: thousandths (%) of the rated torque per second, representing the target torque change rate during operation.

Start/Stop: Start Execution, including pattern configuration, enabling, and motion data transmission, then the button changes to Stop.

Update: Running, update parameters by clicking this button.

As an application example, the following shows the motion parameters for a 20% rated torque, as illustrated in Figure 3-13:

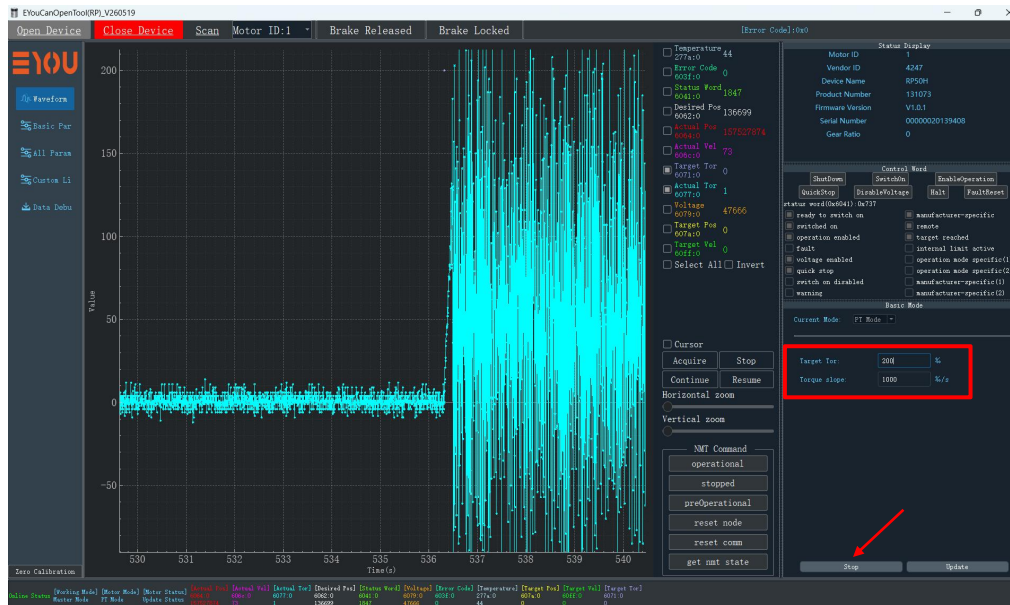


Figure 3-6 Waveform Diagram

4) Cyclic Synchronous Position Mode:

In this mode, the joint's internal mechanisms execute immediately based on the target position specified by the cycle, making it suitable for high-frequency, low-cycle control.

Trapezoidal /Sinusoidal Planning: The EYouCanOpenTool acts as the host to plan the operational trajectory according to the selected mode and transmit it in real-time to the joints.

Target position: Unit: Pulse, the target position along the trajectory to be executed.

Interpolation time: The trajectory planning interval, during which data is transmitted to the joints at this cycle frequency. The joints immediately execute interpolation without performing linear interpolation internally.

Speed: Unit: pulses/second – the constant speed used for trajectory planning in the trapezoidal speed mode.

Acceleration: Unit: pulses/(second·second) – the acceleration of the trajectory planned using the trapezoidal velocity method.

Deceleration: Unit: pulses/(second·second) – the deceleration rate of the trajectory planned using the trapezoidal velocity method.

Synchronization: Selecting this option configures RPDO in synchronous frame mode, leaving it unchecked uses asynchronous mode.

Frequency: Unit: Hertz. During sine wave planning, this is the frequency of the planned trajectory.

Amplitude: Unit: pulse; the amplitude of the planning trajectory during sinusoidal planning.

Start/Stop: Start Execution, including pattern configuration, enabling, PDO configuration, and motion data transmission, then the button changes to Stop.

Update: Running, update parameters by clicking this button.

An example of a trapezoidal trajectory application. Below are the motion parameters for a planning interpolation cycle of 4 ms, as shown in Figure 3-14.



Figure 3-4 Waveform Diagram

An example of sine trajectory application: Below is a 1 Hz operation test with a planned interpolation cycle of 4 ms, as shown in Figure 3-15.

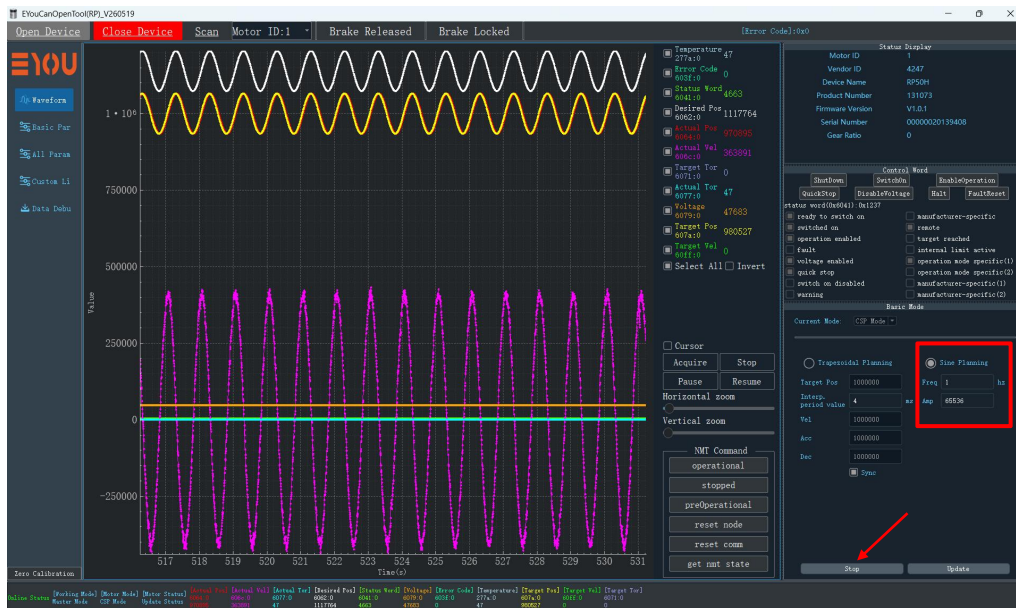


Figure 3-5 Waveform Diagram

5) Cyclic Synchronous Velocity Mode:

In this mode, the joint's internal mechanisms execute immediately based on the target speed set by the cycle, making it suitable for high-frequency, low-cycle control.

Target speed: Unit: pulses/second, the final target speed. Under this function, the system calculates the speed trajectory based on the current speed, target speed, acceleration/deceleration rates, and control cycle, then executes it to the joint according to the cycle.

Interpolation time: The interval for trajectory planning, during which data is transmitted to the joints for execution.

Acceleration: Unit: pulses/(second·second), the acceleration of the trajectory planned using the trapezoidal velocity method.

Deceleration: Unit: pulses/(second·second), the deceleration rate of the trajectory planned using the trapezoidal velocity method.

Synchronization: Selecting this option configures RPDO in synchronous frame mode; leaving it unchecked uses asynchronous mode.

Start/Stop: Start Execution, including pattern configuration, enabling, PDO configuration, and motion data transmission, then the button changes to Stop.

Update: Running, update parameters by clicking this button.

As an example, the following shows motion parameters with a planning interpolation cycle of 4 ms, as illustrated in Figure 3-16:

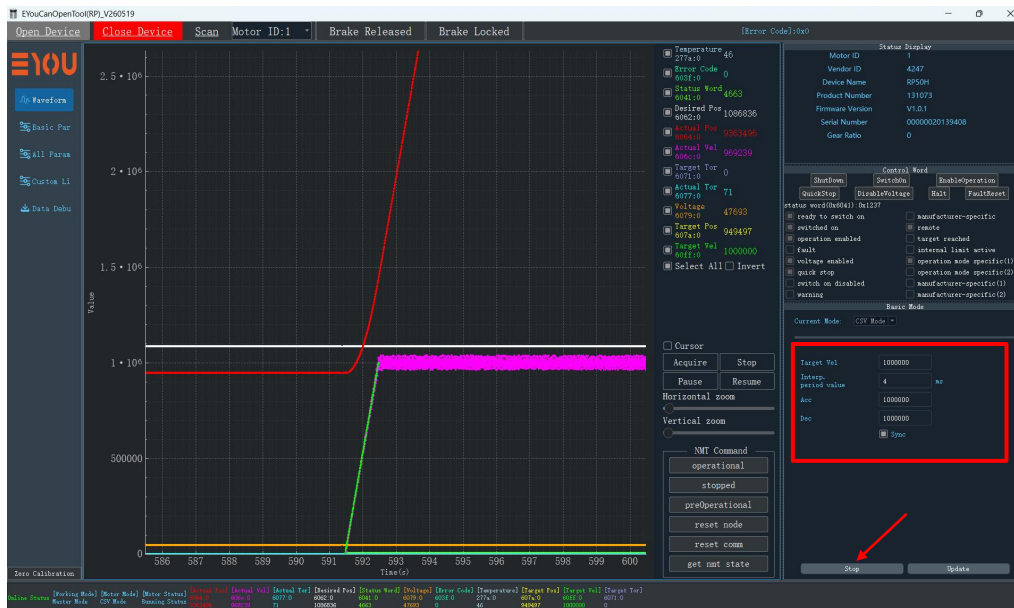


Figure 3-5 Waveform Diagram

6) Cyclic Synchronous Torque Mode:

In this mode, the joint internally executes the target torque generated periodically in real-time, making it suitable for high-frequency, low-cycle control.

Target Torque: Unit: thousandths (‰) of the rated torque, final target torque. Under this function, the system calculates the torque trajectory based on the current torque, target torque, torque slope, and control cycle, then dispatches it to the joint for execution according to the cycle.

Interpolation time: The interval for torque trajectory planning, during which data is transmitted to the joints for execution.

Torque slope: Unit: thousandths (‰) of the rated torque per second, representing the acceleration of the trajectory planned under the trapezoidal torque method.

Synchronization: Selecting this option configures RPDO in synchronous frame mode; leaving it unchecked uses asynchronous mode.

Start/Stop: Start Execution, including pattern configuration, enabling, PDO configuration, and motion data transmission, then the button changes to Stop.

Update: Running, update parameters by clicking this button.

As an example, the following shows motion parameters with a planning interpolation cycle of 4 ms, as illustrated in Figure 3-17:

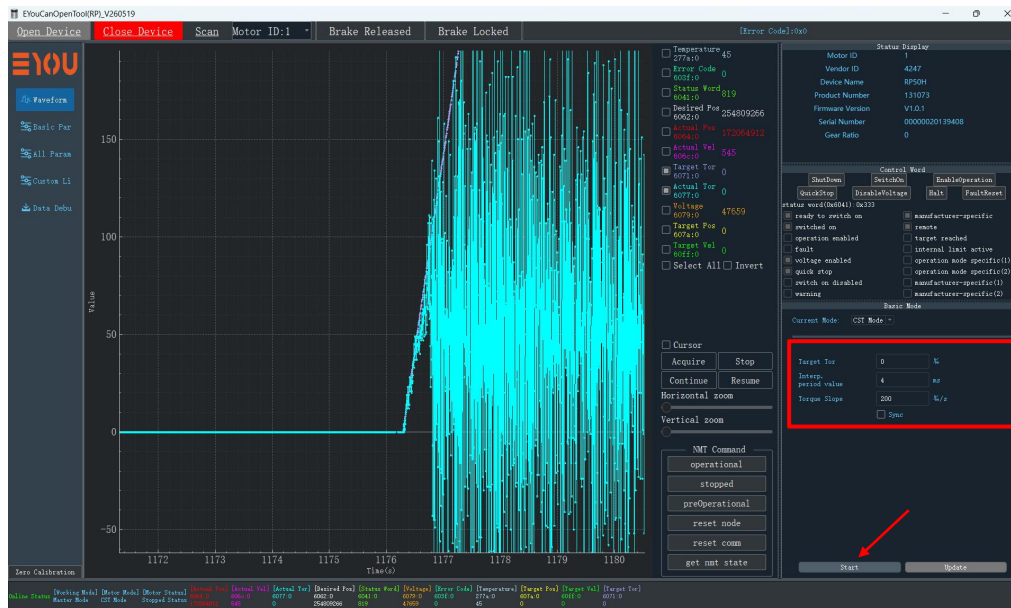


Figure 3-4 Waveform Diagram

Note: The starting and operating torque varies depending on the motor type and load. If the target torque is set too low, the motor may fail to rotate.

3.2.6. Waveform View

On the Waveform Display page, users can perform waveform display selection, pause, zoom and resume operations to facilitate joint evaluation and commissioning. Only preconfigured fixed data is available for selection under default mode.

Waveform scaling and dragging can be easily performed using the left mouse button or the scroll wheel.

3.2.7. Parameter Modification

For CANopen joints, parameter modifications are primarily performed using SDO for dictionary read/write operations. In EYouCanOpenTool, parameters can be adjusted under <Basic Parameters> <All Parameters> <Custom List><Data Debug>.

1) **<Basic Parameters>**: Includes reading, displaying, and modifying the manufacturer

dictionary and the CIA402 motion control dictionary. After modification, click the "Write to Motor" button below. To save these parameters after power-off for the joint, click the <Save to EEPROM> button. As shown in Figure 3-18:

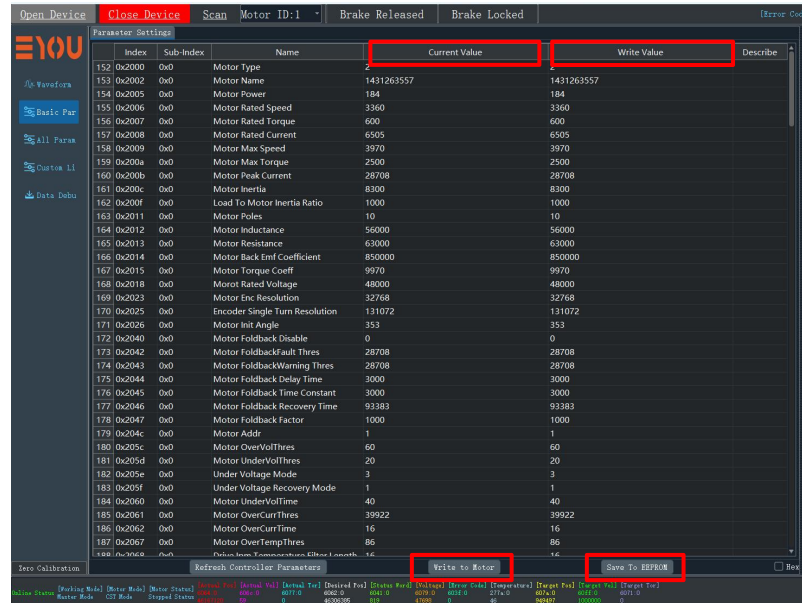


Figure 3-5 Basic Parameter Interface Diagram

- 2) **<All Parameters>**: Similar to <Basic Parameters>, this section additionally contains object dictionaries related to the CIA301 communication profile.
- 3) **<Custom List>**: Select items under <Basic Parameters> or <All Parameters> , right-click to add them to Custom Parameters for quick viewing and modification of frequently-used parameters. Import, export and load default parameters functions are supported.
- 4) **<Read/Write SDO>**: The above parameter modifications can be made via the editing box in the UI interface or using the <Read/Write SDO> function under the <Data Debug> interface, as shown in Figure 3-19.

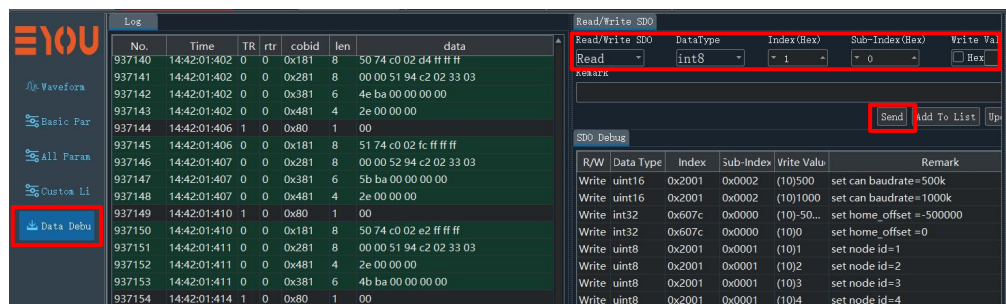


Figure 3-5 SDO read/write interface diagram

5) **<SDO Debug>**: This feature enables storage of commonly used SDO instruction tables. When you select the **<Add to List>** option under the **<Read/Write SDO>** function for a motor, the current SDO instructions are added to the debugging list. The functionality supports importing, exporting, deleting, moving instruction sequences, and sending all instructions simultaneously, double-clicking an entry initiates immediate transmission, providing efficient command table management as shown in Figure 3-20.

SDO Debug

R/W	Data Type	Index	Sub-Index	Write Value	Remark
Write	uint16	0x2001	0x0002	(10)500	set can baudrate=500k
Write	uint16	0x2001	0x0002	(10)1000	set can baudrate=1000k
Write	int32	0x607c	0x0000	(10)-50...	set home_offset = -500000
Write	int32	0x607c	0x0000	(10)0	set home_offset = 0
Write	uint8	0x2001	0x0001	(10)1	set node id=1
Write	uint8	0x2001	0x0001	(10)2	set node id=2
Write	uint8	0x2001	0x0001	(10)3	set node id=3
Write	uint8	0x2001	0x0001	(10)4	set node id=4
Write	uint8	0x2001	0x0001	(10)5	set node id=5
Write	uint8	0x2001	0x0001	(10)6	set node id=6
Write	int32	0x607d	0x0001	(10)-10...	set soft position limit min
Write	int32	0x607d	0x0002	(10)100...	set soft position limit max
Read	int32	0x607d	0x0001		read soft position limit min
Read	int32	0x607d	0x0002		read soft position limit max
Write	uint32	0x2003	0x0000	(16)4C4...	set soft position limit on
Write	uint32	0x2003	0x0000	(16)0	set soft position limit off

ImportExportRemoveMove UpMove DownSend AllRestore Factory Settings

Figure 3-6 SDO Debugging Interface Diagram

3.2.8. Communication Data

The <Data Transmission> interface displays various real-time communication data with timestamps, and offers options to export the data to Excel or other formats for easy viewing, as shown in Figure 3-21.

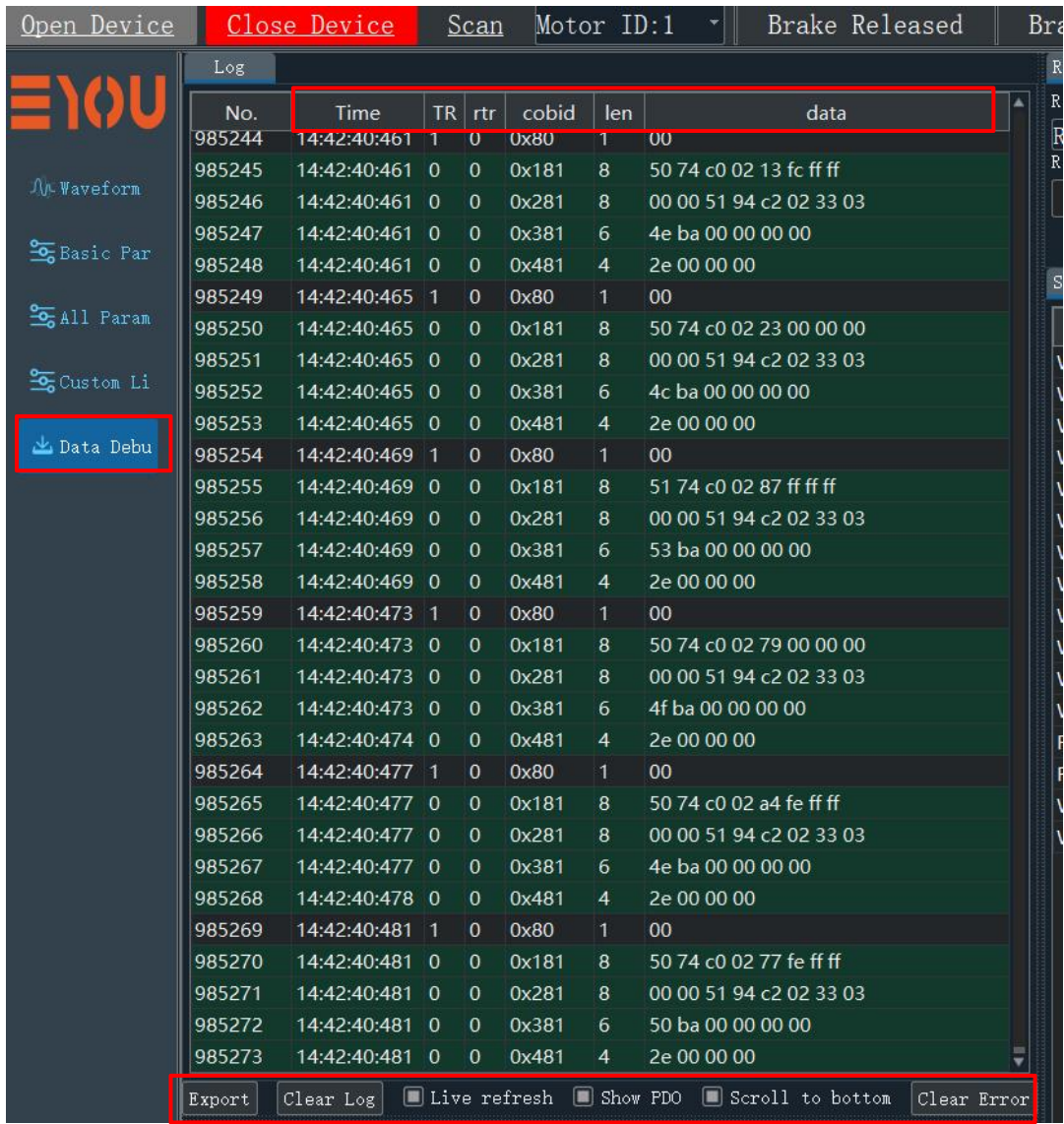


Figure 3-7 Communication Data Interface Diagram

3.2.9. Summary of The Host Computer

With the above operations, users can get a basic understanding of EYCanOpenTool software and CANopen-series joints. Refer to the application manual and relevant development chapters for further application information.

4. Driver Protocol and Usage Instructions

The motor communication utilizes a CAN 2.0 interface with a baud rate of 1 Mbps, employing a standard frame format and supporting both the CANOpen CIA301 protocol and the CIA402 motor motion control protocol.

4.1. Running Mode

Use the Run Mode Object (0x6060) to set the desired run mode, and use the Run Mode Display Object (0x6061) to read the current run mode. Different modes are shown in Table 4-1.

Regarding operation mode switching, the current system supports switching modes while in the enabled idle state. Before transitioning from other operation modes to position modes (PP, CSP), the actual position value 0x6064 must be assigned to the target position 0x607A.

Table 4-1 Control Word Table

Mode	Abbr.	0x6060/6061	Characteristics
Profile Position Mode	PP	1	Master plans the profile, drive executes locally.
Profile Velocity Mode	PV	3	Master sets the velocity profile.
Profile Torque Mode	PT	4	Master sets the torque profile.
Cyclic Synchronous Position Mode	CSP	8	Master cyclically sends position commands; highest synchronization.
Cyclic Synchronous Velocity Mode	CSV	9	Master cyclically sends velocity commands.
Cyclic Synchronous Torque Mode	CST	10	Master cyclically sends torque commands.
Mixed Integrated Torque Mode	MIT	11	Master cyclically sends MIT torque commands.

4.2. Control Word and Status Word

4.2.1. Control Word

A control word is a 16-bit integer with the standard object dictionary index 0x6040. Its primary function is to manage state transitions in the drive. The drive operates according to a predefined state machine (e.g., as specified in the DS402 specification), and the master station initiates state transitions by transmitting specific control word sequences. These control words are listed in Table 4-2.

Table 4-2 Control Word Table

Bit	Name	Description
0	Servo enabled	1 - Valid, 0 - Invalid
1	Main circuit powered on	1 - Valid, 0 - Invalid
2	Quick stop	0 - Valid, 1 - Invalid
3	Servo operation	1 - Valid, 0 - Invalid
4~6	Operation mode specific	Mode dependent
7	Fault reset	Bit7: Active on rising edge
8	Halt	0: Default value (0) 1: Stop movement using the halt option code 0x605D
9	Operation mode specific	Related to each servo operation mode
10	Reserved	Undefined
11~15	Manufacturer specific	Defined by manufacturer

4.2.2. Status Word

The control characters are shown in Table 4-3.

Table 4-3 Status Word Table

Bits	Name	Description
0	Ready to switch on	1-valid, 0-invalid

1	Switched on	1-valid, 0-invalid
2	Operation enabled	1-valid, 0-invalid
3	Fault	1-valid, 0-invalid
4	Voltage enabled	1-valid, 0-invalid
5	Quick stop	1-valid, 0-invalid
6	Switch on disabled	1-valid, 0-invalid
7	Warning	1-valid, 0-invalid
8	Manufacturer-specific	Zero speed state
9	Remote	1-valid(Defaulted), 0-invalid
10	Target reach	1-valid, 0-invalid
11	Internal limit active	1-valid, 0-invalid
12	Operation mode specific	Related to each servo operation mode
13	Follow the wrong path	1-valid, 0-invalid
14~15	Manufacturer-specific	No define

4.3. Profile Operation Mode

The profile operation mode is a set of motion control modes based on "target points." Unlike the cyclic synchronous mode, which requires real-time transmission of set values, in this mode the master controller defines target positions, target speeds, or target torques along with relevant profile parameters (such as acceleration and deceleration) using an object dictionary, then triggers the movement via a control command. Upon receiving the trigger signal, the driver automatically and independently completes the entire point-to-point motion profile. This mode reduces the demand for real-time communication and simplifies the control logic of the host computer.

4.3.1. Profile Position Mode (PP)

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

Basic operation steps: Set the mode to 1 (0x6060=1) for profile position mode.

① Set Target Position (0x607A), Profile Velocity (0x6081), Profile Acceleration (0x6083) and Profile Deceleration (0x6084).

② Set the control command 0x6040 (0x06-0x07-0x0F) to enable servo mode.

③ Set the control command 0x6040 (Bit4 from 0 to 1), the command is triggered. Since motion triggering is rising-edge driven, Bit4 must be switched OFF then ON again to initiate another movement of the servo.

4.3.2. Profile Velocity Mode (PV)

In this mode, the master station controller sets target speed and acceleration/deceleration parameters, while the module internally calculates and generates a smooth speed variation curve based on these parameters.

Basic operation steps: Set the mode to 3 (0x6060=3), profile velocity Mode.

① Set Profile Acceleration (0x6083), Profile Deceleration (0x6084) and Target Velocity (0x60FF).

② Set the control command 0x6040 (0x06-0x07-0x0F) to enable servo mode.

4.3.3. Profile Torque Mode (PT)

In this mode, the master controller sets the target torque, and the module maintains this torque output until receiving a new command. This mode typically requires setting a speed limit as a safety protection measure.

Basic operation steps:

- ①Set the mode to 4 (0x6060=4), profile torque mode;
- ②Set the target torque (0x6071);
- ③Set the control command 0x6040 (0x06-0x07-0x0F) to enable servo mode.

4.4. Circular Synchronous Operation Mode

The cyclic synchronous operation mode is an advanced set of modes employed in high-performance servo drives to achieve precise synchronous motion control. These modes rely strictly on the synchronization clock of the network communication system (maintained by periodic synchronization messages such as the SYNC signal in CANopen or EtherCAT). All devices participating in the synchronization network share a unified time reference, ensuring precise alignment of control cycles across drives and enabling strict phase synchronization and low-jitter control among multiple axes.

4.4.1. Cyclic Synchronous Position Mode (CSP)

In this mode, the master controller performs trajectory planning and transmits target position commands to the joint module every EtherCAT/CAN communication cycle. The joint executes three closed-loop control (position, velocity and torque) internally based on received commands.

Basic operation steps:

- ①Set the mode to 8 (0x6060=8) for cyclic synchronous position mode.
- ②Read the actual position 0x6064, setting the target position 0x607A to match the current actual position value.
- ③Set the control command 0x6040 (0x06-0x07-0x0F) to enable servo mode.
- ④The master station controller periodically sends the planned target position points to the joint module via the 0x607A object dictionary.

4.4.2. Cyclic Synchronous Velocity Mode (CSV)

In this mode, the master station controller is responsible for planning the speed trajectory and periodically issuing target speed commands; the joint module receives these commands and executes internal speed and torque loop controls. Additionally, dynamic control performance can be optimized through speed feedforward and torque feedforward. It should be noted that the profile acceleration and profile deceleration parameters only become active when the stop or rapid-stop function is activated.

Basic operation steps:

- ①Set the mode to 9 (0x6060=9) for cyclic synchronization speed mode.
- ②Set the control command 0x6040 (0x06-0x07-0x0F) to enable servo mode;
- ③Set the target speed to 0x60FF.

4.4.3. Circular Synchronous Torque Mode (CST)

In this mode, the master controller handles velocity trajectory planning and sends target velocity commands cyclically. The joint module receives the commands and implements internal velocity-loop and torque-loop control. In addition, velocity feedforward and torque feedforward can be applied to optimize dynamic control performance. Note that Profile Acceleration and Profile Deceleration parameters only take effect when Stop or Quick Stop function is activated.

Basic operation steps:

- ①Set the mode to 10 (0x6060=10), cyclic synchronous torque mode.
- ②Set the target torque to 0x6071 = 0. In torque mode, once enabled, the servo target torque takes effect; therefore, set it to 0 first for safety.
- ③Set the control command 0x6040 (0x06-0x07-0x0F) to enable servo mode.
- ④Set the target torque to 0x6071.

4.5. Set zero point

Set the zero-point object dictionary as shown in Table 4-4: 0x2262 Sub-index: 0x00

Table 4-4: Zero Point Object Dictionary Table

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
INT	0x00	0x01	0x00	-	RW	YES	immediately	Rx/Tx
Note: To select the mechanical origin detection method, the host computer should send 0x01 to set the current position as the zero point.								

4.6. Set up ID

Set the ID object dictionary as shown in Table 4-5: Sub-index 0x204C:0x00

Table 4-5: ID Object Dictionary Table Settings

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UINT	0x0	0xFFFF	0x1	-	RW	YES	immediately	Rx/Tx
Description: In a multi-axis bus network, this is the unique identifier used to distinguish different drivers.								

4.7. Save parameter

Save the parameter object dictionary as shown in Table 4-6: Sub-index: 0x1010; Value: 0x01

Table 4-6: Parameter Object Dictionary Table

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

Description: This object is used to save parameters to non-volatile memory. Writing the value 0x65766173 ("save" instruction) saves the change, writing other values is invalid (return value is 0).

Note: Do not power off during saving. Otherwise, saving may fail or parameters may be lost.

5. Canopen Communication Protocol Type Description

5.1. Object Dictionary (OD)

The Object Dictionary (OD) is the core concept of the CANopen protocol, defining a structured collection of all accessible data within a device. Every CANopen device must contain an OD that serves as a bridge between its functional parameters and external network communications, forming the foundation for the device's self-description and self-configuration.

An object dictionary is an ordered collection of objects, where each object is addressed using a 16-bit index ranging from 0x0000 to 0xFFFF. To access individual elements within an indexed object, an 8-bit sub-index can be defined under each index.

The object dictionary can be visualized as a book with multiple chapters (indexes), and each chapter may contain several subsections (sub-indexes). This structure enables precise access to any parameter within the device, ranging from simple Boolean variables to complex array members. Each entry in the object dictionary is defined by specific attributes, including the object name, data type (e.g., UNSIGNED32, VisibilityString), access permissions (read-only, write-only, read-write), and whether it is Mandatory or Optional.

To enhance interoperability between devices, the content of the object dictionary is typically defined by an Electronic Data Specification (EDS) file or a Device Configuration File (DCF). The EDS file serves as the template for the device object dictionary and is provided by the device manufacturer, while the DCF is a configuration-specific file tailored to particular application scenarios, containing detailed parameter values.

The configuration table for index partitions of different data types is shown in Table 5-1:

Table 5-1 Definition Table of CANopen Object Dictionary Index Partition

Index Range	Description
0000h	Reserved
0001h~ 025Fh	Data Type

0260h ~ 0FFFh	Reserved
1000h~1FFFh	Communication Object Subprotocol Area
2000h ~5FFFh	Manufacturer-specific Subprotocol Area
6000h ~9FFFh	Standardized Device Subprotocol Area
A000h~AFFFh	Network variable (compliant with IEC61131-3)
B000h ~ BFFFh	System variables for the routing gateway
C000h ~ FFFFh	Reserved

5.2. NMT State Machine and Network Management

5.2.1. NMT State Machine

Network Management (NMT) is a mechanism within the CANopen protocol for monitoring and controlling the status of network nodes. It operates on a master-slave model, where an NMT master station manages one or more NMT slaves in the network. Each CANopen device contains an NMT state machine that defines four basic operational states, as shown in Figure 5-1:

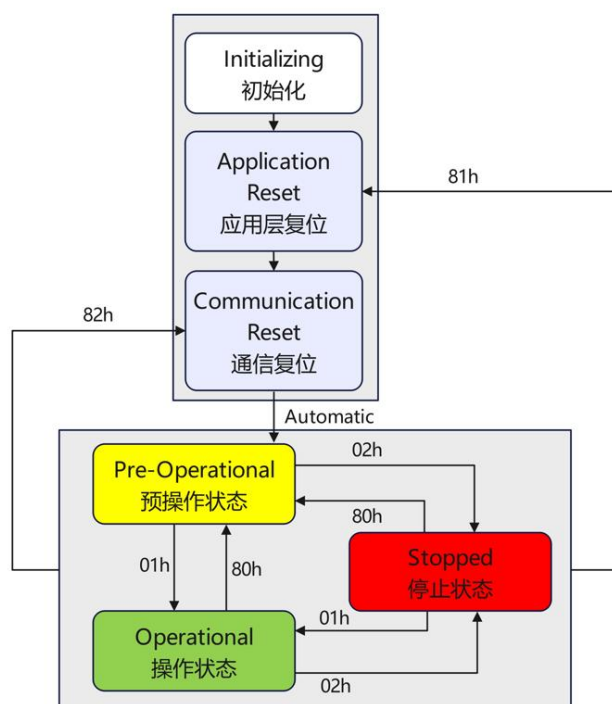


Figure 5-1 NMT State Machine Diagram

The NMT state machine determines the communication objects available for determining communication states, as detailed in Table 5-2:

Table 5-2 NMT Status and Communication Object Table

State	Description	Allowed Communication Objects
Initialization	The self-check and initialization state after the device is powered on or reset.	Boot-UP
Pre-Operational	The device is ready for configuration, but real-time transmission of process data (PDO) is not supported.	SDO、SYNC、EMCY、NMT
Operational	The device is operating normally and allows all communications.	PDO、SDO、SYNC、EMCY、NMT
Stopped	The device application function is suspended, but basic network management communications may still proceed.	NMT

5.2.2. NMT Module Control Message

The COB-ID of the NMT module control message is 0x000, with a fixed data packet length of 2 bytes. Its specific format is shown in Table 5-3:

Table 5-3 NMT Module Control Message Format Table

NMT Module Control Message Format		
COB-ID	Data	
	Byte0	Byte1
0x000	CMD	Node ID

Table 5-4 NMT Command Table

Command (CMD)	Description
0x01	Change the node status to "operational"

0x02	Change the node status to "Stopped"
0x80	The command node has been changed to "pre-operational".
0x81	Similar to a hardware reset, the node parameters return to their default power-on values.
0x82	Communication parameters of the restoration node; re initialize the CANopen protocol stack

5.2.3. NMT Node Monitoring Message

The COB-ID of the NMT node monitoring message is 0x700 + Node ID, with a fixed data packet length of 1 byte. Its specific format is shown in Table 5-5:

Table 5-5 NMT Node Monitoring Message Format Table

NMT Node Monitoring Message Format	
COB-ID	Data
	Byte0
0x700+ Node ID	00

Table 5-6 NMT Status Code Table

Status Code	Description
0x00	Initialization State
0x04	Stopped State
0x05	Operating State
0x7F	Pre-operation State

5.3. Service Data Object (SDO)

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

SDO can transmit up to 4 bytes of data. When the data length exceeds 4 bytes, it is split into

multiple packets for transmission—a method known as segmented transmission. Transmissions of 4 bytes or less are referred to as accelerated transmission. The standard length of an SDO packet is 8 bytes, and its general format is shown in Table 5-7:

Table 5-7 SDO Data Packet Description Table

Byte	Definition	Description
Byte0	Command Code	Determine the type and behavior of SDO
Byte1- Byte2	Index	The 16-bit index of the object dictionary
Byte3	Sub-index	The 8-bit sub-index of the object dictionary
Byte4- Byte7	Data	The transmitted data or control information

5.3.1. Write SDO data

When the master needs to write parameters to a slave node, the request message must be constructed in strict compliance with the SDO protocol frame format. The packet should sequentially include the following key fields: the command identifier (indicating the write operation and transmission mode), the target index and sub-index (for locating the specific entry in the object dictionary), and the data to be written, as shown in Table 5-8:

Table 5-8 SDO Message Format Table

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

Note: Returning 0x80 indicates a failed SDO operation. For details on abort codes, refer to the SDO Abort Codes section below. Example: Using servo ID=1 as an example

Table 5-9 SDO Example Table

Operation	COB-ID	Message Data (Hex)
Set the operation mode to Profile Position Mode (write 1 to 0x6060)	601	2F 60 60 00 01 00 00 00
	581	60 60 60 00 00 00 00 00
The control word is set to 6 (0x6040 write 6)	601	2B 40 60 00 06 00 00 00
	581	60 40 60 00 00 00 00 00

5.3.2. Read SDO data

When the master intends to read parameters from the joint module, an SDO read request frame shall be constructed in advance. This request frame contains the specified command code to identify read operation, as well as the index and sub-index of the target object. After receiving the request, the joint accesses its internal object dictionary and returns the data of the specified object to the master via an SDO upload response frame.

Table 5-10 SDO Message Format Table

Operation	COB-ID	Data							
		Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Master Read	0x600+ Node ID	40h	Index		Sub-Index	-	-	-	-
Slave Normal Response	0x580+ Node ID	43h	Index		Sub-Index	Data			
		47h				Data			-
		4Bh				Data		-	-
		4Fh				Data	-	-	-
Slave Error		80h				Abort codes			

Response					
----------	--	--	--	--	--

Note: Returning 0x80 indicates a failed SDO operation. For details on abort codes, refer to the SDO Abort Codes section below.

Example: Using servo ID=1 as an example

Table 5-11 SDO Reading Example Table

Operation	COB-ID	Message Data (Hex)
Read the current operating mode (Read address data at 0x6061)	601	40 61 60 00 00 00 00 00
	581	4F 61 60 00 01 00 00 00
Read status word feedback (Read address data at 0x6041)	601	40 41 60 00 00 00 00 00
	581	4B 41 60 00 31 01 00 00

5.4. Process Data Object (PDO)

The Process Data Object (PDO) is a key mechanism in the CANopen protocol for achieving efficient, real-time data transmission. The communication direction is defined from the perspective of the slave device: sending a PDO (TxPDO) means the joint module sends data (e.g., status information) to the master station, while receiving a PDO (RxPDO) means the module receives data (e.g., control commands) from the master station. Before using a PDO, its communication parameters and mapping parameters must 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.

Table 5-12 PDO Communication and Mapping Object Table

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

Table 5-13 PDO Mapping Parameter Format Table

Bit0-Bit7	Bit8-Bit15	Bit17-Bit31
Object data length	Object Sub-index	Object Index

Table 5-14 PDO Data Packet Format Table

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

5.4.1. PDO Transfer Type

The transmission behavior of PDO (how and when to send/receive data) is precisely controlled by its transmission type parameter. The definition of this parameter in the object dictionary is as follows: TxPDO is set in sub-index 0x02 within indices 0x1800–0x1803 (corresponding to TxPDO1–TxPDO4), while RxPDO is set in sub-index 0x02 within indices 0x1400–0x1403 (corresponding to RxPDO1–RxPDO4). The value of the transmission type determines the PDO triggering mechanism, with specific classifications as follows:

Table 5-15 TXPDO Transmission Type Table

Transmission type value	Transmission Mechanism and Description
-------------------------	--

(decimal)	
0	Non-cyclic synchronization: This PDO can trigger transmissions via remote frames or events defined in the device subprotocol (e.g., device startup).
1~240	Sync cycle: PDO shall be transmitted once after receiving every N SYNC messages. For example, setting it to 1 means transmission occurs upon each SYNC frame received; setting it to 5 means transmission occurs after every 5 SYNC frames. A smaller value indicates higher real-time performance.
254	Asynchronous, event-driven device protocol: Transmission is triggered when a specific event predefined in the device subprotocol occurs (e.g., error status change or reaching a particular state).
255	Asynchronous, manufacturer-specific event-driven: Transmission is triggered by internal events defined by the device manufacturer (e.g., timer timeout, input signal changes, etc.).

Table 5-16 RXPDO Transmission Type Table

Transmission type value (decimal)	Transmission Mechanism and Description
255	Asynchronous (triggered by device-specific events): This PDO can initiate transmission based on events defined in remote frames or device sub-protocols (e.g., device startup).

0~240	Sync cycle: PDO transmits once after receiving N SYNC messages. For example, setting it to 1 means transmission occurs upon each SYNC frame received; setting it to 5 means transmission occurs after every 5 SYNC frames. A smaller value indicates higher real-time performance.
-------	--

5.4.2. PDO Configuration Parameters and Configuration Process

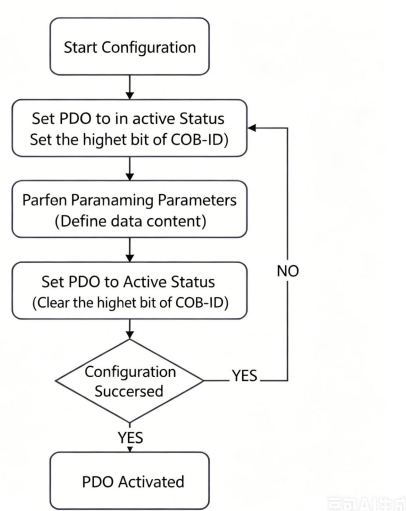


Figure 5-1 PDO Configuration Flowchart

Example 1: Using servo ID=1 as an example, map the control word (6040) to RXPDO1

Table 5-17 RXPDO1 Mapping Control Word Table

Step	COB-ID	Message Data (Hex)
Disable RxPDO1	601	23 00 14 01 01 02 00 80
	581	60 00 14 01 00 00 00 00
Set Transmission Type	601	2F 00 14 02 01 00 00 00
	581	60 00 14 02 00 00 00 00
Delete the Original Mapping	601	2F 00 16 00 00 00 00 00
	581	60 00 16 00 00 00 00 00
Mapping Control Word	601	23 00 16 01 10 00 40 60

(6040)	581	60 00 16 01 00 00 00 00
Number of Write Mapping Objects (1)	601	2F 00 16 00 02 00 00 00
	581	60 00 16 00 00 00 00 00
Enable RxPDO1	601	23 00 14 01 01 02 00 00
	581	60 00 14 01 01 00 00 00

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

Table 5-18 TXPDO1 Mapping Status Word Table

Step	COB-ID	Message Data (Hex)
Disable TxPDO1	601	23 00 18 01 81 01 00 80
	581	60 00 18 01 00 00 00 00
Set Transmission Type	601	2F 00 18 02 01 00 00 00
	581	60 00 18 02 00 00 00 00
Delete the Original Mapping	601	2F 00 1A 00 00 00 00 00
	581	60 00 1A 00 00 00 00 00
Mapping State Word (6041)	601	23 00 1A 01 10 00 41 60
	581	60 00 1A 01 00 00 00 00
Number of Write Mapping Objects (1)	601	2F 00 1A 00 02 00 00 00
	581	60 00 1A 00 00 00 00 00
Enable TXPDO1	601	23 00 18 01 81 01 00 00
	581	60 00 18 01 00 00 00 00

5.5. Sync Object (SYNC)

The SYNC object is a broadcast communication entity in the CANopen protocol designed for time synchronization among network nodes. It is periodically transmitted by SYNC producers (typically the NMT master node) across the network, while other slave nodes acting as SYNC consumers execute predefined periodic tasks upon receiving the message—such as synchronizing input sampling, updating outputs, or triggering PDO transmissions.

SYNC cycle period: The time interval between two consecutive SYNC messages sent by the master station. It determines the fundamental time granularity for system synchronization.

Sync window length: The maximum time window reserved for all SYNC slaves to complete synchronization operations after the SYNC message is sent. Slaves must complete all synchronization-related tasks within this time window.

It can be configured using the following parameters: 1006h (cycle synchronization period), 1007 (synchronization window time), and 1005h (synchronization object).

Table 5-19 SYNC Configuration Message Table

Operation	COB-ID	Message Data (Hex)
Update COB-ID	601	23 05 10 01 80 00 00 00
	581	60 05 10 01 00 00 00 00
Set the Configuration Synchronization Cycle to 1000 us (Index 0x1006)	601	23 06 10 00 E8 03 00 00
	581	60 06 10 00 00 00 00 00
Configure the Synchronization Window Time to 300 ms (Index 0x1007)	601	23 07 10 01 2C 01 00 00
	581	60 07 10 01 00 00 00 00

Table 5-20 SYNC Message Format Table (No data)

COB-ID	Data
0x80	0

5.6. Emergency Medical Care Unit (EMCY)

An emergency message is an asynchronous alert sent by a CANopen node upon detecting a critical internal error. Its purpose is to promptly and swiftly notify other devices in the network (e.g., the master station) of the device's fault status, enabling the system to take appropriate actions.

Table 5-21 Emergency Message Format Table

COB-ID	Data
--------	------

	Byte0~Byte1	Byte2	Byte3	Byte4~Byte7
0x80 + Node ID	Invalid Error Code	Error Register	-	-

5.7. Network Protection (Heartbeat and Node Protection)

The comparison and selection of heart rate and node protection are shown in Table 5-22:

Table 5-22 Comparison Table

Characteristic	Heartbeat Protocol	Node Protection Protocol
Communication Model	Producer/Consumer (Radio/Peer-to-Peer)	Master-slave (Request-Response)
Network Load	Relatively low (nodes send periodically, proportional to the number of nodes)	Relatively high (the main station needs to poll each node)
Complexity Implementation	The implementation is simple, just send messages periodically.	The master station has complex logic and must manage polling for all slave stations.
Real-time	Fault detection time $\leq$ Heartbeat generation time	Fault detection time $\leq$ Protection time
Recommended Scenario	The preferred choice for modern CANopen systems, particularly suitable for scenarios with a large number of slaves or when the master station itself requires monitoring.	For traditional applications or when compatibility with older device versions is required

5.7.1. Heartbeat Protection Mechanism

The heartbeat protection mechanism is based on the producer-consumer model. In this mechanism, heartbeat producers periodically send heartbeat messages to the network, while heartbeat consumers monitor these messages. The heartbeat producer can be either the master

machine (NMT main station) or the joint module (slave station), and correspondingly, the consumer can also be either the master machine or the joint module. As shown in Figure 5-3:

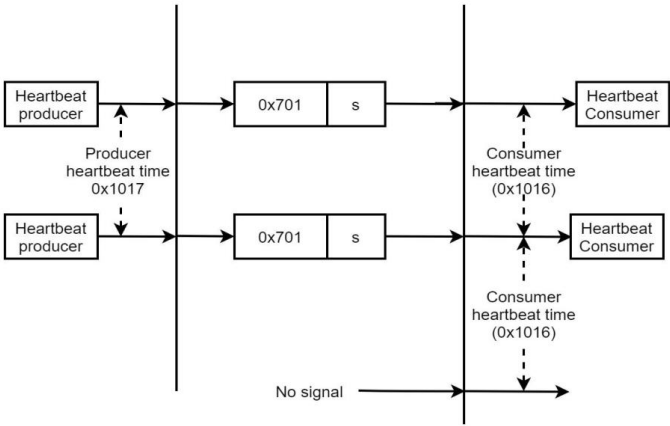


Figure 5-1 Model diagram of the heartbeat protection mechanism

The heart protection configuration process is as follows:

Table 5-23 Heartbeat Protection Configuration Flowchart

Step	Target	Parameter Index	Description
1	Joint Module (Consumer)	0x1016	Set the consumer heartbeat interval to be longer than the producer heartbeat interval of the host computer and include a tolerance margin.
2	Host Computer/Main Station (Producer)	0x1017	The host computer automatically sets its heartbeat transmission interval.
3	-	-	The host computer begins sending heartbeat messages, and the mechanism takes effect.

After completing the joint configuration by the consumer, simply have the host computer begin periodically sending heartbeat messages to activate the heartbeat protection mechanism.

Table 5-24 Heartbeat Message Format Table

COB-ID	Data	State
0x700 + Node ID	0	Boot-up

	4	Stopped
	5	Operational
	127	Pre-Operational

5.7.2. Node Protection Mechanism

Node protection is a communication monitoring mechanism based on a master-slave bidirectional query-and-response model. Unlike heartbeat protocols that employ one-way broadcasting, this mechanism is actively initiated by the NMT master station to establish one-to-one monitoring dialogues with each slave station. It enables the master station to monitor the status of slave stations while allowing slaves to verify the master station's operational integrity, thereby achieving bidirectional communication health checks. As shown in Figure 5-4:

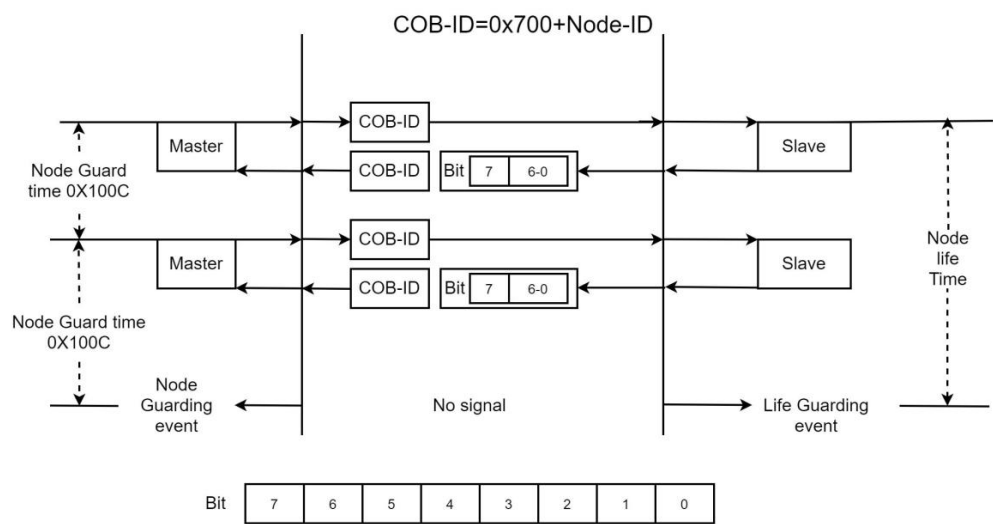


Figure 5-1 Model diagram of the node protection mechanism

The node protection configuration process is shown in Table 5-25:

Table 5-25 Node Protection Configuration Flowchart

Step	Target	Parameter Index	Description
1	Master Configuration	0x100C(Sub-index x 0x04)	Set the node's Guard Time via SDO write
2	Slave Configuration	0x100D	Set the Life Time Factor within the module

	(Joint)		
3	Operation and Error Detection	-	① Normal: The master sends a request, and the module responds immediately; ② Slave failure: If the slave fails to respond to the master within the Guard Time, the operation is deemed failed. ③ The master Failure: If the master ceases sending requests and the module fails to receive any requests within its continuous Life Time (Guard Time × Life Time Factor), it determines that communication with the main station has failed and triggers predefined error actions (e.g., entering a safe state).

6. MIT Communication Protocol Type Description

6.1. MIT Introduce

The MIT Control Mode (full name: Mixed Integrated Torque) is a multi-degree-of-freedom hybrid servo control system designed for robots and motors. Its core principle involves simultaneously integrating position feedback, velocity feedback, and feedforward torque within a single command, directly outputting target current and torque to achieve flexible, high-dynamic-performance, and multi-objective collaborative control.

6.2. MIT Control Block Diagram

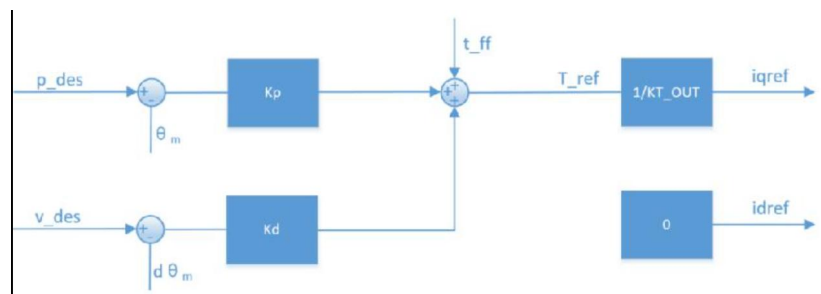


Figure 6-1 Control Diagram

6.3. MIT Core Formula

$$i_{ref} = K_p \cdot (p_{des} - p_{act}) + K_d \cdot (v_{des} - v_{act}) + iff$$

Among :

- 1) p_{des} , p_{act} : expected / actual position
- 2) v_{des} , v_{act} : Expected / Actual speed
- 3) K_p , K_d : Position and speed gains
- 4) iff : Feedforward current (direct torque command)
- 5) i_{ref} : Total reference current (input to the current loop)

6.4. MIT control protocol

Basic control parameters:

0x2130:00h-MIT mode control parameter 1 (Mit ctrl CMD 1)

0x2131:00h-MIT mode control parameter 2 (Mit ctrl CMD 2)

Table 6-1 MIT Control Protocol Table

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RW	YES	Immediately	Rx/Tx
Bit number			Value		Meaning			
Bit51~48 Bit63~56			x		MIT Target Torque (Big-Endian)			
Bit47~40 Bit55~52			x		MIT Kd (Big-Endian)			
Bit27~24 Bit39~32			x		MIT Kp (Big-Endian)			
Bit23~16 Bit28~31			x		MIT Target Speed (Big-Endian)			
Bit15~0			x		MIT Target Position (Big-Endian)			
Note: Define the MIT mode control parameters, where 2130 occupies the lower 32 bits and 2131 occupies the up per 32 bits.								

0x2132:00h-MIT mode reply parameter 1 (Mit ctrl Reply 1)

0x2133:00h-MIT mode reply parameter 2 (Mit ctrl Reply 2)

Table 6-2 MIT Control Protocol Table

Data Type	Default data	Max data	Min data	Unit	Access	Backup	Update	PDO mapping
UDINT	0x00000000	0xFFFFFFFF	0x00000000	-	RW	YES	Immediately	Rx/Tx
Bit number			Value		Meaning			
Bit63~48			0		Reserve			
Bit35~32 Bit47~40			x		MIT Torque Feedback (Big-Endian)			
Bit31~24 Bit39~36			x		MIT Speed Feedback (Big-Endian)			
Bit23~8			x		MIT Position Feedback(Big-Endian)			
Bit8~0			0		Reserve			
Note: Define the MIT mode response parameters, where 2130 occupies the lower 32 bits and 2131 occupies the upper 32 bits.								

7. Maintenance and Care

7.1. Daily Inspection Items

Daily inspections aim to identify potential issues through sensory observation and the use of simple tools, thereby preventing problems before they occur.

Table 7-1 Daily Inspection Items

Inspection Item	Method	Normal	Unusual
Abnormal Sound and Vibration Inspection	Listen carefully to the operating sounds during no-load and low-load operation conditions.	A smooth and uniform gear meshing sound	A sharp creaking sound, periodic impact noises, irregular clicking sounds, or abnormal vibrations. These are typically early signs of poor lubrication, gear wear, or bearing damage.
Temperature Rise Inspection	After the operation has stopped (or under safe conditions using an infrared thermometer), touch or measure the temperature of the module housing.	The temperature rise remains within a reasonable range (typically, the housing temperature does not exceed the ambient temperature +60°C).	Local or overall overheating and burning sensation indicate potential issues such as overload, insufficient lubrication, or improper assembly.
Leak Detection	Visually inspect the reducer seal area (outer ring of the output housing) for oil stains or grease	Completely dry, with no oil stains whatsoever.	There is noticeable oil leakage, indicating that the seal may be aged or damaged and requires attention.

	leakage.		
Appearance and Cleaning Inspection	Check the module surface for dents, scratches, or corrosion, and remove contaminants such as dust, oil stains, and cutting fluid.	Clean appearance	The exterior exhibits abnormal corrosion or contaminants.
Operating Performance	Observe whether the operation is smooth, with no lagging, shaking, or reduction in positioning accuracy.	Normal operation.	Any performance degradation may be an early sign of an internal fault.

7.2. Maintenance Routine

Regular maintenance refers to planned, in-depth upkeep tasks that must be strictly carried out based on operational duration or usage cycles.

Table 7-2 Daily Inspection Items

Project Maintenance	Period	Content and Steps
Fastener inspection	Monthly or every 500 hours of operation	Check and re-tighten all fasteners between the module and the robot structure, including mounting bolts, motor connection bolts, and positioning pins.

7.3. Storage Conditions and Expiration Date

1) Storage environment:

- ① Temperature and Humidity: Store in a dry, non-condensing environment. The ideal temperature range is 5°C to 35°C, with relative humidity below 70%.
- ② Environment: Keep away from corrosive chemicals, acids, alkalis, and salts. Prevent the ingress of dust and metal powders.
- ③ Vibration: The storage location should be free from strong vibration or impact.

2) Storage posture: Place in the normal working position on shelves or pads to avoid unnecessary stress.

3) Preventive Measure :

- ① All exposed machining surfaces (e.g., flange surfaces, shaft ends) should be coated with rust preventive oil (such as a thin layer of Vaseline or a specialized rust inhibitor).
- ② Cover the interfaces and openings with rust-proof paper, plastic covers, or protective caps to prevent dust and moisture from entering.
- ③ For brand-new unused modules: an appropriate amount of grease has been pre-applied internally, requiring no special treatment. However, during long-term storage, regular operation is recommended (ideally running unloaded every 3–6 months) to ensure even distribution of the grease and prevent corrosion on the working surfaces of bearings and gears.

4) Storage duration: Typically not exceeding 1 year. If the storage period exceeds 1 year, a comprehensive inspection must be conducted prior to use, with particular attention to assessing whether the seals have aged.

7.4. Maintenance and Replacement Recommendations

Maintenance Precautions

- ① Non-repairability: Planetary reducers (including sun gears, planet gears, and ring gears) are highly precision components. Users or on-site engineers are strictly prohibited from disassembling or repairing them independently; any unauthorized removal or assembly may cause permanent damage and complete loss of accuracy.
- ② Fault Diagnosis: If severe abnormalities (such as persistent 異異鳴, severe overheating, significant clearance, or jamming) are detected during routine or periodic maintenance, the machine should be shut down immediately.
- ③ Professional return to the manufacturer: The only repair option is to return it to the original manufacturer or an authorized service center.

Life Span and Replacement Recommendations

The service life of a planetary reducer is typically defined by the number of operating hours under rated load and speed. Even with proper maintenance, it remains a wear component. Replacement should be planned when any of the following conditions occur:

- ① The accuracy decreases and cannot be compensated by the control system.
- ② The background contrast exceeds the allowable value, compromising the robot's absolute accuracy.
- ③ The operating noise and vibration have increased significantly, and inspection confirmed internal damage.

8. Fault Diagnosis and Resolution

8.1. CANopen Communication Error

Table 8-1 CANopen Communication Error Table

Suspension Code	Name	Explain
0x00000000	No error	Communication successful
0x05030000	Switch error	The trigger bit has not been switched.
0x05040000	SDO overtime	SDO protocol timeout
0x05040001	Unknown command	Illegal or unknown client/server command word
0x05040004	CRC verification error	CRC verification failed
0x06010000	Access error	The object does not support access
0x06010001	Read-only error	Try to read a write-only object
0x06010002	Write error only	Try to write a read-only object
0x06010003	The sub-index cannot be written to	Cannot write to the sub-index. The sub-index must be "0" to write.
0x06010004	SDO access is not supported	The object cannot be accessed with full permissions
0x06020000	The access object does not exist	The object does not exist in the object dictionary.
0x06040041	PDO mapping error	The object cannot be mapped to PDO
0x06040042	PDO length error	The number and length of mapped objects exceed the PDO length.
0x06040043	General parameter error	General parameters are incompatible
0x06040047	Internal error in general equipment	Internal incompatibility of general equipment
0x06060000	Hardware error	Hardware error caused object access failure

0x06070010	Invalid service parameter	Data type does not match. The service parameter length is incorrect.
0x06070013	The service parameter is too short, causing an error.	The service parameter length is too short
0x06090011	Sub-index error	The sub-index does not exist
0x06090030	Invalid parameter value range	Value outside the specified parameter range
0x08000000	General fault	Unspecified general error
0x08000020	Data cannot be transmitted/saved	The data cannot be sent or saved to the application.
0x08000022	Device status error	The current device status prevents data from being sent or saved.
0x0F00FFBE	Wrong password	wrong password
0x0F00FFBF	Invalid instruction code	Illegal (non-existent) instruction code.
0x0F00FFC0	NMT status error	The device is in the incorrect NMT state and cannot perform the requested operation.

8.2. Device Error Code

Table 8-2 Equipment Error Report Table

code	Bus error code (0x603F)	Error Name	Type of Error
E101	0x2320	IPM bridge short circuit	Driver failure
E103	0x5210	Current sensor malfunction	Driver failure
E105	0x5211	The current sensor is abnormal when enabled.	Driver failure
E107	0x6321	EEPROM write failed	Driver failure
E120	0x2222	Hardware Overcurrent	Driver failure

E121	0x2221	Software Overcurrent	Driver failure
E123	0x4210	Motor overheating	Driver failure
E124	0x4310	MOS driver overtemperature	Driver failure
E125	0x2350	Driven overload	Driver failure
E126	0x7121	Stall fault	Driver failure
E127	0x2351	Motor overload	Driver failure
E129	0x7122	Motor phase loss	Driver failure
E130	0x3210	DC bus overvoltage	Driver failure
E131	0x3220	Direct current busbar under-voltage	Driver failure
E139	0xFF04	internal error	Driver failure
E140	0xFF10	Error occurred during driver parameter initialization	Driver failure
E141	0x6322	MCU parameter initialization verification error	Driver failure
E157	0x6323	Invalid EEPROM version information	Driver failure
E158	0x6320	Parameter EEPROM error	Driver failure
E160	0xFF24	Save and restart after power off	Driver failure
E161	0xFF03	Perform the configuration action	Driver failure
E203	0x7510	The first encoder communication connection has been lost.	Motor encoder failure
E206	0x7521	Failed to initialize the encoder model	Motor encoder failure
E209	0x7515	First encoder CRC error	Motor encoder failure
E230	0xFF11	Loading motor parameter error	Motor encoder

			failure
E302	0x8611	The positional deviation is too large.	Application Fault
E303	0x8400	The speed variation is too large.	Application Fault
E304	0x8401	Over-speed fault	Application Fault
E308	0xFF35	Electronic gear ratio calculation overflow	Application Fault
E309	0xFF36	Electronic gear ratio out of range	Application Fault

9. Appendix

9.1. Warranty Policy and Duration

1) General Rules

Thank you for choosing the planetary joint module manufactured by our company (hereinafter referred to as the "Product"). We guarantee that the Product meets stringent quality standards in both materials and manufacturing processes. This chapter provides detailed information on the warranty services, duration, scope, and applicable liability limitations for the product. Please review them carefully before use.

2) Warranty Period

The product is covered by a limited warranty for 12 months starting from the customer's receipt date.

3) Warranty Scope

During the warranty period, provided that the product is installed, used, and maintained properly, our company will provide free repair or replacement services for any malfunction caused by material defects or manufacturing defects. Services include, but are not limited to:

- ① Fracture of the planetary reducer (sun gear, planet gears, and ring gear).
- ② Short circuit in the integrated motor winding; magnetic steel detachment.
- ③ Absolute encoder; the driver is functionally failed.
- ④ Abnormal wear or damage to the bearing.

4) Outside Warranty Coverage

The following causes of failure or damage are not covered by the free warranty; our company provides paid repair services for such cases:

- ① Excessive operation: Operating beyond the rated torque, rotational speed, inertia

matching, or overload capacity specified in the product manual.

- ② Incorrect installation and operation: Failure to follow the manual requirements for installation (e.g., improper or overly tight fit), wiring (e.g., reversed power connection or incorrect voltage), parameter configuration, or operational procedures.
- ③ External Environment and Disasters: Damage caused by use in non-compliant environments (e.g., high dust levels, humidity, corrosive gases, extreme temperatures), or due to force majeure events such as fire, water immersion, earthquakes, lightning strikes, or voltage surges.
- ④ External factors: Physical injuries caused by transportation impacts, falls, external shocks, or other accidental human interventions.
- ⑤ Unauthorized maintenance: Disassembly, repair, or modification performed by users or technicians not authorized by the company.
- ⑥ Normal wear and tear: This refers to normal performance degradation or wear (e.g., the natural depletion of grease over time).
- ⑦ Included accessories: Standard components such as the power cord and signal cable provided with the product.

5) Warranty Service Process

- ① If you encounter a product malfunction, please first contact our company's technical support department for remote diagnosis.
- ② If you need to return the product for testing or repair, please confirm in advance with our sales representative. Our company reserves the right to reject any products that have not been confirmed for return.
- ③ Please package the product properly (it is recommended to use the original packaging), attach a detailed description of the issue and contact information, and send it to the

address specified by our company. Any damage incurred during transportation shall be borne by the sender.

- ④ Upon receiving the product, our company will conduct tests to determine whether the fault falls within the warranty coverage.
- ⑤ If the product is covered by warranty: our company will provide free repair or replacement and cover the cost of returning the repaired product.
- ⑥ For items not covered by warranty: Our company will issue a test report and provide a paid repair quote. The repair will be carried out after your confirmation and payment.

6) Limitation of Liability

- ① This warranty policy supersedes and excludes all other express or implied warranty terms.
- ② This warranty policy is the sole and exclusive remedy available to you.
- ③ Under no circumstances shall our company be liable for indirect, incidental, specific, or consequential losses arising from the use or non-use of the product (including but not limited to data loss, production downtime, or profit impairment).

7) Other

This warranty policy applies only to products purchased through the company's official channels or authorized distributors.

The company reserves the final right to interpret this warranty policy and to revise it at any time without prior notice. The latest version shall be as published on the Company's official website.

Important Notice: Proper installation, standardized operation, and regular maintenance are crucial for extending product lifespan. Please carefully review the remaining chapters of this manual to ensure optimal product performance. Keep your purchase receipt securely. **Important Notice:** Proper installation, standardized operation, and regular maintenance are crucial for extending product lifespan. Please carefully review the remaining chapters of this manual to ensure optimal product performance. Keep your purchase receipt securely.

9.2. Contact Information and Technical Support

1) Important Notice

Before contacting us, we recommend that you:

- ① Refer to this manual: The issue you are experiencing is likely detailed in relevant sections such as "Operation, Installation, and Troubleshooting."
- ② Prepare product information: Please provide the product model and device serial number (S/N). Our technical support staff requires this information to assist you.
- ③ Describe the issue: Provide a detailed description of the problem symptoms, their frequency, and any solutions you have tried. This will significantly improve support efficiency.

2) Technical Support and Services

We offer you multiple technical support channels:

- ① Technical Contact Information:

Table 9-1 Technical Support Contact Information

engineer	telephone	postbox
Engineer Shen (East China Region)	15251673298	jun.shen@eyoubot.com
Engineer Lu (East China Region)	17851788985	congsheng.lu@eyoubot.com
Engineer Chen (South China Region)	18961828318	yin.chen@eyoubot.com
Engineer Tong (South China Region)	18033095498	wenyu.tuo@eyoubot.com
Mr.Li (North China Region)	15833086282	jinzhaoli@eyoubot.com
Mr.Li (Taobao)	18362391134	xiaoen.li@eyoubot.com

- ② Opening hours: Monday to Friday, 9:00 AM – 12:00 PM, 1:30 PM – 6:00 PM (Beijing Time, excluding public holidays).
- ③ Technical support email: see Table 9-1. When sending an email, please include the product model and a brief description of the issue in the subject line (e.g., "Inquiry regarding the power-on initialization alarm"). We will respond within 1–3 working days.

- ④ Online Support and Document Center: Visit our official website www.eyoubot.com and navigate to the [Services and Support] section, where you can find product technical documentation, manuals, and application notes.

3) After-sales Service and Maintenance

If you need to return the product to the factory for repair or inspection, please contact our sales staff first to obtain the shipping address:

Jiangsu EYou Robot Technology Co., Ltd.

Receiving Department: After-sales Service Department

Address: Obtained from the sales staff

Contact number: Obtain from the sales staff

4) Business Relation

Sales Consultation: Sales Consultation:

Area	Sell	Telephone	Postbox
East China	Manager Chen	17508913141	csl@eyoubot.com
North China	Manager Wang	18611151809	wx@eyoubot.com
south China	Manager Peng	17620316328	pj@eyoubot.com
southwest	Manager Huang	19822950310	hwn@eyoubot.com

5) Official Information Channels

To ensure you receive accurate product information and safety notices, please consult only through our company's official website or the contact details provided in this manual. Our company assumes no responsibility for information or services provided through unauthorized third-party channels.

9.3. Glossary

Noun	Definition
Joint Module	A highly integrated mechatronic unit that combines key components such as drivers, motors, reducers, encoders, and brakes within a

	compact housing, directly generating rotational motion to serve as the robot's core joint.
Planetary reducer	A planetary reducer is a precision transmission device that utilizes a "planetary gear system" to achieve speed reduction and torque multiplication. It primarily consists of components such as the sun gear, planet gears, and a ring gear.
Frameless torque motor	A high-performance direct-drive motor typically consists of an independent rotor and stator, eliminating the need for additional bearings or enclosures, allowing it to be directly integrated into customers' mechanical structures.
servo drivers	The control core of the joint module receives commands from the host computer and drives the motor to operate. It integrates control algorithms, power amplification circuits, and communication interfaces.
Absolute encoder	A sensor capable of recording and providing feedback on the current position information (absolute coordinates), ensuring that positional data is not lost even after power failure and allowing accurate position restoration without zeroing.
Arrester	A safety device, typically a power-off brake (normally closed type). It automatically closes under servo activation, power failure, or fault conditions to lock the output shaft and prevent load slippage.
Nominal Torque	At the rated input speed, the reducer output end can withstand a continuously applied load torque.
Peak Torque	The maximum torque a joint can withstand during startup, shutdown, or short-term overload. Exceeding this value may lead to damage.
Maximum Allowable Torque at a Given Instant	The maximum value of the unpredictable, transient impact torque from external sources that the reducer can withstand.

Return to Zero/Zero Point Calibration	The process of determining the mechanical zero point of the joint. This operation establishes a correspondence between the encoder's count value and the mechanical position, serving as the foundation for ensuring absolute positioning accuracy.
position mode	The controller sends target position commands to the joint, where internal closed-loop control enables precise position tracking.
Speed Mode	The controller sends the target speed command to the joint, which then operates at the specified speed.
Current/Torque Mode	The controller sends the target current (I_q) command to the joint, directly controlling the motor's output torque.
Enable	A control signal used to activate the servo driver. When enabled upward, the driver prepares to receive commands and drive the motor; when enabled downward, the driver stops outputting signals and the brake typically engages.
CANOpen	The high-level communication protocol built on the CAN bus defines standard communication objects and device profiles, and is widely used in embedded control networks.
Over-voltage Protection	When the bus voltage exceeds the safety threshold (e.g., 60 V), the driver automatically activates its protection function, triggering an error shutdown to prevent equipment damage.
Under-voltage Protection	When the bus voltage falls below the minimum operating voltage (e.g., 24V), the driver automatically activates its protection function, which may prevent the brake from opening properly.
Thread Fastener	A chemical agent applied to threads to prevent screws from loosening due to vibration. It must be used when installing joint flange screws to ensure connection reliability.

*Note: As products evolve, some terminology definitions or features may be updated. Refer to the

latest official documentation for accurate information.