Laifual®



Rotary Actuator

Low-voltage Series

User Manual

Zhejiang Laifual Drive Co., Ltd.

Preface

Thank you very much for using our low-voltage series products.

Incorrect operation and improper use of this product may lead to accidents and shorten the product's lifespan. To ensure long-term and safe use of this product, please read this manual carefully before use.

Our company reserves the right to change the contents of this manual without notice.

Company names and product names mentioned in this manual are generally registered trademarks or trademarks of their respective companies.

Please keep this manual properly. Make sure to deliver this manual to the end user.

Safety Precautions for Safe Use

To ensure the safe and correct use of this product, please read the "Safety Precautions for Safe Use" and the main text thoroughly before use, and fully understand the contents.

Symbol Explanation

The safety-related warnings provided here are important. Please be sure to follow them diligently.

 Warning	Indicates that incorrect operation may result in death or serious injury.
 Caution	Indicates that incorrect operation may result in injury or property damage.
Warning	Indicates measures that should be taken or avoided to prevent malfunction,

Usage Restrictions

This product is not recommended for the following applications. If necessary, please consult with our company in advance.

·Aerospace equipment	· Aircraft equipment	· Nuclear equipment	· Vacuum equipment
· Automotive equipment	· Gaming facilities	· Equipment directly affecting the human body	
· Household equipment and appliances		· Equipment intended for transporting people	
· Equipment for special environments			

Precautions for Using Actuators

- **Usage Precautions**

 Caution	**Use Only Within the Specified Operating Environment** The actuator is designed for indoor use. Please follow the conditions below: ● Operating temperature: -10 to 55˚C (standard grease) -30 to 55˚C (low-temperature grease) ● Storage temperature: -20 to 80˚C(standard grease) -40 to 80˚C (low-temperature grease) ● Ambient humidity: 20–80% RH (non-condensing) ● Vibration: 25 m/s² or below ● Avoid exposure to water, oil, or similar liquids. ● Ensure no corrosive or explosive gases are present. **Install the Actuator Using the Specified Methods** ● Follow the technical documentation to properly align the actuator with the driven mechanical components. ● Any misalignment of the center axis may cause vibration or damage to the output shaft.

- **Usage Precautions**

 Caution	**Do not exceed the allowable torque.** ●The applied torque shall not exceed the maximum torque. ●If a robotic arm or other load is directly mounted on the output shaft, collision of the arm will result in loss of output shaft control. **Do not plug or unplug the battery while power is off.** ● Plugging/unplugging the battery in a power-off state will cause loss of multi-turn encoder counts and abnormal turn-switching positions.After plugging/unplugging the battery with power off, encoder synchronization calibration must be performed. Refer to the《Synchronization Calibration Operation Manual》for details. **Do not pull cables with excessive force.** ● Forcible pulling of cables will damage wiring terminals and cause loss of actuator control. **Notes on suspended no-load operation** ● Joints generate heat even during no-load operation. Modules without complete

	physical installation lack heat dissipation paths, leading to continuous temperature rise and eventual thermal protection triggering. Exercise caution during testing.Overheating occurring during continuous high-speed suspended operation is not indicative of module failure. No additional heat dissipation components are required once the module is properly installed. **Risk of metal debris entering connector gaps** ● Thoroughly clean the mounting housing surface before installation and ensure the working environment is free of metal debris, such as metal shavings generated during screw disassembly for robot assembly, grinding residues from machined fitting surfaces, and broken copper wire fragments from cable fabrication. ● During installation and wiring, prevent metal debris from falling into gaps of electrical connectors on the joint rear cover (including CAN, EtherCAT, RS485, IO, multi-turn battery and power connectors), through-holes, and the hollow joint bore (where the output-side encoder code disc is installed. Otherwise, poor communication and electrical failures will occur. **Do not plug or unplug power and communication cables while powered on.** ● Perform wiring and inspection work only after confirming the Power LED indicator is off. ● The ground potential levels of the master controller and joint may differ when unconnected. The potential difference between the two grounds at the moment of connection can damage CAN, EtherCAT and RS485 interfaces. **Select power supplies per recommended specifications** ● Select module power supplies complying with recommended specifications. Undersized power supplies may trigger under-voltage alarms during operation. **External discharge resistors are recommended** ● Unexpected power loss or emergency stop triggered by faults generates high peak surge voltages. Modules are highly susceptible to damage without discharge resistors installed. ● Excessive load, speed or acceleration leads to high operating currents, which can easily damage modules if discharge resistors are not fitted.

Disposal Instructions

 Caution	**Please dispose of this product in accordance with industrial waste disposal standards.** When discarding the product, disassemble it as much as possible. Components with material markings should be sorted according to their labels and disposed of following the appropriate industrial waste regulations.

Content

Preface I
Safety Precautions for Safe Use II
Symbol Explanation II
Usage Restrictions II
Precautions for Using Actuators III
Disposal Instructions V
Chapter 1 Overview 9
Chapter 2 Model Naming Rules and Parameters 10
Model Naming Rules 10
Module Parameters 11
Chapter 3 Input Power Specifications, ... 25
Electrical Interfaces and Cables 25
Power Specifications 25
Electrical Interfaces and Instructions 27
CAN communication interface 27
L40I-C/F 28
L52I-C/F 28
L60I-C/F 29
L70I-C/F 29
L80I-C/F 30
L90I-C/F 30
L110I-C/F 31
L142I-C/F 31
L170I-C/F 32
EtherCAT communication interface 33
L40I-E 34
L52I-E 34
L60I-E 35
L70I-E 35
L80I-E 36
L90I-E 37
L110I-E 37
L142I-E 38
L170I-E 38

L190I-E 39
485 communication interface 40
Cable Specification 40
Chapter 4 Multi-Joint Connection Configuration 42
CANopen/CAN FD Communication Wiring Diagram 42
EtherCAT Communication Wiring Diagram 42
Chapter 5 Brake 44
Brake Precautions 44
Brake Lifetime 45
Forced Brake Release 45
Brake Power 45
Chapter 6 Encoder Specifications 46
Specifications 46
Output Shaft Resolution 46
Absolute Position Data Conversion 47
Multi-turn Encoder Backup Battery 47
Chapter 7 Environment and Installation 48
Operating Environment 48
Installation Steps 48
Discharge Module Description 51
Chapter 8 Debugging and Operation 56
Introduction 56
Installation 56
Hardware Connection Block Diagram 56
Steps to Connect to the software 57
Chapter 9 JOG Test Run 58
JOG control 58
The program JOG 58
Chapter 10 Key Parameter Verification and Rigidity Adjustment 60
Parameter confirmation 61
Rigidity Adjustment 65
Chapter 11 Firmware Upgrade and Initialization 67
Upgrade via RS-485 Firmware 67
Firmware Upgrade via J-LINK 71
Chapter 12 CANopen Configuration Example 77
Chapter 13 EtherCAT Configuration Example 86
EtherCAT Configuration Operation Case for Beckhoff Controller 86

EtherCAT Configuration Operation Case for Inovance Controller 125
EtherCAT Configuration Operation Case for Xinje Controller 134
Chapter 14 CAN FD Message Description 152
Appendix 1 Module Dimension Drawing 155
L-40-I-XX 155
L-52-I-XX 156
L-60-I-XX 156
L-70-I-XX 157
L-80-I-XX 157
L-90-I-XX 158
L-110-I-XX 158
L-142-I-XX 159
L-170-I-XX 159
L-190-I-XX 160
Appendix 2 Parameters 161
Firmware Parameters 161
CANopen Alarm Code 173
CAN FD Alarm Code 175
EtherCAT Alarm Code 176
Appendix 3 Battery Safety Precautions 178
Appendix 4 Frequently Asked Questions (FAQ) 179
Chapter 15 Document Revision Record 180
Document Revision Record 180

Chapter 1 Overview

The low-voltage series comprises servo rotary modules that deliver high torque and precise rotational movements. These modules are composed of FHG-type reducers, motors, and encoders, available in models ranging from 11 to 40.

These products are widely used in the following fields:CNC machine tools,Laser processing,Electronics and semiconductors,Factory automation,Medical devices,Robotics,Logistics automation,Solar photovoltaic systems,LED equipment,Testing devices,Printing machinery,Precision measuring instruments,Aerospace equipment,Aircraft-related applications,FPD (Flat Panel Display) manufacturing equipment.

Advantages:

Power Supply Voltage

●DC48V

Excellent Environmental Adaptability

- IP54 protection rating
- Compliant with neutral salt spray requirements
- Operating temperature: -10 ~ 55 ℃ (standard grease);
  -30 ~ 55 ℃ (low-temperature grease)
- Storage temperature: -20 ~ 80 ℃ (standard grease);
  -40 ~ 80 ℃ (low-temperature grease)
- Resistance to cyclic damp heat

Highly Integrated Product Design

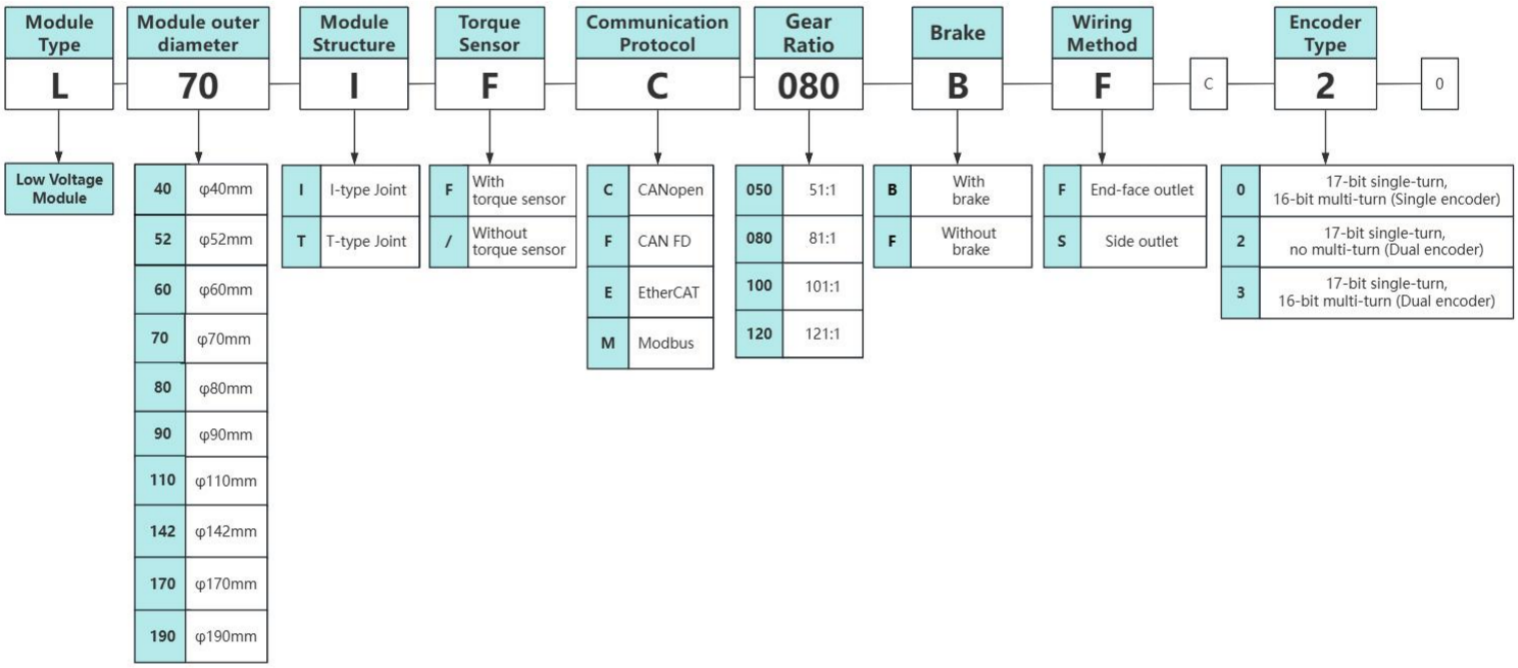
- Integrated with harmonic reducer, motor, encoder and drive
- Extra-large hollow bore for easy routing of cables, pipelines and laser lines
- Flange mounting structure

Superior Product Performance

- Over 20% higher torque under the same volume
- Excellent dynamic performance with ultra-low noise and vibration
- Maintenance-free throughout the entire service life
- Ultra-high positioning accuracy

Chapter 2 Model Naming Rules and Parameters

Model Naming Rules



Detailed Product Model Description (Example: L70IFC080BFC20)

L	Low-voltage series
70	Module outer diameter, unit: mm
I	Modular structure:I-type,T-type
F	Torque-sensor option: F: with torque sensor; / : without torque sensor
C	Communication protocol C: CANopen F: CAN FD E: EtherCAT M: Modbus
080	Reducer gear ratio: 81 motor shaft revolutions per one output-shaft revolution.
B	Brake option: B: With brake,F: Without brake

F	Cable outlet style: F: End-face outlet,S: Side outlet
2	Encoder type 0: 17-bit single-turn,16-bit multi-turn (single encoder) 2: 17-bit single-turn, no multi-turn (dual encoders) 3: 17-bit single-turn,16-bit multi-turn (dual encoders)

Module Parameters

The performance specifications of the low-voltage series modules are as follows:

Model			L40l	
Reduction Ratio			51	101
Input Voltage		V	48（±10%）	
Maximum Torque		N·m	4.6	6.3
		kgf·m	0.47	0.64
Permissible Continuous Torque		N·m	1.6	2.3
		kgf·m	0.16	0.23
Peak Starting Torque		N·m	2.3	3.3
		kgf·m	0.23	0.34
Maximum Speed		r/min	98	49.5
Rated Speed		r/min	78.4	39.6
Torque Constant		N·m/A	0.56	1.11
		kgf·m/A	0.06	0.11
Maximum Current		A	4.09	2.96
Permissible Continuous Current		A	2.84	2.06
Back EMF Constant		V/Krpm	4.95	
Phase Resistance(20℃)		Ω	1.9	
Phase Inductance		mH	0.31	
Moment of Inertia	$GD^2/4$	$kg \cdot mm^2$	3	
	J	$kgf \cdot cm \cdot s^2$	3*10^-4	
Repeatability*1		Arc-sec	20	
Positioning Accuracy*2		Arc-sec	60	
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus	
Encoder Resolution		Single-turn Detector	17bit（131072pulses per revolution）	

	Multi-turn Detector	16bit（-32768~32767turns）	
Output Shaft Resolution	Pulses per Revolution	6684672	13238272
Mass	kg		
Ambient Conditions		Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20–80% RH (non-condensing) Vibration Resistance: 25m/s^2(Frequency：10～400Hz) Shock Resistance：300m/s^2 No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sun light Altitude below 1000m	
Design Life (H)		10000	
Motor Insulation		Insulation Resistance：Above 500 M Ω Withstand Voltage：AC1500 V / 1 min Insulation Class : Class F (155 °C)	
Installation Direction		Can be installed in all directions	
Protection Level		Totally enclosed, self-cooling type (IP54)	

Model		L52I	
Reduction Ratio		51	101
Input Voltage	V	48（±10%）	
Maximum Torque	N ·m	17	25
	kgf ·m	1.73	2.55
Permissible Continuous Torque	N ·m	5.5	8.9
	kgf ·m	0.56	0.91
Peak Starting Torque	N ·m	8.3	11
	kgf ·m	0.85	1.12
Maximum Speed	r/min	98	49.5
Rated Speed	r/min	78.4	39.6
Torque Constant	N ·m/A	1.84	3.64
	kgf ·m/A	0.19	0.37
Maximum Current	A	4.52	3.03
Permissible Continuous Current	A	3.00	2.45
Back EMF Constant	V/Krpm	5.1	

Phase Resistance(20℃)		Ω	0.93	
Phase Inductance		mH	0.2	
Moment of Inertia	GD²/4	kg ·mm²	12.8	
	J	kgf ·cm ·s²	12.8*10^-4	
Repeatability*1		Arc-sec	20	
Positioning Accuracy*2		Arc-sec	60	
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus	
Encoder Resolution		Single-turn Detector	17bit（131072pulses per revolution）	
		Multi-turn Detector	16bit（-32768~32767turns）	
Output Shaft Resolution		Pulses per Revolution	6684672	13238272
Mass		kg		
Ambient Conditions			Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20–80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sun light Altitude below 1000m	
Design Life (H)			10000	
Motor Insulation			Insulation Resistance：Above 500 M Ω Withstand Voltage：AC1500 V / 1 min Insulation Class : Class F (155 °C)	
Installation Direction			Can be installed in all directions	
Protection Level			Totally enclosed, self-cooling type (IP54)	

Model		L60I	
Reduction Ratio		51	101
Input Voltage	V	48（±10%）	
Maximum Torque	N ·m	17	25
	kgf ·m	1.73	2.55
Permissible Continuous Torque	N ·m	5.5	8.9
	kgf ·m	0.56	0.91
Peak Starting Torque	N ·m	8.3	11

		kgf ·m	0.85	1.12
Maximum Speed		r/min	117.6	59.4
Rated Speed		r/min	98	49.5
Torque Constant		N ·m/A	2.25	4.47
		kgf ·m/A	0.23	0.46
Maximum Current		A	3.68	2.46
Permissible Continuous Current		A	2.44	1.99
Back EMF Constant		V/Krpm	5.43	
Phase Resistance(20℃)		Ω	0.53	
Phase Inductance		mH	0.23	
Moment of Inertia	GD²/4	kg ·mm²	15.5	
	J	kgf ·cm ·s²	15.5*10^-4	
Repeatability*1		Arc-sec	20	
Positioning Accuracy*2		Arc-sec	60	
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus	
Encoder Resolution		Single-turn Detector	17bit（131072pulses per revolution）	
		Multi-turn Detector	16bit（-32768~32767turns）	
Output Shaft Resolution		Pulses per Revolution	6684672	13238272
Mass		kg		
Ambient Conditions			Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20–80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sun light Altitude below 1000m	
Design Life (H)			10000	
Motor Insulation			Insulation Resistance：Above 500 M Ω Withstand Voltage：AC1500 V / 1 min Insulation Class : Class F (155 °C)	
Installation Direction			Can be installed in all directions	
Protection Level			Totally enclosed, self-cooling type (IP54)	

Model			L70I		
Reduction Ratio			51	81	101
Input Voltage		V	48（±10%）		
Maximum Torque		N ·m	46	61	70
		kgf ·m	4.69	6.22	7.14
Permissible Continuous Torque		N ·m	9	14	14
		kgf ·m	0.92	1.43	1.43
Peak Starting Torque		N ·m	23	30	36
		kgf ·m	2.35	3.06	3.67
Maximum Speed		r/min	107.8	67.9	54.5
Rated Speed		r/min	58.8	37.0	29.7
Torque Constant		N ·m/A	0.08	0.08	0.08
		kgf ·m/A	0.0082	0.0082	0.0082
Maximum Current		A	8.25	6.77	6.52
Permissible Continuous Current		A	3.23	3.16	2.53
Back EMF Constant		V/Krpm	6.15		
Phase Resistance(20℃)		Ω	0.39		
Phase Inductance		mH	0.3		
Moment of Inertia	GD²/4	kg ·mm²	61.2		
	J	kgf ·cm ·s²	61.2*10^-4		
Repeatability*1		Arc-sec	20		
Positioning Accuracy*2		Arc-sec	60		
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus		
Encoder Resolution		Single-turn Detector	17bit（131072pulses per revolution）		
		Multi-turn Detector	16bit（-32768~32767turns）		
Output Shaft Resolution		Pulses per Revolution	6684672	10616832	13238272
Mass		kg	1.01KG		
Ambient Conditions			Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20–80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz)		

	Shock Resistance：300m/s^2 No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sun light Altitude below 1000m
Design Life (H)	10000
Motor Insulation	Insulation Resistance：Above 500 M Ω Withstand Voltage：AC1500 V / 1 min Insulation Class : Class F (155 °C)
Installation Direction	Can be installed in all directions
Protection Level	Totally enclosed, self-cooling type (IP54)

Model			L80I			
Reduction Ratio			51	81	101	121
Input Voltage		V	48 (±10%)			
Maximum Torque		N ·m	91	113	143	112
		kgf ·m	9. 29	11. 53	14. 59	11. 43
Permissible Continuous Torque		N ·m	34	35	51	51
		kgf ·m	3. 47	3. 57	5. 20	5. 20
Peak Starting Torque		N ·m	44	56	70	70
		kgf ·m	4. 49	5. 71	7. 14	7. 14
Maximum Speed		r/min	98	61. 7	49. 5	41. 3
Rated Speed		r/min	58. 8	37	29. 7	24. 8
Torque Constant		N ·m/A	0. 09	0. 09	0. 09	0. 09
		kgf ·m/A	0. 0092	0. 0092	0. 0092	0. 0092
Maximum Current		A	13. 48	10. 80	10. 83	9. 04
Permissible Continuous Torque		A	10. 42	6. 75	7. 89	6. 59
Back EMF Constant		V/Krpm	6.67			
Phase Resistance(20℃)		Ω	0.14			
Phase Inductance		mH	0.3			
Moment of Inertia	GD^2/4	kg ·mm^2	65			
	J	kgf ·cm ·s^2	65*10^-4			
Repeatability*1		Arc-sec	20			
Positioning Accuracy*2		Arc-sec	60			
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus			

Encoder Resolution	Single-turn Detector	17bit（1310722 pulses per revolution）			
	Multi-turn Detector	16bit（-32768~32767turns）			
Output Shaft Resolution	Pulses per Revolution	6684672	10616832	13238272	15859712
Mass	kg	1.36KG			
Ambient Conditions		Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20 -80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300 m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sunlight Altitude below 1000m			
Design Life (H)		10000			
Motor Insulation		Insulation Resistance：Above 500 MΩ Withstand Voltage：AC1500 V / 1 min Insulation Class: Class F (155°C)			
Installation Direction		Can be installed in all directions			
Protection Level		Totally enclosed, self-cooling type (IP54)			

Model		L90I			
Reduction Ratio		51	81	101	121
Input Voltage	V	48 (±10%)			
Maximum Torque	N ·m	127	165	191	191
	kgf ·m	12. 96	16. 84	19. 49	19. 49
Permissible Continuous Torque	N ·m	44	61	64	64
	kgf ·m	4. 49	6. 22	6. 53	6. 53
Peak Starting Torque	N ·m	73	96	107	113
	kgf ·m	7. 45	9. 80	10. 92	11. 53
Maximum Speed	r/min	78. 4	49. 4	39. 6	33. 1
Rated Speed	r/min	58. 8	37. 0	29. 7	24. 8
Torque Constant	N ·m/A	0. 10	0. 11	0. 11	0. 11
	kgf ·m/A	0. 0112	0. 0112	0. 0112	0. 0112
Maximum Current	A	19. 59	15. 15	13. 54	11. 94

Permissible Continuous Current		A	11. 81	9. 63	8. 10	6. 76
Back EMF Constant		V/Krpm	6.78			
Phase Resistance(20℃)		Ω	0.11			
Phase Inductance		mH	0.24			
Moment of Inertia	GD²/4	kg·mm²	101			
	J	kgf·cm·s²	101*10^-4			
Repeatability*1		Arc-sec	20			
Positioning Accuracy*2		Arc-sec	60			
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus			
Encoder Resolution		Single-turn Detector	17bit（131072 pulses per revolution）			
		Multi-turn Detector	16bit（-32768~32767turns）			
Output Shaft Resolution		Pulses per Revolution	6684672	10616832	13238272	15859712
Mass		kg	1.86KG			
Ambient Conditions			Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20 -80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300 m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sunlight Altitude below 1000 m			
Design Life (H)			10000			
Motor Insulation			Insulation Resistance：Above 500 MΩ Withstand Voltage：AC1500 V / 1 min Insulation Class: Class F (155 °C)			
Installation Direction			Can be installed in all directions			
Protection Level			Totally enclosed, self-cooling type (IP54)			

Model		L110I			
Reduction Ratio		51	81	101	121
Input Voltage	V	48 (±10%)			
Maximum Torque	N ·m	242	332	369	395
	kgf ·m	24. 69	33. 88	37. 65	40. 31

Permissible	N ·m	72	113	140	140
Continuous Torque	kgf ·m	7. 35	11. 53	14. 29	14. 29
Peak Starting Torque	N ·m	127	178	204	217
	kgf ·m	12. 96	18. 16	20. 82	22. 14
Maximum Speed	r/min	78. 4	49. 4	39. 6	33. 1
Rated Speed	r/min	58. 8	37. 0	29. 7	24. 8
Torque Constant	N ·m/A	0. 11	0. 11	0. 11	0. 11
	kgf ·m/A	0. 0112	0. 0112	0. 0112	0. 0112
Maximum Current	A	32. 42	28. 61	26. 30	23. 35
Permissible Continuous Current	A	18. 38	18. 16	18. 05	15. 07
Back EMF Constant	V/Krpm	6.88			
Phase Resistance(20℃)	Ω	0.032			
Phase Inductance	mH	0.11			
Moment of Inertia GD²/4	kg ·mm²	201			
Moment of Inertia J	kgf ·cm ·s²	201*10^-4			
Repeatability[1]	Arc-sec	20			
Positioning Accuracy[2]	Arc-sec	60			
Bus Communication Protocol	/	CANopen/CAN FD/EtherCAT/Modbus			
Encoder Resolution	Single-turn Detector	17bit（131072 pulses per revolution）			
	Multi-turn Detector	16bit（-32768~32767turns）			
Output Shaft Resolution	Pulses per Revolution	6684672	10616832	13238272	15859712
Mass	kg	2.7KG			
Ambient Conditions		Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20 -80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300 m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sunlight Altitude below 1000 m			
Design Life (H)		10000			

Motor Insulation	Insulation Resistance：Above 500 MΩ Withstand Voltage：AC1500 V / 1 min Insulation Class: Class F (155℃)
Installation Direction	Can be installed in all directions
Protection Level	Totally enclosed, self-cooling type (IP54)

Model			L142I			
Reduction Ratio			51	81	101	121
Input Voltage		V	48 (±10%)			
Maximum Torque		N ·m	497	738	841	892
		kgf ·m	50. 71	75. 31	85. 82	91. 02
Permissible Continuous Torque		N ·m	140	217	281	281
		kgf ·m	14. 29	22. 14	28. 67	28. 67
Peak Starting Torque		N ·m	281	395	433	459
		kgf ·m	28. 67	40. 31	44. 18	46. 84
Maximum Speed		r/min	58. 8	37. 0	29. 7	24. 8
Rated Speed		r/min	39. 2	24. 7	19. 8	16. 5
Torque Constant		N ·m/A	0. 17	0. 17	0. 17	0. 17
		kgf ·m/A	0. 0173	0. 0173	0. 0173	0. 0173
Maximum Current		A	38. 93	34. 45	30. 29	26. 80
Permissible Continuous Current		A	19. 40	18. 93	19. 66	16. 41
Back EMF Constant		V/Krpm	11.2			
Phase Resistance(20℃)		Ω	0.036			
Phase Inductance		mH	0.12			
Moment of Inertia	GD²/4	kg ·mm²	625			
	J	kgf ·cm ·s²	625*10^-4			
Repeatability[1]		Arc-sec	20			
Positioning Accuracy[2]		Arc-sec	60			
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus			
Encoder Resolution		Single-turn Detector	17bit（131072 pulses per revolution）			
		Multi-turn Detector	16bit（-32768~32767turns）			
Output Shaft Resolution		Pulses per Revolution	6684672	10616832	13238272	15859712
Mass		kg	5.15KG			

Ambient Conditions	Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20 -80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300 m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sunlight Altitude below 1000 m
Design Life (H)	10000
Motor Insulation	Insulation Resistance：Above 500 MΩ Withstand Voltage：AC1500 V / 1 min Insulation Class: Class F (155℃)
Installation Direction	Can be installed in all directions
Protection Level	Totally enclosed, self-cooling type (IP54)

Model		L170I			
Reduction Ratio		51	81	101	121
Input Voltage	V	48 (±10%)			
Maximum Torque	N ·m	892	1270	1400	1530
	kgf ·m	91. 02	129. 59	142. 86	156. 12
Permissible Continuous Torque	N ·m	255	369	484	586
	kgf ·m	22. 96	37. 65	49. 39	59. 80
Peak Starting Torque	N ·m	523	675	738	802
	kgf ·m	53. 37	68. 88	75. 31	81. 84
Maximum Speed	r/min	49. 0	30. 9	24. 8	20. 7
Rated Speed	r/min	39. 2	24. 7	19. 8	16. 5
Torque Constant	N ·m/A	0. 17	0. 17	0. 17	0. 17
	kgf ·m/A	0. 0173	0. 0173	0. 0173	0. 0173
Maximum Current	A	87. 08	70. 76	62. 05	56. 28
Permissible Continuous Current	A	42. 46	38. 68	40. 69	41. 12
Back EMF Constant	V/Krpm	11. 31			
Phase Resistance(20℃)	Ω	0. 031			
Phase Inductance	mH	0. 105			

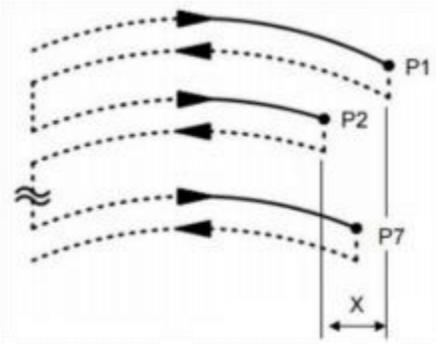
Moment of Inertia	$GD^2/4$	$kg \cdot mm^2$	1927			
	J	$kgf \cdot cm \cdot s^2$	1927*10^-4			
Repeatability[*1]		Arc-sec	20			
Positioning Accuracy[*2]		Arc-sec	60			
Bus Communication Protocol		/	CANopen/CAN FD/EtherCAT/Modbus			
Encoder Resolution		Single-turn Detector	17bit（131072pulses per revolution）			
		Multi-turn Detector	16bit（-32768~32767 turns）			
Output Shaft Resolution		Pulses per Revolution	6684672	10616832	13238272	15859712
Mass		kg	9.48kg			
Ambient Conditions			Operating Temperature:Standard grease: -10 to 55°C; Low-temperature grease: -30 to 55°C Storage Temperature:Standard grease: -20 to 80°C Low-temperature grease: -40 to 80°C Operating/Storage Humidity: 20 -80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300 m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sunlight Altitude below 1000m			
Design Life (H)			10000			
Motor Insulation			Insulation Resistance：Above 500 MΩ Withstand Voltage：AC1500 V / 1 min Insulation Class: Class F (155℃)			
Installation Direction			Can be installed in all directions			
Protection Level			Totally enclosed, self-cooling type (IP54)			

Model		L190I		
Reduction Ratio		81	101	121
Input Voltage	V	48（±10%）		
Maximum Torque	N·m	1651	2041	2288
	kgf·m	168.47	208.27	233.47
Permissible Continuous Torque	N·m	507	650	806
	kgf·m	51.73	66.33	82.24
Peak Starting Torque	N·m	918	982	1070
	kgf·m	93.67	100.20	109.18
Maximum Speed	r/min	18.5	14.9	12.4

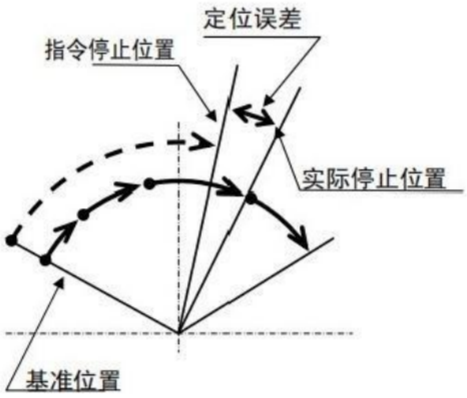
Rated Speed	r/min	18. 5	14. 9	12. 4
Torque Constant	N ·m/A	0. 29	0. 24	0. 24
	kgf ·m/A	0. 030	0. 024	0. 024
Maximum Current	A	56. 75	48. 69	44. 28
Permissible Continuous Current	A	31. 34	32. 23	33. 35
Back EMF Constant	V/Krpm	17. 90		
Phase Resistance(20℃)	Ω	0. 019		
Phase Inductance	mH	0. 120		
Moment of Inertia GD²/4	kg ·mm²	3604		
Moment of Inertia J	kgf ·cm ·s²	3604*10^-4		
Repeatability*1	Arc-sec	20		
Positioning Accuracy*2	Arc-sec	60		
Bus Communication Protocol	/	CANopen/CAN FD/EtherCAT/Modbus		
Encoder Resolution	Single-turn Detector	17bit（131072pulses per revolution）		
	Multi-turn Detector	16bit（-32768~32767turns）		
Output Shaft Resolution	Pulses per Revolution	10616832	13238272	15859712
Mass	kg			
Ambient Conditions		Operating Temperature:Standard grease: -10 to 55° C; Low-temperature grease: -30 to 55° C Storage Temperature:Standard grease: -20 to 80° C Low-temperature grease: -40 to 80° C Operating/Storage Humidity: 20 - 80% RH (non-condensing) Vibration Resistance: 25m/s²(Frequency：10～400Hz) Shock Resistance：300m/s² No dust, metal powder, corrosive gases, flammable gases, or oil mist Indoor use, avoid direct sun light Altitude below 1000m		
Design Life (H)		10000		
Motor Insulation		Insulation Resistance：Above 500 M Ω Withstand Voltage：AC1500 V / 1 min Insulation Class : Class F (155 °C)		
Installation Direction		Can be installed in a ll direct ions		
Protection Level		Totally enclosed, self-cooling type (IP54)		

*1 Repeatability: Refers to the precision with which the output shaft can return to a specific position after

performing seven repeated positioning operations from the same direction. This measurement is taken at four different positions on the output shaft, and the maximum difference among these positions is calculated.



*2Positioning Accuracy: Refers to the precision of positioning in a fixed rotational direction. At each position, the difference between the actual rotational angle and the intended rotational angle relative to a reference position is calculated. The maximum value of these differences within one full rotation is then recorded.



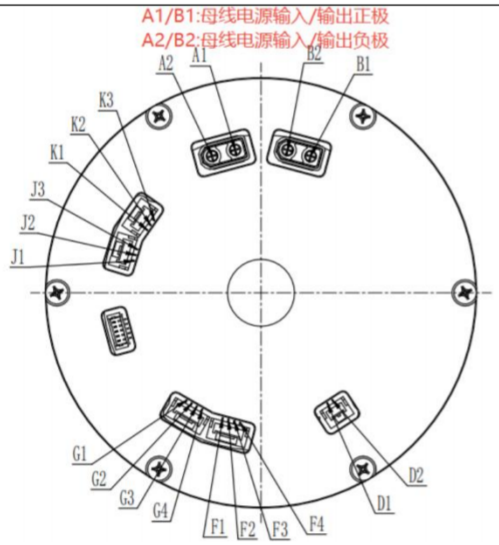
Chapter 3 Input Power Specifications,

Electrical Interfaces and Cables

Power Specifications

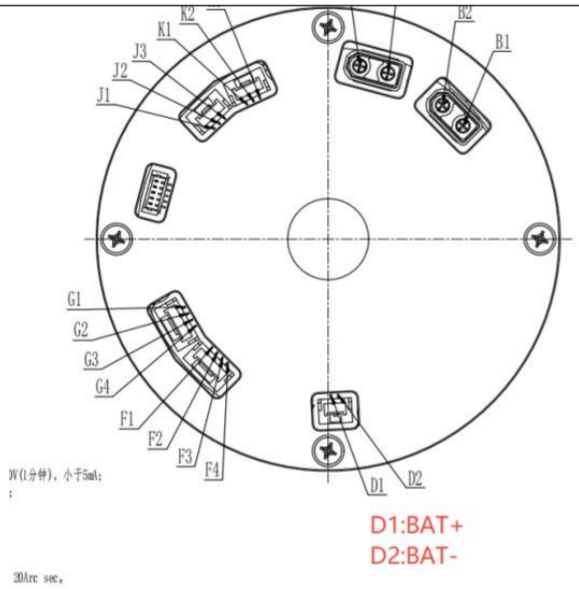
48V power supply interface

Pin	Terminal Label	Terminal function
1	DC+	Positive Power Supply
2	DC-	Negative terminal of Power Supply

Pin position	Connector
	
Connector Information	Wiring Terminal Information
Model：XT30UPB-M	Brands：ams Model：XT30U-F
Specifications：Straight legs, leg spacing 5mm, leg length 2mm, 2-Pin	Specifications：foot spacing 5mm 2Pin

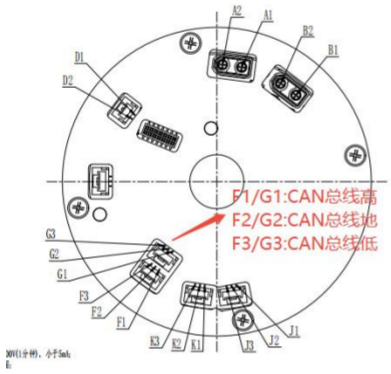
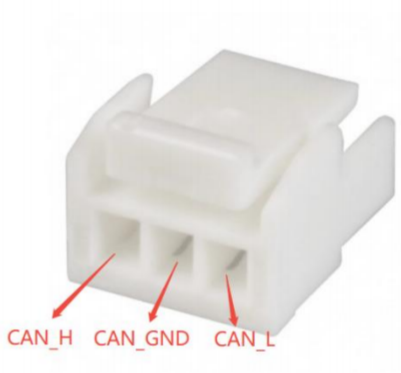
Multi-turn power supply battery interface

Pin	Terminal Label	Terminal function
1	BAT+	Multi-turn encoder backup battery positive terminal
2	BAT-	Multi-turn encoder backup battery negative terminal

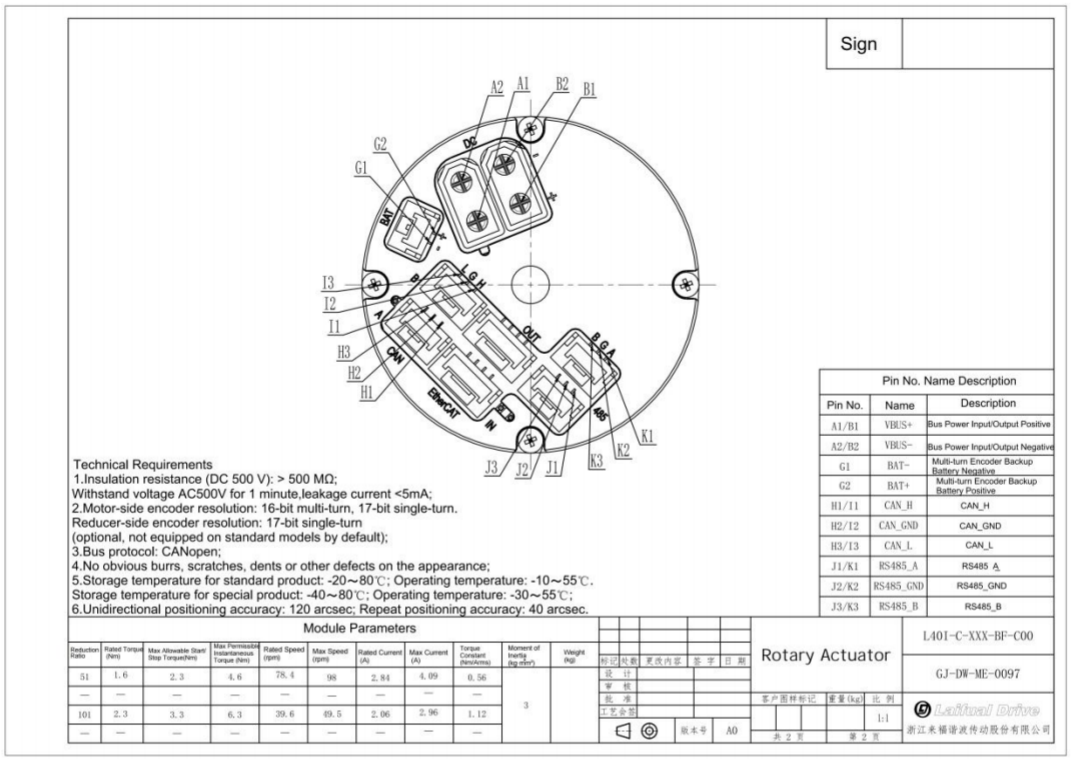
Pin Position	Connector
	
Connector information	Wiring terminal information
Model:BM02B-GHS-TBT	Brand:JST Housing model:GHR-02V-S Terminal model:SSHL-002T-P0.2
Specifications:Single row,1.25mm spacing,2 pins	Specifications:JST single-ended terminal block,1.25mm pitch,2 pins

Electrical Interfaces and Instructions

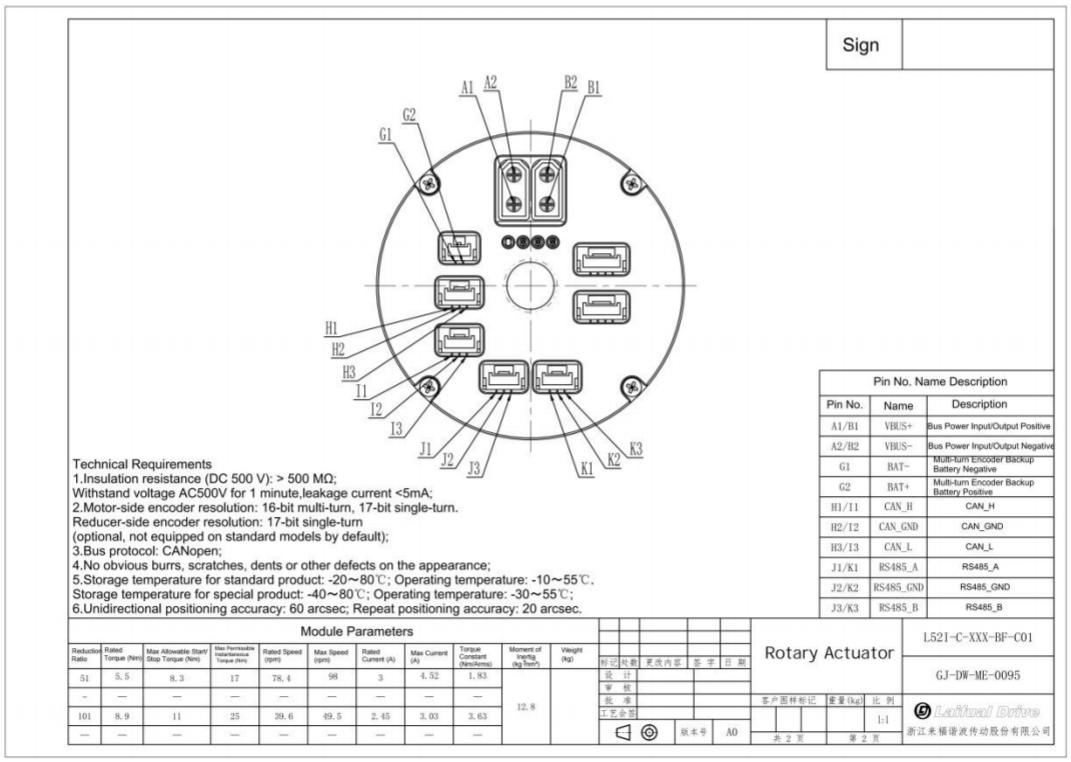
CAN communication interface

Pin	Terminal label	Terminal function
1	CAN_H	CAN bus high
2	CAN_GND	CAN bus ground
3	CAN_L	CAN bus low
Pin Position		Connector
		
Connector information		Wiring terminal information
Model:BM03B-GHS-TBT		Brand:JST Housing model:GHR-03V-S Terminal model:SSHLL-002T-P0.2 (or equivalent)
Specifications:Single row,1.25mm spacing,3 pins		Specifications:JST single-ended terminal block,1.25mm pitch,3-pin

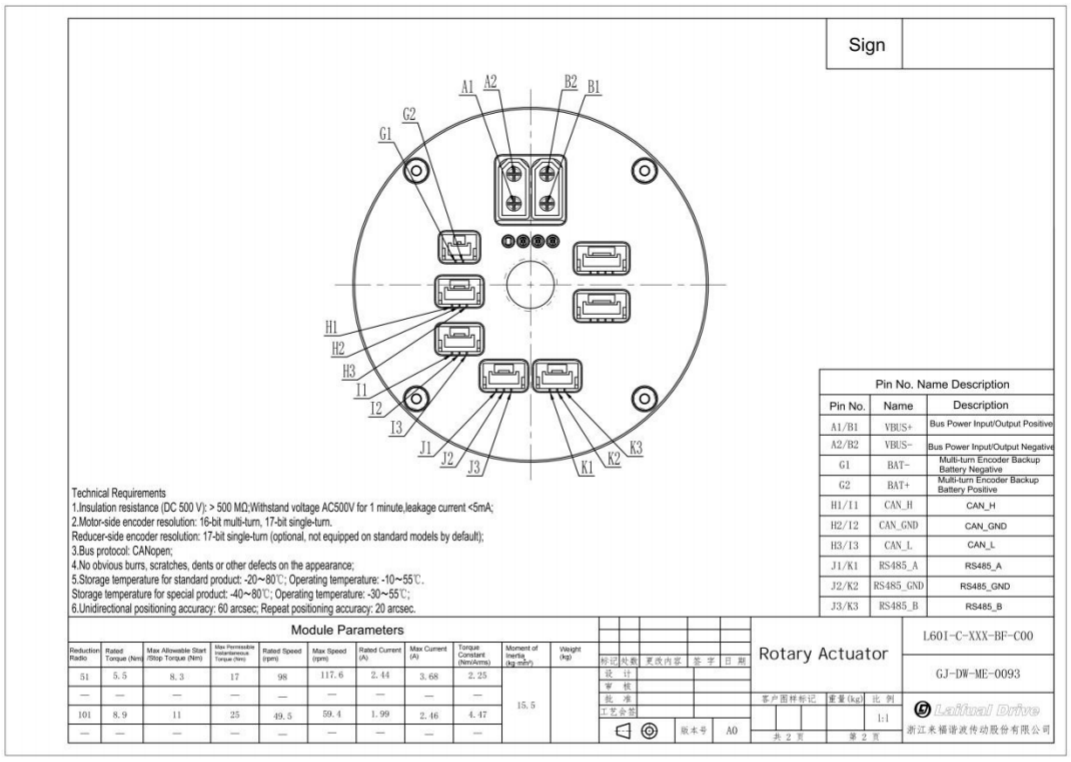
L40I-C/F



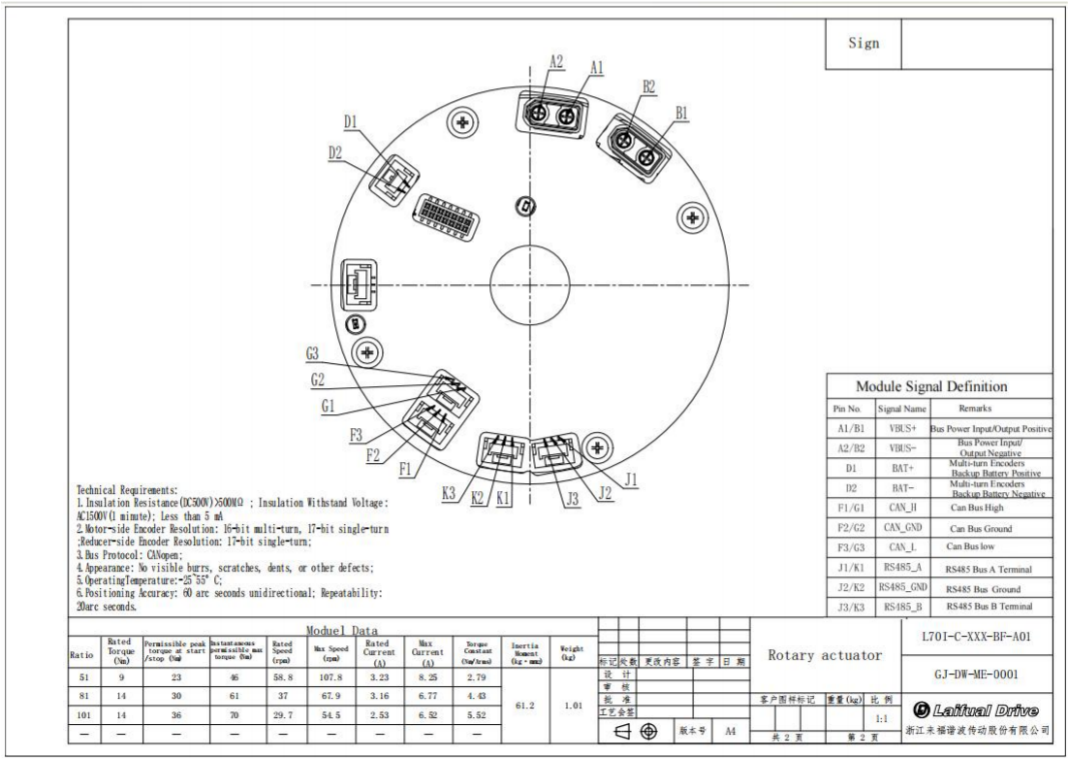
L52I-C/F



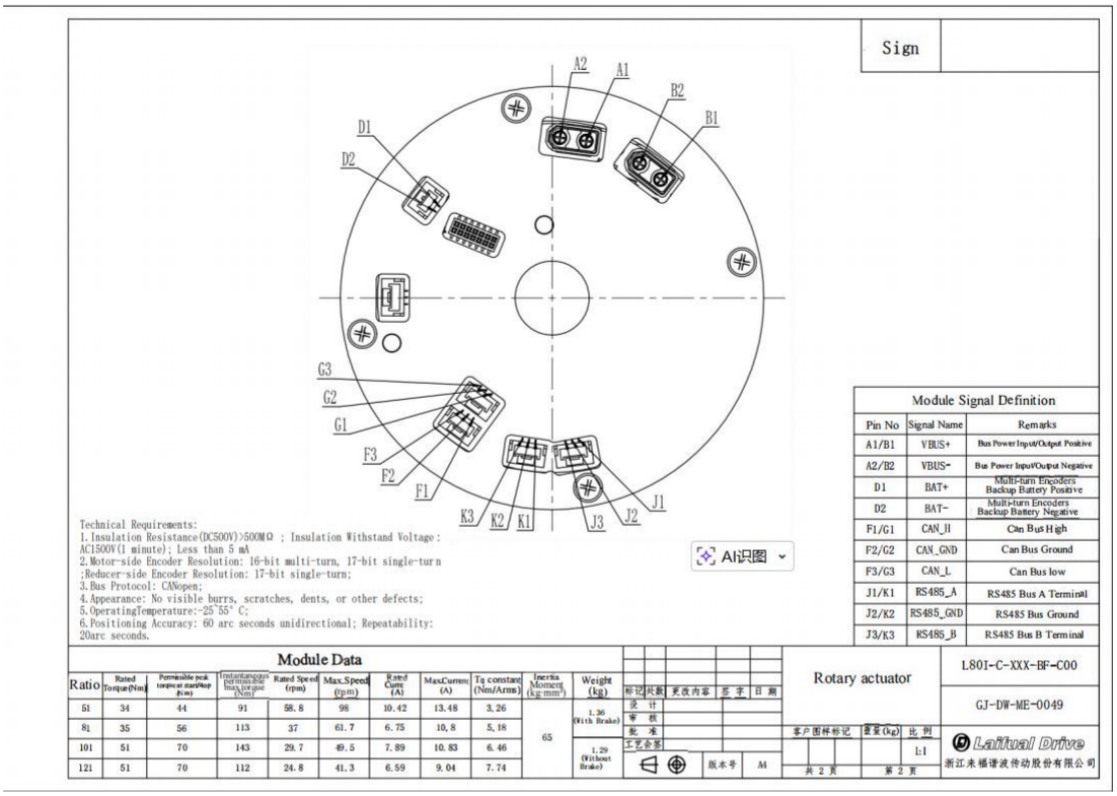
L60I-C/F



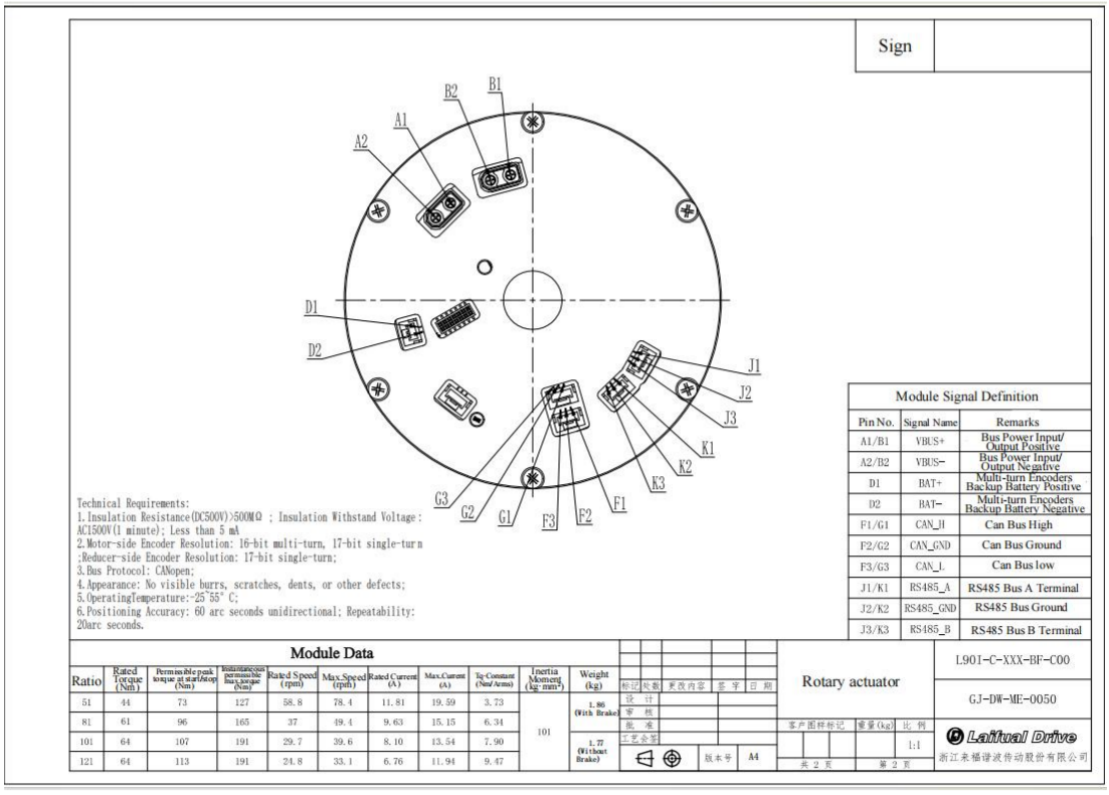
L70I-C/F



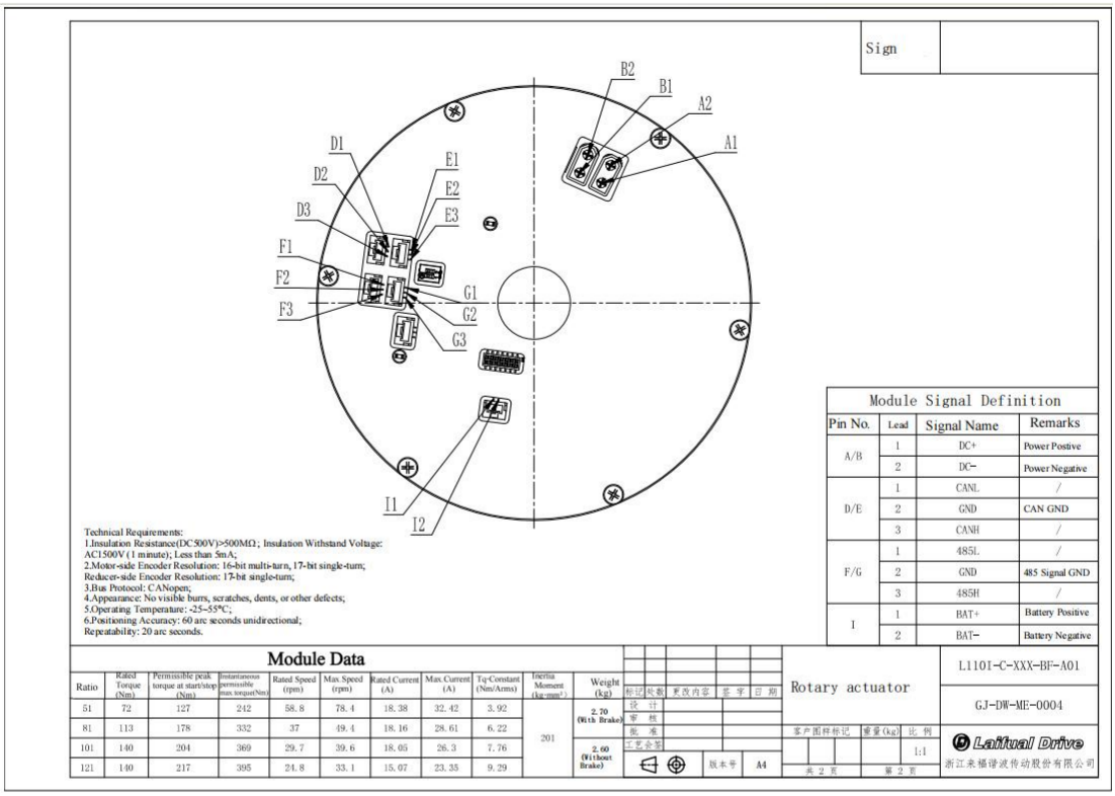
L80I-C/F



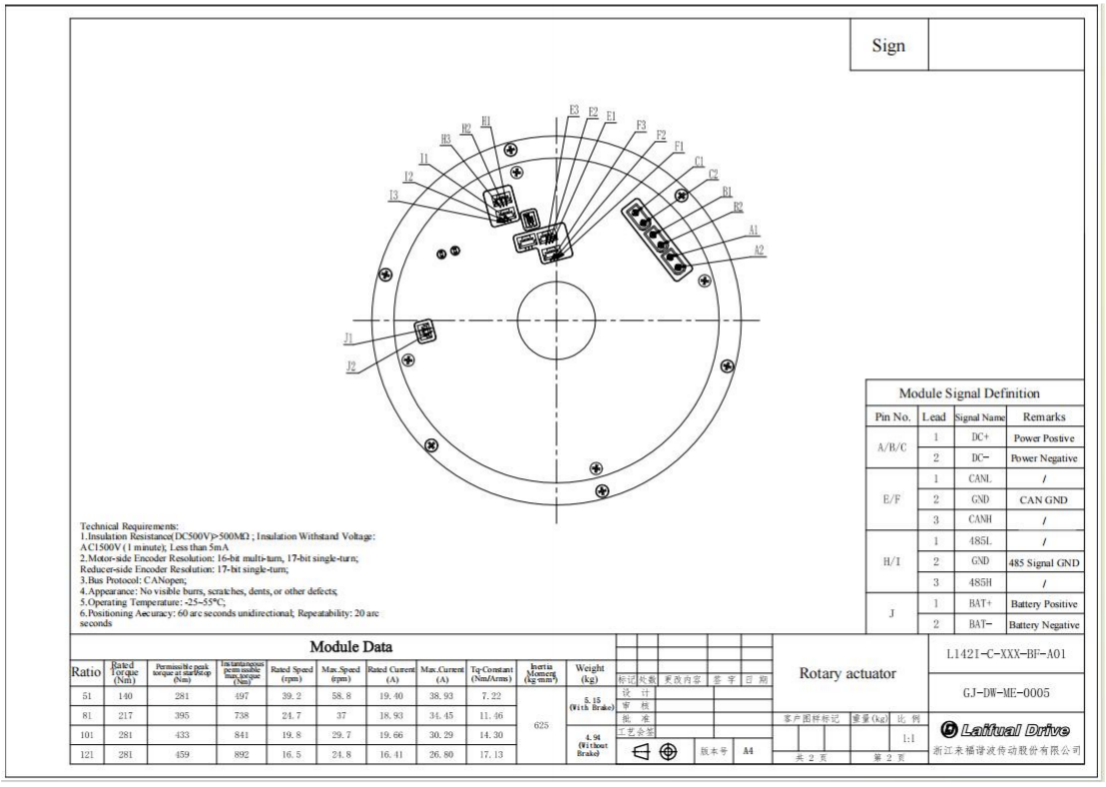
L90I-C/F



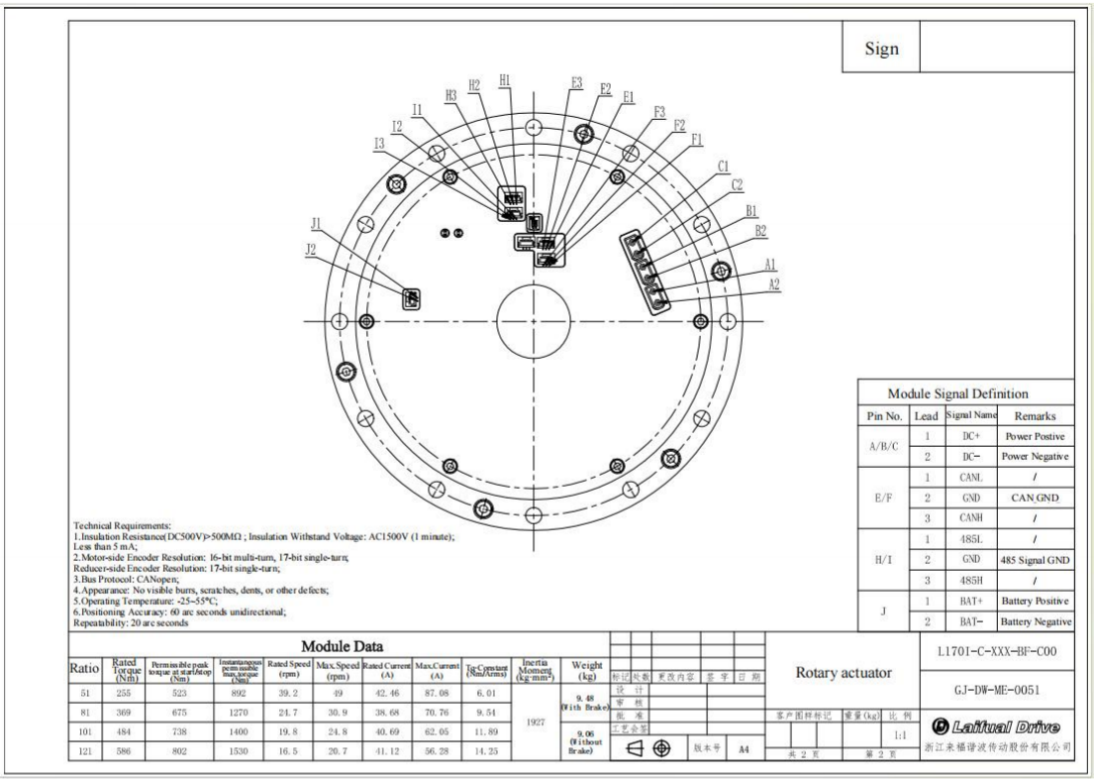
L110I-C/F



L142I-C/F



L170I-C/F



Technical Requirements:
1.Insulation Resistance(DC500V)>500MΩ ; Insulation Withstand Voltage: AC1500V (1 minute);
Less than 5 mA;
2.Motor-side Encoder Resolution: 16-bit multi-turn, 17-bit single-turn;
Reducer-side Encoder Resolution: 17-bit single-turn;
3.Bus Protocol: CANopen;
4.Appearance: No visible burns, scratches, dents, or other defects;
5.Operating Temperature: -25~55℃;
6.Positioning Accuracy: 60 arc seconds unidirectional;
Repeatability: 20 arc seconds

Module Signal Definition

Pin No.	Lead	Signal Name	Remarks
A/B/C	1	DC+	Power Postive
	2	DC−	Power Negative
E/F	1	CANL	/
	2	GND	CAN GND
	3	CANH	/
H/I	1	485L	/
	2	GND	485 Signal GND
	3	485H	/
J	1	BAT+	Battery Positive
	2	BAT−	Battery Negative

Module Data

Ratio	Rated Torque (Nm)	Permissible peak torque at start&stop (Nm)	Instantaneous permissible max. torque (Nm)	Rated Speed (rpm)	Max.Speed (rpm)	Rated Current (A)	Max.Current (A)	Tq-Constant (Nm/Arms)	Inertia Moment (kg·cm²)	Weight (kg)
51	255	523	892	39.2	49	42.46	87.08	6.01	1927	9.48 (With Brake)
81	369	675	1270	24.7	30.9	38.68	70.76	9.54		
101	484	738	1400	19.8	24.8	40.69	62.05	11.89		9.06 (Without Brake)
121	586	802	1530	16.5	20.7	41.12	56.28	14.25		

标记	处数	更改内容	签字	日期
设计				
审核				
批准				
工艺会签				

Rotary actuator

L170I-C-XXX-BF-C00

GJ-DW-ME-0051

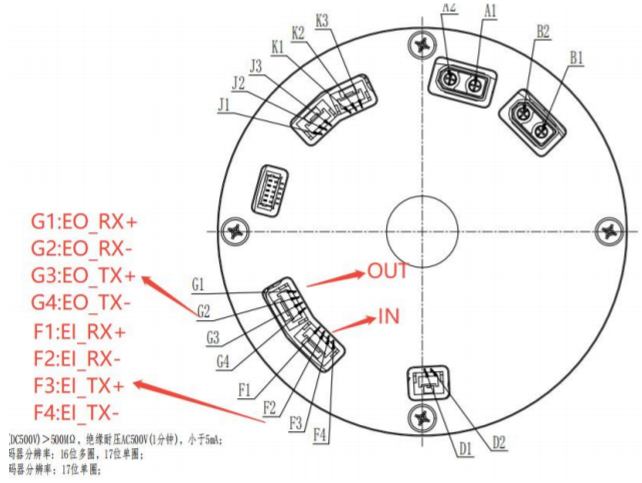
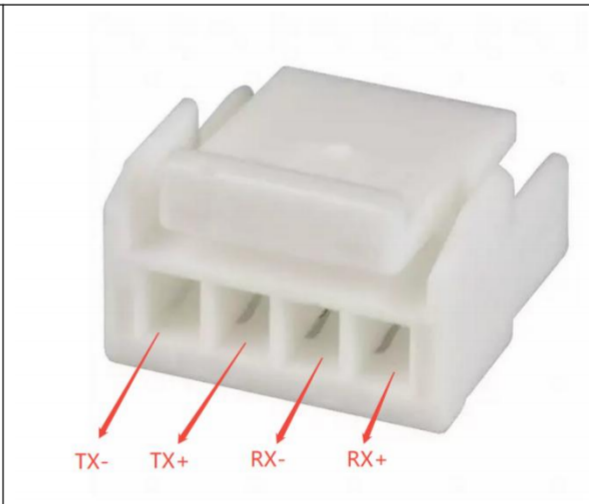
客户图样标记	重量(kg)	比例
		1:1

版本号 A4

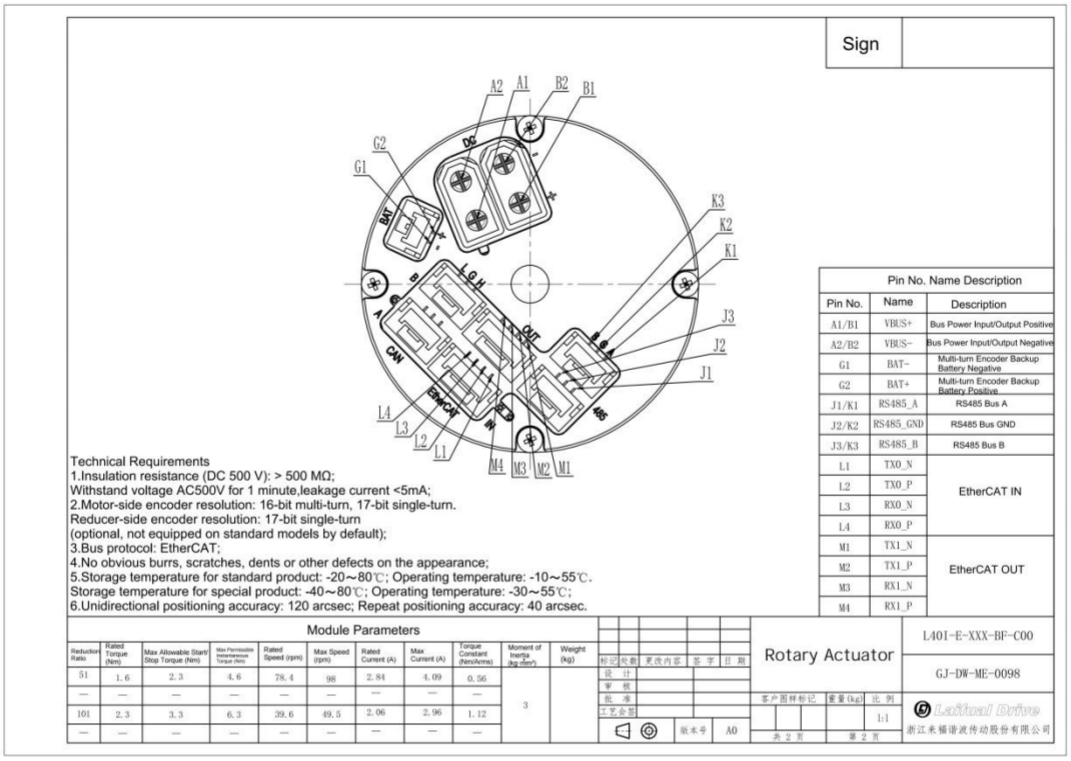
共 2 页 第 2 页

Laifual Drive
浙江来福谐波传动股份有限公司

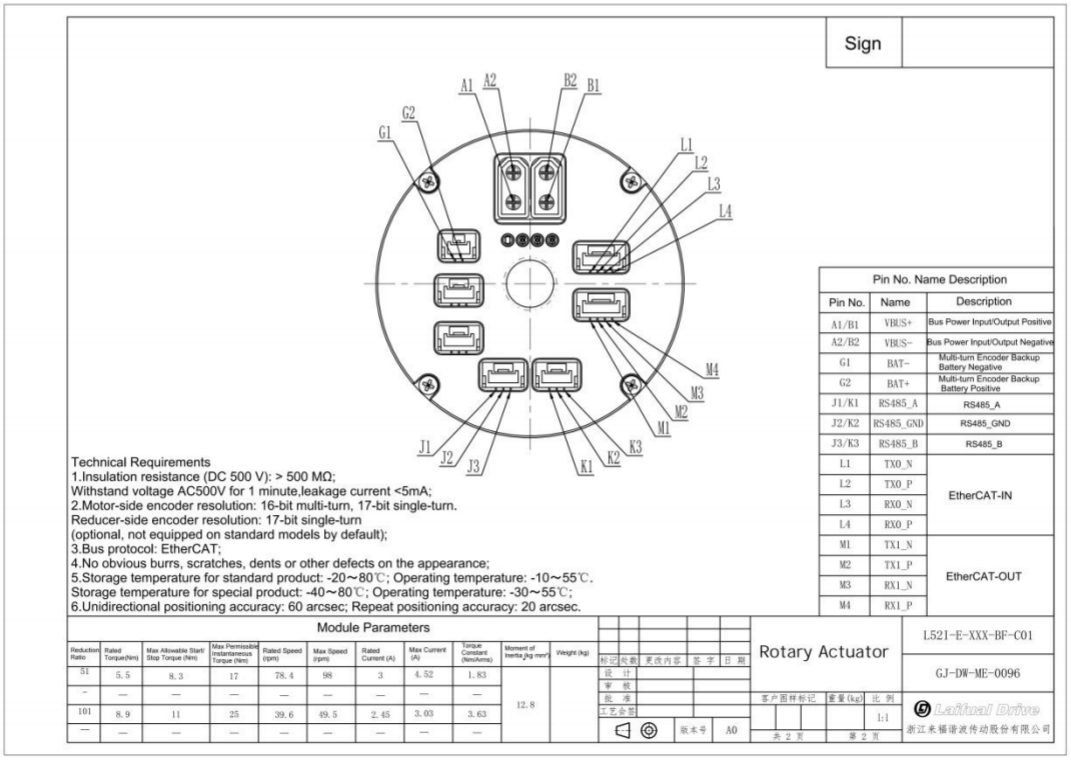
EtherCAT communication interface

	ECAT In		ECAT Out	
Pin	Terminal markings	Terminal function	Terminal markings	Terminal function
1	E I_T X -	EtherCAT Input Send -	E O_T X -	EtherCAT output transmission -
2	E I_T X +	EtherCAT input send +	E O_T X +	EtherCAT output transmission +
3	EI_RX-	EtherCAT input reception -	EO_RX-	EtherCAT output and reception -
4	EI_RX+	EtherCAT input receiver +	EO_RX+	EtherCAT output and reception +
Pin Position		Terminal blocks		
				
Connector information			Wiring terminal information	
Model：BM04B-GHS-TBT			Brand：JST Housing model：GHR-04V-S Terminal model：SSHL-002T-P0.2	
Specifications：Singlerow.1.25mm spacing.4pins			Specifications：JST single-ended terminal, pitch 1.25mm, 4-Pin	

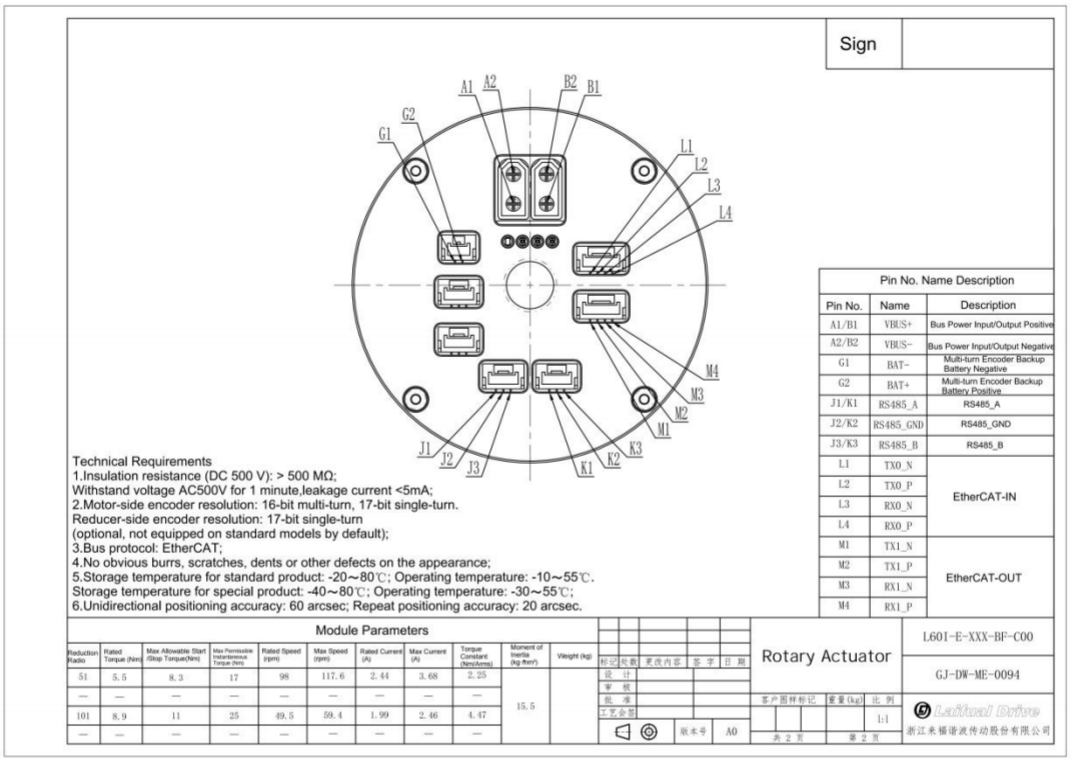
L40I-E


Sign
A2
A1
B2
B1
G2
G1
K3
K2
K1
J3
J2
J1
L4
L3
L2
L1
M4
M3
M2
M1
Technical Requirements
1.Insulation resistance (DC 500 V): > 500 MΩ;
Withstand voltage AC500V for 1 minute,leakage current <5mA;
2.Motor-side encoder resolution: 16-bit multi-turn, 17-bit single-turn.
Reducer-side encoder resolution: 17-bit single-turn
(optional, not equipped on standard models by default);
3.Bus protocol: EtherCAT;
4.No obvious burrs, scratches, dents or other defects on the appearance;
5.Storage temperature for standard product: -20~80℃; Operating temperature: -10~55℃.
Storage temperature for special product: -40~80℃; Operating temperature: -30~55℃;
6.Unidirectional positioning accuracy: 120 arcsec; Repeat positioning accuracy: 40 arcsec.
Pin No. Name Description
Pin No. Name Description
A1/B1 VBUS+ Bus Power Input/Output Positive
A2/B2 VBUS- Bus Power Input/Output Negative
G1 BAT- Multi-turn Encoder Backup Battery Negative
G2 BAT+ Multi-turn Encoder Backup Battery Positive
J1/K1 RS485_A RS485 Bus A
J2/K2 RS485_GND RS485 Bus GND
J3/K3 RS485_B RS485 Bus B
L1 TX0_N EtherCAT IN
L2 TX0_P
L3 RX0_N
L4 RX0_P
M1 TX1_N EtherCAT OUT
M2 TX1_P
M3 RX1_N
M4 RX1_P
Module Parameters
Reduction Ratio
Rated Torque (Nm)
Max Allowable Start/ Stop Torque (Nm)
Max Permissible Instantaneous Torque (Nm)
Rated Speed (rpm)
Max Speed (rpm)
Rated Current (A)
Max Current (A)
Torque Constant (Nm/Arms)
Moment of Inertia (kg·cm²)
Weight (kg)
51 1.6 2.3 4.6 78.4 98 2.84 4.09 0.56 3
— — — — — — — — —
101 2.3 3.3 6.3 39.6 49.5 2.06 2.96 1.12
—
Rotary Actuator
L40I-E-XXX-BF-C00
GJ-DW-ME-0098
Laifual Drive
浙江来福谐波传动股份有限公司

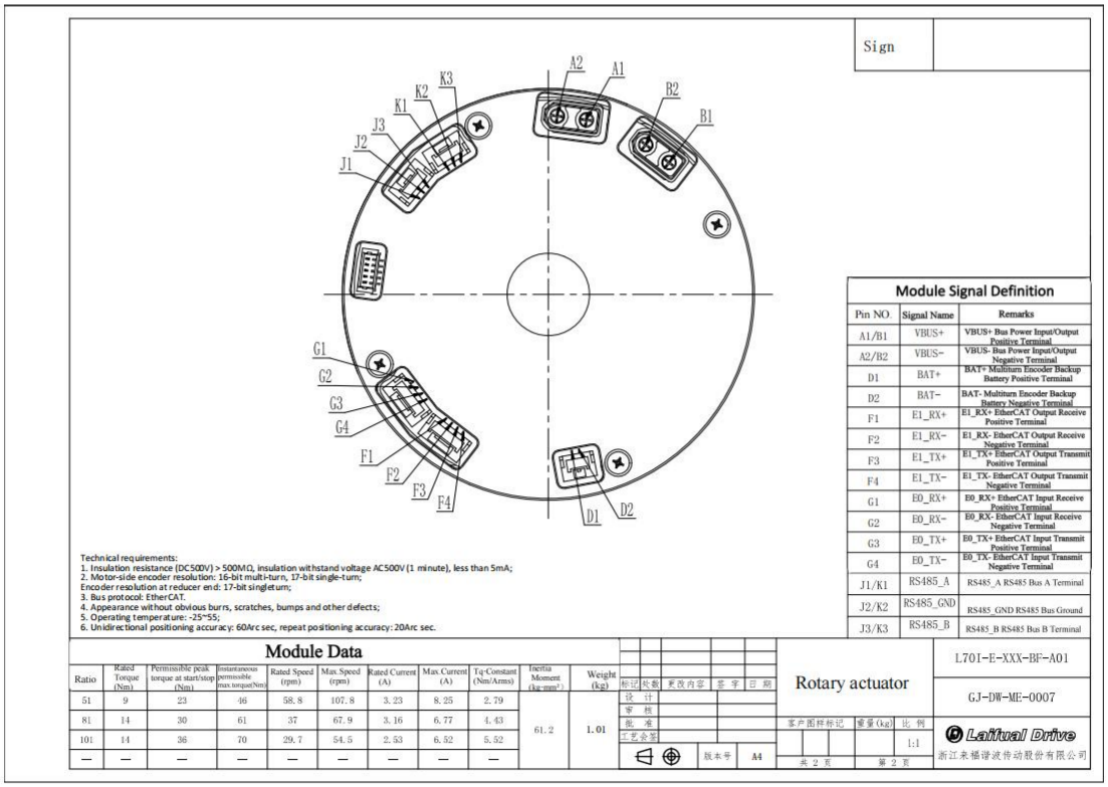
L52I-E


Sign
A1
A2
B2
B1
G2
G1
L1
L2
L3
L4
M4
M3
M2
M1
J1
J2
J3
K1
K2
K3
Technical Requirements
1.Insulation resistance (DC 500 V): > 500 MΩ;
Withstand voltage AC500V for 1 minute,leakage current <5mA;
2.Motor-side encoder resolution: 16-bit multi-turn, 17-bit single-turn.
Reducer-side encoder resolution: 17-bit single-turn
(optional, not equipped on standard models by default);
3.Bus protocol: EtherCAT;
4.No obvious burrs, scratches, dents or other defects on the appearance;
5.Storage temperature for standard product: -20~80℃; Operating temperature: -10~55℃.
Storage temperature for special product: -40~80℃; Operating temperature: -30~55℃;
6.Unidirectional positioning accuracy: 60 arcsec; Repeat positioning accuracy: 20 arcsec.
Pin No. Name Description
Pin No. Name Description
A1/B1 VBUS+ Bus Power Input/Output Positive
A2/B2 VBUS- Bus Power Input/Output Negative
G1 BAT- Multi-turn Encoder Backup Battery Negative
G2 BAT+ Multi-turn Encoder Backup Battery Positive
J1/K1 RS485_A RS485_A
J2/K2 RS485_GND RS485_GND
J3/K3 RS485_B RS485_B
L1 TX0_N EtherCAT-IN
L2 TX0_P
L3 RX0_N
L4 RX0_P
M1 TX1_N EtherCAT-OUT
M2 TX1_P
M3 RX1_N
M4 RX1_P
Module Parameters
Reduction Ratio
Rated Torque(Nm)
Max Allowable Start/ Stop Torque (Nm)
Max Permissible Instantaneous Torque (Nm)
Rated Speed (rpm)
Max Speed (rpm)
Rated Current (A)
Max Current (A)
Torque Constant (Nm/Arms)
Moment of Inertia (kg·cm²)
Weight (kg)
51 5.5 8.3 17 78.4 98 3 4.52 1.83 12.8
— — — — — — — — —
101 8.9 11 25 39.6 49.5 2.45 3.03 3.63
—
Rotary Actuator
L52I-E-XXX-BF-C01
GJ-DW-ME-0096
Laifual Drive
浙江来福谐波传动股份有限公司

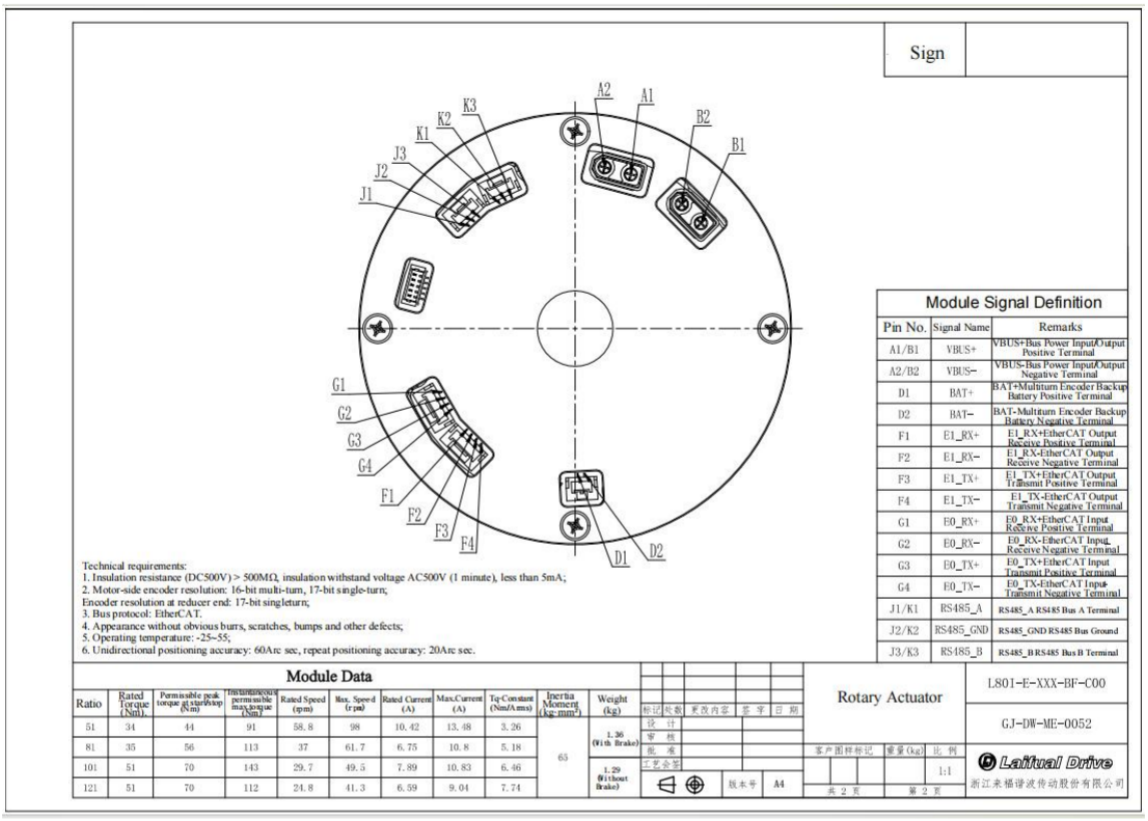
L60I-E


Sign
A1 A2 B2 B1
G2 G1
L1 L2 L3 L4
M4 M3 M2 M1
J1 J2 J3 K1 K2 K3
Technical Requirements
1.Insulation resistance (DC 500 V): > 500 MΩ;
Withstand voltage AC500V for 1 minute,leakage current <5mA;
2.Motor-side encoder resolution: 16-bit multi-turn, 17-bit single-turn.
Reducer-side encoder resolution: 17-bit single-turn
(optional, not equipped on standard models by default);
3.Bus protocol: EtherCAT;
4.No obvious burrs, scratches, dents or other defects on the appearance;
5.Storage temperature for standard product: -20～80℃; Operating temperature: -10～55℃.
Storage temperature for special product: -40～80℃; Operating temperature: -30～55℃;
6.Unidirectional positioning accuracy: 60 arcsec; Repeat positioning accuracy: 20 arcsec.
Pin No. Name Description
Pin No. | Name | Description
A1/B1 | VBUS+ | Bus Power Input/Output Positive
A2/B2 | VBUS− | Bus Power Input/Output Negative
G1 | BAT− | Multi-turn Encoder Backup Battery Negative
G2 | BAT+ | Multi-turn Encoder Backup Battery Positive
J1/K1 | RS485_A | RS485_A
J2/K2 | RS485_GND | RS485_GND
J3/K3 | RS485_B | RS485_B
L1 | TX0_N | EtherCAT-IN
L2 | TX0_P
L3 | RX0_N
L4 | RX0_P
M1 | TX1_N | EtherCAT-OUT
M2 | TX1_P
M3 | RX1_N
M4 | RX1_P
Module Parameters
Reduction Ratio | Rated Torque (Nm) | Max Allowable Start /Stop Torque(Nm) | Max Permissible Instantaneous Torque (Nm) | Rated Speed (rpm) | Max Speed (rpm) | Rated Current (A) | Max Current (A) | Torque Constant (Nm/Arms) | Moment of Inertia (kg·cm²) | Weight (kg)
51 | 5.5 | 8.3 | 17 | 98 | 117.6 | 2.44 | 3.68 | 2.25 | 15.5
101 | 8.9 | 11 | 25 | 49.5 | 59.4 | 1.99 | 2.46 | 4.47
Rotary Actuator
L60I-E-XXX-BF-C00
GJ-DW-ME-0094
A0
Laifual Drive
浙江来福谐波传动股份有限公司

L70I-E


Sign
A2 A1 B2 B1
K3 K2 K1 J3 J2 J1
G1 G2 G3 G4 F1 F2 F3 F4
D1 D2
Technical requirements:
1. Insulation resistance (DC500V) > 500MΩ, insulation withstand voltage AC500V (1 minute), less than 5mA;
2. Motor-side encoder resolution: 16-bit multi-turn, 17-bit single-turn;
Encoder resolution at reducer end: 17-bit singleturn;
3. Bus protocol: EtherCAT.
4. Appearance without obvious burrs, scratches, bumps and other defects;
5. Operating temperature: -25~55;
6. Unidirectional positioning accuracy: 60Arc sec, repeat positioning accuracy: 20Arc sec.
Module Signal Definition
Pin NO. | Signal Name | Remarks
A1/B1 | VBUS+ | VBUS+ Bus Power Input/Output Positive Terminal
A2/B2 | VBUS− | VBUS- Bus Power Input/Output Negative Terminal
D1 | BAT+ | BAT+ Multiturn Encoder Backup Battery Positive Terminal
D2 | BAT− | BAT- Multiturn Encoder Backup Battery Negative Terminal
F1 | E1_RX+ | E1_RX+ EtherCAT Output Receive Positive Terminal
F2 | E1_RX− | E1_RX- EtherCAT Output Receive Negative Terminal
F3 | E1_TX+ | E1_TX+ EtherCAT Output Transmit Positive Terminal
F4 | E1_TX− | E1_TX- EtherCAT Output Transmit Negative Terminal
G1 | E0_RX+ | E0_RX+ EtherCAT Input Receive Positive Terminal
G2 | E0_RX− | E0_RX- EtherCAT Input Receive Negative Terminal
G3 | E0_TX+ | E0_TX+ EtherCAT Input Transmit Positive Terminal
G4 | E0_TX− | E0_TX- EtherCAT Input Transmit Negative Terminal
J1/K1 | RS485_A | RS485_A RS485 Bus A Terminal
J2/K2 | RS485_GND | RS485_GND RS485 Bus Ground
J3/K3 | RS485_B | RS485_B RS485 Bus B Terminal
Module Data
Ratio | Rated Torque (Nm) | Permissible peak torque at start/stop (Nm) | Instantaneous permissible max torque(Nm) | Rated Speed (rpm) | Max. Speed (rpm) | Rated Current (A) | Max. Current (A) | Tq-Constant (Nm/Arms) | Inertia Moment (kg·mm²) | Weight (kg)
51 | 9 | 23 | 46 | 58.8 | 107.8 | 3.23 | 8.25 | 2.79 | 61.2 | 1.01
81 | 14 | 30 | 61 | 37 | 67.9 | 3.16 | 6.77 | 4.43
101 | 14 | 36 | 70 | 29.7 | 54.5 | 2.53 | 6.32 | 5.52
Rotary actuator
L70I-E-XXX-BF-A01
GJ-DW-ME-0007
A4
Laifual Drive
浙江来福谐波传动股份有限公司

L80I-E



Technical requirements:
1. Insulation resistance (DC500V) > 500MΩ, insulation withstand voltage AC500V (1 minute), less than 5mA;
2. Motor-side encoder resolution: 16-bit multi-turn, 17-bit single-turn;
Encoder resolution at reducer end: 17-bit singleturn;
3. Bus protocol: EtherCAT.
4. Appearance without obvious burrs, scratches, bumps and other defects;
5. Operating temperature: -25~55;
6. Unidirectional positioning accuracy: 60Arc sec, repeat positioning accuracy: 20Arc sec.

Module Signal Definition

Pin No.	Signal Name	Remarks
A1/B1	VBUS+	VBUS+Bus Power Input/Output Positive Terminal
A2/B2	VBUS−	VBUS-Bus Power Input/Output Negative Terminal
D1	BAT+	BAT+Multiturn Encoder Backup Battery Positive Terminal
D2	BAT−	BAT-Multiturn Encoder Backup Battery Negative Terminal
F1	E1_RX+	E1_RX+EtherCAT Output Receive Positive Terminal
F2	E1_RX−	E1_RX-EtherCAT Output Receive Negative Terminal
F3	E1_TX+	E1_TX+EtherCAT Output Transmit Positive Terminal
F4	E1_TX−	E1_TX-EtherCAT Output Transmit Negative Terminal
G1	E0_RX+	E0_RX+EtherCAT Input Receive Positive Terminal
G2	E0_RX−	E0_RX-EtherCAT Input Receive Negative Terminal
G3	E0_TX+	E0_TX+EtherCAT Input Transmit Positive Terminal
G4	E0_TX−	E0_TX-EtherCAT Input Transmit Negative Terminal
J1/K1	RS485_A	RS485_A RS485 Bus A Terminal
J2/K2	RS485_GND	RS485_GND RS485 Bus Ground
J3/K3	RS485_B	RS485_B RS485 Bus B Terminal

Module Data

Ratio	Rated Torque (N·m)	Permissible peak torque at start/stop (N·m)	Instantaneous permissible max.torque (N·m)	Rated Speed (rpm)	Max. Speed (rpm)	Rated Current (A)	Max.Current (A)	Tq-Constant (Nm/Arms)	Inertia Moment (kg·mm²)	Weight (kg)
51	34	44	91	58.8	98	10.42	13.48	3.26	65	1.30 (With Brake)
81	35	56	113	37	61.7	6.75	10.8	5.18		
101	51	70	143	29.7	49.5	7.89	10.83	6.46		1.29 (Without Brake)
121	51	70	112	24.8	41.3	6.59	9.04	7.74		

Rotary Actuator

L80I-E-XXX-BF-C00

GJ-DW-ME-0052

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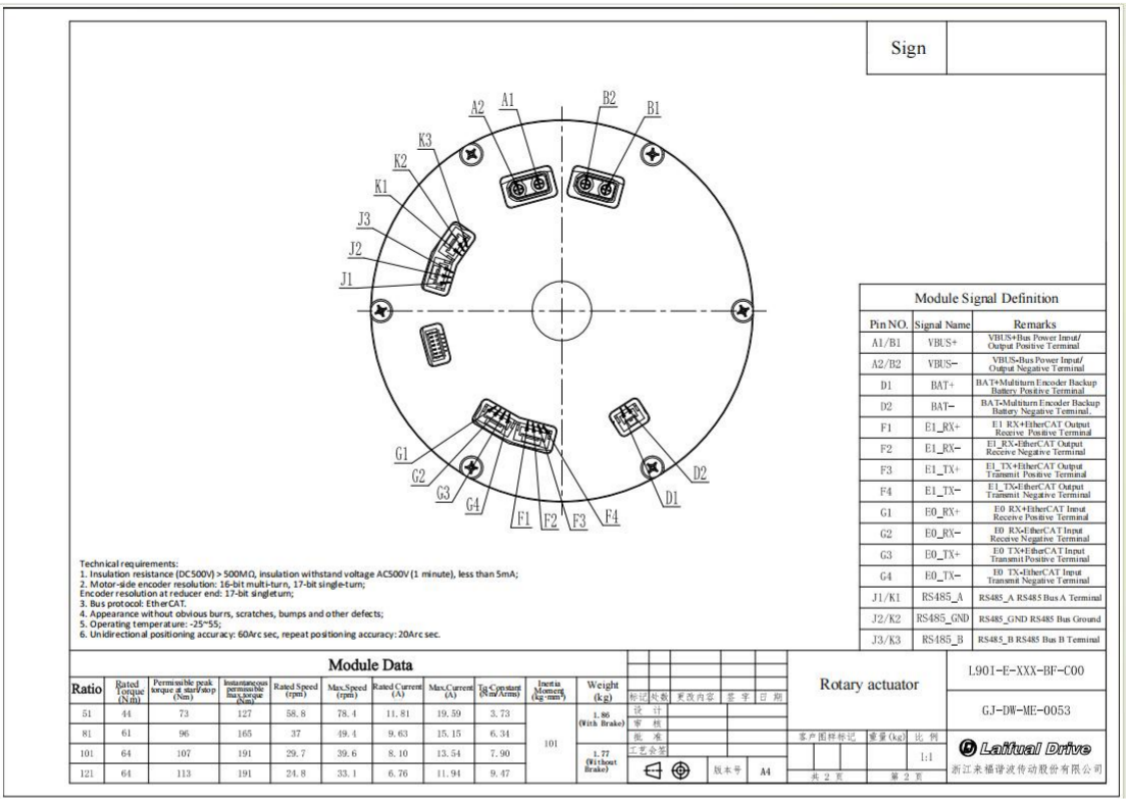
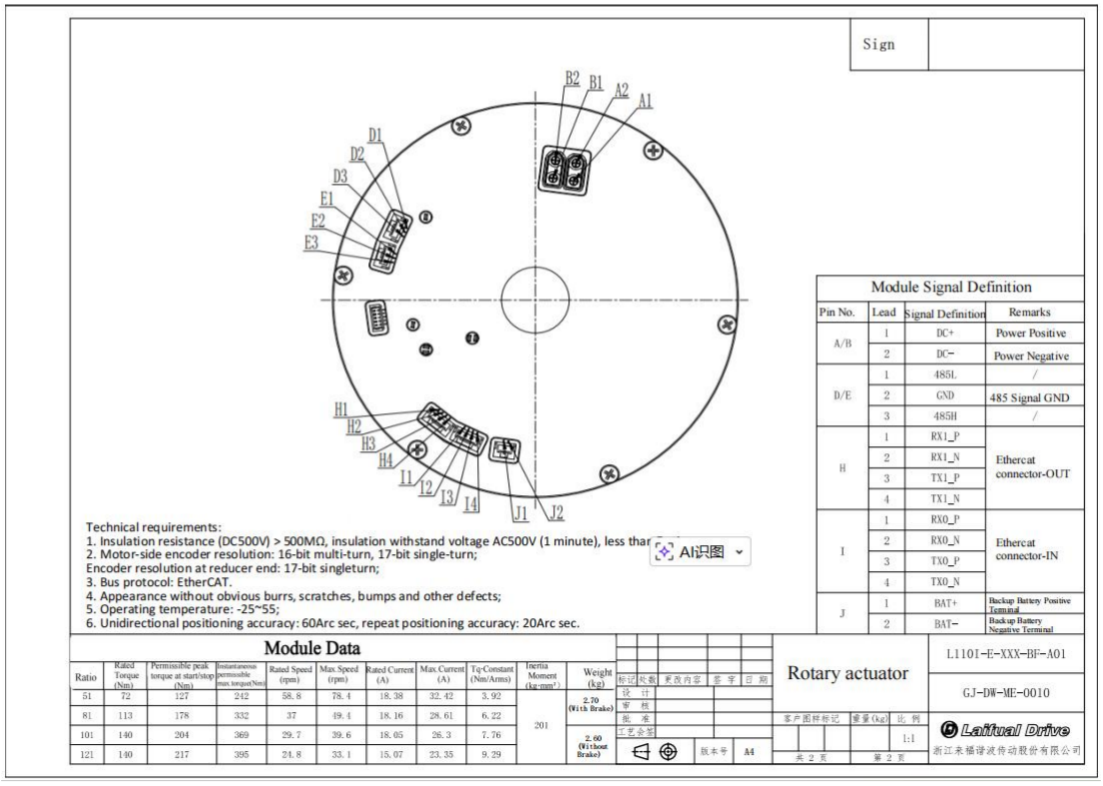
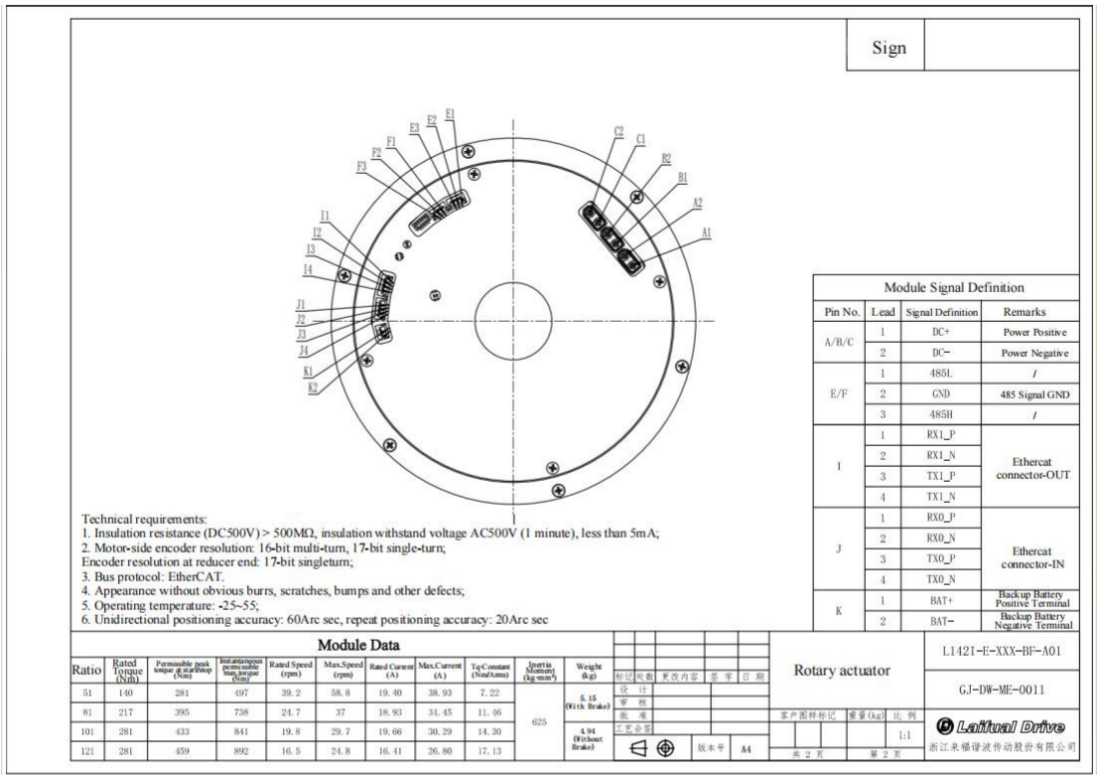
L90I-E



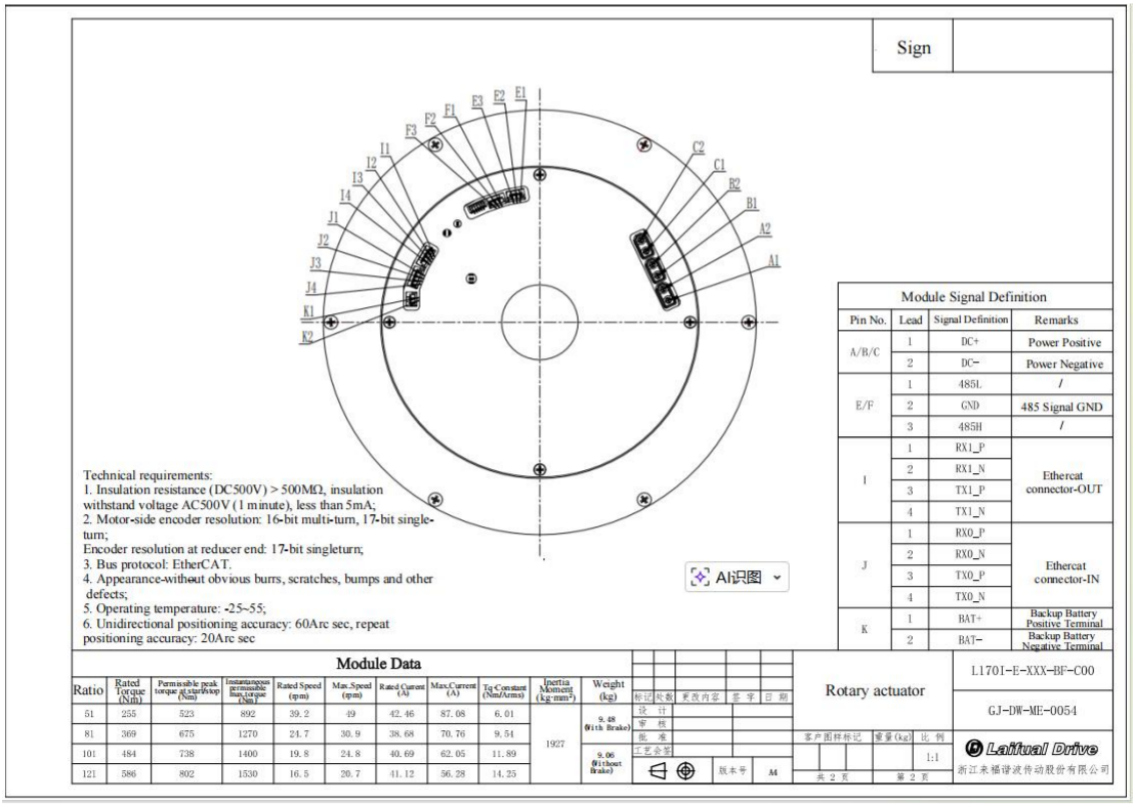
L110I-E



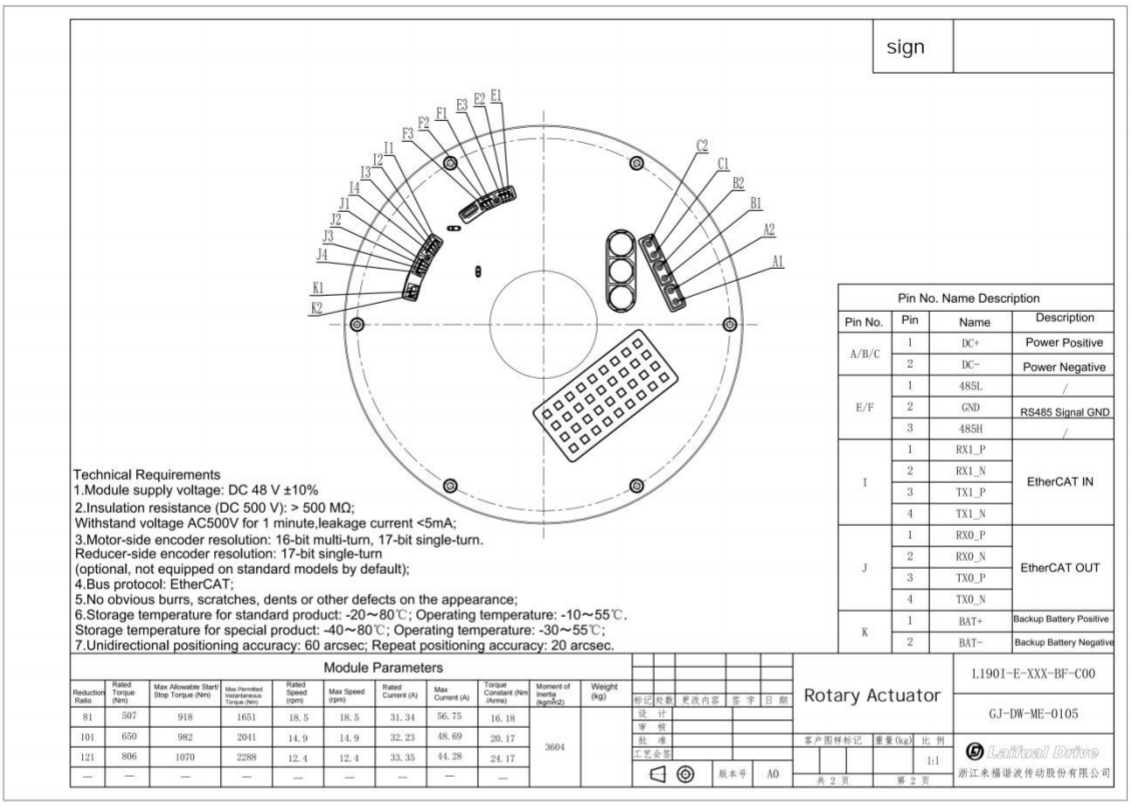
L142I-E



L170I-E



L190I-E



Technical Requirements
1.Module supply voltage: DC 48 V ±10%
2.Insulation resistance (DC 500 V): > 500 MΩ;
Withstand voltage AC500V for 1 minute,leakage current <5mA;
3.Motor-side encoder resolution: 16-bit multi-turn, 17-bit single-turn.
Reducer-side encoder resolution: 17-bit single-turn
(optional, not equipped on standard models by default);
4.Bus protocol: EtherCAT;
5.No obvious burrs, scratches, dents or other defects on the appearance;
6.Storage temperature for standard product: -20~80℃; Operating temperature: -10~55℃.
Storage temperature for special product: -40~80℃; Operating temperature: -30~55℃;
7.Unidirectional positioning accuracy: 60 arcsec; Repeat positioning accuracy: 20 arcsec.

Pin No. Name Description

Pin No.	Pin	Name	Description
A/B/C	1	DC+	Power Positive
	2	DC-	Power Negative
E/F	1	485L	/
	2	GND	RS485 Signal GND
	3	485H	/
I	1	RX1_P	EtherCAT IN
	2	RX1_N	
	3	TX1_P	
	4	TX1_N	
J	1	RX0_P	EtherCAT OUT
	2	RX0_N	
	3	TX0_P	
	4	TX0_N	
K	1	BAT+	Backup Battery Positive
	2	BAT-	Backup Battery Negative

Module Parameters

Reduction Ratio	Rated Torque (Nm)	Max Allowable Start/ Stop Torque (Nm)	Max Permitted Instantaneous Torque (Nm)	Rated Speed (rpm)	Max Speed (rpm)	Rated Current (A)	Max Current (A)	Torque Constant (Nm /Arms)	Moment of Inertia (kgm²x2)	Weight (kg)
81	507	918	1651	18.5	18.5	31.34	56.75	16.18	3604	
101	650	982	2041	14.9	14.9	32.23	48.69	20.17		
121	806	1070	2288	12.4	12.4	33.35	44.28	24.17		
—	—	—	—	—	—	—	—	—		

Rotary Actuator

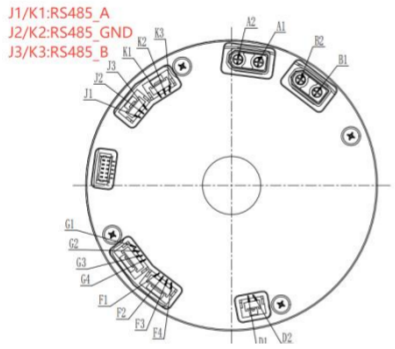
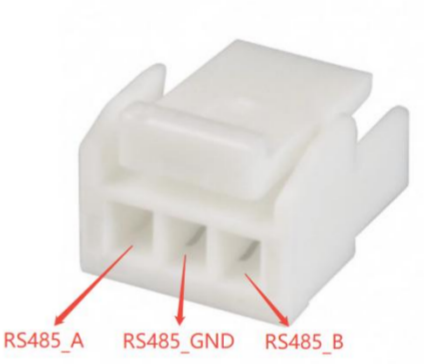
L190I-E-XXX-BF-C00

GJ-DW-ME-0105

Laifual Drive
浙江来福谐波传动股份有限公司

485 communication interface

Pin	Terminal Lable	Terminal Function
1	RS485_A	RS485 bus A end
2	RS485_GND	RS485 bus ground
3	RS485_B	RS485 bus B end

Pin Position	Terminal blocks
	
Connector information	Wiring terminal information
Model：BM03B-GHS-TBT	Brand：JST Housing model：GHR-03V-S Terminal model：SSHL-002T-P0.2 （or equivalent specifications）
Specifications：Singlerow.1.25mm spacing.3pins	Specifications：JST single-ended terminal, pitch 1.25mm, 3-Pin

Cable Specification

The specifications for the selection of various signal interface cables for the joint are detailed in the table.

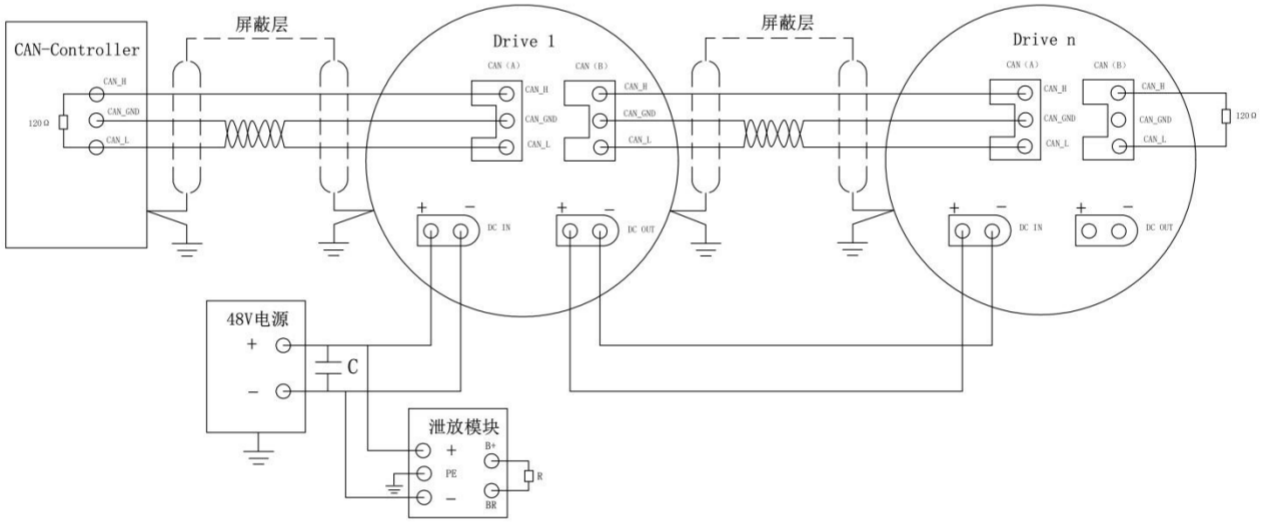
Module Number	Signal interface	Number of lines	Applicablewire specifications		Wiringclearance（mm）
			Cross-sectiona Area（mm²）	AWG#	
Full Series	CAN communication interfaces: CAN(A)CAN(B)	3P*2	0.05~0.13	30~26	10

Module Number	Signal interface	Number of lines	Applicablewire specifications		Wiringclearance（mm）
			Cross-sectiona Area（mm²）	AWG#	
	EtherCAT communication interfaces:EI,EO	4P*2			
	Multi-turn power supply battery interface:BAT	2P*1			
L40	48V power supply interface:DC in	2P*2	1.0	18	15
L52					
L60					
L70					
L80					
L90					
L110					
L142			1.5	16	
L170					
L190					

Chapter 4 Multi-Joint Connection Configuration

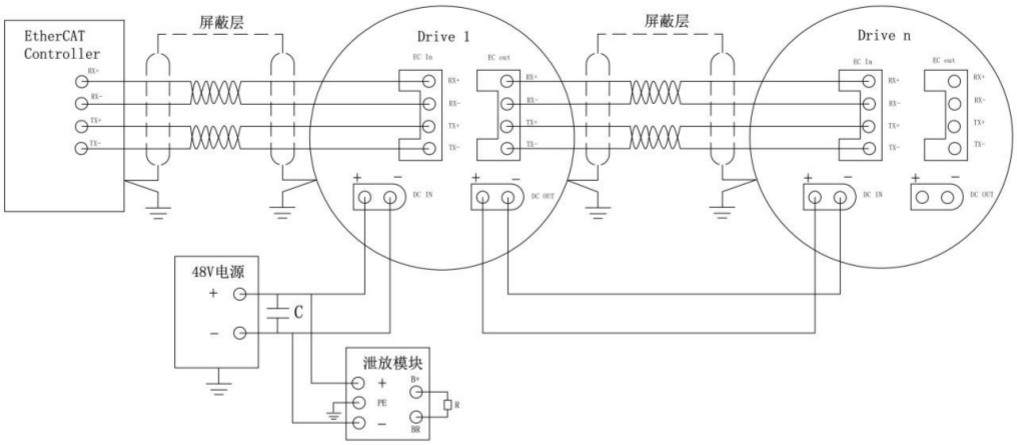
CANopen/CAN FD Communication Wiring Diagram

The CAN communication line uses individually shielded twisted-pair cable. The communication rate of the joint module can be set to 1 kbps. The maximum communication distance between the two farthest nodes on the CAN bus can reach 25 meters. A 120Ω terminal resistor shall be connected in parallel to each CAN interface of the controller and the end servo.



EtherCAT Communication Wiring Diagram

EtherCAT communication cables shall be selected as individually shielded twisted pairs. The wiring sequence of EC_In and EC_Out between joint modules must not be reversed; otherwise, it will cause inconsistency between the communication logic sequence of the EtherCAT master controller and the servo axes and the actual physical wiring sequence.


EtherCAT
Controller
屏蔽层
Drive 1
屏蔽层
Drive n
48V电源
C
泄放模块

Chapter 5 Brake

Brake Precautions

（1）The brake does not require an additional power supply. When the module is powered on and enabled, the system will automatically energize the brake according to the configured brake type: （P0-01 = 0: Electromagnetic brake, P0-01 = 1: Permanent magnet brake)

（2）Do not disable the module abruptly at high speed. Under no circumstances should the enable signal be suddenly turned off during high-speed operation. Sudden emergency braking may cause irreversible damage to the module body, gearbox, and brake.

（3）Avoid strong magnetic fields. The brake is an magnetoelectric device. Do not use the module in strong magnetic fields to prevent brake malfunction. Magnetic shielding can be applied to the module body if necessary.

（4）Brake holding torque limitations. The brake has a maximum holding torque. Even when the brake is engaged, forces exceeding the holding torque may still move the module. Do not apply the module in situations where the torque exceeds the rated torque or the brake 's holding torque, to avoid brake failure or module damage.

The holding torque of brakes for different module models is listed in the table below:

Module	Holding Torque
L70	0.6N ·m
L80	0.71N ·m
L90	1N ·m
L110	2.2N ·m
L142	4N ·m
L170	8.5N ·m
L190	15N·m

（5）Due to the physical limitations of the brake, ensure that the interval between two enable commands is at least 300 ms. After enabling the module, do not send motion commands immediately; delay 500 ms

before issuing the first motion command.

（6）Avoid prolonged enable in unloaded conditions. Do not keep the module enabled or operate it for long periods in a suspended, no-load state. In such cases, the brake will remain energized without proper contact cooling, which may lead to module overheating. Overheating under these conditions is normal and does not indicate a quality issue.

Brake Lifetime

≥ 2,000,000 engage/disengage cycles

≥ 1 hour of break-in dragging

Forced Brake Release

To forcibly release the brake, set P5.14 = 4 via the upper-level controller through the RS -485 connection.

Caution: Ensure there is no risk of falling or uncontrolled motion.

After testing, promptly restore P5.14 to its normal value to prevent accidental situations.

Brake Power

Module	Power	Current
L70	Startup / Holding Power 13.5W/3.4W	0.56A/0.28A
L80	3.4W	0.14A
L90	4.5W	0.19A
L110	9.1W	0.38A
L142	7.6W	0.32A
L170	9.35W	0.39A
L190	10W	0.417A

Chapter 6 Encoder Specifications

The built-in encoder in the low-voltage series is a multi-turn absolute encoder capable of recording absolute positions and absolute rotation counts. It consists of a single-turn detector (17-bit) for detecting the motor shaft's rotational position and a multi-turn detector (16-bit) for detecting the number of rotations.

This encoder continuously detects the mechanical absolute position, regardless of the power ON/OFF status of the driver and external controller, and utilizes battery backup for data preservation. As long as the origin positioning is performed during mechanical installation, there is no need for origin resetting upon each power-up. It is also easy to restore after power outages or malfunctions.

The encoder communicates directly with the internal drive board, eliminating the need for any additional configuration operations.

Specifications

Type	Magnetic sensor / electronic battery backup system
Single-turn Detector	2^{17}:131072puleses
Multi-turn Detector	2^{16}:65536(-32768～32767)
Maximum Permissible Encoder Speed	7000 r/min*1
Safety and Redundancy	Matching detection method based on dual single-turn detectors Matching detection method based on dual cumulative rotation counters
External Battery Backup Duration	5 years (when not powered) *2

*1 :The maximum speed at which the encoder can rotate, which is distinct from the speed at which the motor can drive.

*2 :This value applies when the motor shaft is not moving. If the shaft rotates frequently while the system is unpowered, the external battery will deplete more quickly

Output Shaft Resolution

Encoder Resolution		17bit(217:131072Pulses)					
Reduction Ratio		1:31	1:51	1:81	1:101	1:121	1:161
Output Shaft Resolution	Pulses per Revolution	4063232	6684672	10616832	13238272	15859712	21102592
Single Pulse Angle	seconds	approx 0.3	approx 0.2	approx 0.12	approx 0.1	approx 0.082	approx 0.061

Absolute Position Data Conversion

"Absolute Position" refers to the absolute position of the motor shaft in one rotation, while "Multiple Rotations" refers to the number of rotations of the motor. The position of the output shaft of the transmission device can be calculated using the formula below.

Transmission Device Output Shaft Position= (Absolute Position + Multi-turn Rotation × Encoder Resolution) ÷ Reducer Ratio

Multi-turn Encoder Backup Battery

For joints equipped with a multi-turn version, a 3.6 V battery provides power to the multi-turn encoder when the module loses main power. This allows the encoder to retain its multi-turn position, preventing robots or other devices from losing the zero reference.



3.6V battery

Precautions for Using Our Multi-turn Backup Battery：

（1）Do not alter the original wiring sequence；

（2）Do not use wires or other conductive materials to directly short the positive and negative terminals of the battery.

（3）Ensure correct insertion：Insert the battery in the correct orientation. After insertion, fix the battery body to prevent the Connection Terminal from being pulled or shaken..

（4）Battery replacement procedure：When removing the Connection Terminal, do not pull it out directly. First, release the latch at the front of the terminal, then gently remove it.

Chapter 7 Environment and Installation

Operating Environment

The operating conditions for the low-voltage series modules are as follows:

- Operating Temperature ：-10～55 ℃ (for normal-temperature grease) and -30～55 ℃ (for low-temperature grease)
- The temperature inside the cabinet may be higher than the ambient temperature, depending on the power loss of the external equipment and the size of the cabinet. Plan the cabinet size, heat dissipation system and equipment layout to ensure that the ambient temperature is maintained at 55 ℃ or below.
- Operating Humidity：20%-80%
- Ensure no condensation. Note that condensation may occur with significant day-to-night temperature changes or frequent starting and stopping of actuators.
- Vibration ：24.5 m/s² （2.5G）（10-400Hz）
- The module cannot operate in applications subjected to continuous shock.
- Operating Environment：No dust, condensation, metal powder, corrosive gases, water, oil mist, etc.
- Protection Rating：IP54
- Altitude: Below 1000 meters
- Leakage Measures：
- Oil seals in rotating and sliding areas cannot completely prevent lubricant leakage. If the actuator is used in clean rooms or similar environments, additional oil leakage prevention measures should be provided.
- Installation Location:
- Should be installed indoors or in protected outdoor areas, avoiding direct exposure to sunlight.

Installation Steps

When installing the module, do not hit the module with a hammer. The module's reducer is a precision mechanism , and the module is equipped with an encoder. Excessive impact may damage the reduction mechanism and the encoder.

1.Align the Module Output and Load Shaft Precisely.

Note: Perform this alignment carefully, especially when using rigid couplings. Even slight

misalignment can cause the actuator to exceed the allowable load, leading to damage to the output shaft.

2.The cross roller bearing integrated inside the module serves as the sole load-bearing component. Load and overturning moment must be verified prior to installation to prevent loss of precision and bearing damage. Refer to the parameters in the table below for matching flanges, bolts and tooling fixtures.

Type	Basic rated load				Allowable static moment	
	Basic rated dynamic load		Basic rated static load			
	KN	kgf	KN	kgf	Nm	kgfm
40	1.4	143	1.8	183	10	1
52/60	5.29	540	7.55	770	74	7.6
70	5.8	590	8.6	880	74	7.6
80	10.4	1060	16.3	1670	124	12.6
90	14.6	1490	22	2250	187	19.1
110	21.8	2230	35.8	3660	258	26.3
142	38.2	3900	65.4	6680	580	59.1
170	43.3	4410	81.6	8330	849	86.6
190	77.6	7920	135	13800	1127	115

3.Use flat washers and high-strength bolts to secure the module flange to the load end,Tighten them with a torque wrench to control the tightening torque.

The tightening torque is shown in the table below：

Module / Item	L-40-I		L-52-I		L-60-I	
	Output shaft	Flange	Output shaft	Flange	Output shaft	Flange
Screw Specifications	M1.6	M2	M2.5	M2.5	M2.5	M2.5
Hole Depth	8（Threaded depth: 5)	4	8.7（Threaded depth: 5)	5	9（Threaded depth: 6)	5
Tightening Torque	0.2N·m	0.6N·m	1.2N·m	1.2N·m	1.2N·m	1.2N·m

Module / Item	L-70-I		L-80-I		L-90-I	
	Output shaft	Flange	Output shaft	Flange	Output shaft	Flange
Screw Specifications	M3	M3	M3	M3	M3	M4
Hole Depth	15（Threaded depth: 6)	7.5	16.5（Threaded depth: 6)	7.5	17.5（Threaded depth: 6)	10
Tightening Torque	2.4N·m	2.4N·m	2.4N·m	2.4N·m	2.4N·m	5.4N·m

Module / Item	L-110-I		L-142-I		L-170-I		L-190-I	
	Output shaft	Flange	Output shaft	Flange	Output shaft	Flange	Output shaft	Flange
Screw Specifications	M4	M4	M5	M5	M6	Φ6.6	M8	Φ6.5
Hole Depth	22（Threaded depth: 8)	10	27.5（Threaded depth: 8)	10	34（Threaded depth: 10)	50(Through hole)	38（Threaded depth: 10)	54(Through hole)
Tightening Torque	5.4N·m	5.4N·m	10.8N·m	10.8N·m	18.4N·m	18.4N·m	45N·m	18.4N·m

3. Proper Connection of Motor Power and Encoder Cables

Do not pull the cables forcefully, as this may damage the terminals at the connection points.

Keep the cables slack to avoid applying tension to the module.When bending the cables, maintain a sufficient bending radius (R=40mm or more) to prevent excessive bending that could cause cable breakage.

Discharge Module Description

1.Product Description

The power discharge module is a dedicated component for handling the regenerative braking kinetic energy of robot joint modules operating under high-speed and heavy-load conditions, thereby preventing the bus voltage overvoltage alarm and shutdown caused by the surge in power supply voltage due to regenerative energy feedback.

The discharge resistor functions to dissipate excess energy through resistance when the circuit loop is in the kinetic energy recovery process, thus avoiding the power supply voltage surge induced by regenerative energy feedback. However, the discharge resistor cannot be connected to the circuit for an extended period; otherwise, it will continuously generate excessive heat, leading to component damage, circuit malfunctions and unnecessary power consumption. Therefore, it is recommended to design a reliable control logic for the discharge resistor connection.

When the joint module is powered by a 48V switching power supply, the control logic for the discharge resistor connection of the power discharge module is as follows: the resistor is disconnected when VDC $\leqslant$ 52V (see Figure 1-1), and the power supply only outputs electric energy to the motor at this time; the resistor is connected when VDC $\geqslant$ 55V (see Figure 1-2), and the excess electric energy is dissipated through the resistor at this time.

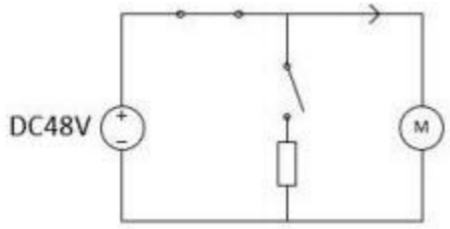


Figure 1-1 Resistor off (V_{DC} ≤52V)

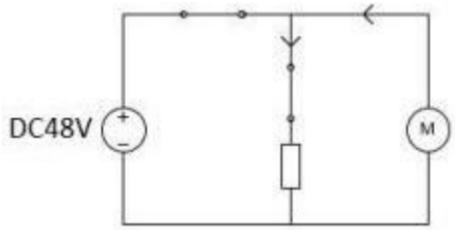


Figure 1-2 Resistor on (V_{DC} ≥55V)

2.Technical Information

2.1Electrical Characteristics

Table 2-1 Electrical Characteristics

Electrical Characteristics	
Input Voltage (VDC)	24-65
External Braking Resistor	See Table 3-2
Capacitance (μF)	1000

2.2 Adjustment of Regenerative Braking Resistor for Start/Shutdown

The discharge module is equipped with two DIP switches, and the discharge voltage value can be adjusted via the DIP switches as detailed in the following table:

Table 2-2 Technical Data

Supply Voltage (DC)	SW1	SW2	Start Regeneration (V)	Stop Regeneration (V)	Description
≤ 50 V	OFF	OFF	55	51	Activates the regenerative braking resistor when VDC ≥ 55 V; Deactivates the regenerative braking resistor when VDC ≤ 52 V.
> 50 V ≤ 58 V	OFF	ON	64	60	Activates the regenerative braking resistor when VDC ≥ 64 V; Deactivates the regenerative braking resistor when VDC ≤ 60 V.
> 50 V ≤ 58 V	ON	OFF	64	60	Activates the regenerative braking resistor when VDC ≥ 64 V; Deactivates the regenerative braking resistor when VDC ≤ 60 V.
> 58 V ≤ 65 V	ON	ON	73	68	Activates the regenerative braking resistor when VDC ≥ 73 V; Deactivates the regenerative braking resistor when VDC ≤ 68 V.

Notes

1.Do not allow the module supply voltage to exceed the regenerative braking resistor activation voltage. Exceeding this voltage will cause the discharge module and braking resistor to operate continuously, resulting in overheating.

2.The voltage error for the regenerative braking resistor activation/deactivation voltage is less than 1.5%.

2.3 LED Indicator Description

This module is equipped with 2 LED indicators, whose functions are described as follows:

Table 2-2 LED Indicator Description

Color	Function	Description	Troubleshooting Notes
Yellow	Power Indicator	Solid on when power is normal; Off or flashing when power is abnormal.	If the light remains off or flashes after power-on, check whether the input voltage of the module is normal and if the power screw terminals are tightened securely.
Green	Brake Resistor Indicator	1.Solid on when powered on normally; 2.Off or flashing when	1.Discharge powered, module not running: If the LED indicator is off or flashing: ①Check if the brake resistor screw terminals are

		regenerative braking resistor is activated.	securely tightened or if the brake resistor is open-circuited. ② Check if the supply voltage exceeds the discharge voltage. 2.Discharge powered, module running: If the LED indicator is solid on: ① The supply voltage rises due to the module's kinetic energy feedback but is lower than the regenerative braking resistor activation voltage. This is normal if the activation/deactivation voltage settings are appropriate. ② The supply voltage rises due to the module's kinetic energy feedback and exceeds the regenerative braking resistor activation voltage, indicating module damage.

Notes

1.Do not allow the module supply voltage to exceed the regenerative braking resistor activation voltage. Exceeding this voltage will cause the discharge module and braking resistor to operate continuously, resulting in overheating.

2.The voltage error for the regenerative braking resistor activation/deactivation voltage is less than 1.5%.

2.4 Environmental Conditions

Table 2-4 Environmental Conditions

Feature	Specification
Operating Temperature	-20 ~ 60°C
Storage Temperature	-30 ~ 60°C
Protection Class	IP30
Operating & Storage Humidity	20% ~ 80% RH (non-condensing)

Note

Please ensure the operating environment is free of dust, metal powder, corrosive gases, flammable gases, oil mist, and other contaminants.

3. Wiring

3.1 Electrical Interface Definition

The electrical interface of the power discharge module is shown in Figure 3-1, and the interface definitions are detailed in Table 3-1.

Table 3-1 Electrical Interface Definition

Category	Pin No.	Pin Label	Pin Function	Part No.	Terminal Specifications
Power Input	1	PE	Connect to housing -ground	DB910-6.35-3P-GN-P	Screw terminal Wire gauge: 10–14 AWG Tool: M3 Phillips screwdriver
	2	48-	Connect to 48 VDC power negative		
	3	48+	Connect to 48 VDC power positive		
Brake Resistor	1	BR+	Connect to brake resistor	DB910-6.35-2P-GN-P	
	2	BR-			

3.2 Wiring and Operation Instructions

The wiring diagram of the 48V DC power supply with the power discharge module and joint module is shown in Figure 3-2. The DC+ and DC- terminals of the discharge module must be directly connected to the DC+ and DC- terminals of the module respectively.The recommended specifications for the DC48V power supply and braking resistor R corresponding to each joint model are listed in Table 3-2.The recommended accessory specifications for the power discharge module matched with each robotic arm model are listed in Table 3-3.

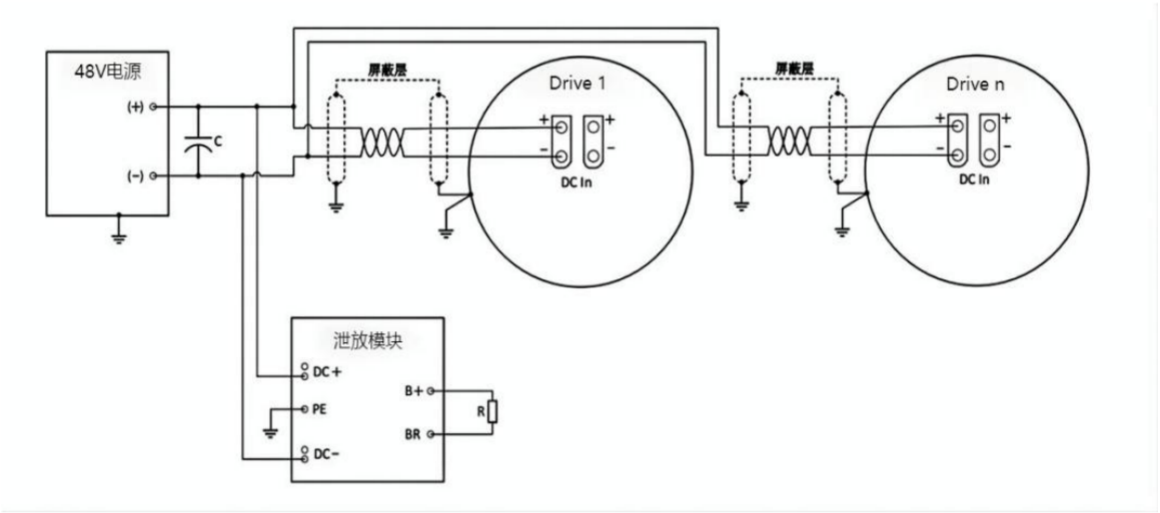


Figure 3-2 Wiring Diagram of Power Discharge Module

Table 3-2 Recommended Accessory Specifications for Each Joint Model

Joint Model	DC Power Supply Specification	Braking Resistor Specification	Electrolytic Capacitor Specification
40	100W 、48VDC	50W、10Ω	12000μF、80V
52/60	150W 、48VDC	50W、10Ω	12000μF、80V
70	200W 、48VDC	50W、10Ω	12000μF、80V

80	600W 、48VDC	200W、5Ω	36000μF、80V
90	800W 、48VDC	200W、5Ω	96000μF、80V
110	1200W 、48VDC	200W、5Ω	96000μF、80V
142	1500W 、48VDC	300W、3Ω	96000μF、80V
170	2000W 、48VDC	300W、3Ω	96000μF、80V
190	2000W 、48VDC	300W、3Ω	96000μF、80V

Robot Arm Model	DC Power Supply Specification	Braking Resistor Specification
7kg	1000W 、48VDC	200W 、5Ω
12kg	1500W 、48VDC	300W 、3Ω
20kg	3000W 、48VDC	300W 、3Ω

4. Mounting Method

The power discharge module generates heat during operation, and the resistor may even become hot to the touch. Do not touch it directly.The power discharge module and discharge resistor shall be mounted in an environment with good ventilation and heat dissipation conditions, such as on a large-area metal plate or in an electrical cabinet equipped with a cooling fan.

Chapter 8 Debugging and Operation

Introduction

This manual describes the usage, precautions, and related information for the AthDrive software developed, designed, and implemented by Laifual Drive. Please read it carefully before operating the software.

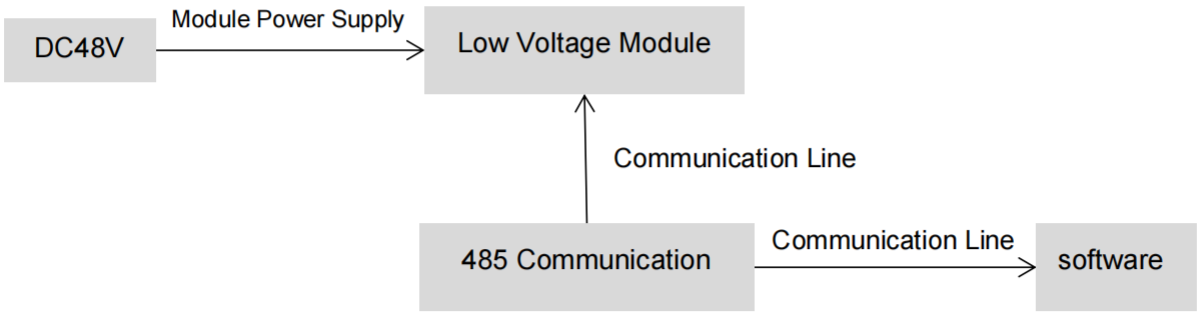
AthDrive is a dedicated software application specifically developed for the Laifual low-voltage series modules. The software provides a range of features — including parameter configuration, phase-finding (commutation alignment), jog testing, and more — presented in a clean, well-organized interface. It is easy to use and enables users to quickly commission, debug, and operate the low-voltage modules.

Installation

Please download our software from the official website（www.laifualdrive.com）For the USB-to-RS485 serial driver, please download version 323 from the following link::https://www.zily-tech.com/driver/

Hardware Connection Block Diagram

Solution Overview:
The module is powered by a 48 V power supply, and RS-485 communication is used to connect the module with the PC software. Module parameter values can be modified through the firm ware .
The hardware wiring diagram is shown below：



Steps to Connect to the software

1.Connect the RS-485 communication cable.

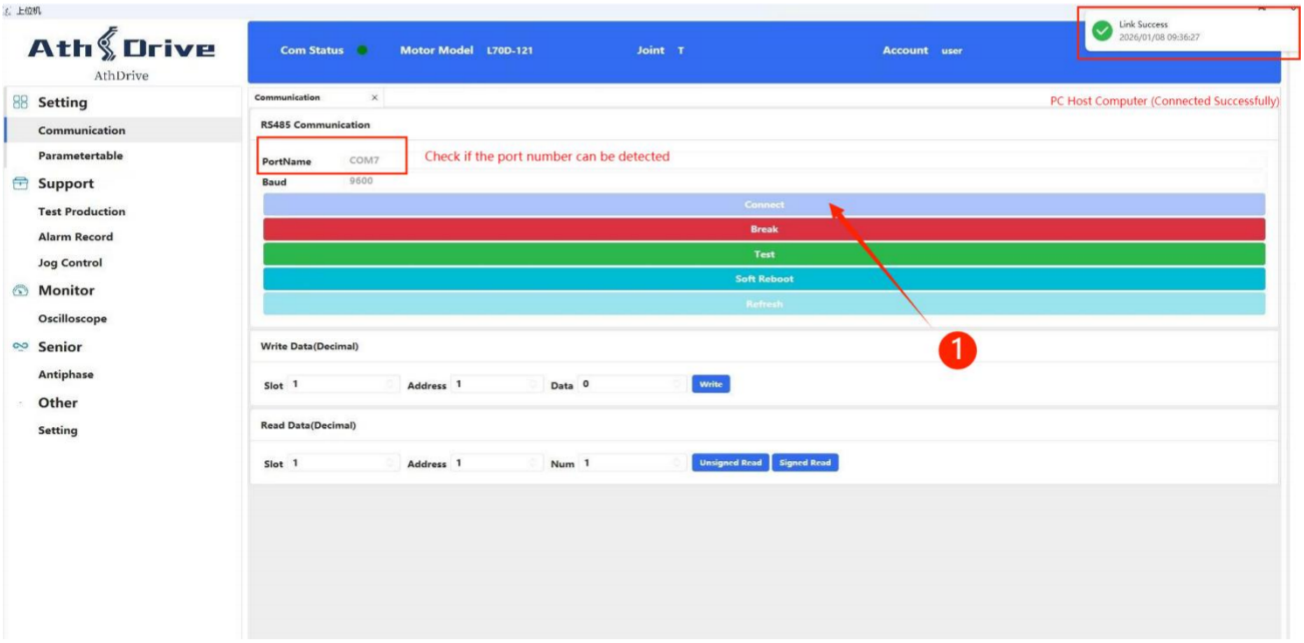
For the communication cable provided by our company: Red wire A → T+/A, Yellow wire B → T-/B, Black wire G → GND

The RS-485 adapter is shown in the figure below：



2.Open the software . If the port cannot be detected, first check the connection of the communication cables. If the cables are in good condition, please download and install the USB-to-RS485 serial driver. The specific download link is provided in the “ Installation ” section.

As shown in the figure below, follow the steps to connect to the software .

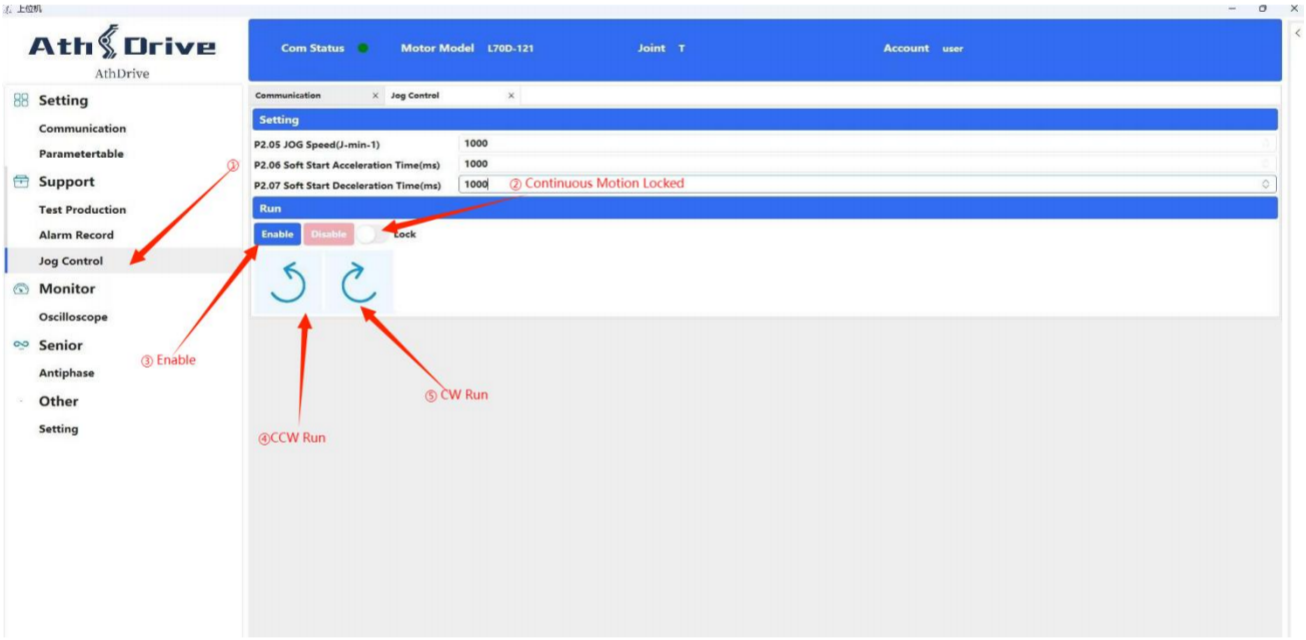


Chapter 9 JOG Test Run

JOG control

Open “JOG Control ” and click “Start ” to enable the servo. Confirm that the brake has been released (a clicking sound “click ” indicates the brake is open).

Click the rotation arrow on the right (press and hold the left mouse button for 8 seconds before releasing) to perform a rotation test.



The program JOG

In the “AthDrive PC software” - “Parameter Table”, modify the following parameters in order to enable the JOG program.

For example: if the module is required to run at a speed of 2000 rpm with an acceleration of 100 ms², and the motor needs to rotate 100 turns forward and 100 turns in reverse repeatedly, the parameters can be set as follows.

P7.00 Bus Mode	**0** (No Bus)
P0.05 Control Module	**12**
P6.00 JPOS0 Position Control Pulse (High)	**1310**

(Set the value of the first position, where the value multiplied by 10000 and added to the low-value will give the target position pulse.)

P6.01 JPOS0 Position Control Pulse (Low) **7200**

P6.02 JPOS1 Position Control Pulse (High) **-1310**

(Set the value of the second position, where the value multiplied by 10000 and added to the low-value will give the target position pulse.)

P6.03 JPOS1 Position Control Pulse (Low) **-7200**

P6.20 JPOS0 Position Speed Control **2000** (Speed control for the first position, in rpm)

P6.21 JPOS1 Position Speed Control **2000** (Speed control for the second position, in rpm)

P6.30 JPOS0 Position Filter Time **1000** (Filter time for the first position, in 0. 1ms)

P6.31 JPOS1 Position Filter Time **1000** (Filter time for the second position, in 0.1ms)

P6.40 JPOS0 Position Stop Time **20**(Stop time from the current position to the next position, in 50ms)

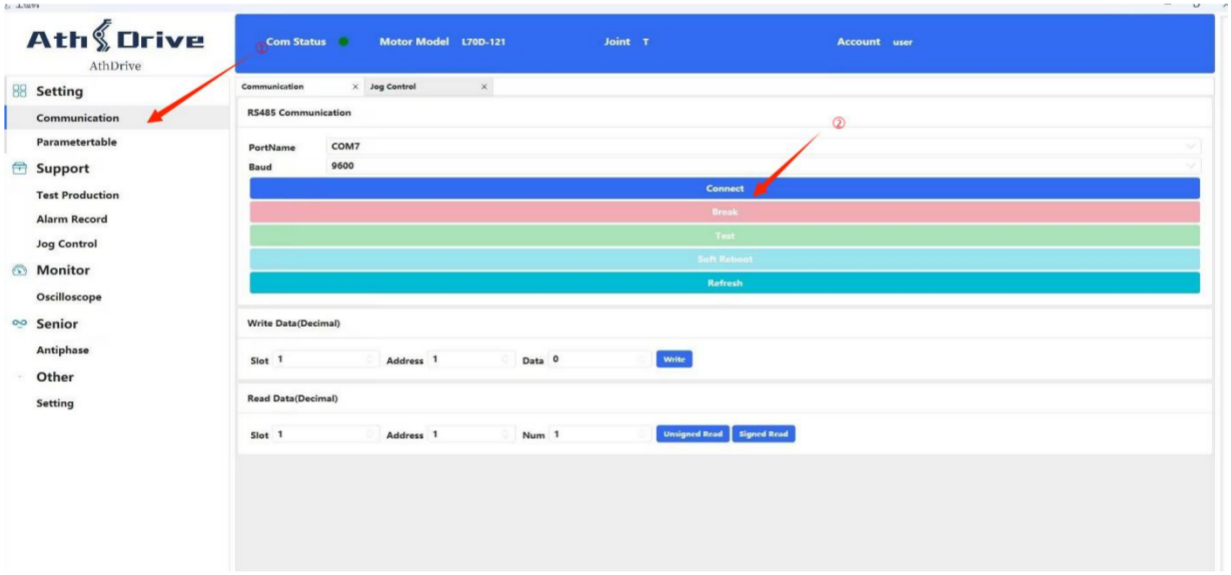
P6.41 JPOS1 Position Stop Time **20** (Stop time from the current position to the next position, in 50ms)

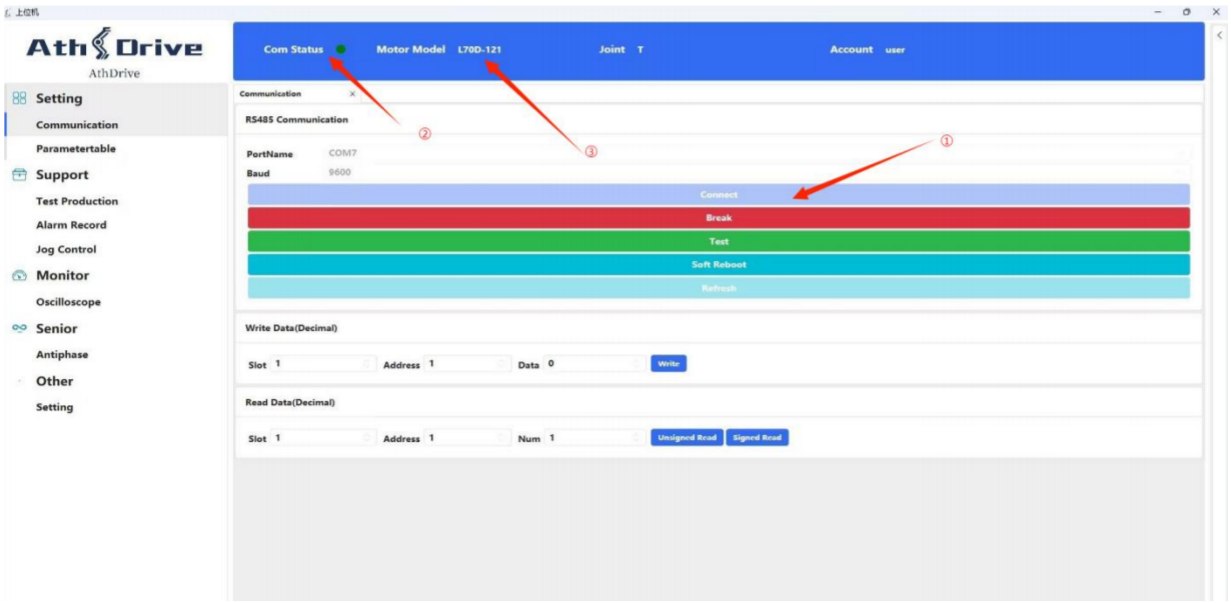
P4.18 Servo ON Wait Time **0**

P5.01 Set to **1** to start the operation

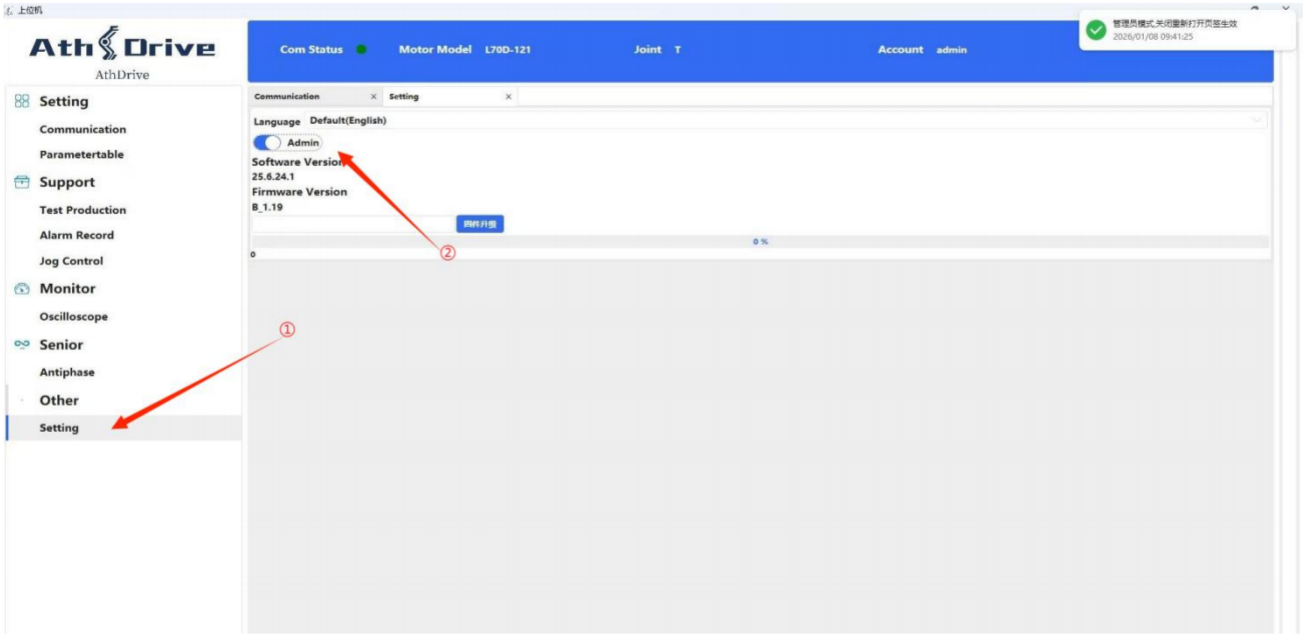
Chapter 10 Key Parameter Verification and Rigidity Adjustment

1.Open the software and select “Settings → Communication. ”
Click the “Connect ” button. Once the connection is successful, the “Connection Status ” will change from red to green, and the corresponding module model will be displayed.
(If “Failed to Open Port ” appears, please unplug and reinsert the USB interface, then try connecting again.)



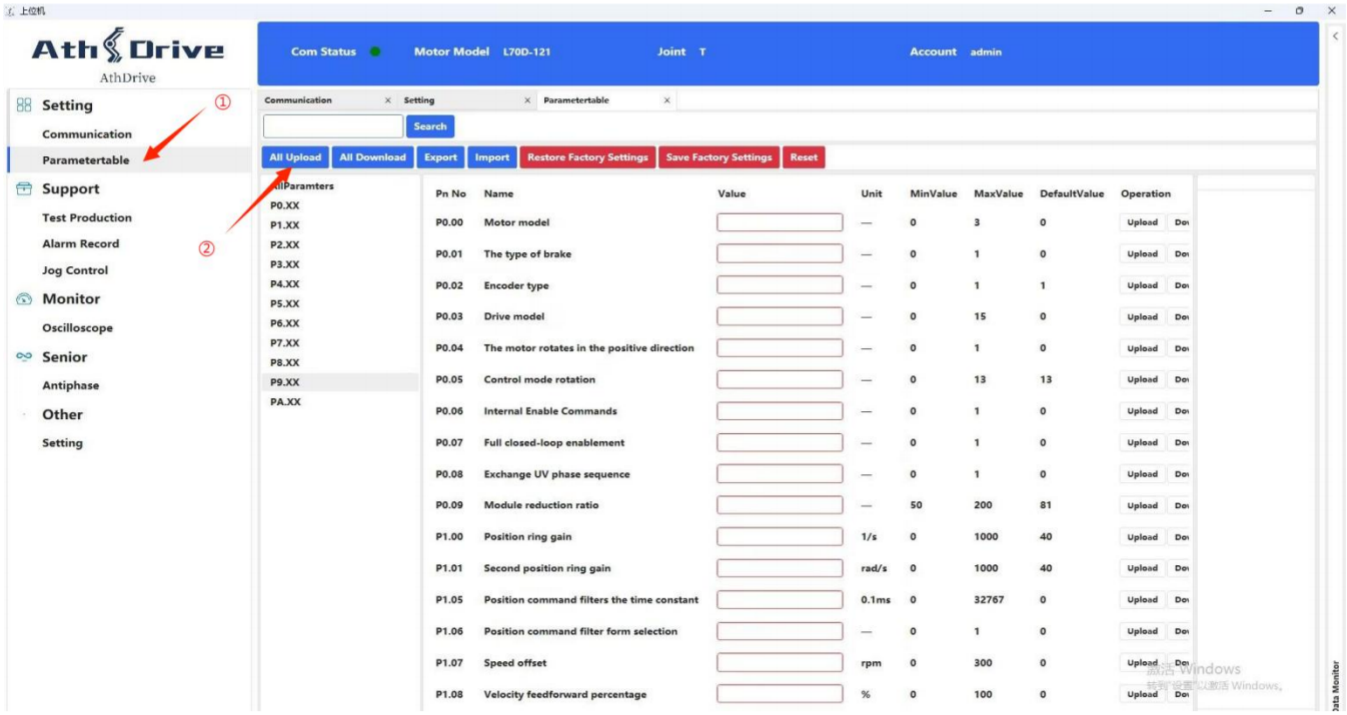


2.Click “Others → Settings ” and select the “Administrator ” button. The top-right corner will indicate that you have entered Administrator Mode.



Parameter confirmation

1.Open “Parameter Table ” and click the “Upload All ” button to upload the motor parameters.



2. Parameter

Joint Module	Key Parameter			
L-40-I-XX	Ratio		50	100
	P0.00	Motor Model	1	2
	P0.03	Drive Model	7	7
	P0.07	Full closed-loop enable	0	0
	P0.08	UV phase sequence	0	0
	P0.09	Module ratio	51	101
	PA.03	Pole pairs	8	8
	PA.04	Rated current	284	206
	PA.05	Maximum current	40.9	29.6
L-52-I-XX	Ratio		50	100
	P0.00	Motor Model	1	2
	P0.03	Drive Model	6	6
	P0.07	Full closed-loop enable	0	0
	P0.08	UV phase sequence	0	0
	P0.09	Module ratio	51	101
	PA.03	Pole pairs	8	8
	PA.04	Rated current	300	245
	PA.05	Maximum current	45.2	30.3
L-60-I-XX	Ratio		50	100
	P0.00	Motor Model	1	2
	P0.03	Drive Model	6	6
	P0.07	Full closed-loop enable	0	0
	P0.08	UV phase sequence	0	0
	P0.09	Module ratio	51	101
	PA.03	Pole pairs	8	8
	PA.04	Rated current	244	199
	PA.05	Maximum current	36.8	24.6

L-70-I-XX	**Ratio**		**50**	**80**	**100**	**120**
	P0.00	Motor Model	1	0	2	
	P0.01	Motor Type	0	0	0	
	P0.03	Drive Model	0	0	0	
	P0.07	Full closed-loop enable	0	0	0	
	P0.08	UV phase sequence	1	1	1	
	P0.09	Module ratio	51	81	101	
	PA.03	Pole pairs	8	8	8	
	PA.04	Rated current	323	316	253	
	PA.05	Maximum current	82.5	67.7	65.2	
L-80-I-XX	**Ratio**		**50**	**80**	**100**	**120**
	P0.00	Motor Model	1	0	2	3
	P0.01	Motor Type	1	1	1	1
	P0.03	Drive Model	1	1	1	1
	P0.07	Full closed-loop enable	0	0	0	0
	P0.08	UV phase sequence	1	1	1	1
	P0.09	Module ratio	51	81	101	121
	PA.03	Pole pairs	8	8	8	8
	PA.04	Rated current	1042	675	789	659
	PA.05	Maximum current	134.8	108	108.3	90.4
L-90-I-XX	**Ratio**		**50**	**80**	**100**	**120**
	P0.00	Motor Model	1	0	2	3
	P0.01	Motor Type	1	1	1	1
	P0.03	Drive Model	3	3	3	3
	P0.07	Full closed-loop enable	0	0	0	0
	P0.08	UV phase sequence	1	1	1	1
	P0.09	Module ratio	51	81	101	121
	PA.03	Pole pairs	8	8	8	8
	PA.04	Rated current	1181	963	810	676
	PA.05	Maximum current	195.9	151.5	135.4	119.4
	Ratio		**50**	**80**	**100**	**120**

L-110-I-XX	P0.00	Motor Model	1	0	2	3
	P0.01	Motor Type	1	1	1	1
	P0.03	Drive Model	2	2	2	2
	P0.07	Full closed-loop enable	0	0	0	0
	P0.08	UV phase sequence	1	1	1	1
	P0.09	Module ratio	51	81	101	121
	PA.03	Pole pairs	10	10	10	10
	PA.04	Rated current	1838	1816	1805	150.7
	PA.05	Maximum current	324.2	286.1	263	233.5
L-142-I-XX	**Ratio**		**50**	**80**	**100**	**120**
	P0.00	Motor Model	1	0	2	3
	P0.01	Motor Type	1	1	1	1
	P0.03	Drive Model	4	4	4	4
	P0.07	Full closed-loop enable	0	0	0	
	P0.08	UV phase sequence	1	1	1	1
	P0.09	Module ratio	51	81	101	121
	PA.03	Pole pairs	10	10	10	10
	PA.04	Rated current	1940	1893	1966	1641
	PA.05	Maximum current	389.3	344.5	302.9	268
L-170-I-XX	**Ratio**		**50**	**80**	**100**	**120**
	P0.00	Motor Model	1	0	2	3
	P0.01	Motor Type	1	1	1	1
	P0.03	Drive Model	5	5	5	5
	P0.07	Full closed-loop enable	0	0	0	0
	P0.08	UV phase sequence	1	1	1	1
	P0.09	Module ratio	51	81	101	121
	PA.03	Pole pairs	10	10	10	10
	PA.04	Rated current	4246	3868	4069	4112
	PA.05	Maximum current	870.8	707.6	620.5	562.8
	P0.09	Module ratio	51	81	101	121

	PA.03	Pole pairs	10	10	10	10
	PA.04	Rated current	4096	3732	3926	3967
	PA.05	Maximum current	840.1	682.7	598.6	543

Rigidity Adjustment

Rigidity adjustment requires appropriate modification of five parameters in the software . The specific parameters are: P1.00 - Position Loop Gain, P1.08 - Velocity Feedforward Gain, P2.00 - Speed Loop Proportional Gain, P2.01 - Speed Loop Integral Time Constant, P2.0C - Load Inertia Percentage

1.Position Loop Gain (P1.00)

Function: Determines how accurately the system follows the commanded position. Higher position loop gain increases system response speed and stiffness, and reduces position lag.

Setting Method:

Initial Setting:

●Set as high as possible while ensuring the motor operates quietly. You may refer to the value obtained from self-learning.

Adjustment Steps:

●Gradually increase the position loop gain and observe whether the system exhibits vibration or overshoot. If vibration or overshoot occurs, reduce the gain slightly until the system stabilizes.

2. Position Feedforward Gain (P1.08)

Function: Improves high-speed response of the control system and reduces position lag.

Setting Method:

Initial Setting:

●Usually set to 0 if high response performance is not required.

Adjustment Steps:

●Gradually increase the position feedforward gain and observe whether the system becomes unstable or exhibits vibration.

If the system remains stable, the gain can be further increased until the desired response speed is achieved.

3.Speed Loop Proportional Gain (P2.00)

Function: Affects the motor’s speed response and stiffness. Higher proportional gain increases system stiffness and accelerates response speed.

Setting Method:

Initial Setting:

●Determined according to the specific servo drive model and load conditions. In general, larger load inertia requires a higher gain setting.

Adjustment Steps:

●Set the integral gain and derivative gain to zero.

●Gradually increase the speed proportional gain and observe whether vibration occurs when the motor stops.

If vibration occurs, slightly reduce the gain until the system stabilizes.

4.Speed Loop Integral Time Constant (P2.01)

Function: Influences the steady-state speed error and the stability of the speed loop. A smaller integral time constant results in faster integration.

Setting Method:

Initial Setting:

●Determined according to the specific servo drive model and load conditions. Larger load inertia typically requires a larger value.

Adjustment Steps:

●Gradually decrease the speed integral time constant while observing the system for vibration.

If vibration occurs, slightly increase the time constant until the system stabilizes.

General Tuning Procedure:

Set an appropriate rotor inertia ratio, referencing the value obtained from self-learning.

Set the speed loop integral time constant to a relatively large value to ensure initial system stability.

Gradually increase the speed loop proportional gain and observe the system. If vibration occurs, slightly reduce the gain.

Gradually decrease the speed loop integral time constant and observe the system. If vibration occurs, slightly increase the value.

Gradually increase the position loop gain and observe the system. If vibration occurs, slightly reduce the gain.

If mechanical resonance occurs, adjust the torque low-pass filter or notch filter to suppress resonance. To achieve shorter positioning time and smaller position tracking error, the position feedforward gain can be increased appropriately, but should not exceed 80%.

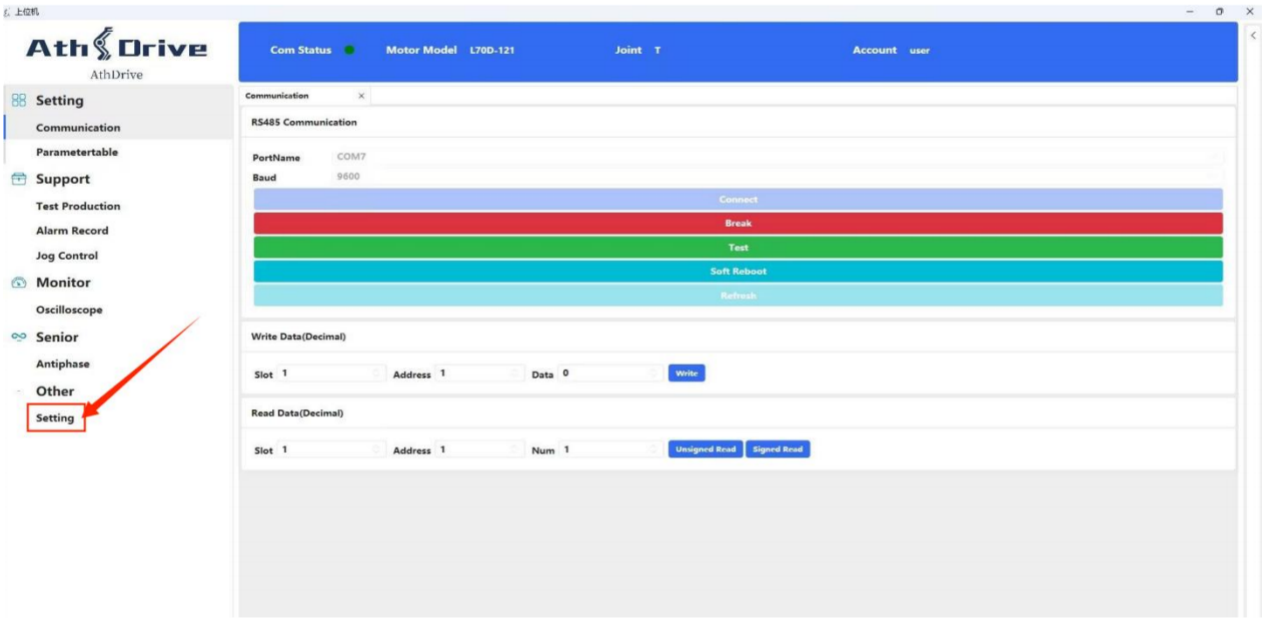
After setting all gain parameters, perform a stability test to observe whether the motor exhibits instability or vibration. If any issues appear, readjust the gain parameters until stable operation is achieved.

By following these steps, the servo motor gain parameters can be gradually tuned to ensure high response speed, high accuracy, and stable operation.

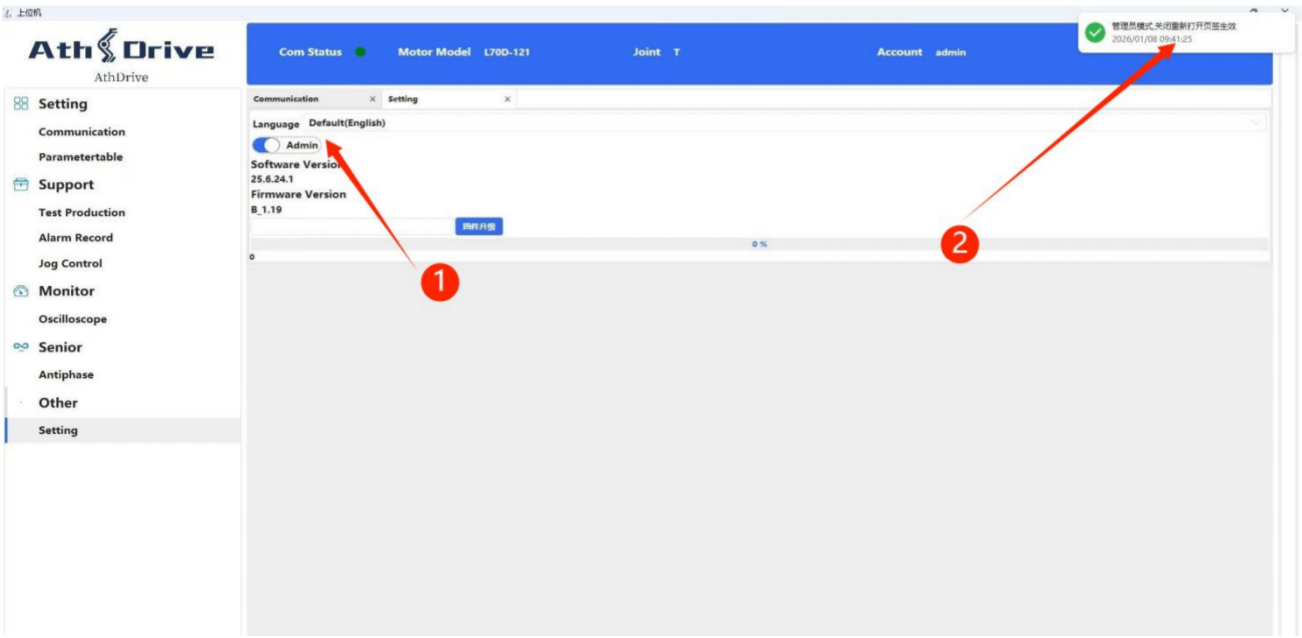
Chapter 11 Firmware Upgrade and Initialization

Upgrade via RS-485 Firmware

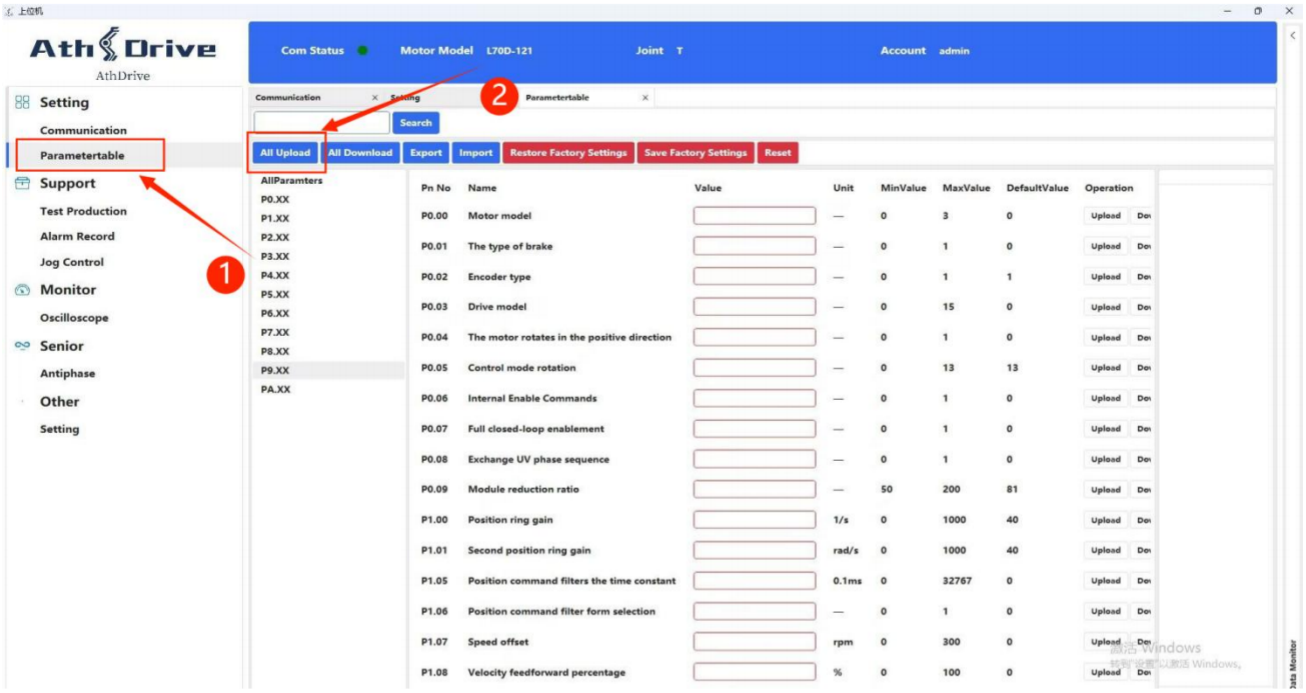
After connecting the module to the firm ware via RS-485, click the “Settings ” button at the bottom of the left-hand function panel.



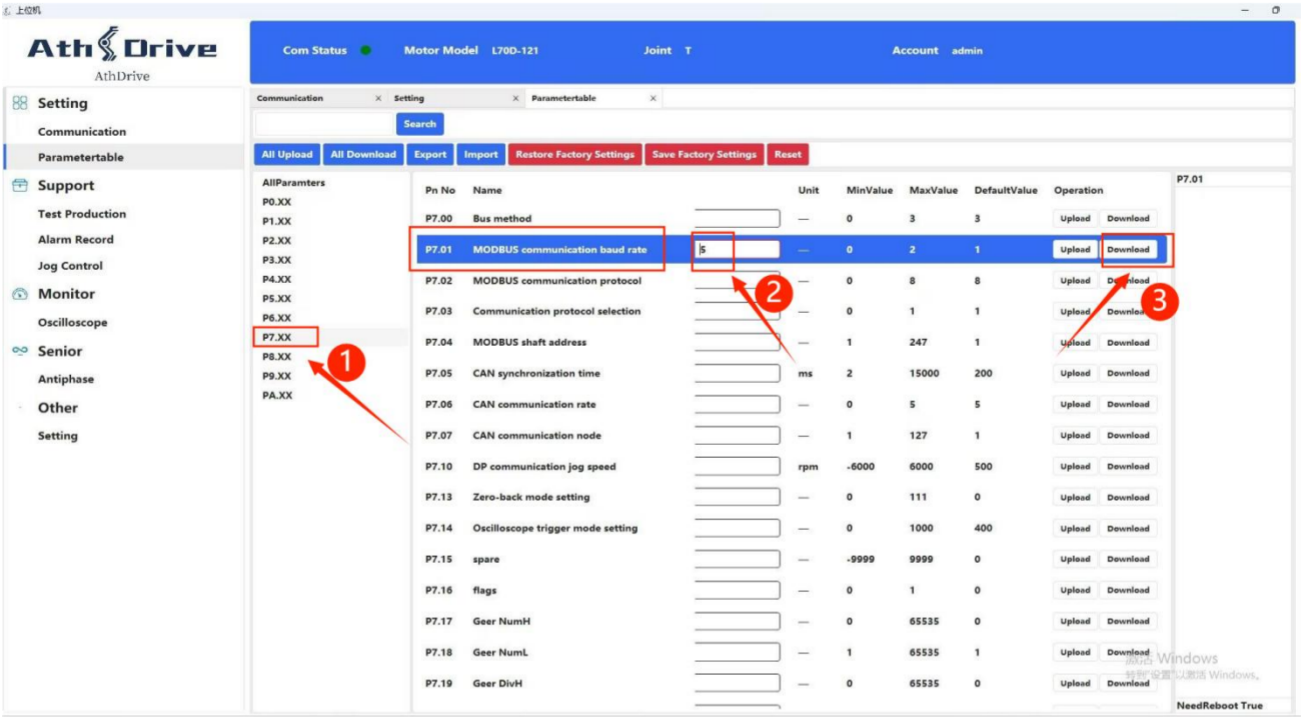
Open Administrator Mode. A window indicating that Administrator Mode is active will appear in the top-right corner.



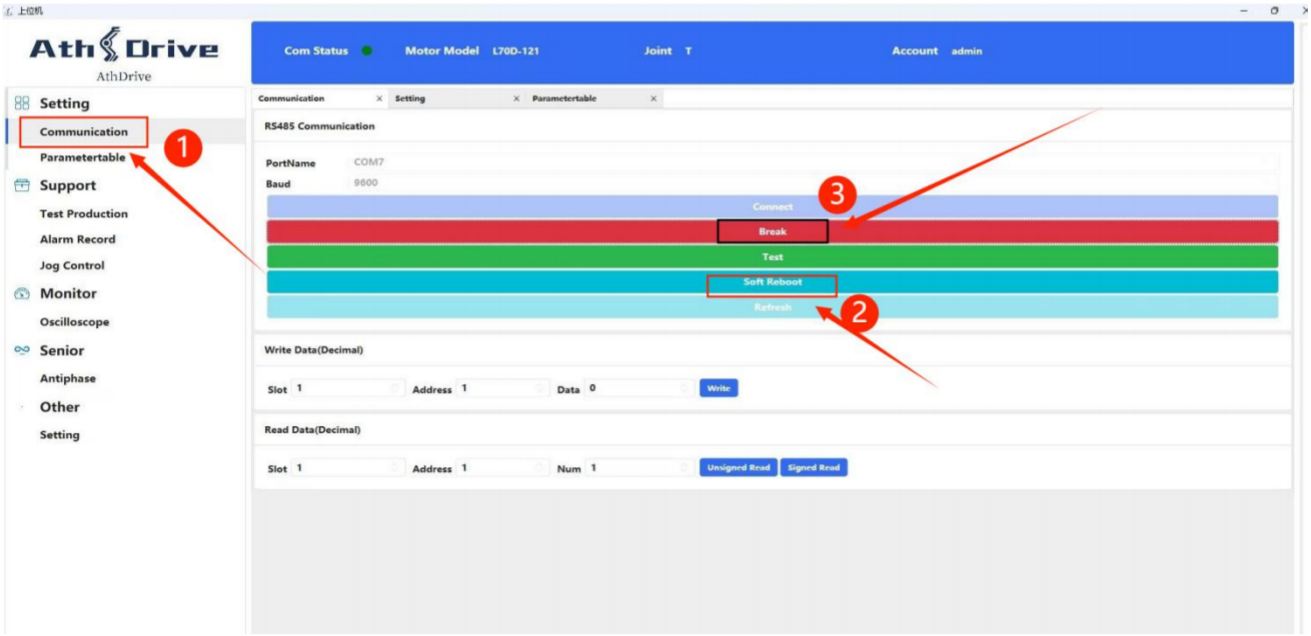
Click “Parameter Table ” in the left-hand function panel, then click the “Upload All” button at the top.



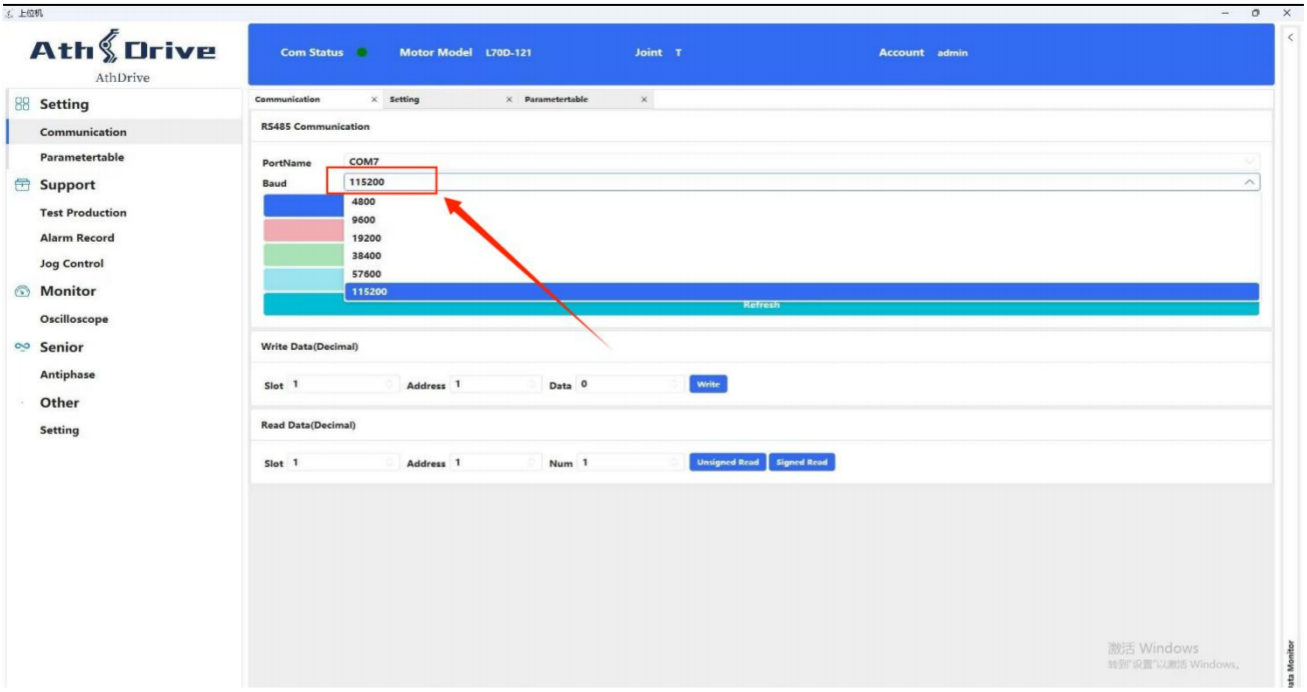
Next, locate the P7.01 “MODBUS Communication Baud Rate” parameter and change its value to “5 ”. Click the “Download” button on the right to download the parameter.



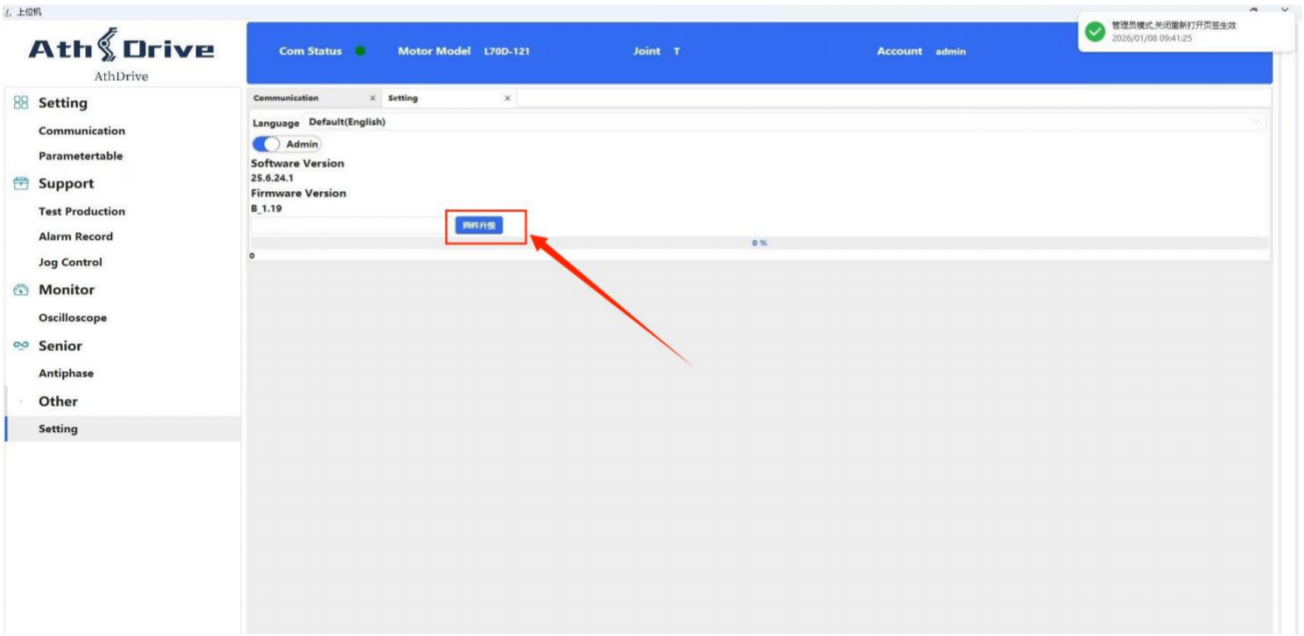
After the download is complete, switch back to the Communication interface and click the dark blue “Soft Restart” button. Once the soft restart is finished, click the red “Disconnect” button to disconnect.



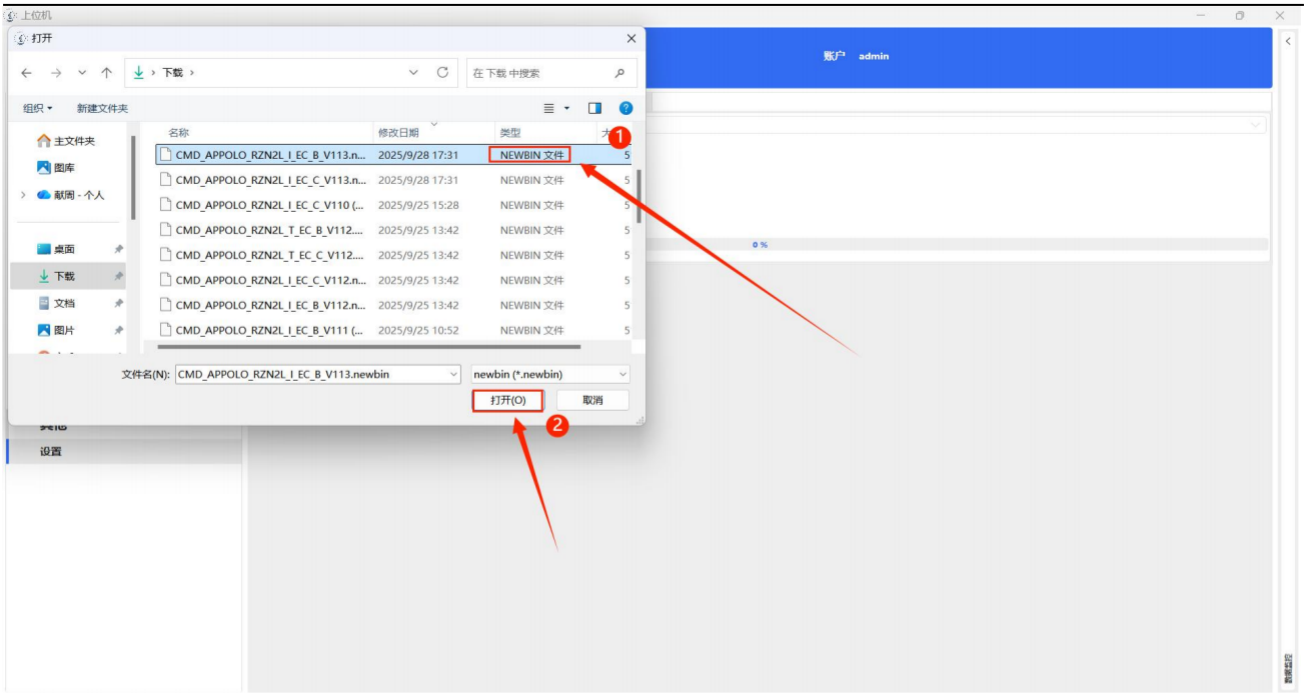
Finally, reselect the 115200 baud rate and click the “Connect” button again.



After connecting, click the Settings tab on the left-hand panel, then click the dark blue “Firmware Upgrade” button.



Select the firmware file to upgrade (485 upgrade requires a .newbin file), then click Open.

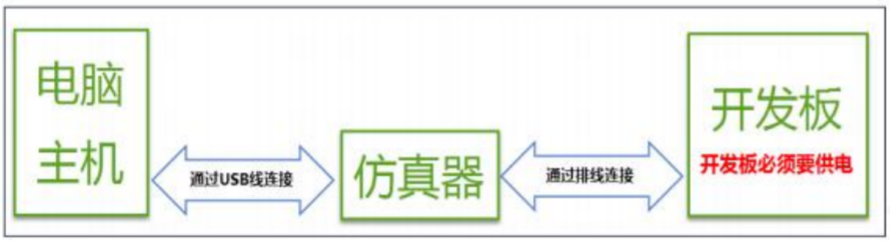


When the blue progress bar reaches 99%, wait for one minute, then power off and restart the module. The firmware upgrade is now complete.

Firmware Upgrade via J-LINK

1. Preparation

1. Hardware Preparation: Prepare the J-Link debugger.



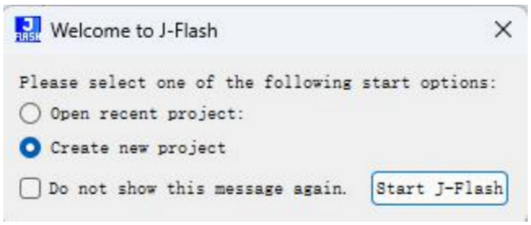
2. Software Preparation: Install the supporting PC software for the programming tool. (Note: Download the software from the tool's official website.)

2. Initial Programming Procedure

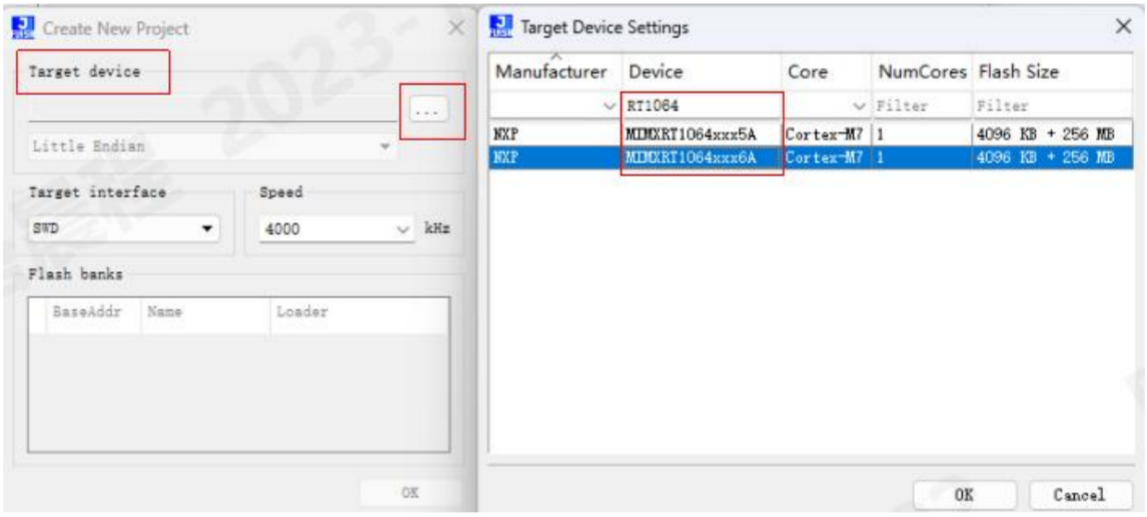
1. After installation, open the J-Link Flash application.



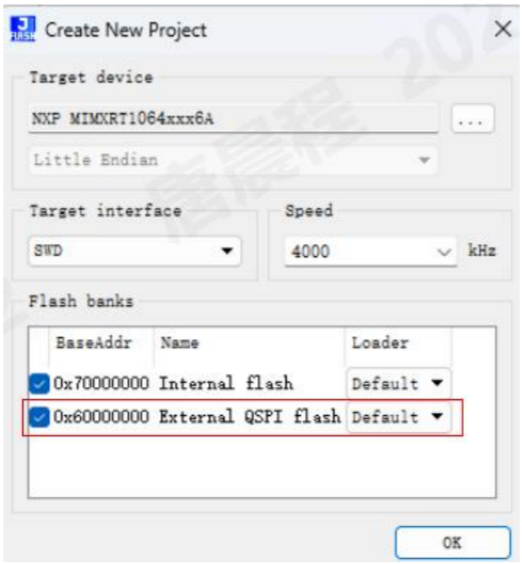
2. Create a new project.



3. Select the corresponding MCU model as required. In this example, choose “MIMXRT1064xxx6A. ”

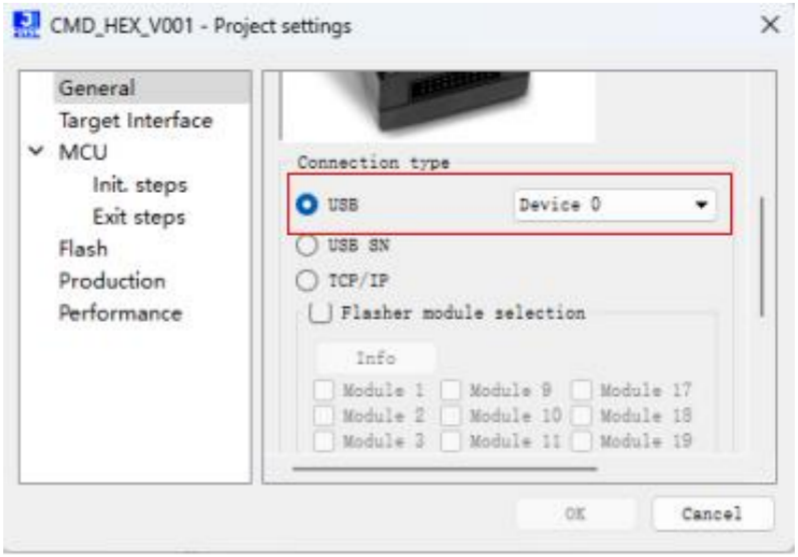


Select“External”Flash

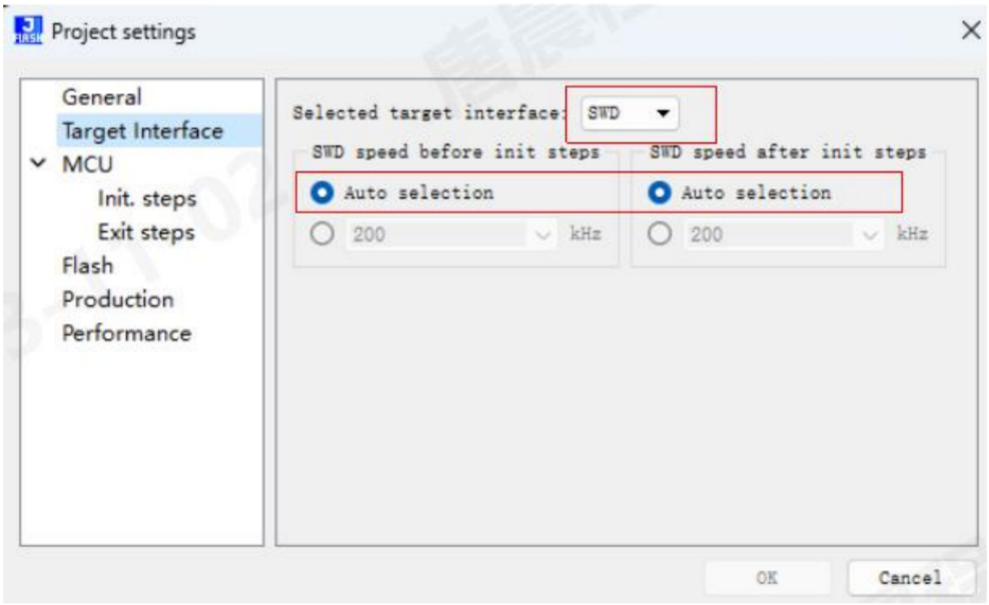


4. Click “Options” > “Project settings” to open the configuration interface.

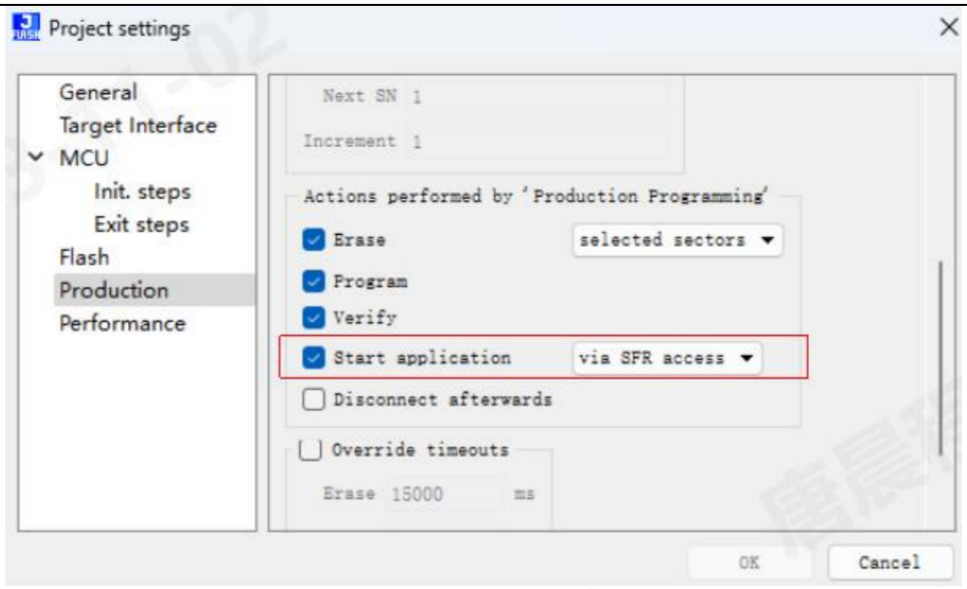
5. Go to the “General” tab and set the connection method to “USB.”



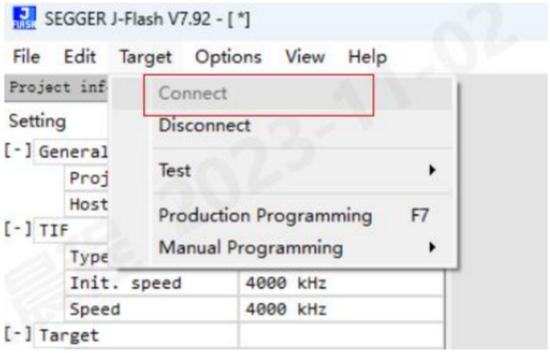
6. Navigate to the “Target Interface ”tab, select “SWD ” as the debugging interface, and set the speed to “AUTO.”



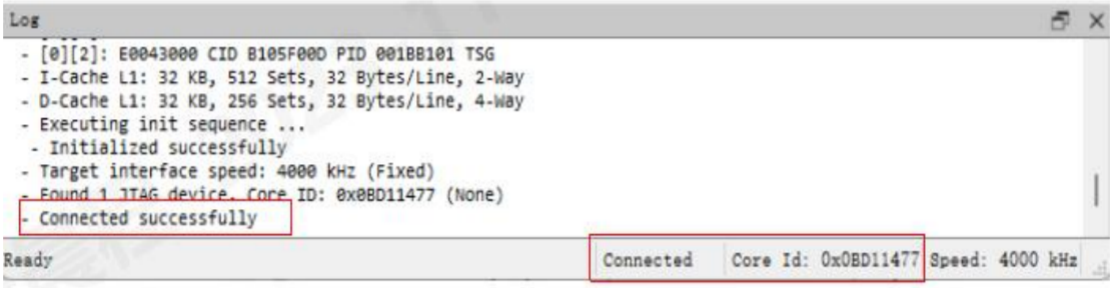
7. Go to the “Production ” tab and check “Start application” to enable automatic reset, allowing the program to run automatically after flashing.



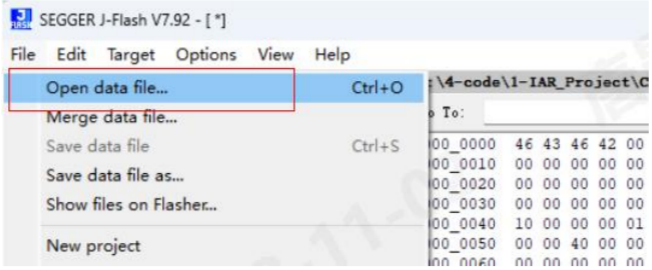
8. After completing the above configuration, exit the settings interface. Then click “Target ” > “Connect ” to establish the connection between the J-Link emulator and the MCU.

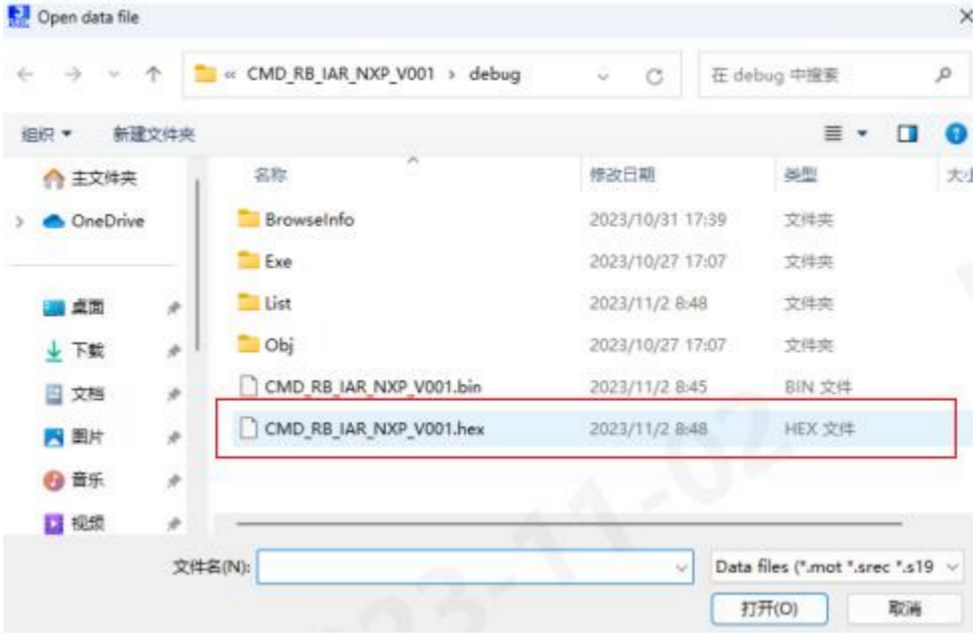


Once the connection is successful, the LOG window will display “successfully. ”

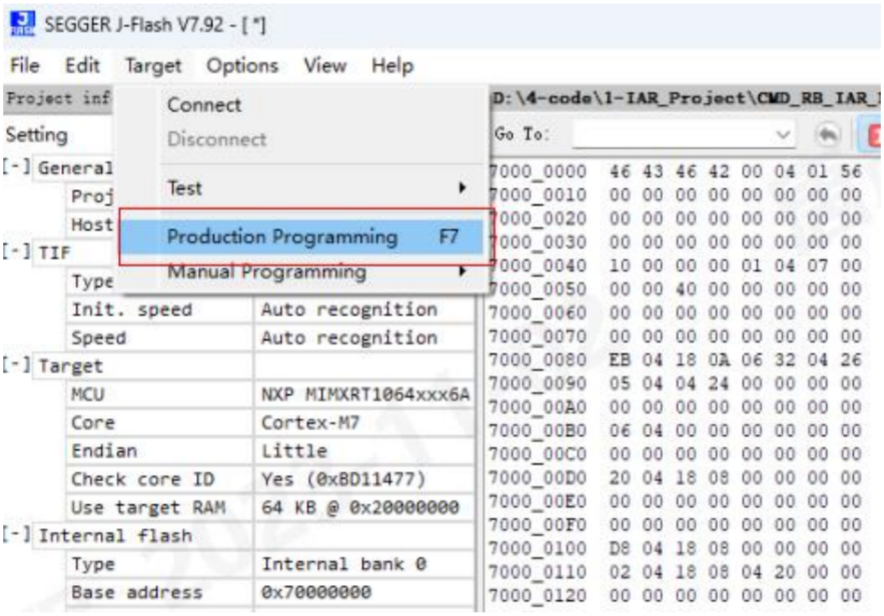


9. After the connection is established, click “File ” > “Open data file” to load the HEX file you want to flash into the project.



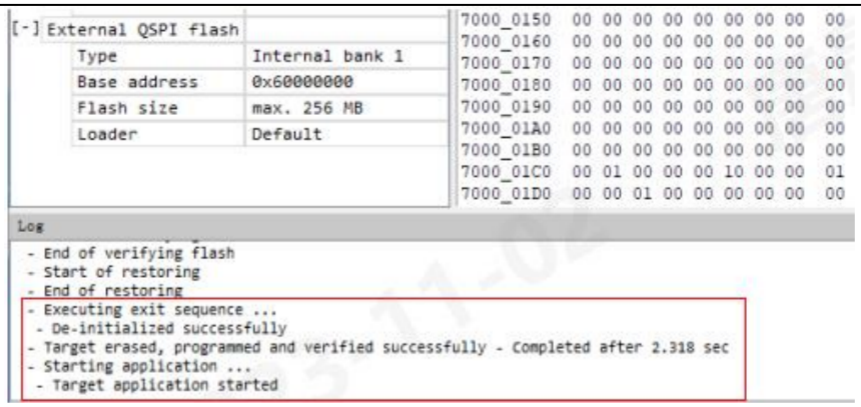


10.After the file is loaded, click “Target”> “Production Programming” to begin flashing the program.



11.Check the flashing result

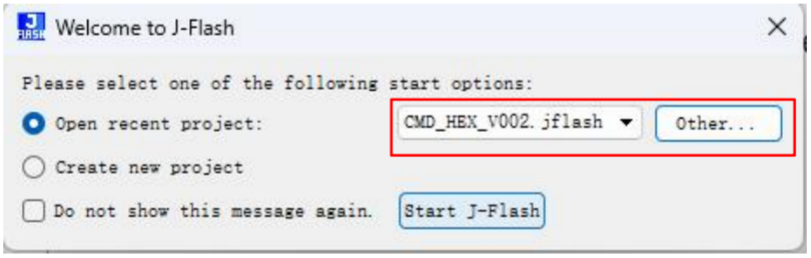
Once the program is successfully downloaded, the LOG window will display “successfully.” If any additional dialog windows pop up, simply close them.



At this point, the flashing process is complete.

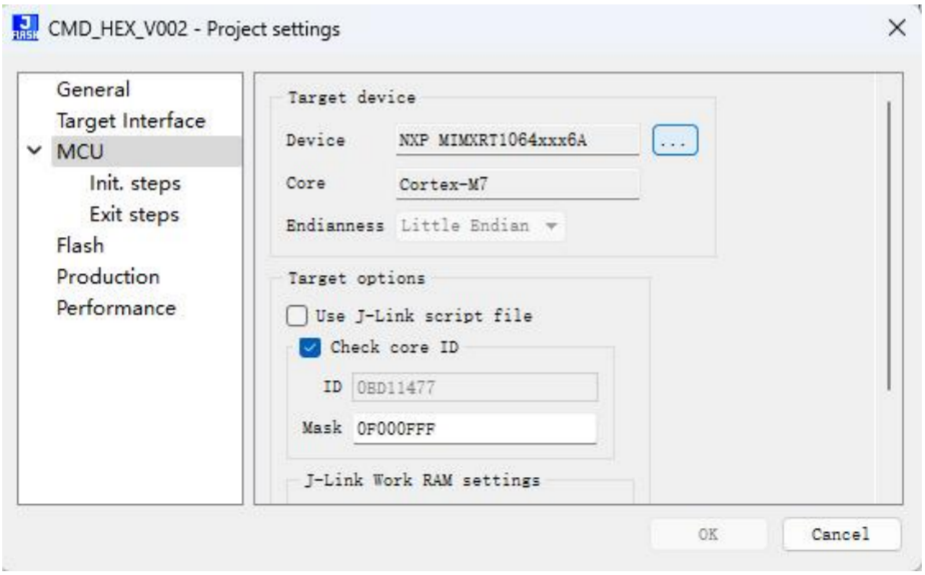
3. Flashing Using a .jflash File

For easier future programming, you may save the above project as a .jflash file.



By opening the .jflash file directly in J-Link Flash, you can connect and flash the program without repeating the configuration steps.

If it is necessary to change the MCU model, open the configuration interface to select the corresponding MCU, and execute step 9 above to update the HEX file.



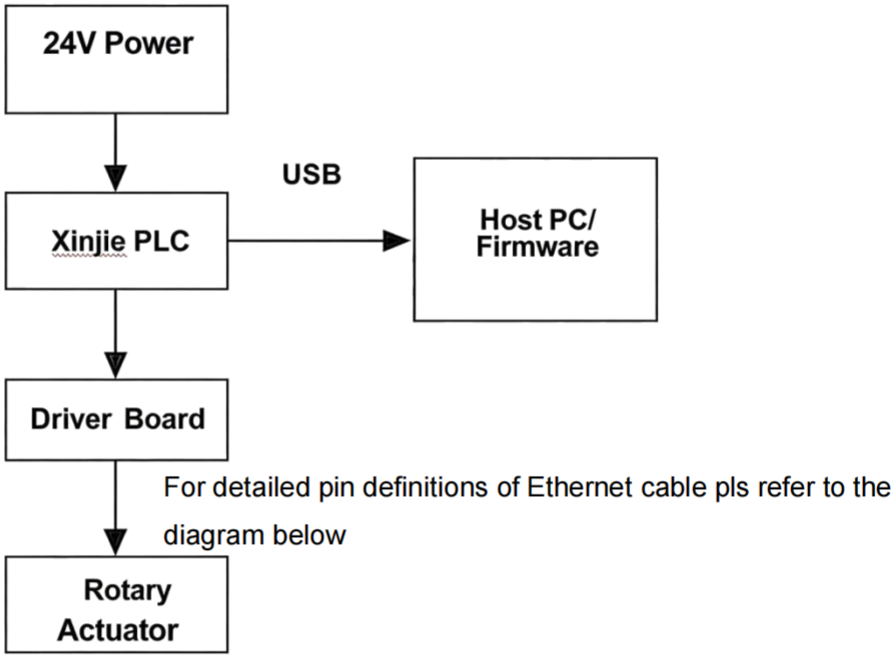
Note:If any issues occur during the flashing process—such as connection failures—you may unplug and reconnect the J-Link cable or power-cycle the development board, then try connecting again.

Chapter 12 CANopen Configuration Example

CANopen Configuration Operation Case for Xinje Controller

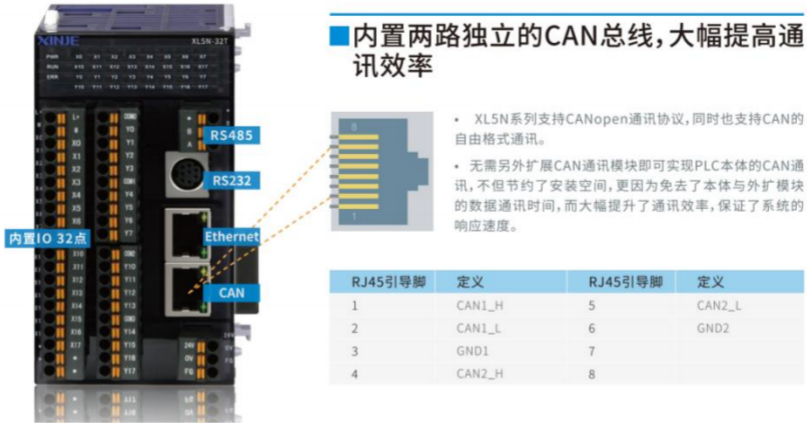
Below is a simple usage and configuration example of the robot joint module using Xinje's XL series PLC as the CANopen master. The wiring diagram is shown below:

1.Hardware Connection



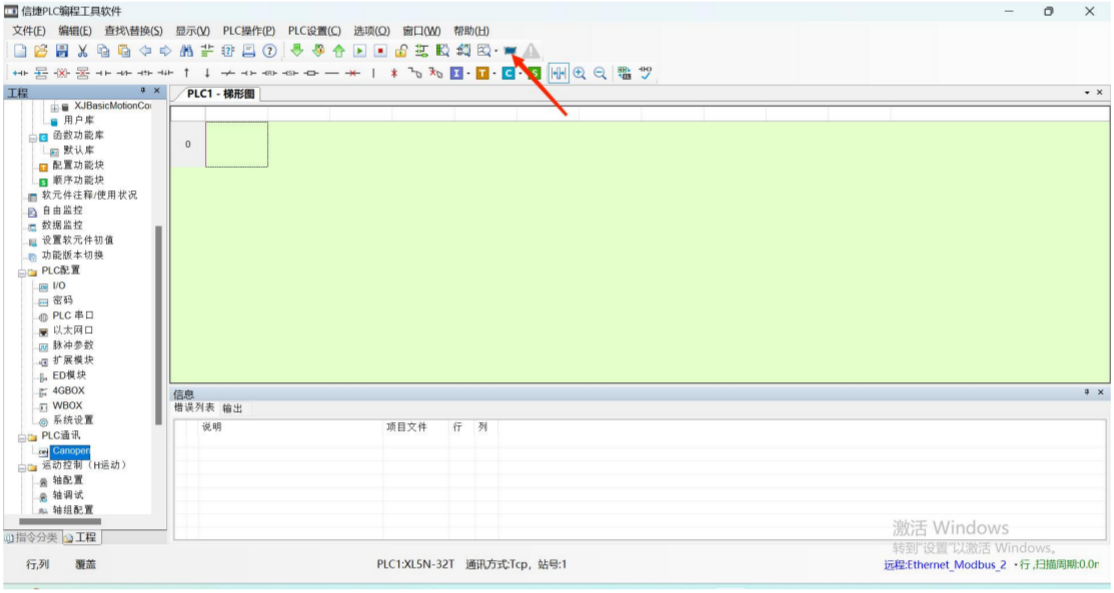
Wiring Diagram for Configuring the Module with Xinje Controller

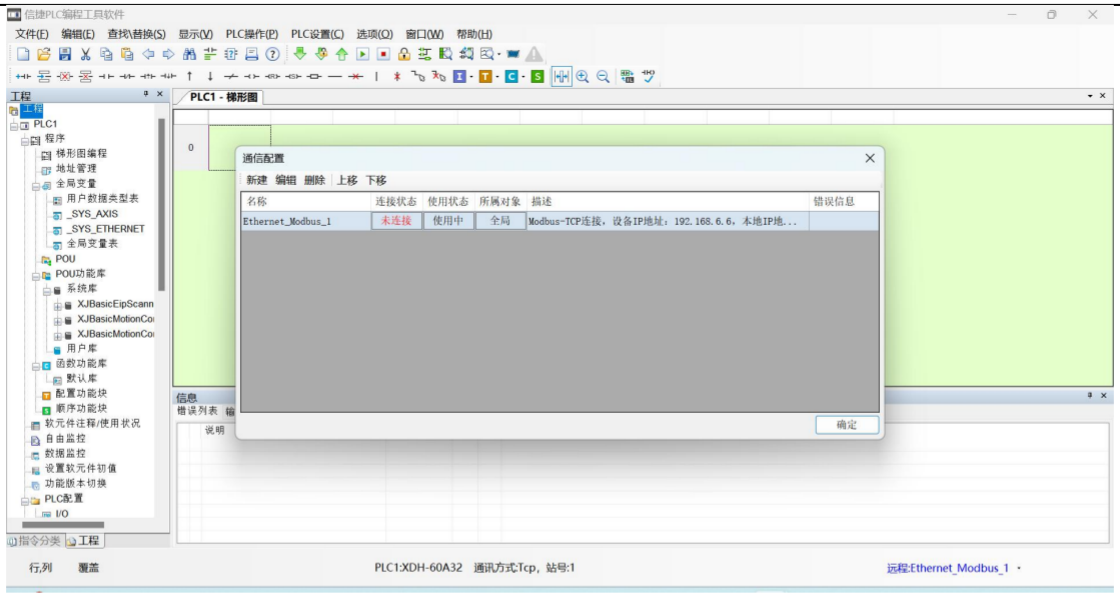
Xinje PLC Ethernet Port Pin Definition:

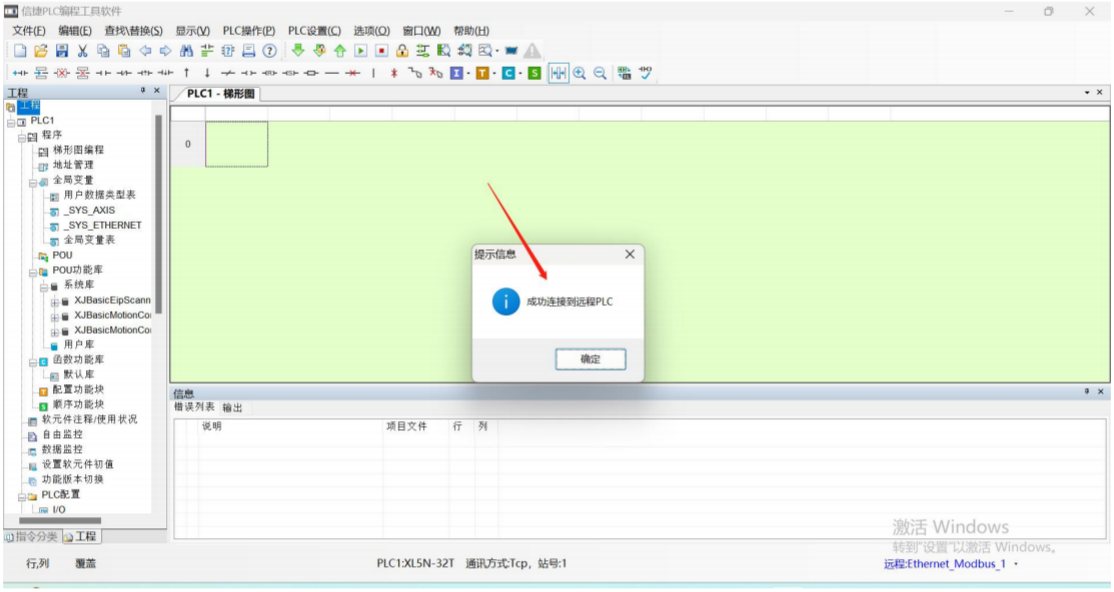


2.New Communication & Connect PLC

1. Open the software and click "Serial Port Settings" in the "Menu" as shown below:

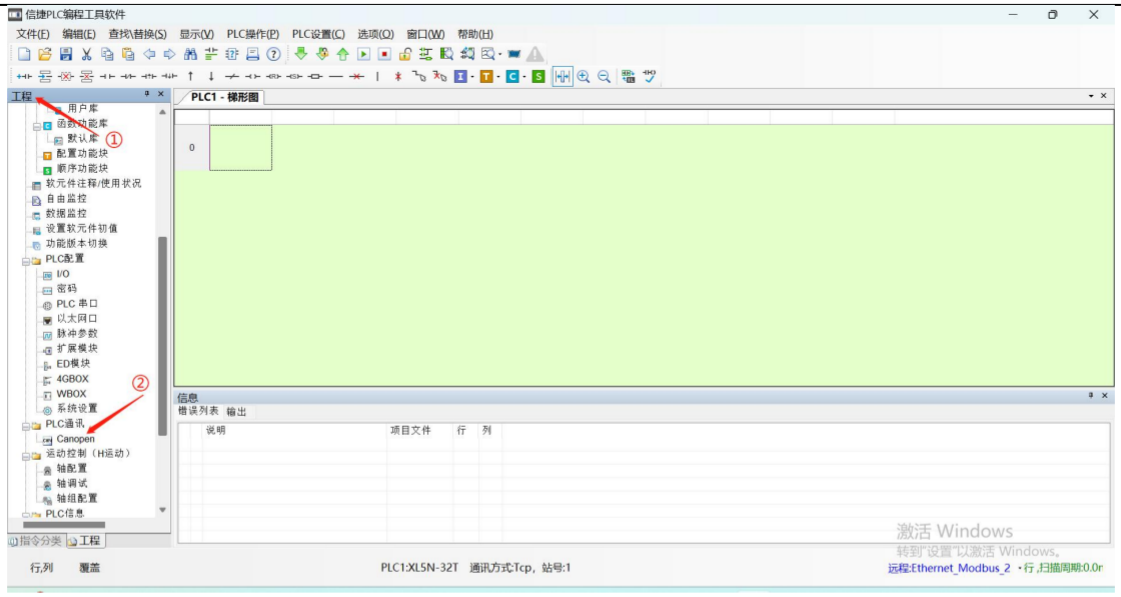


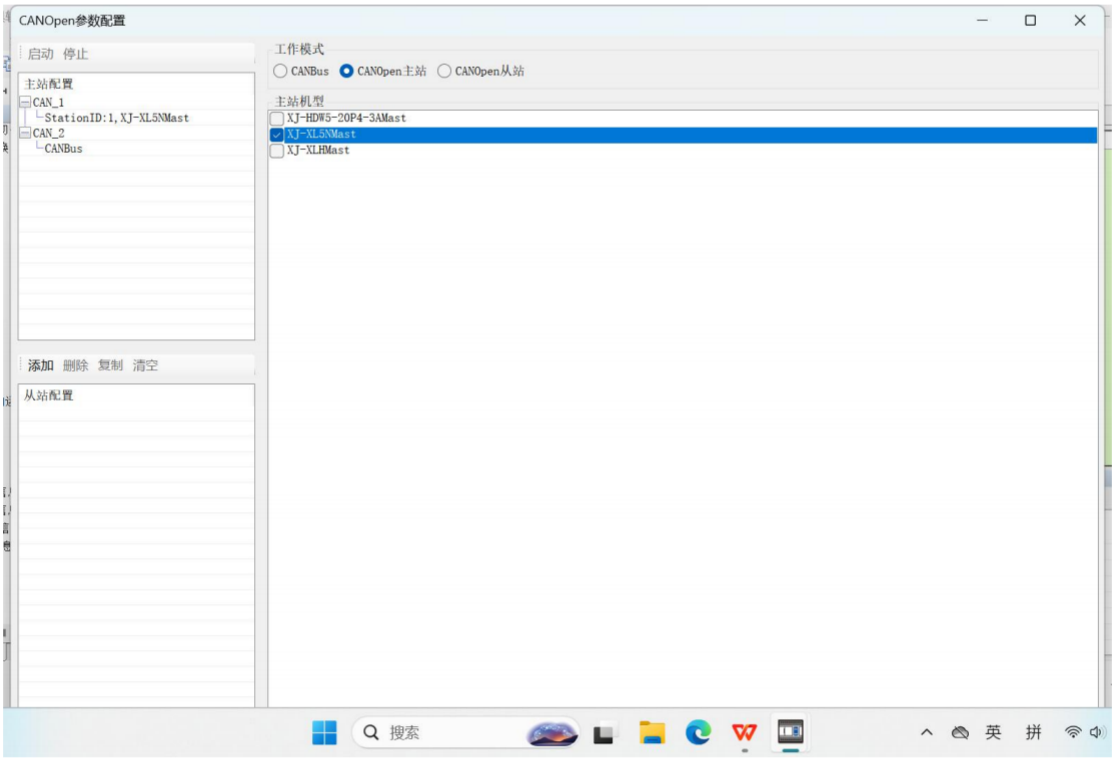




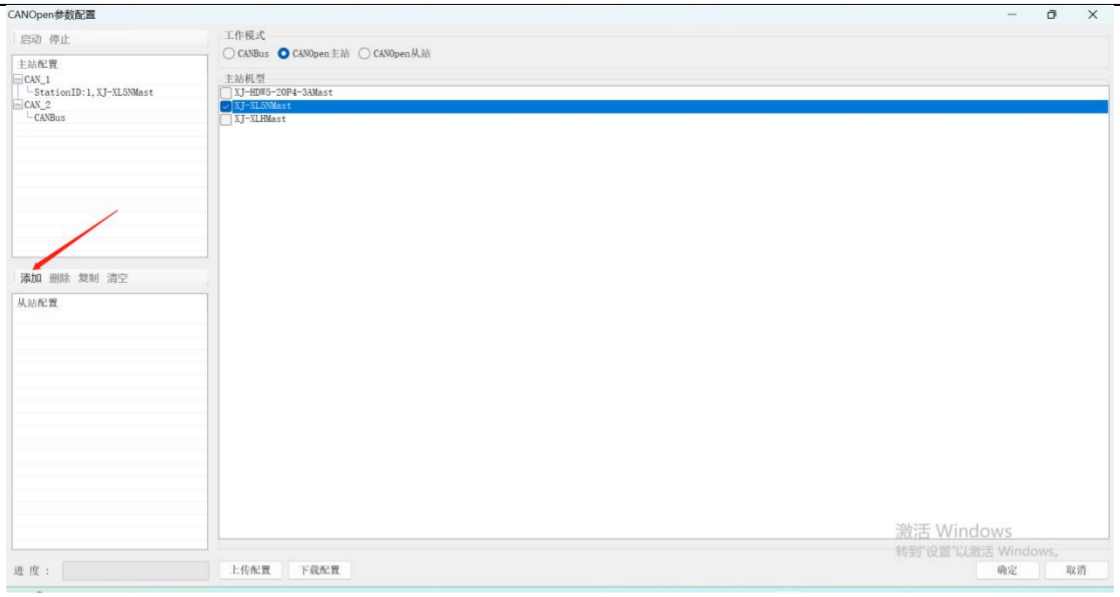
3. Parameter Configuration

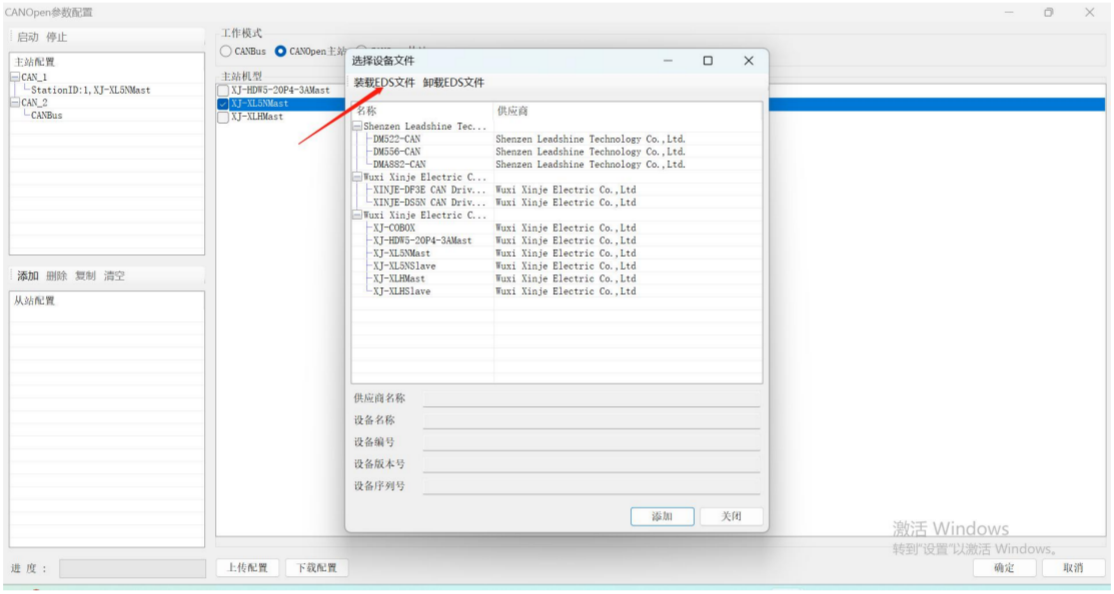
（1）Once connected successfully, the software will automatically return to the main page. Locate and click " CANopen" under “PLC Communication” in the “Project” section on the left, and the “CANopen Parameter Configuration” window will appear.

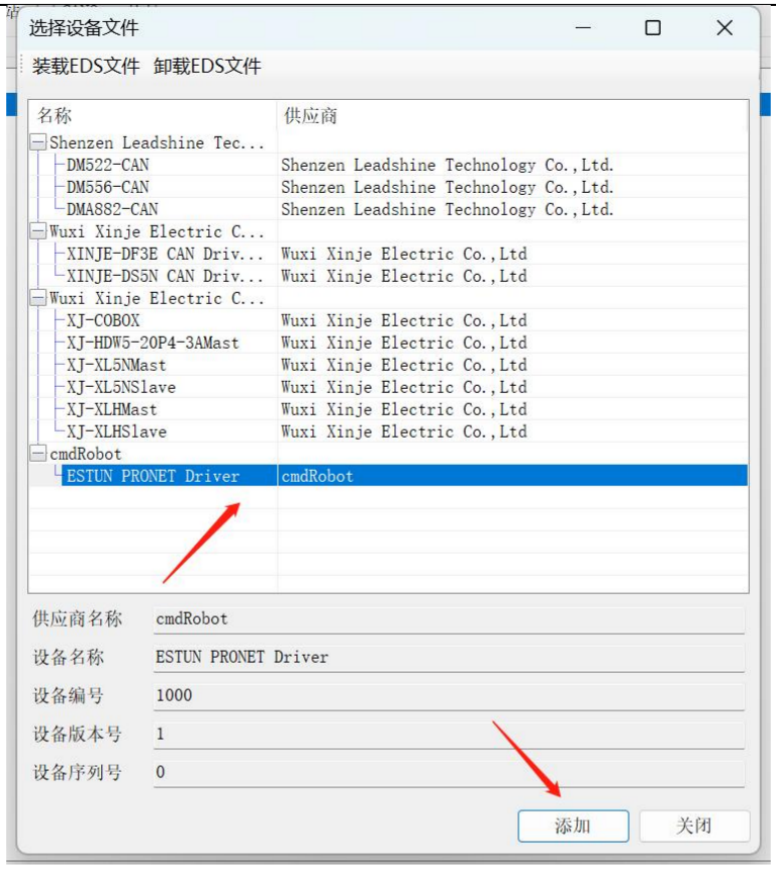




（2）In the “CANopen Parameter Configuration” window, click “Add” to configure a slave device. The “Select Device File” window will appear. Click “Load EDS File,” select the appropriate EDS file, and then click “Add.”


CANOpen参数配置
启动 停止
主站配置
CAN_1
StationID:1,XJ-XL5NMast
CAN_2
CANBus
添加 删除 复制 清空
从站配置
工作模式
CANBus
CANOpen主站
CANOpen从站
主站机型
XJ-HDW5-20P4-3AMast
XJ-XL5NMast
XJ-XLHMast
进 度：
上传配置
下载配置
确定
取消
激活 Windows
转到"设置"以激活 Windows。


CANOpen参数配置
选择设备文件
装载EDS文件
卸载EDS文件
名称
供应商
Shenzen Leadshine Tec...
DMS22-CAN
Shenzen Leadshine Technology Co.,Ltd.
DMS56-CAN
Shenzen Leadshine Technology Co.,Ltd.
DMA8S2-CAN
Shenzen Leadshine Technology Co.,Ltd.
Wuxi Xinje Electric C...
XINJE-DF3E CAN Driv...
Wuxi Xinje Electric Co.,Ltd
XINJE-DSSN CAN Driv...
Wuxi Xinje Electric Co.,Ltd
Wuxi Xinje Electric C...
XJ-COBOX
Wuxi Xinje Electric Co.,Ltd
XJ-HDW5-20P4-3AMast
Wuxi Xinje Electric Co.,Ltd
XJ-XL5NMast
Wuxi Xinje Electric Co.,Ltd
XJ-XL5NSlave
Wuxi Xinje Electric Co.,Ltd
XJ-XLHMast
Wuxi Xinje Electric Co.,Ltd
XJ-XLHSlave
Wuxi Xinje Electric Co.,Ltd
供应商名称
设备名称
设备编号
设备版本号
设备序列号
添加
关闭
激活 Windows
转到"设置"以激活 Windows。

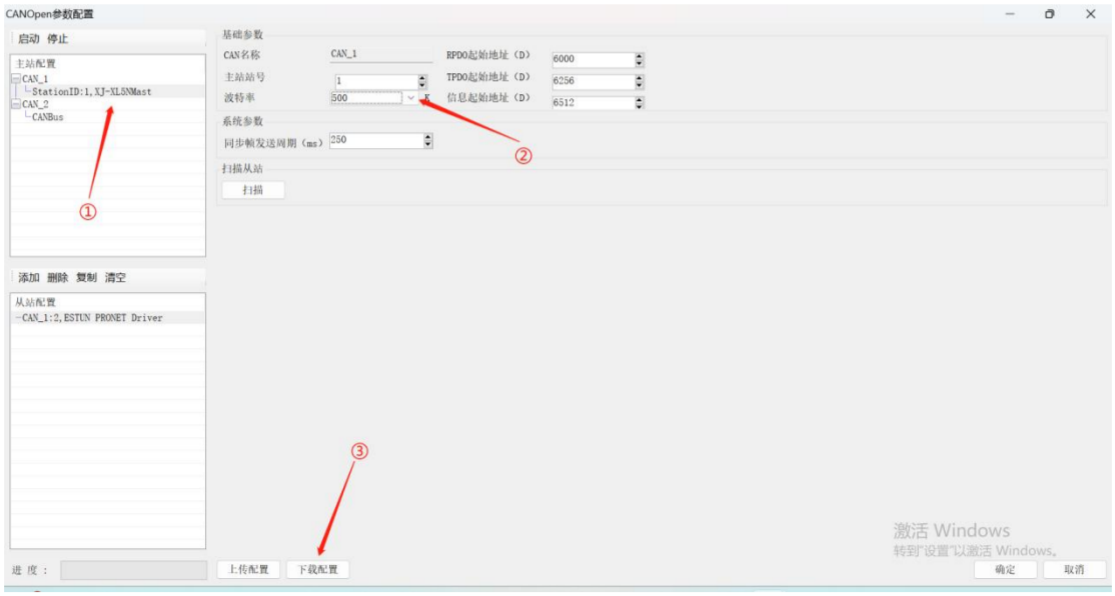


（4）Return to the “CANopen Parameter Configuration” window. Click on “StationID:1, XJ-XL5NMast” under the master “CAN_1” to enter the “Basic Parameters” section. Set the baud rate to 1000K and click “Download Configuration.”

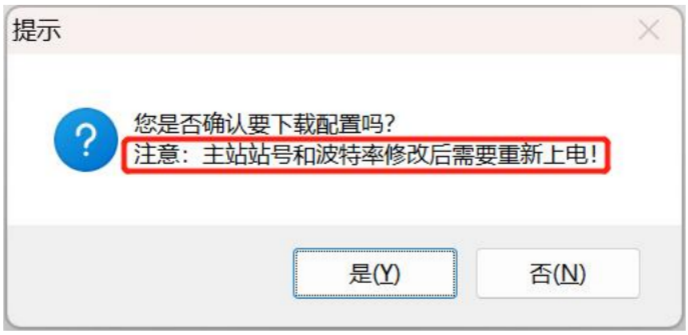
(Note:

① Modified master station number and baud rate require a power cycle and re-establishment of communication connection.

② The master’s baud rate must match that of the third-party device.)



Click “Yes” when the following confirmation window appears.

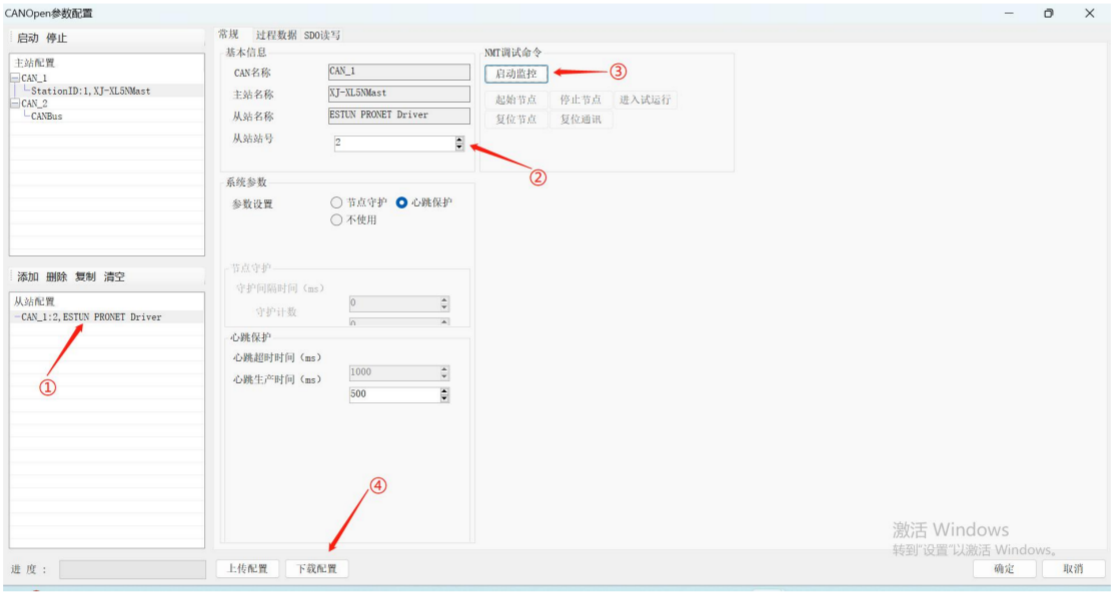


After reconnecting, the master’s baud rate will be updated to 1000K. Then click on “CAN_1:2, XXXX” under “ Slave Configuration,” go to the “General” tab to check the slave station ID, click “Start Monitoring,” and then click “Download Configuration.”

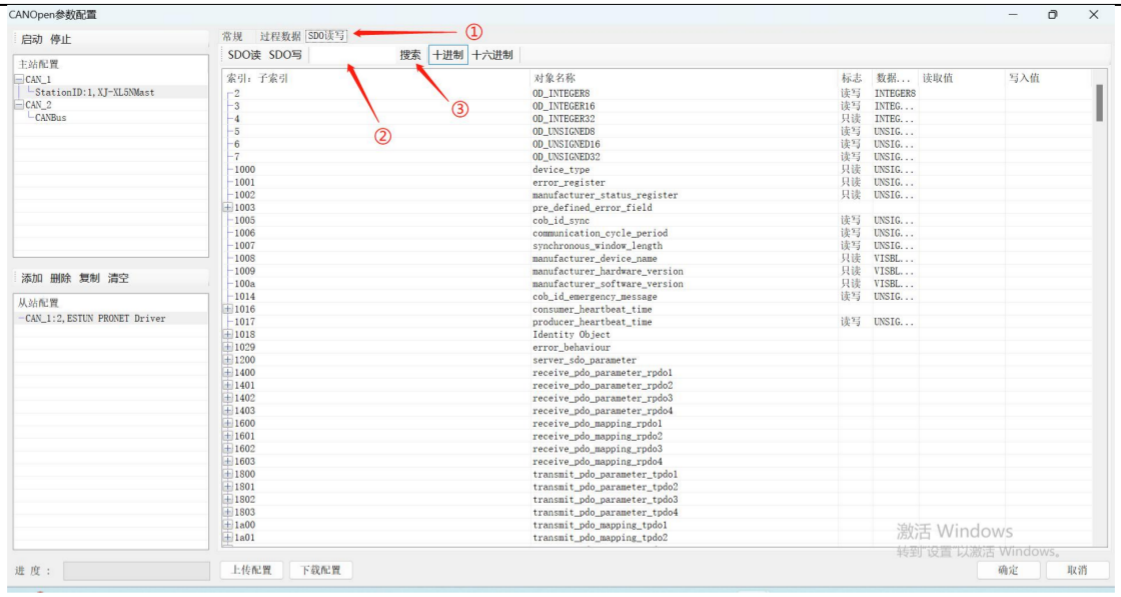
(Note:

① The slave station ID must match the communication node of the third-party driver and should start from ID 3.

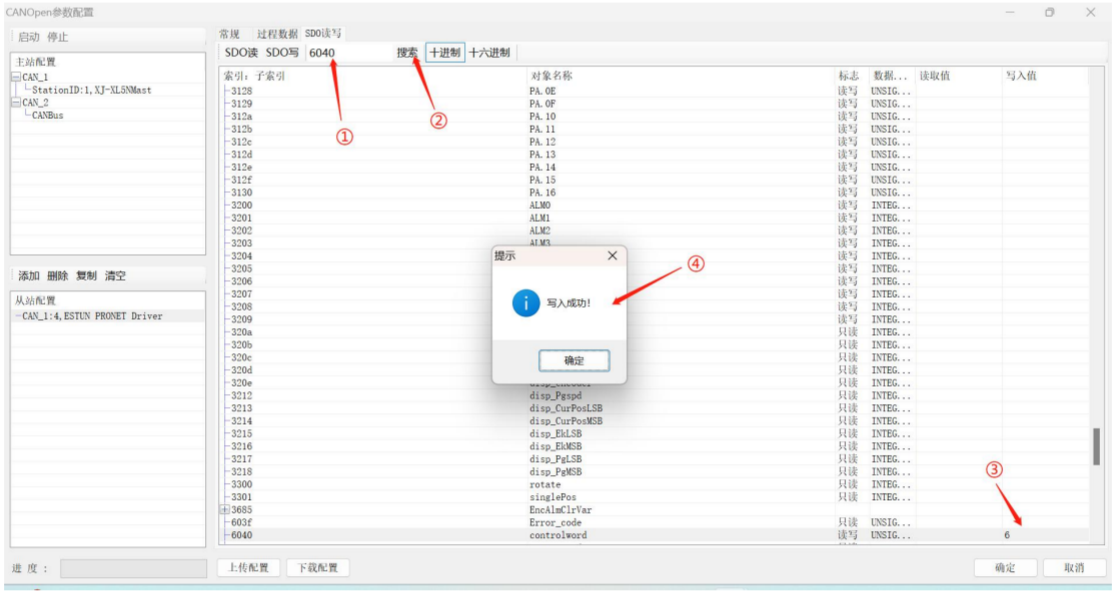
② After changing the communication node of the third-party driver, it must be powered off and restarted.)



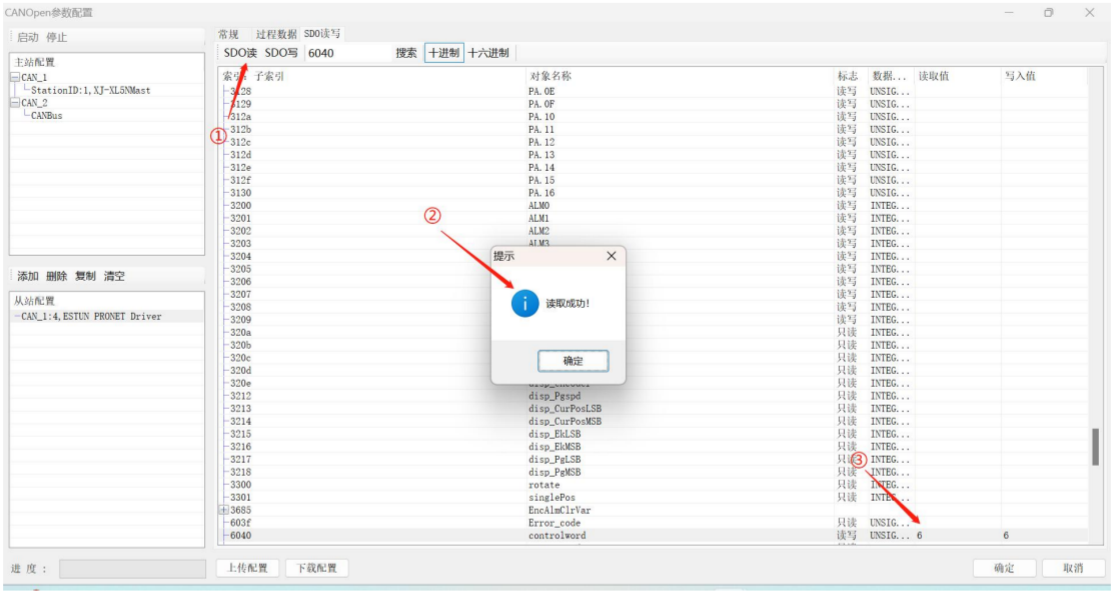
（5） Click “SDO Read/Write,” enter the relevant index in the search box, and click “Search.”



（6）In the “SDO Read/Write” window, enter “6040,” click “Search,” select “6040,” and then enter “6” in the “ Write Value” field. Click “SDO Write,” and a “Success” prompt will appear.



Click SDO Read. A prompt box will pop up indicating "Read Succeeded", and the written value "6" will be displayed in the Read Value column corresponding to index 6040.



Repeat the process to write values “7” and “15.” Once completed, the motor connected to the driver will be enabled, indicating that the PLC and the driver have been successfully connected via CANopen.

Chapter 13 EtherCAT Configuration Example

EtherCAT Configuration Operation Case for Beckhoff Controller

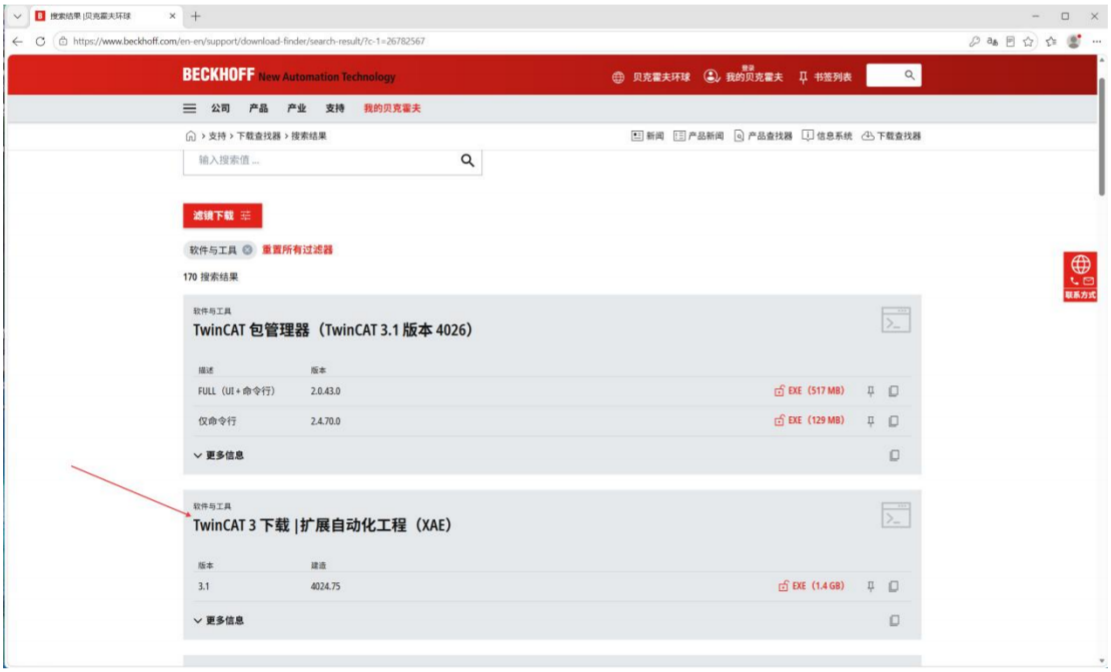
1.Software Installation

Notes:

If you are not using a Beckhoff physical PLC, you will need a computer equipped with an Intel network card that supports Beckhoff TwinCAT 3 software.

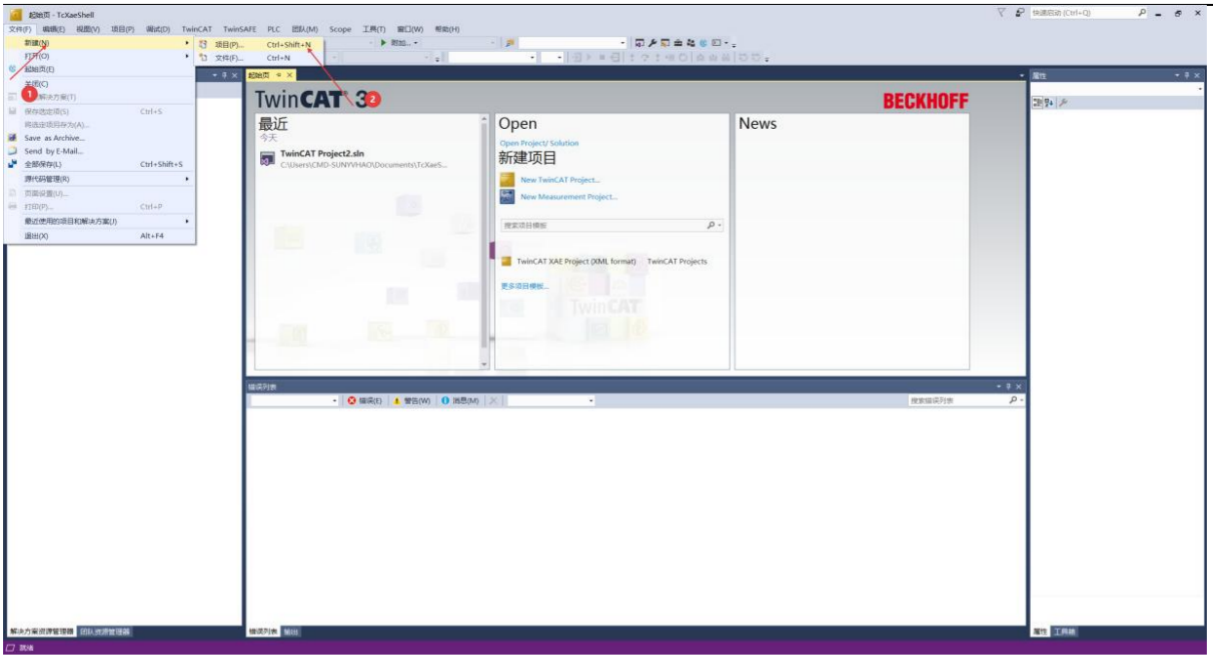
You can find the list of network card models compatible with TwinCAT at the link below:

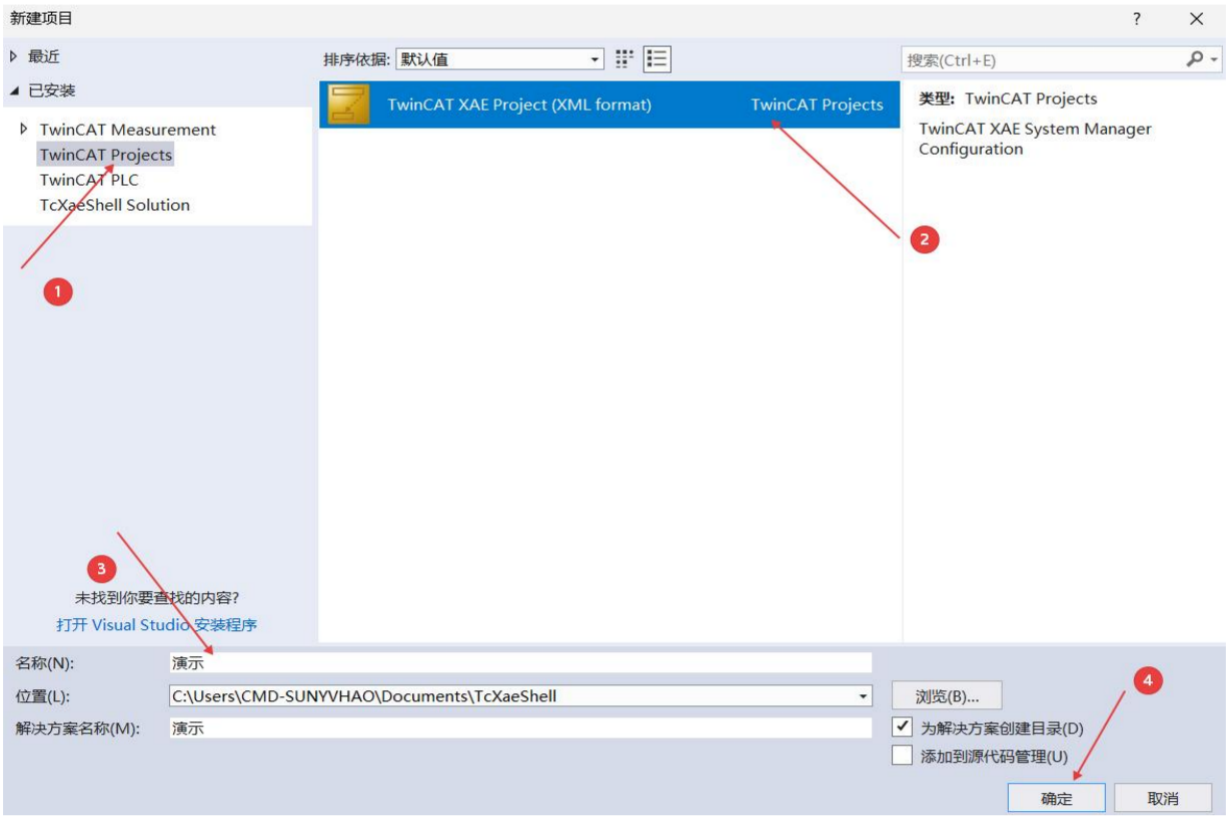
https://infosys.beckhoff.com/english.php?content=../content/1033/tc3_overview/9309844363.html&id=14896984407450360 69



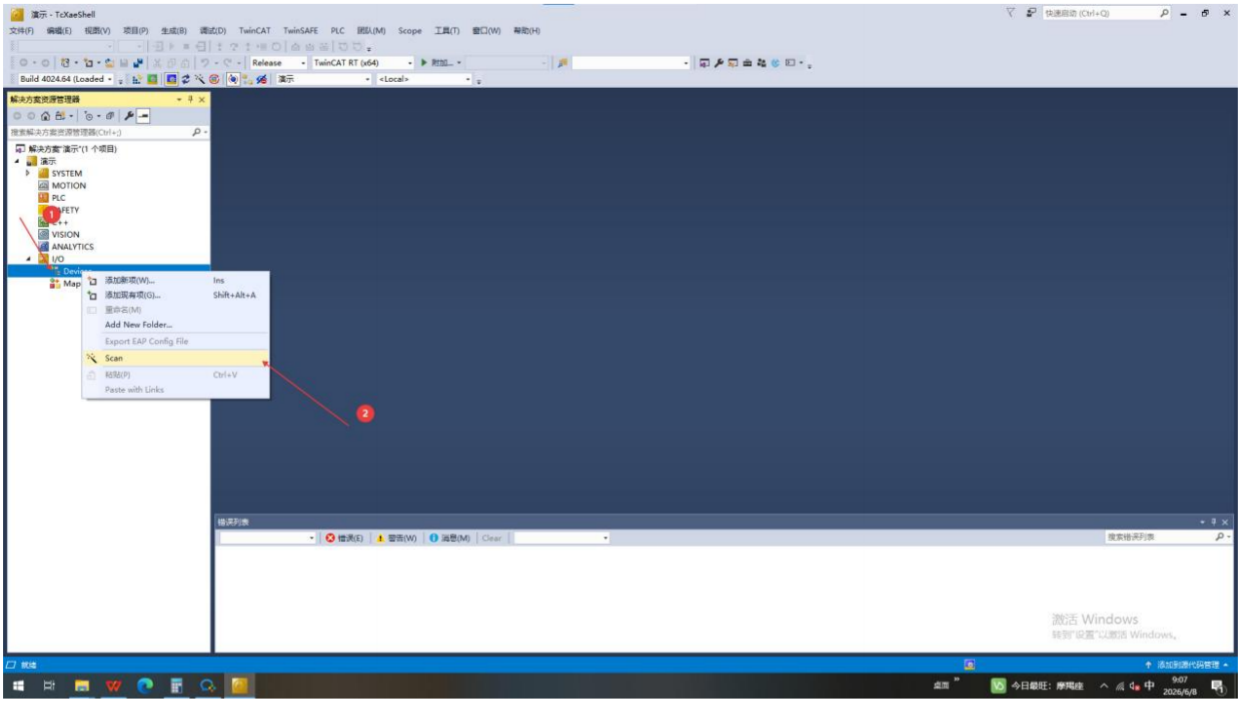
2.Create New Project and Parameter Settings

(1) Create a new project

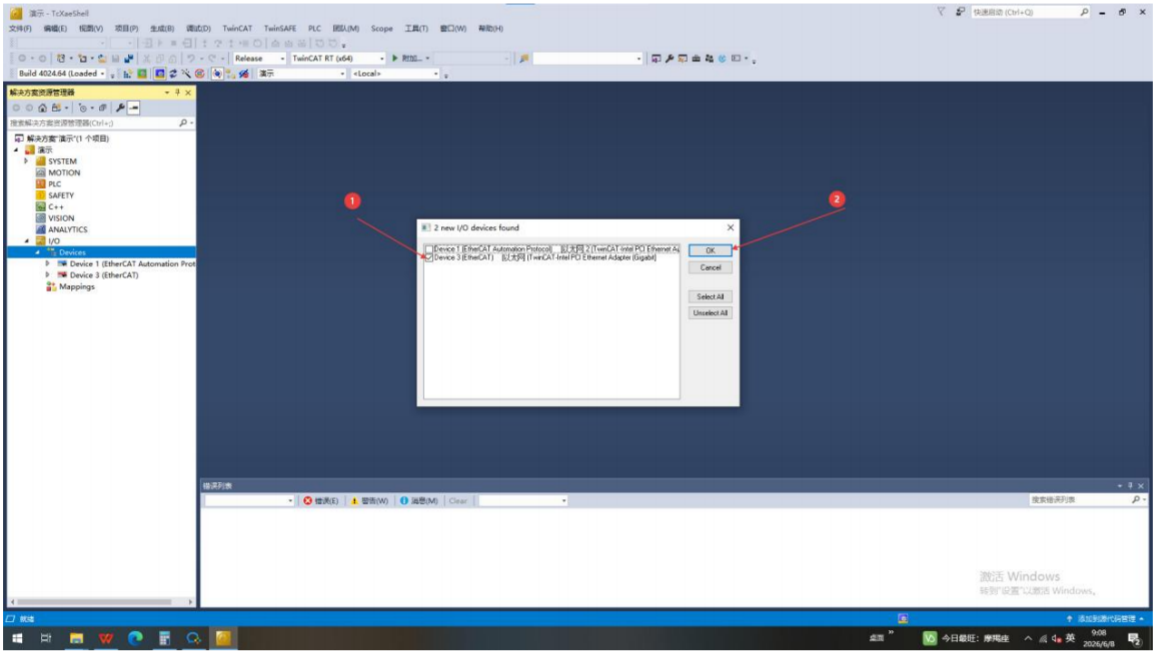

TwinCAT 3
BECKHOFF
最近
Open
新建项目
News

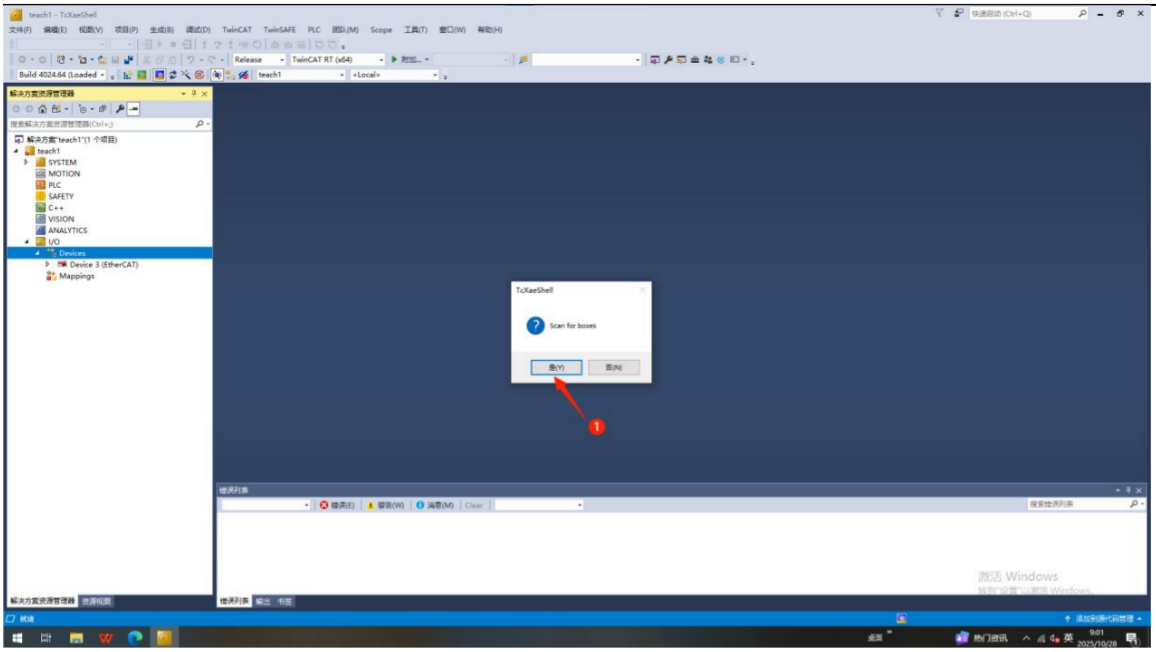

新建项目
最近
已安装
TwinCAT Measurement
TwinCAT Projects
TwinCAT PLC
TcXaeShell Solution
排序依据: 默认值
搜索(Ctrl+E)
TwinCAT XAE Project (XML format)
TwinCAT Projects
类型: TwinCAT Projects
TwinCAT XAE System Manager Configuration
未找到你要查找的内容?
打开 Visual Studio 安装程序
名称(N): 演示
位置(L): C:\Users\CMD-SUNYVHAO\Documents\TcXaeShell
浏览(B)...
解决方案名称(M): 演示
为解决方案创建目录(D)
添加到源代码管理(U)
确定
取消

（2）Right-click Devices and click Scan.

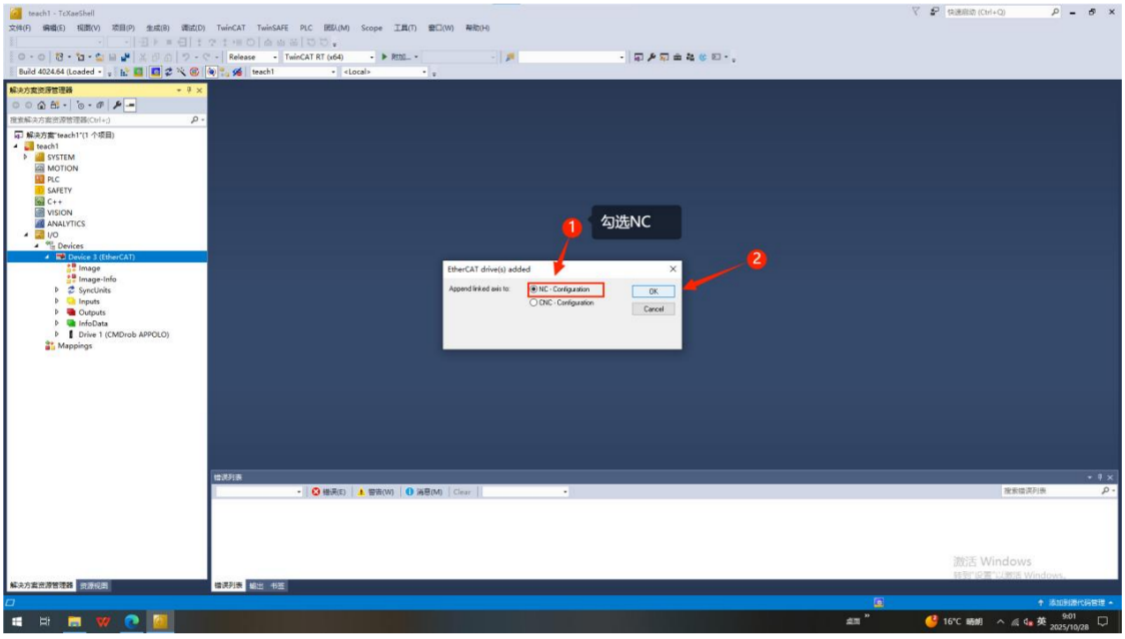


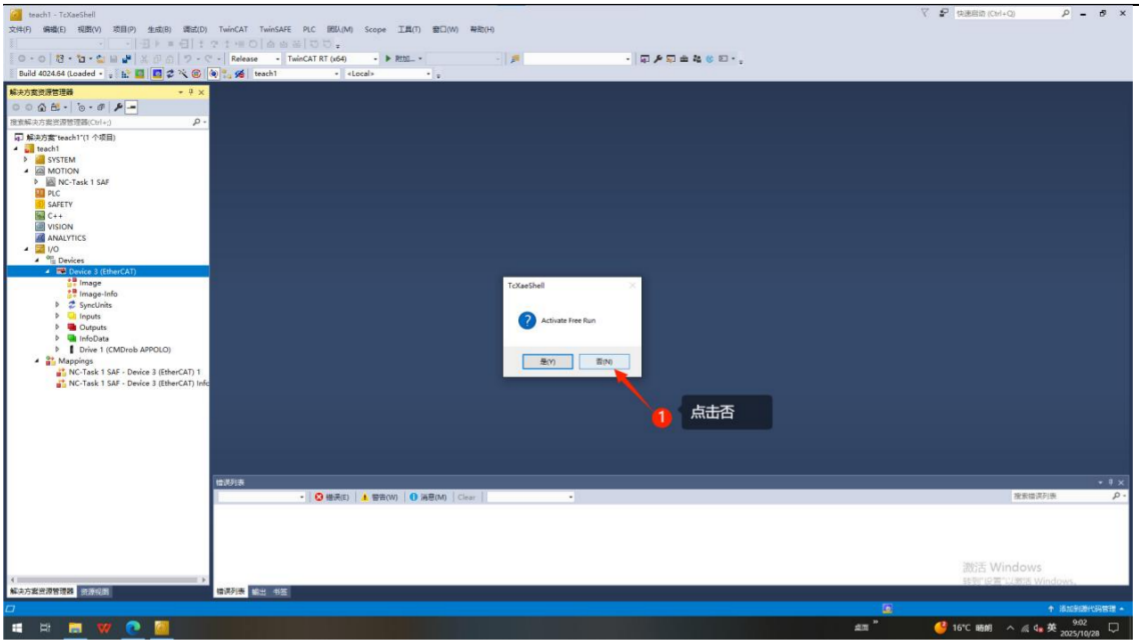
（3）Select the corresponding network port matched with the module, then click OK.



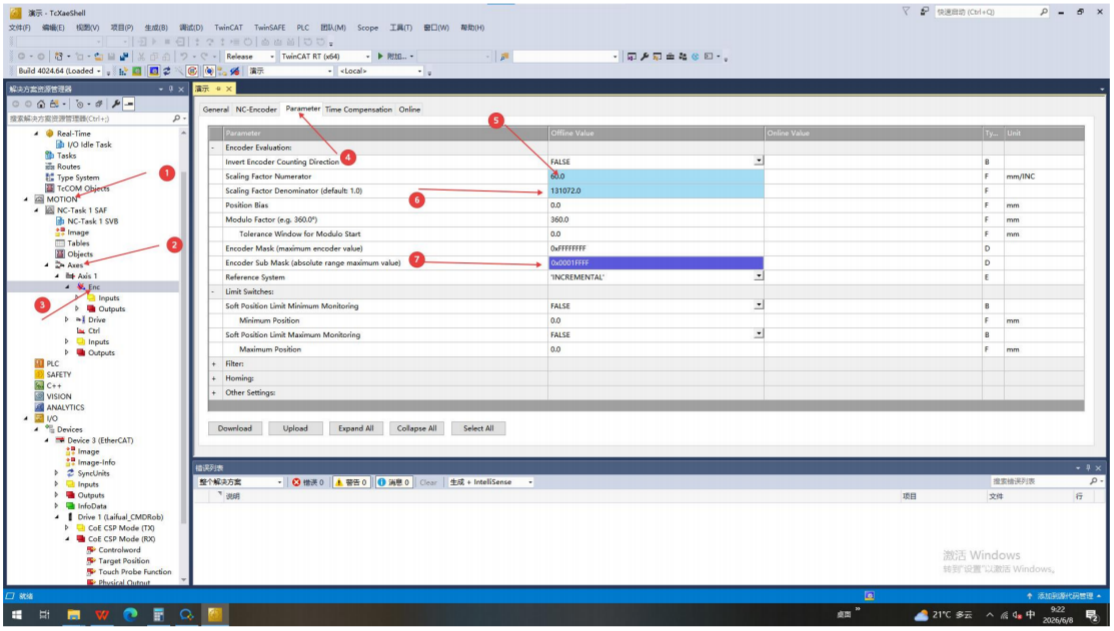


（4）Check the box for NC Configuration

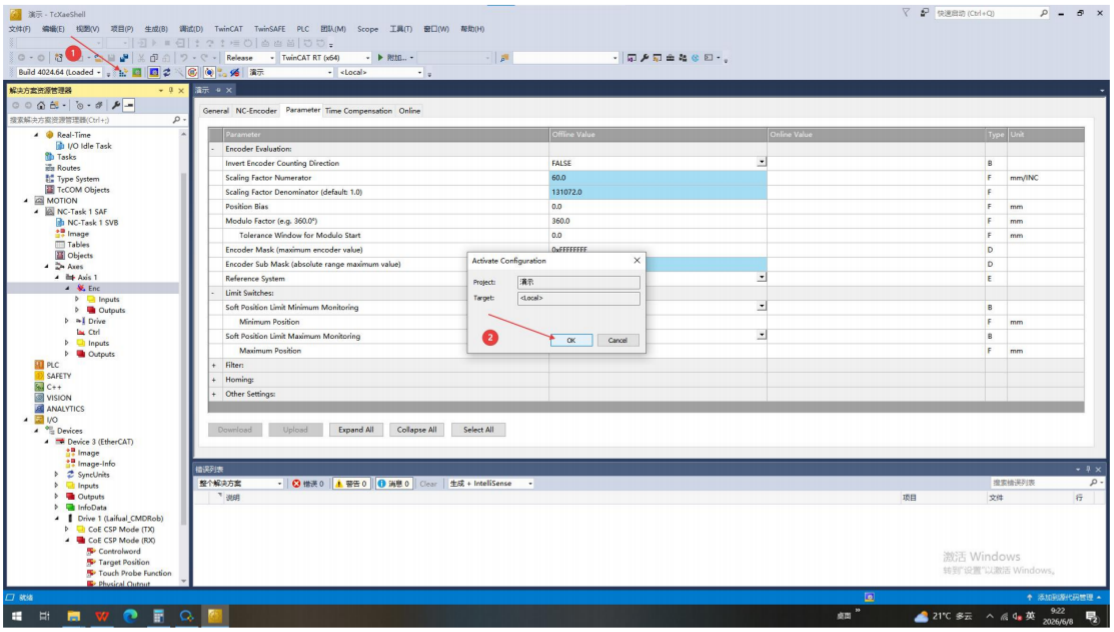




（5）Click MOTION, expand Axes-Enc, select Parameter, and modify the encoder parameters as shown in the figure.

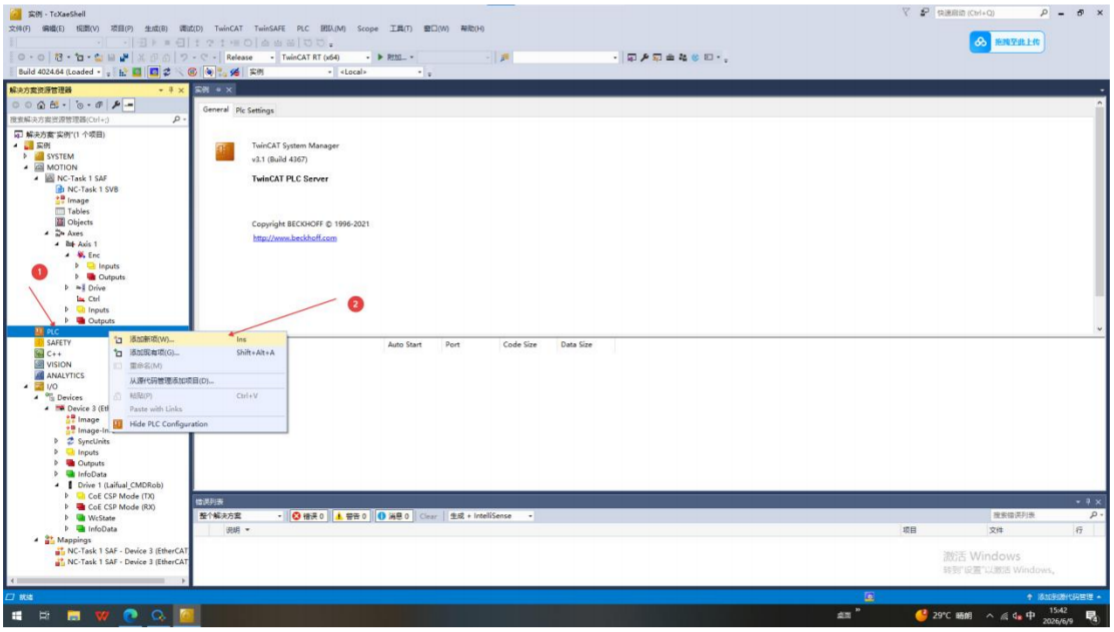


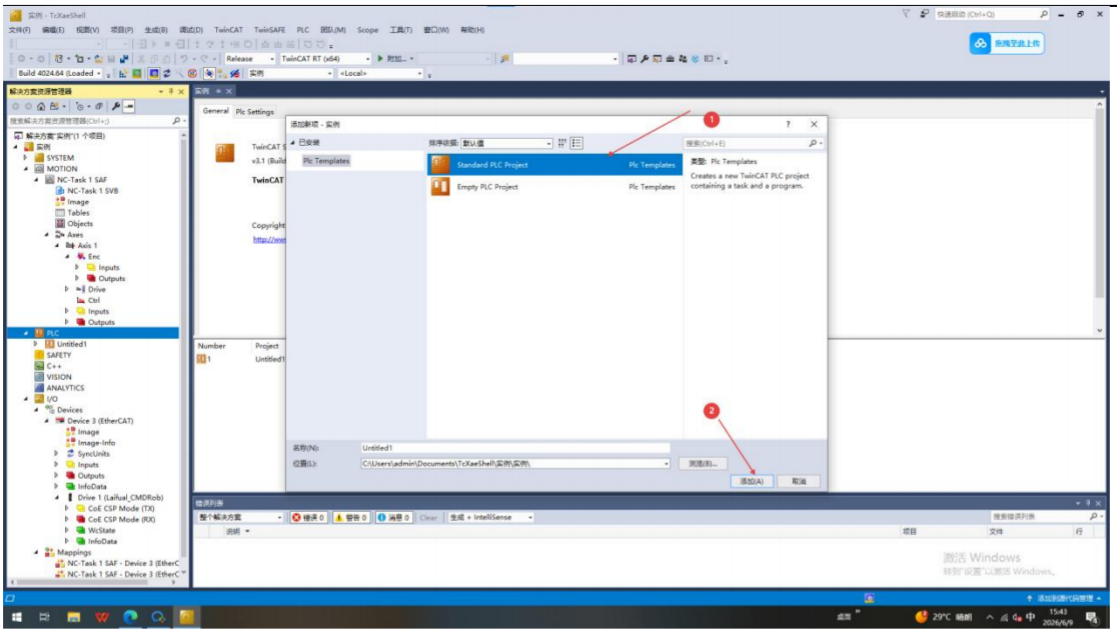
（6）Click Download, then click OK .



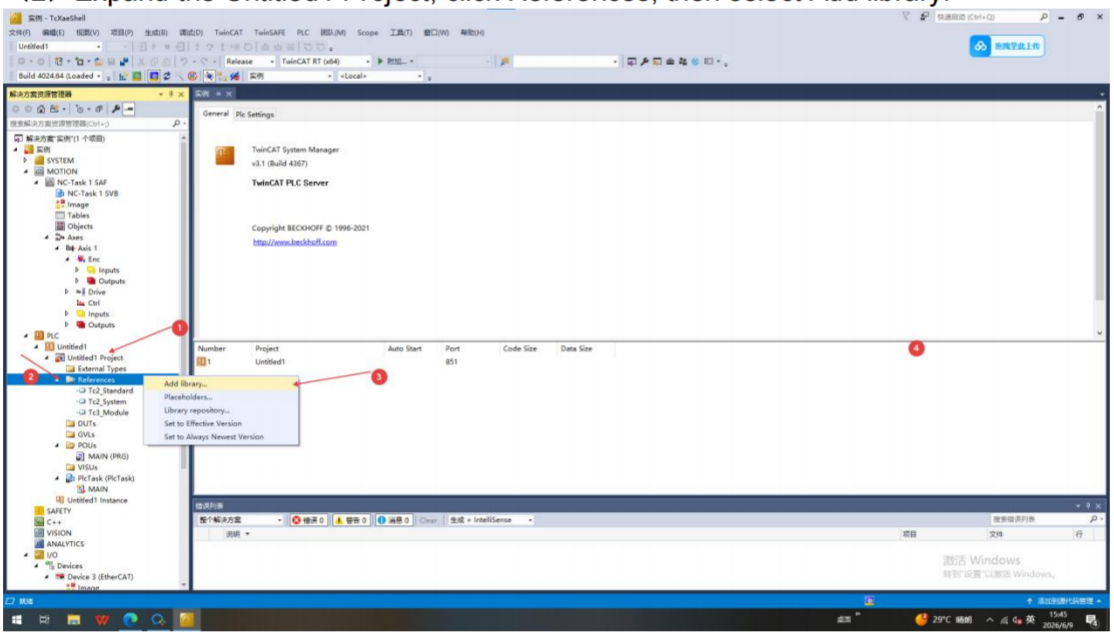
3.Create a New PLC Project and Define Instructions

(1) Right-click PLC, select Add New Item, choose Standard PLC Project, then click Add.

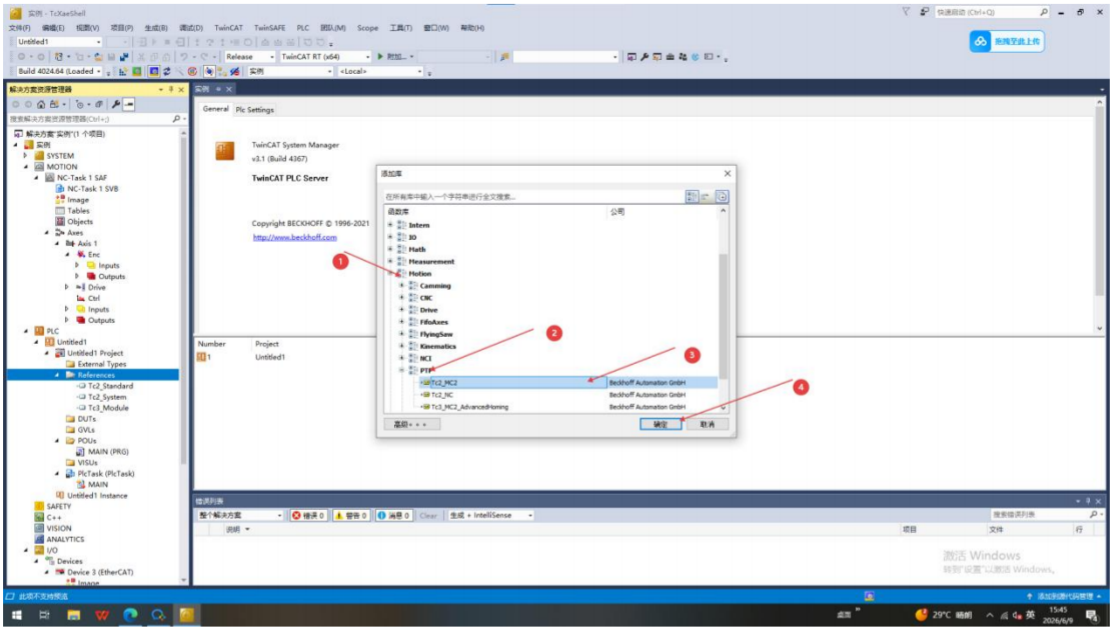




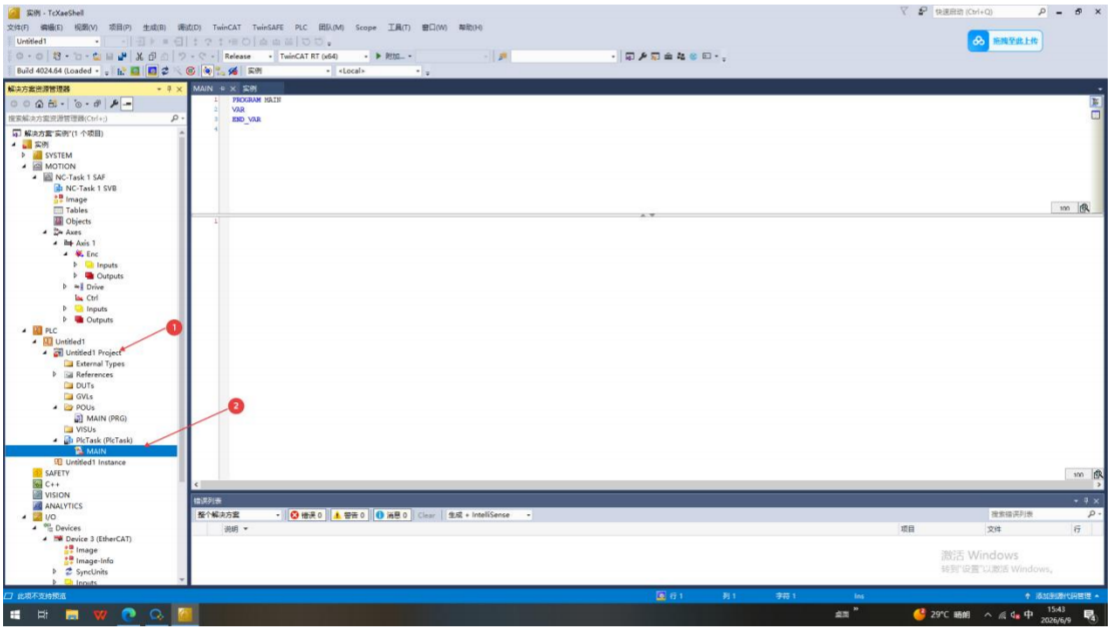
（2）Expand the Untitled1 Project, click References, then select Add library.



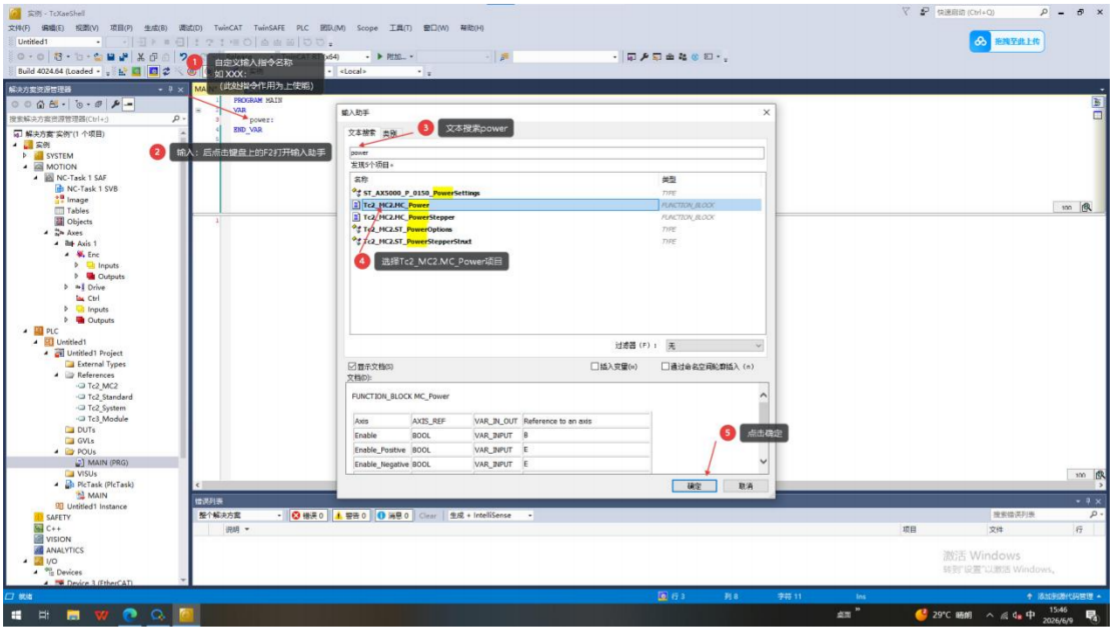
（3）Expand Motion, expand PTP, select Tc2_MC2, and click OK.



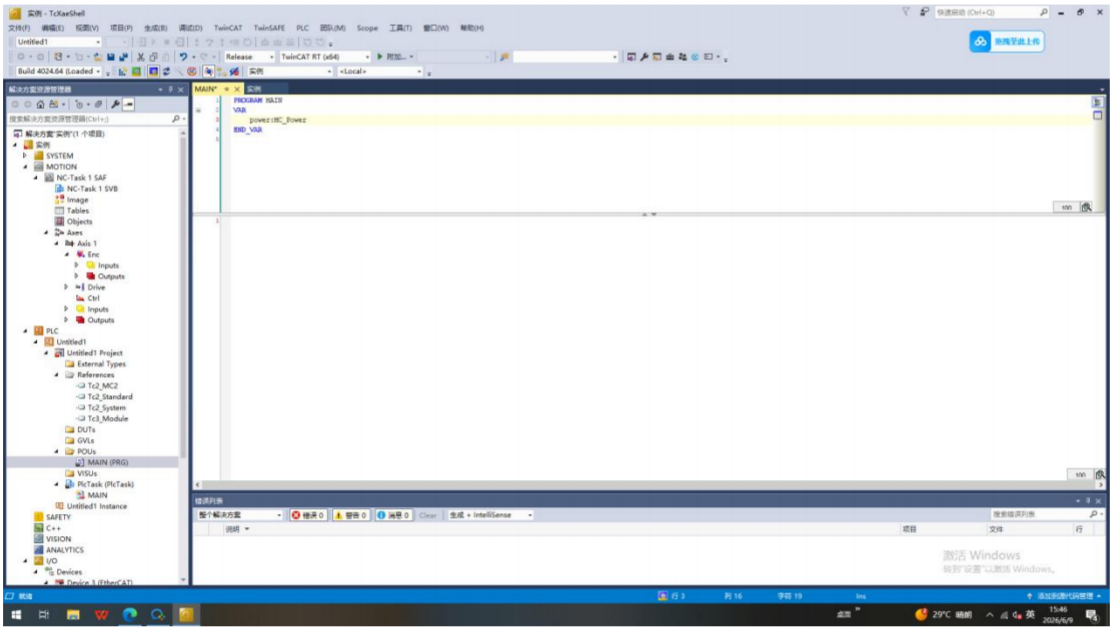
（4）Expand the Untitled1 Project in the left pane and open MAIN.



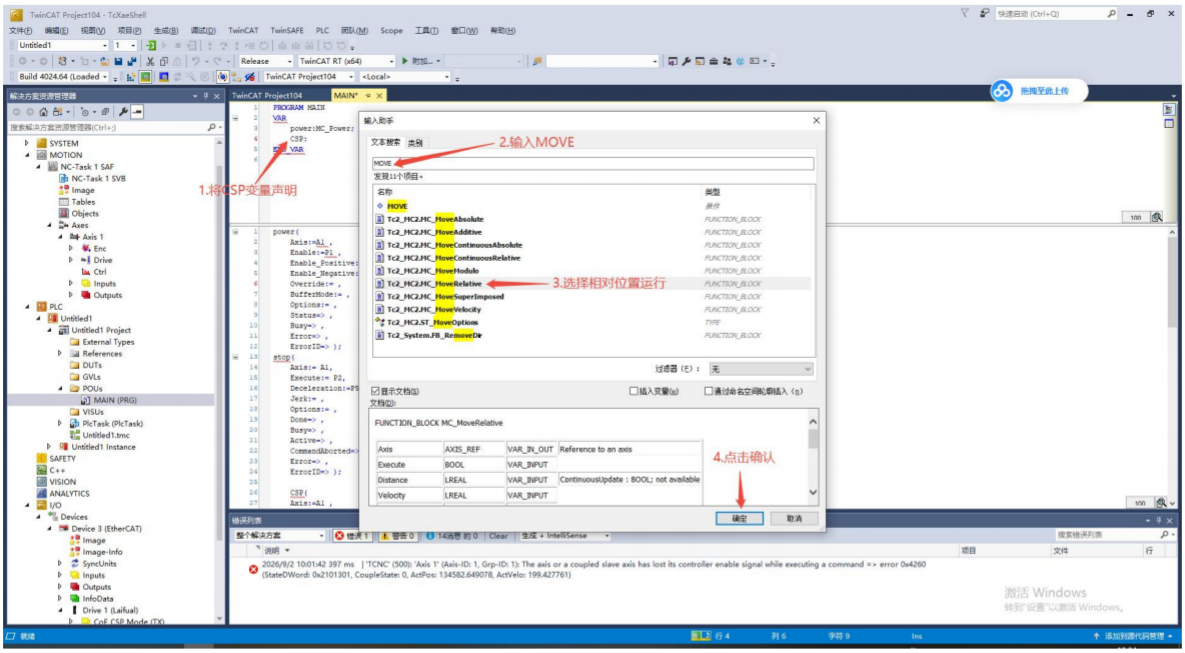
（5）Declare the power enable variable



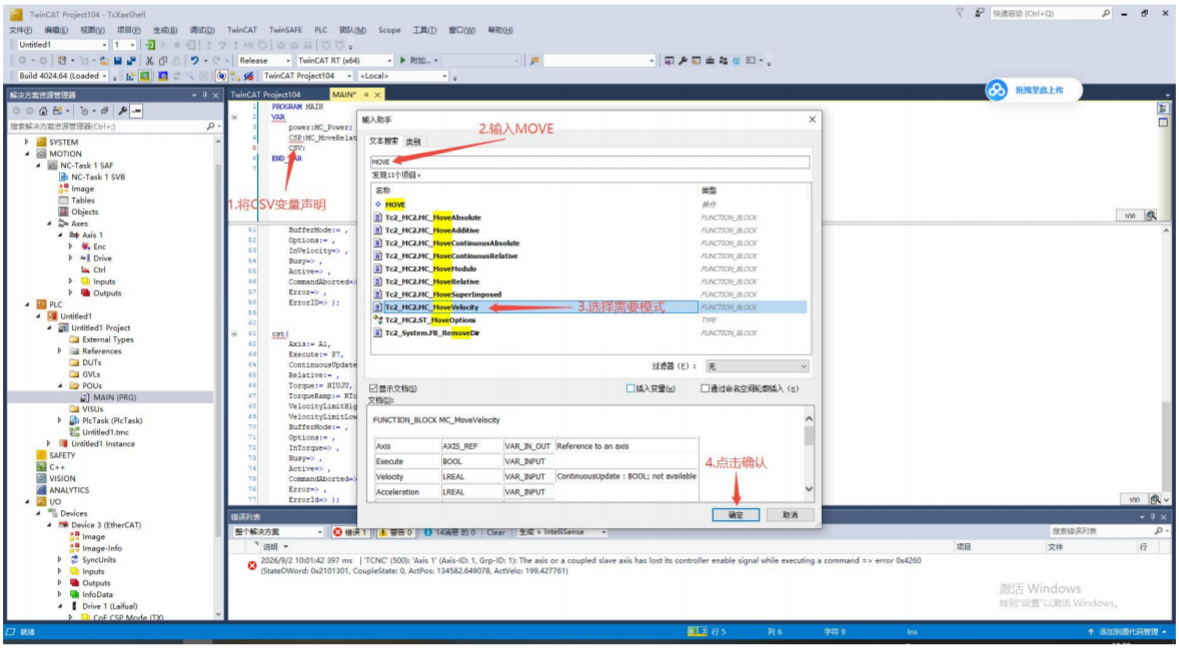
（6）MC_Power function-block appears after variable declaration.



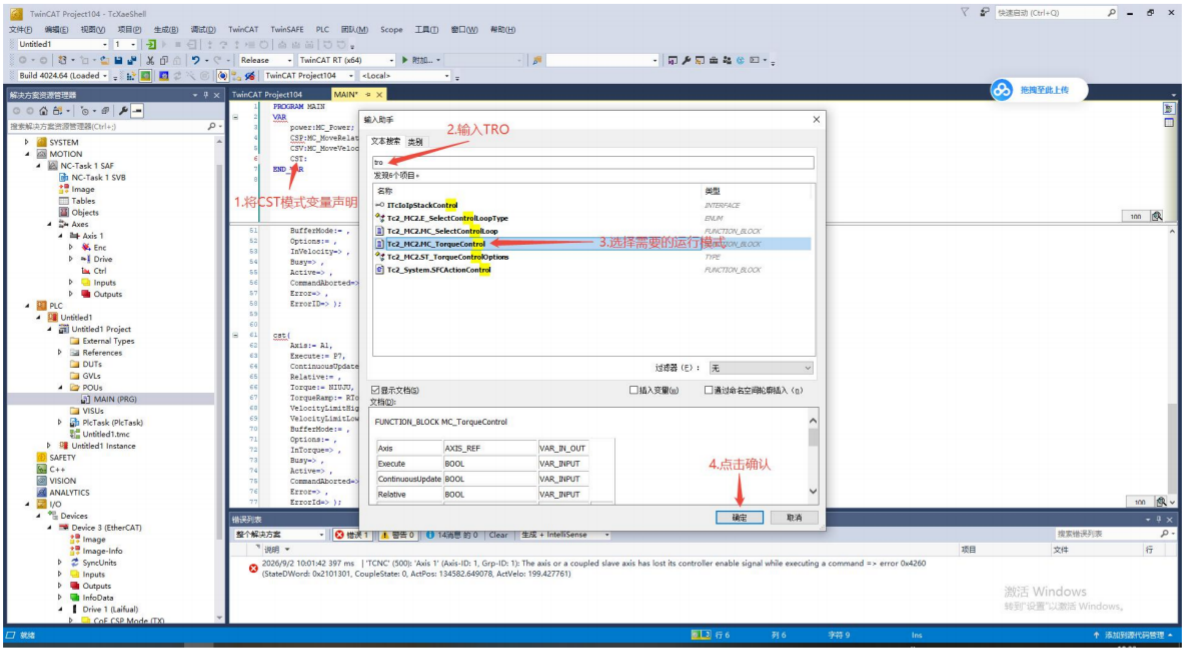
(7)Declare the variable for CSP operating mode



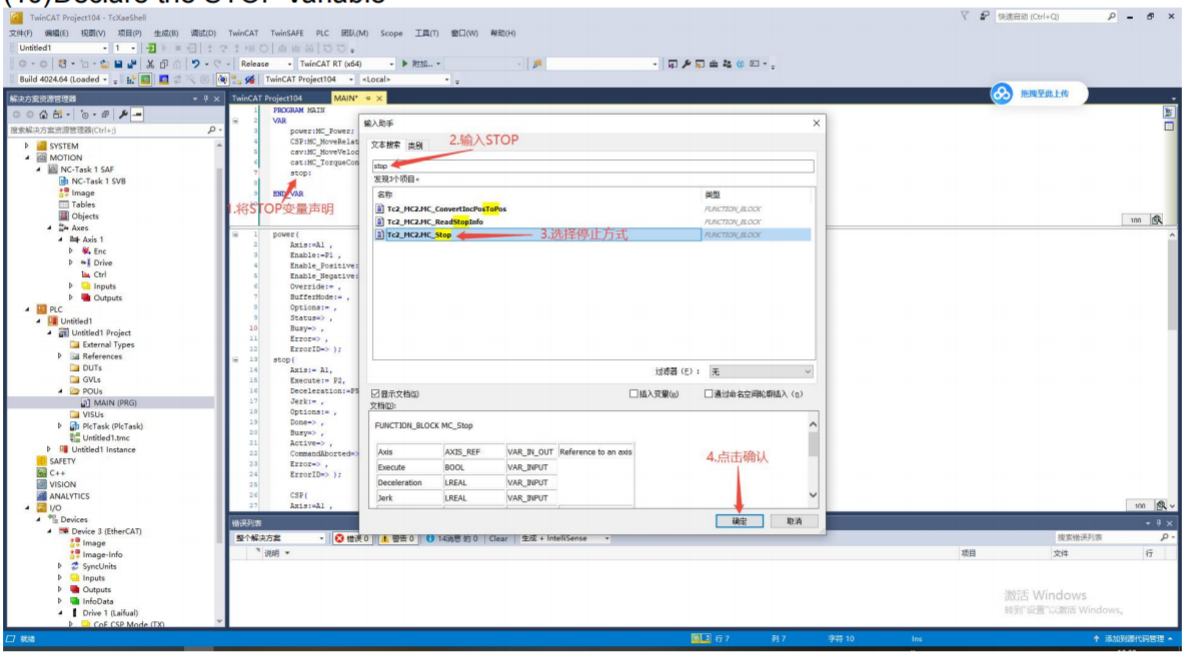
（8）Declare the variable for CSV operating mode



（9）Declare the variable for CST operating mode



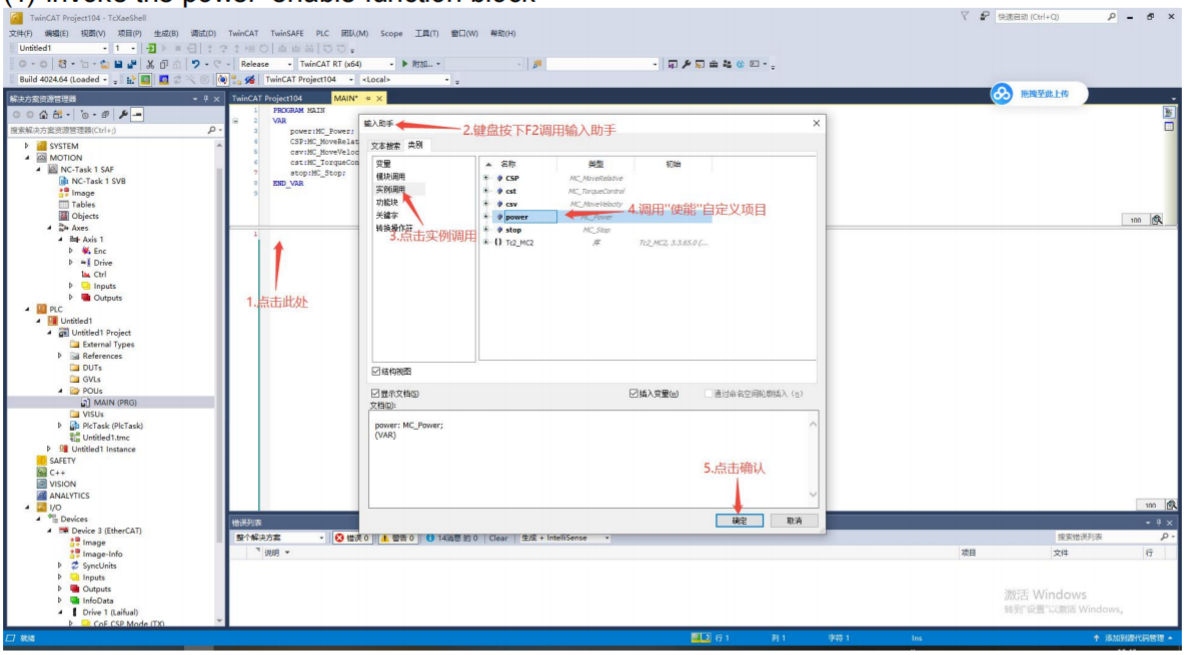
(10)Declare the STOP variable



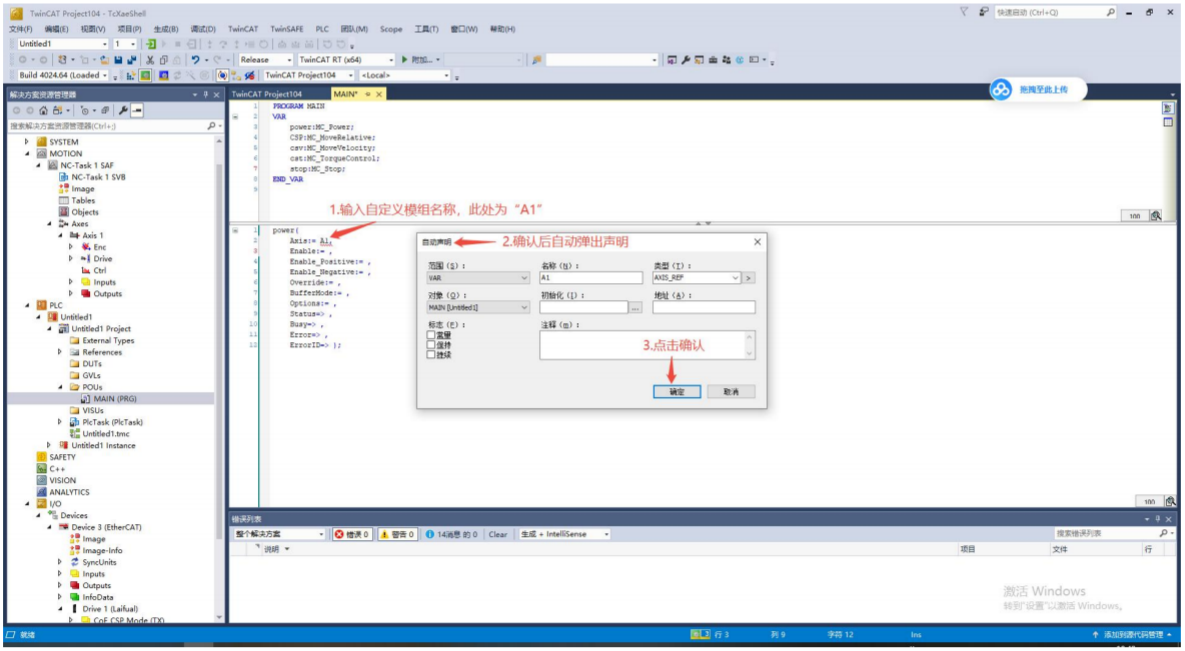
4.Enable Command

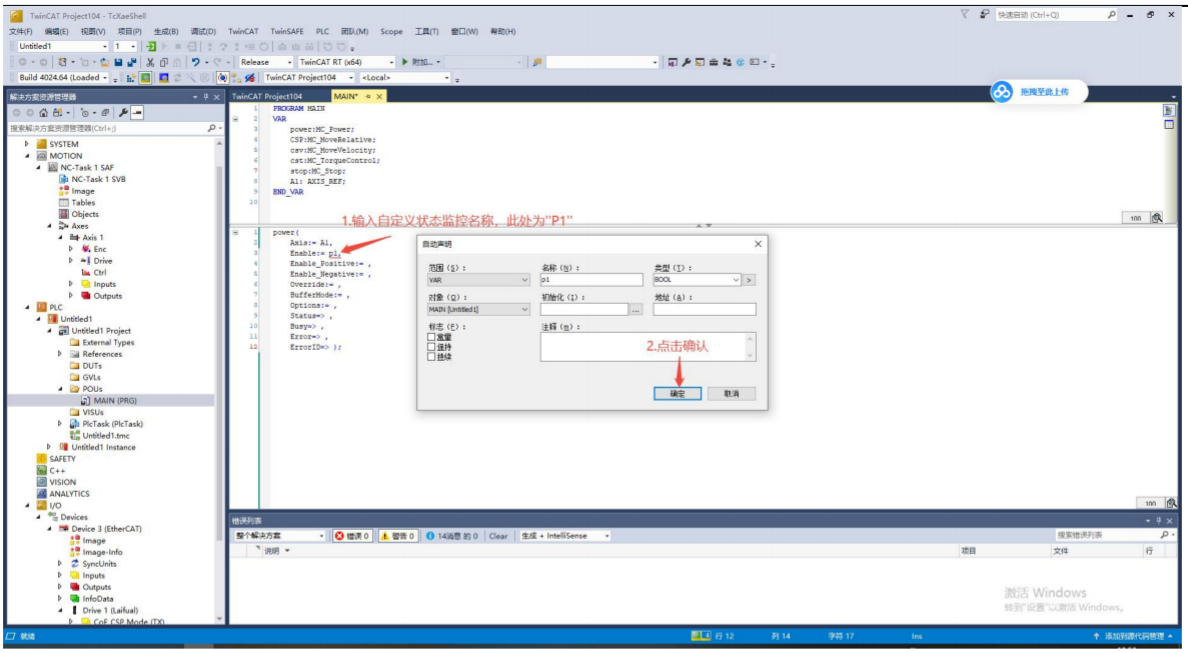
1.Invocation of power-enable function block and usage of function-block commands

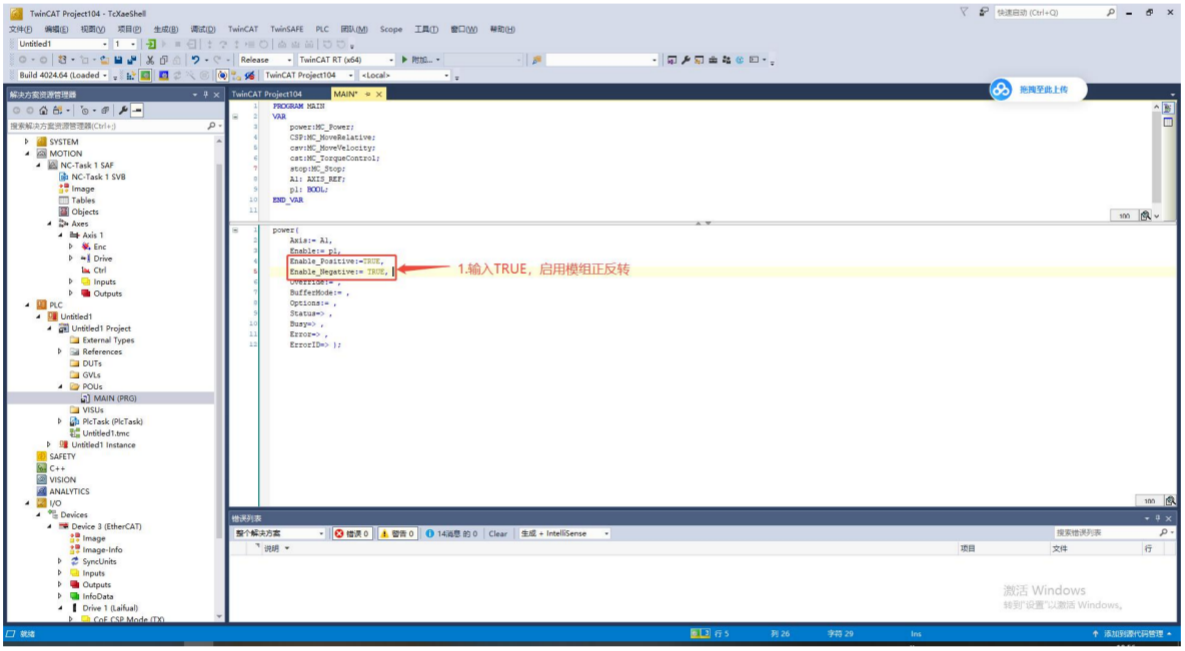
(1) Invoke the power-enable function block



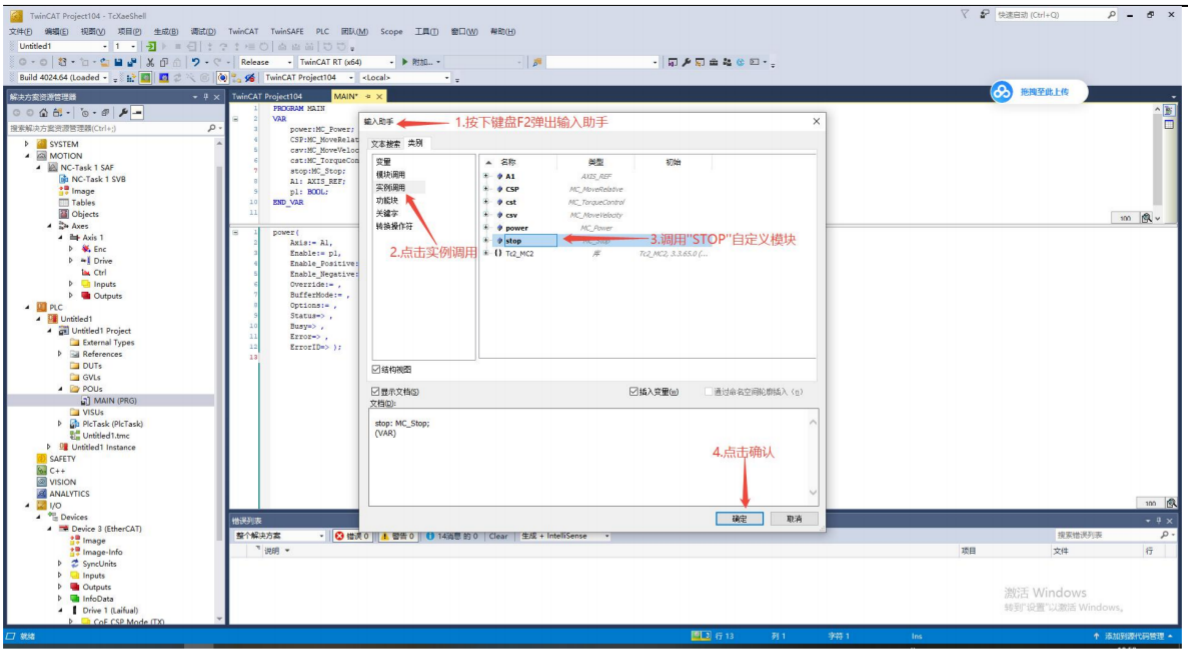
（2）Usage of function-block commands

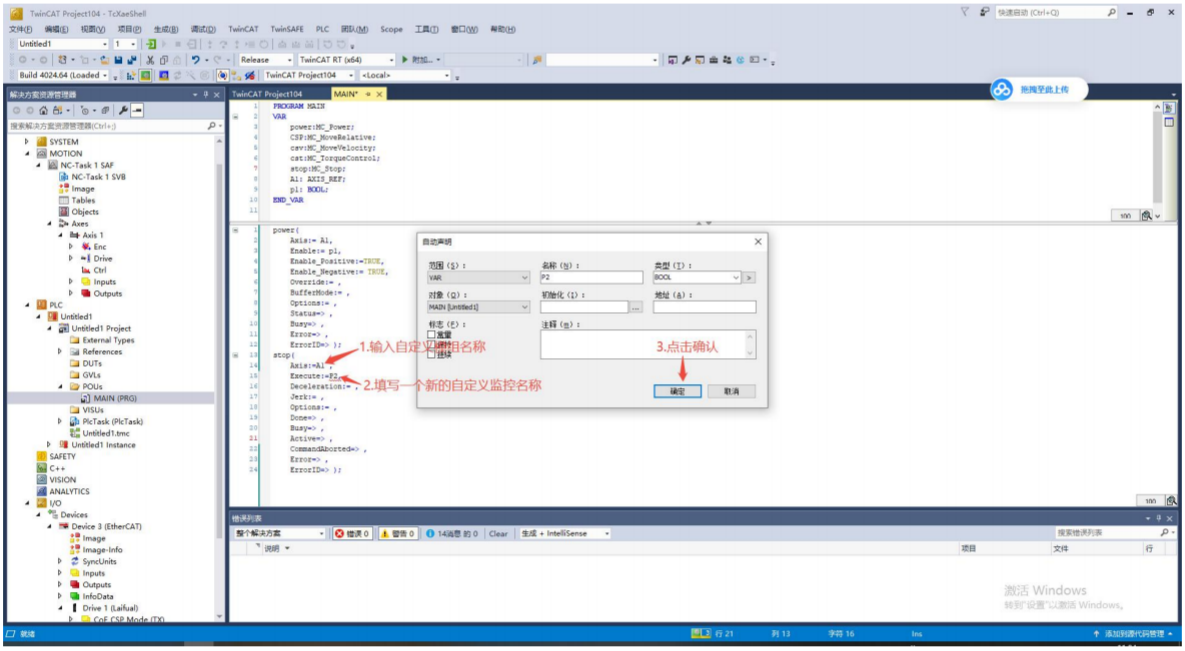




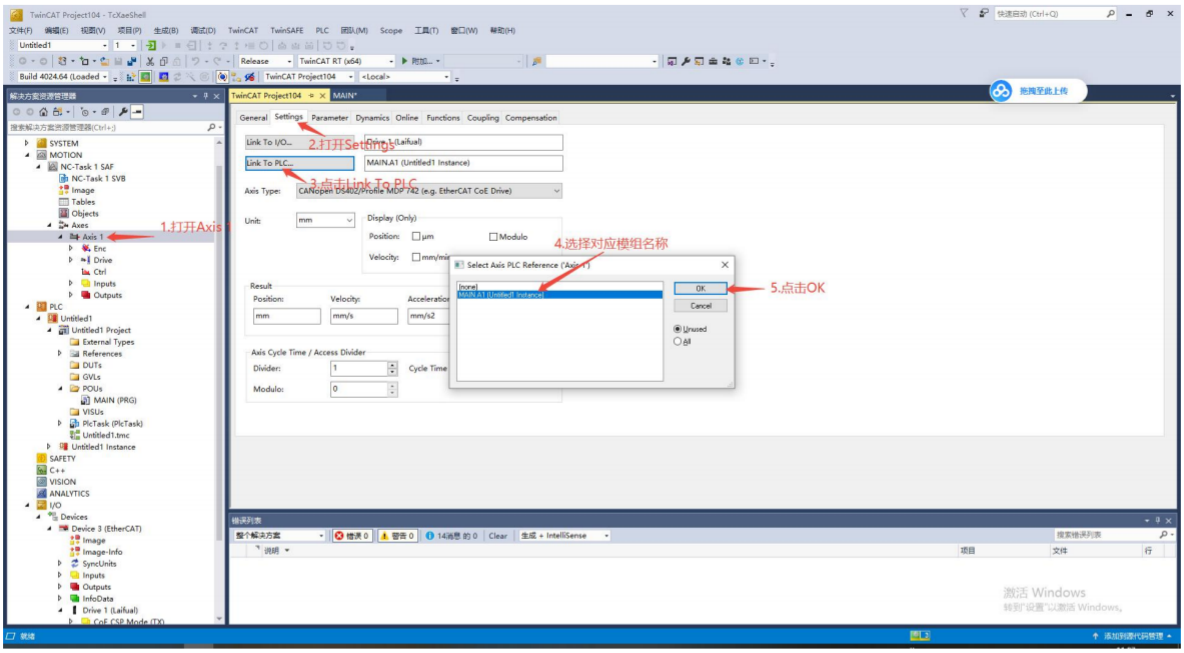


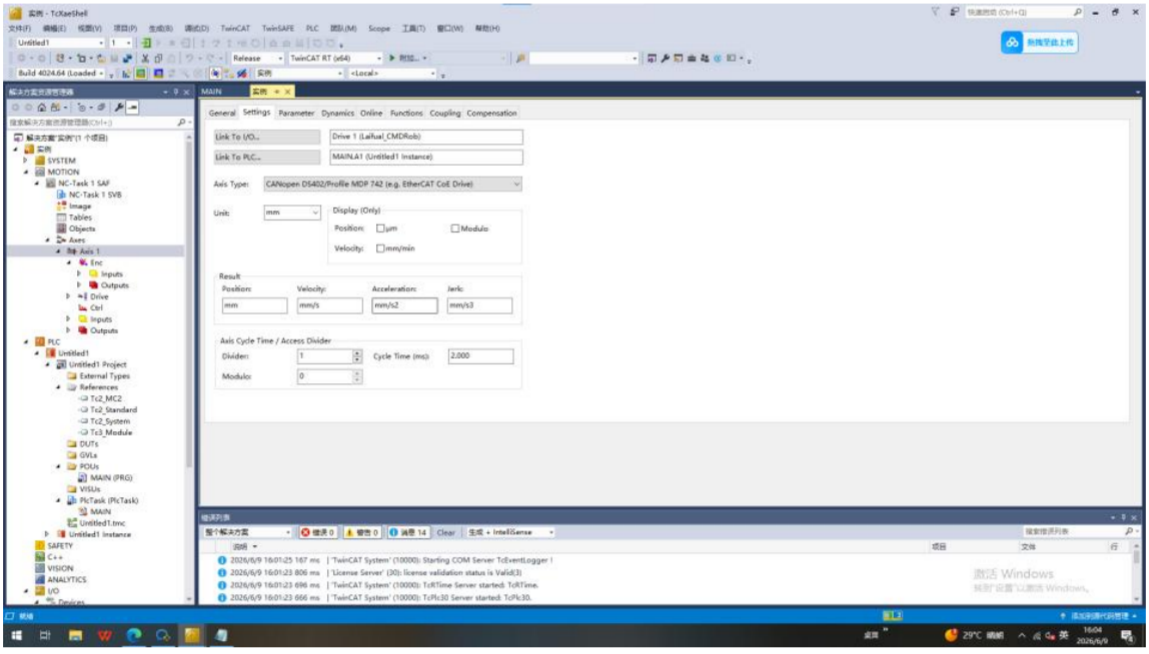
2.Invoke the STOP function- block command


1.按下键盘F2弹出输入助手
2.点击实例调用
3.调用"STOP"自定义模块
4.点击确认


1.输入自定义监控名称
2.填写一个新的自定义监控名称
3.点击确认

3.Bind the module to the PLC.

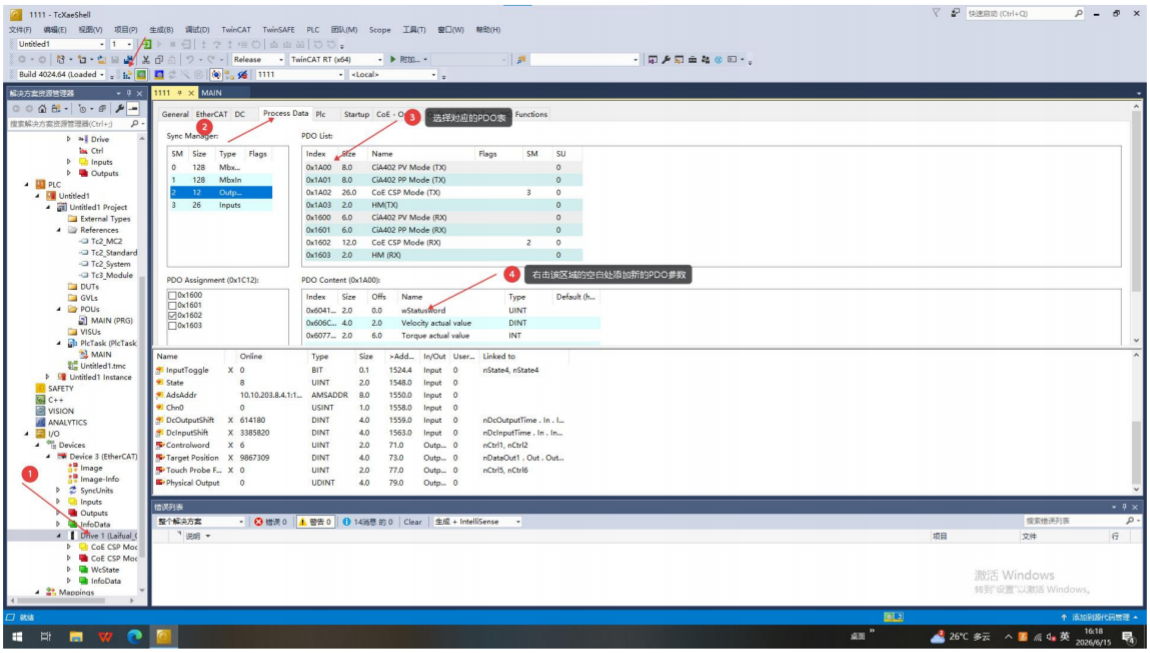




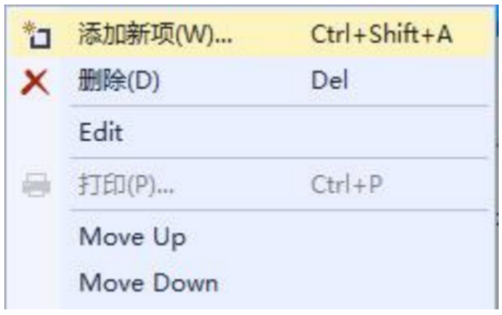
5.CSP Mode

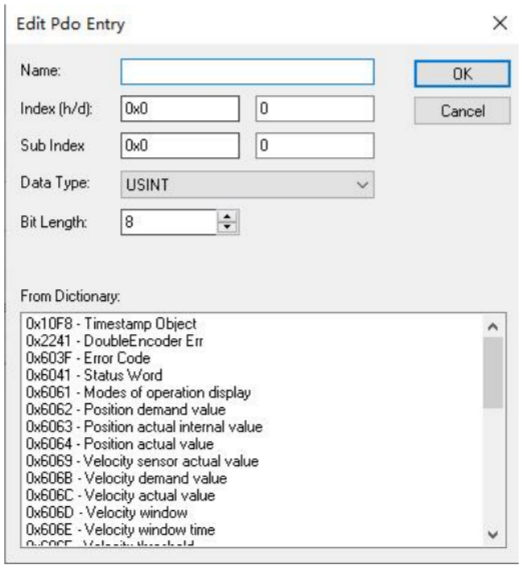
For CSP mode, add the following output objects: 6066 (Modes of Operation Selection), 607A (Target Position for CSP mode), 6040 (Control Word: enable, reset, stop). Add the following input objects: 6041 (Status Word, read-back of control-word status), 6064 (Actual position of axis).

(1) Add PDO parameters as shown in the figure below.

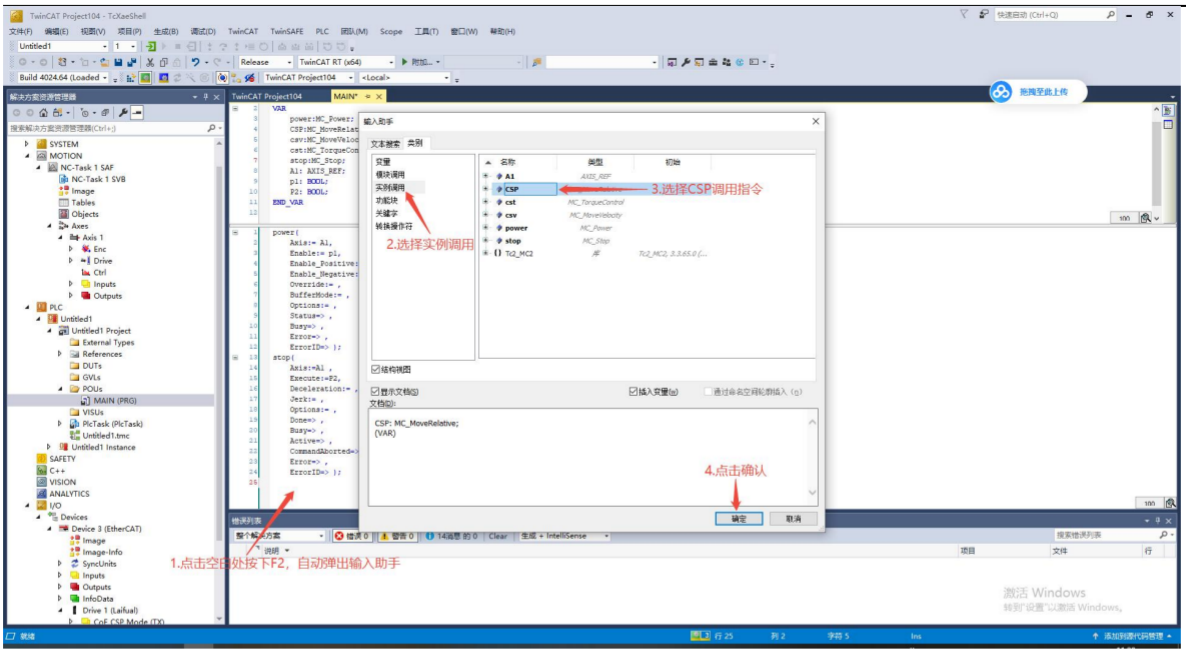


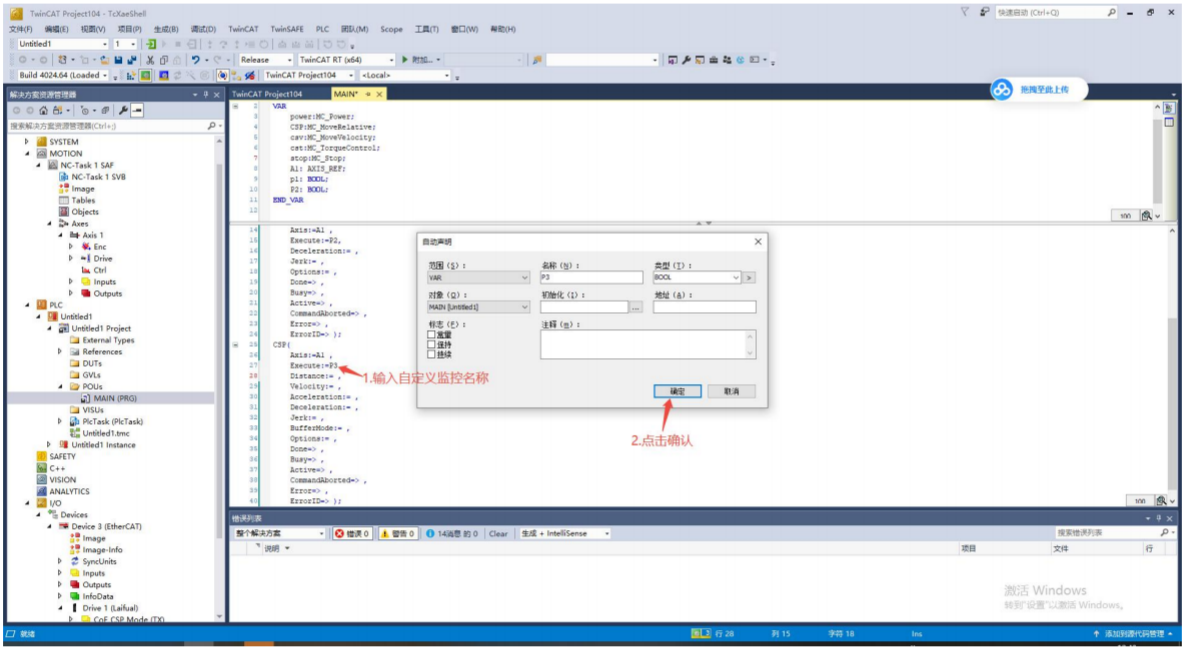
(2)Click Add new item, locate the required parameter in the list and double- click it. After completing the addition, click the Download option in the navigation bar to download and apply the configuration.

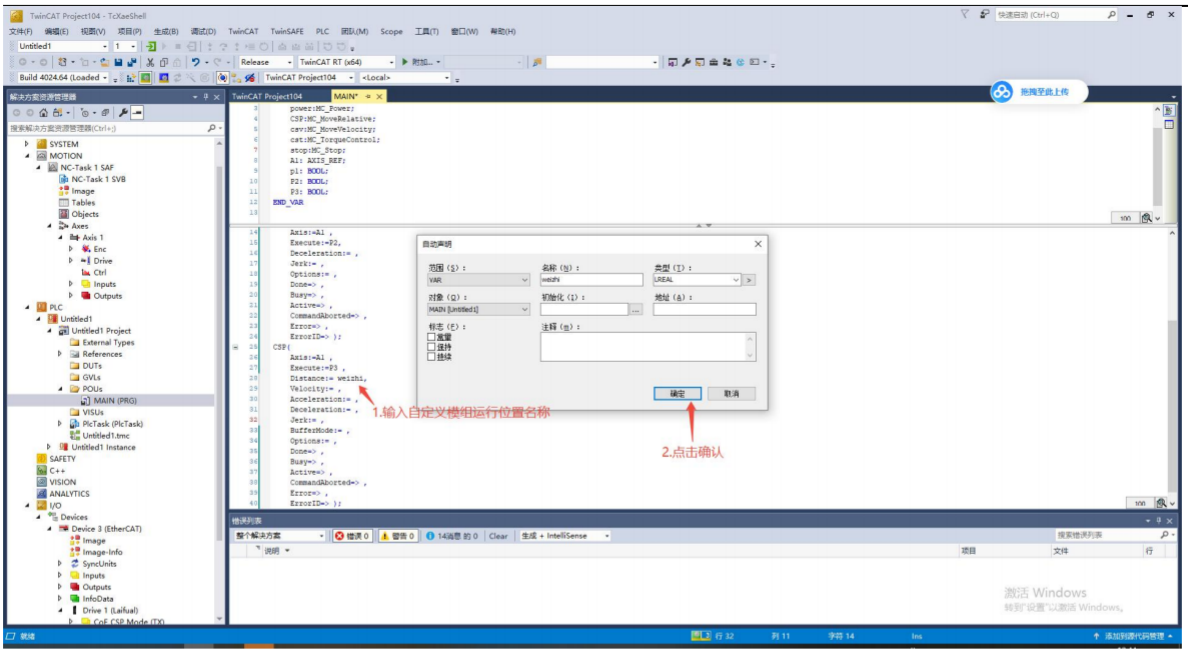


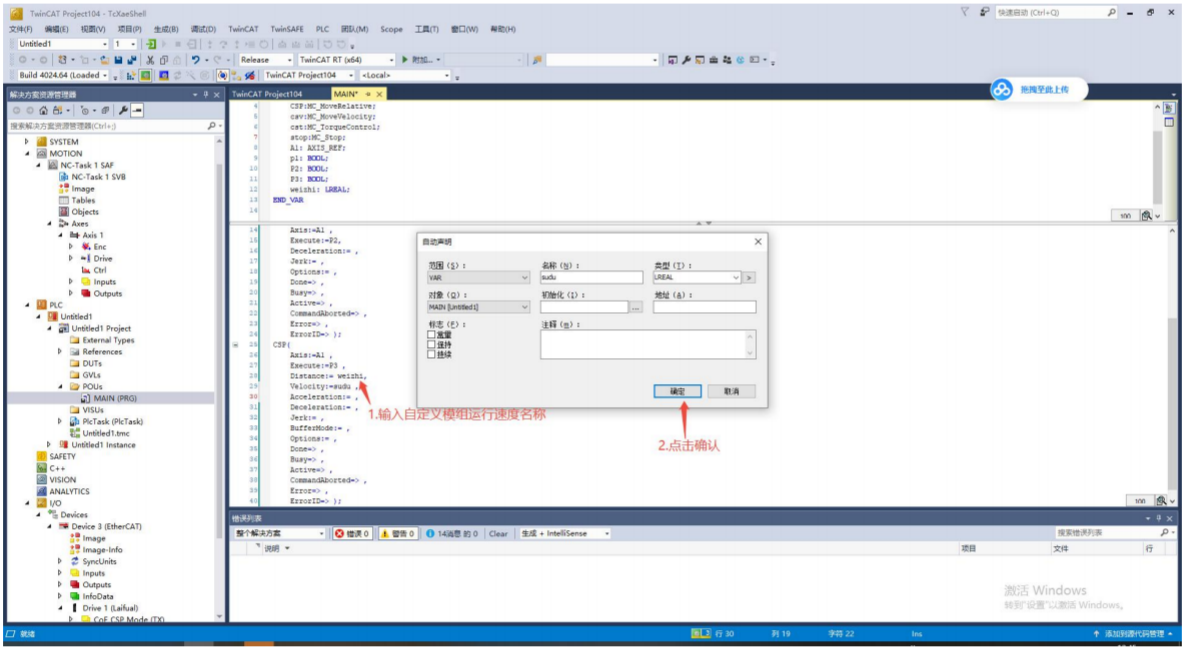


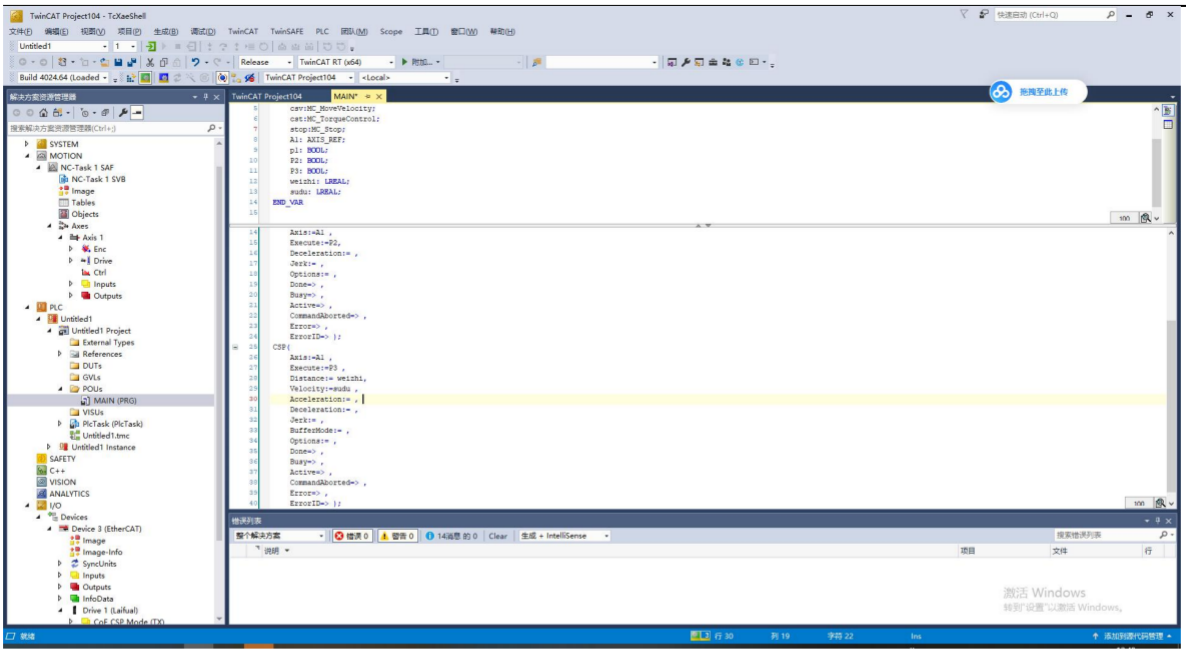
(3)Invoke the CSP command


2.选择实例调用
3.选择CSP调用指令
4.点击确认
1.点击空白处按下F2，自动弹出输入助手

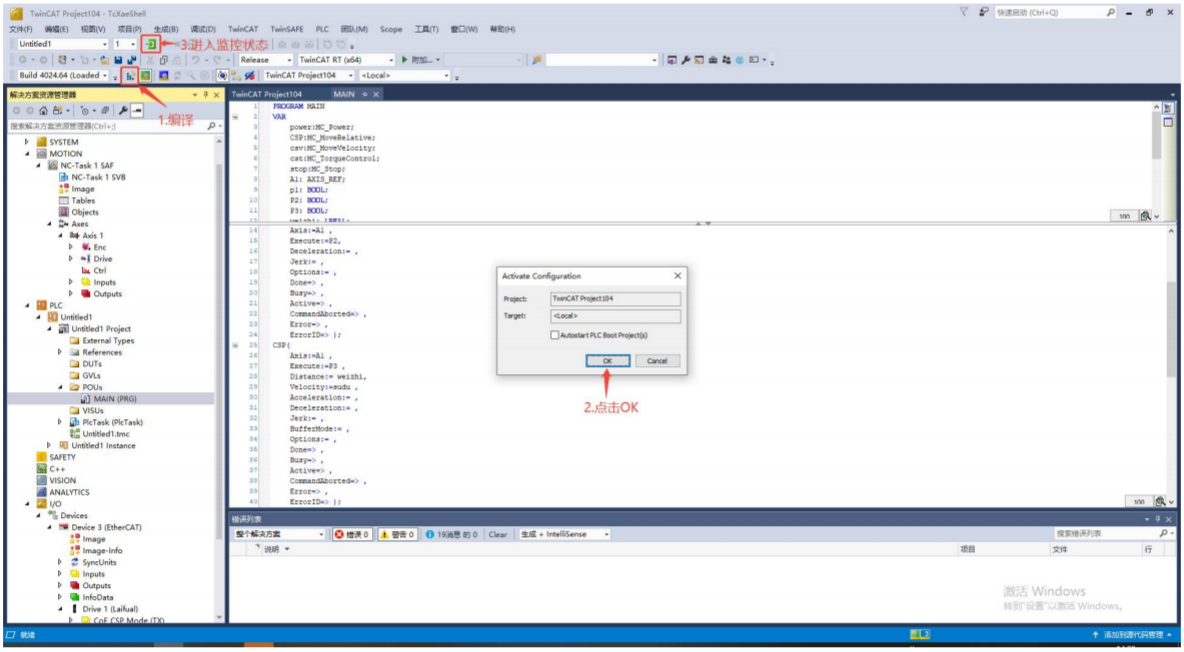

1.输入自定义监控名称
2.点击确认

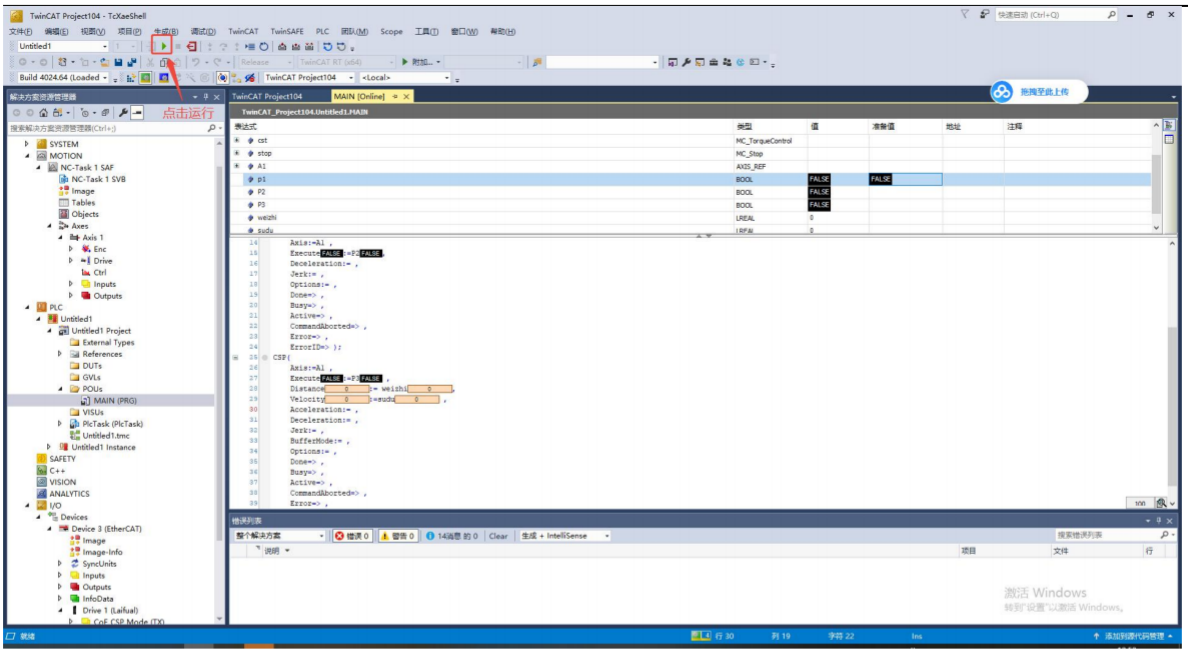

1.输入自定义模组运行位置名称
2.点击确认


1.输入自定义模组运行速度名称
2.点击确认

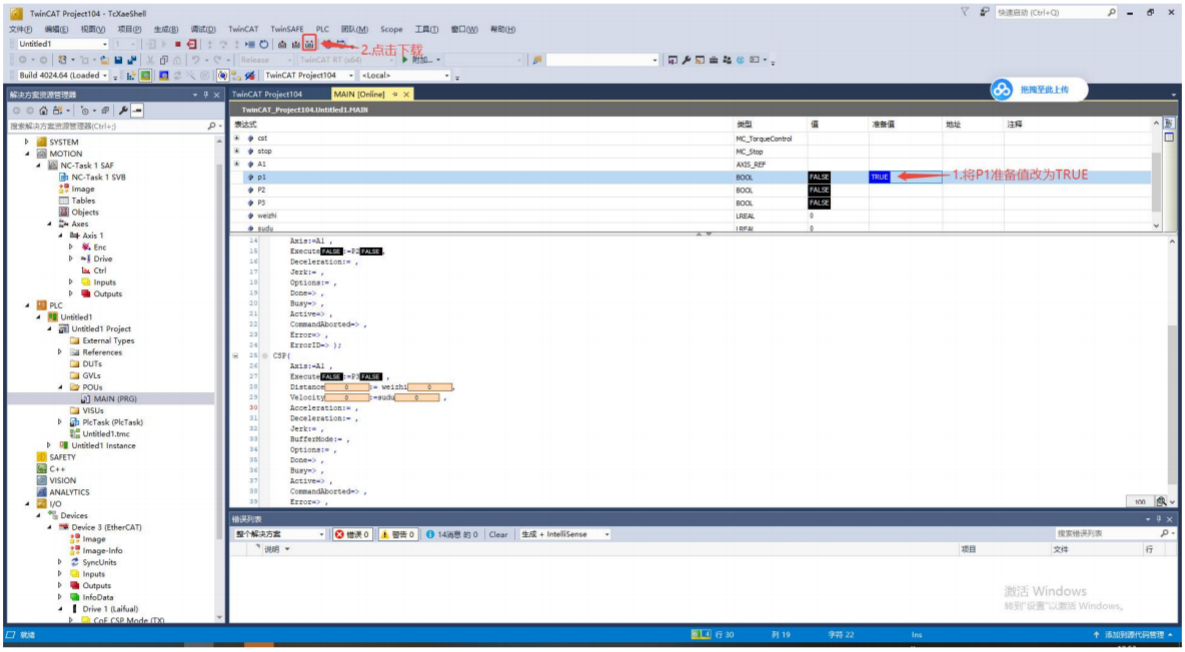


(4)Compile the program and enter monitoring mode.

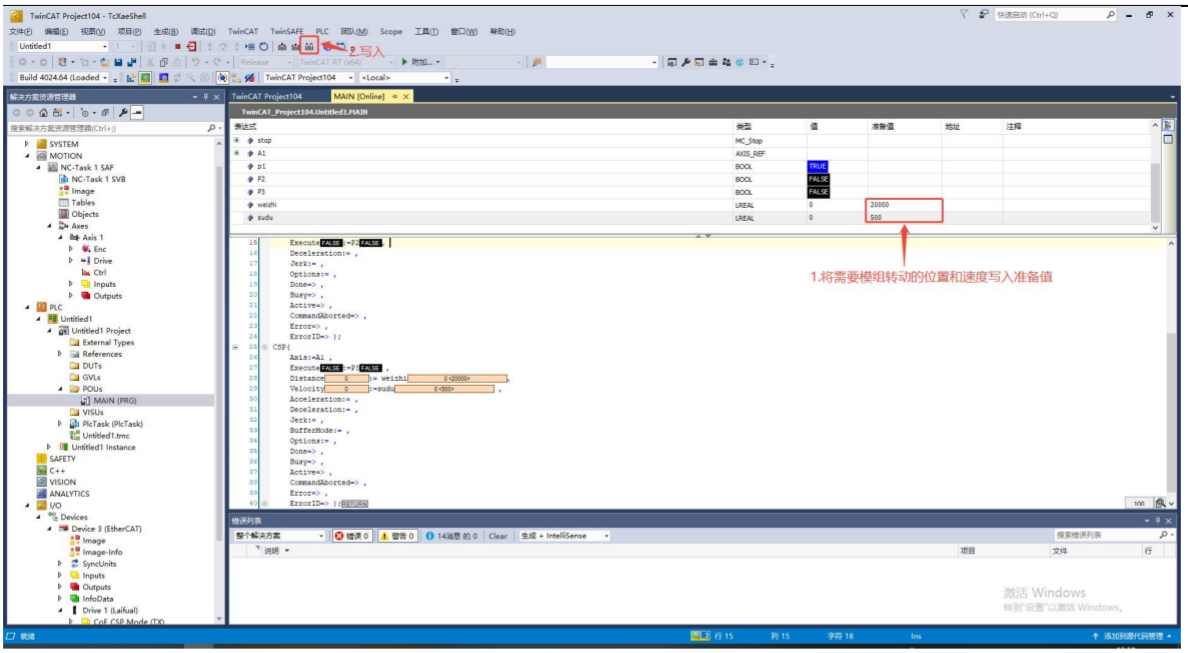


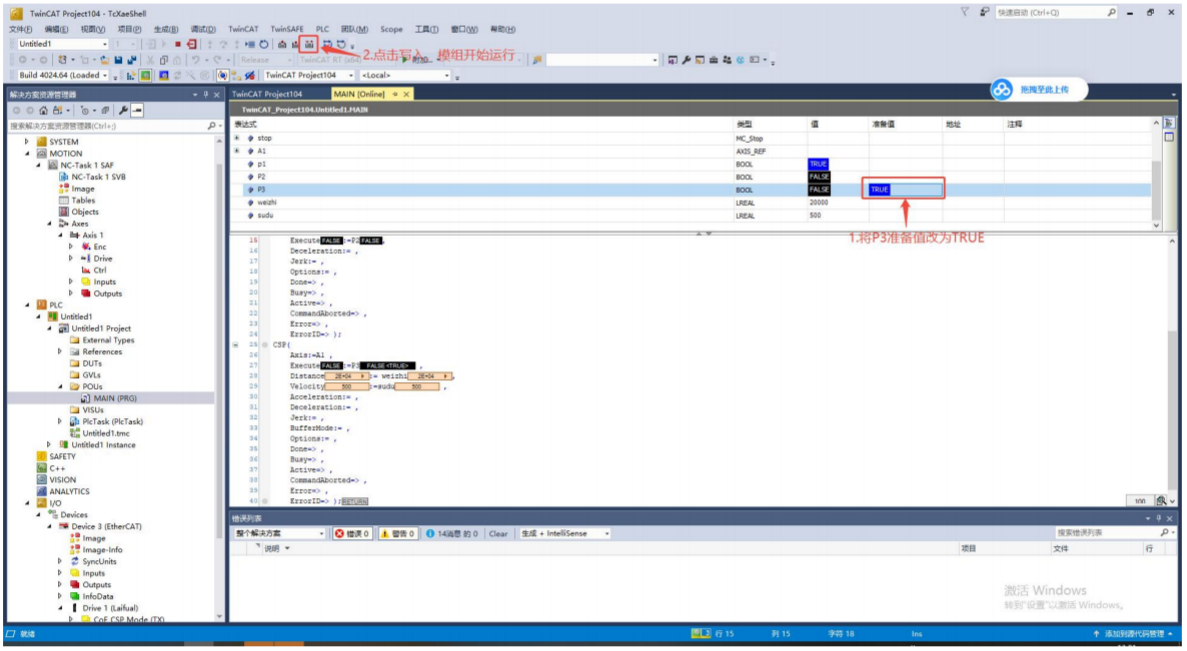


(5) Set the P1 ready value to TRUE; after writing, the actuator module gets powered- on.

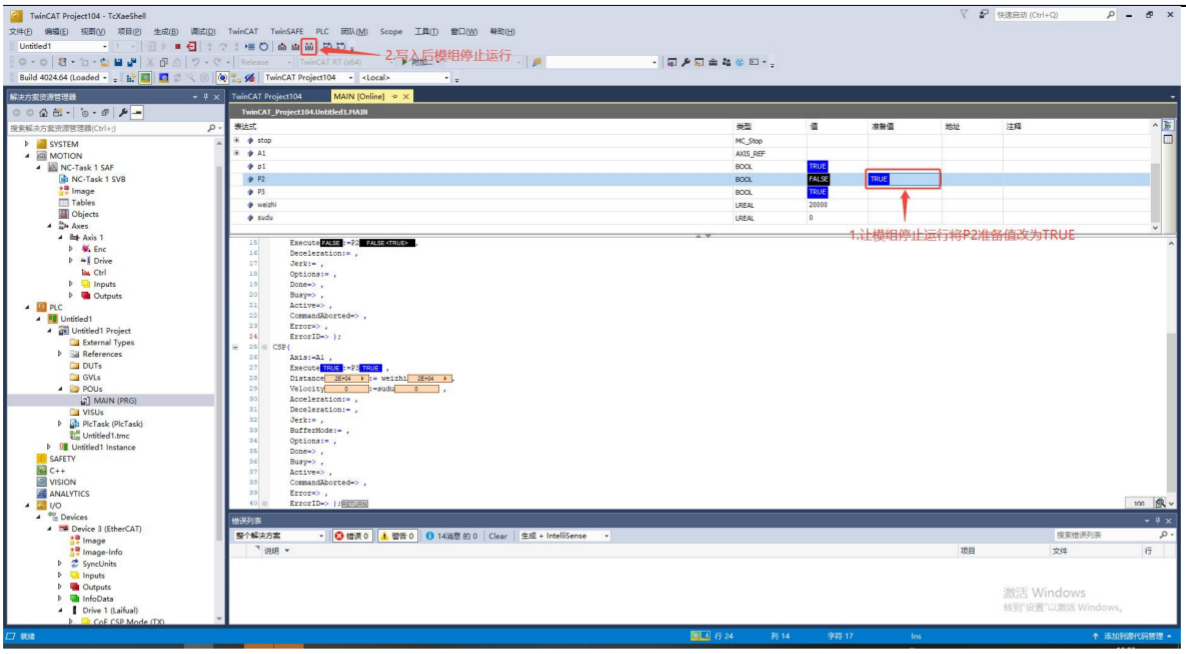


(6)Write the required relative position and velocity values, then trigger the start.





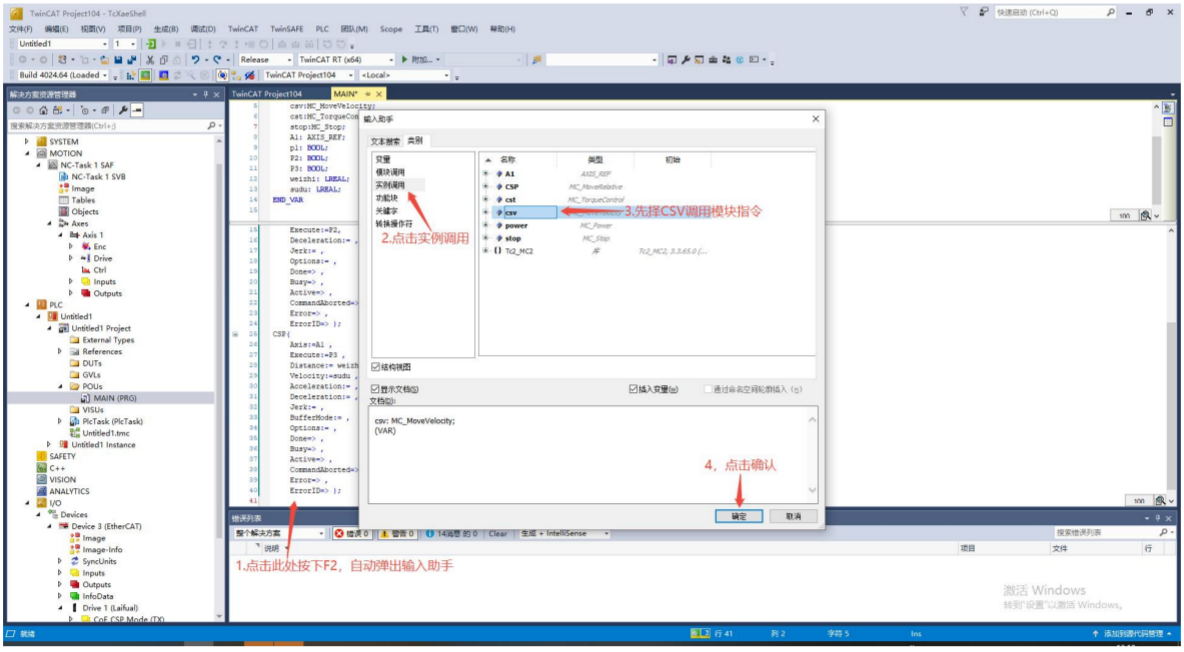
(7)If the module needs to stop, write TRUE to P2; the module will stop running.

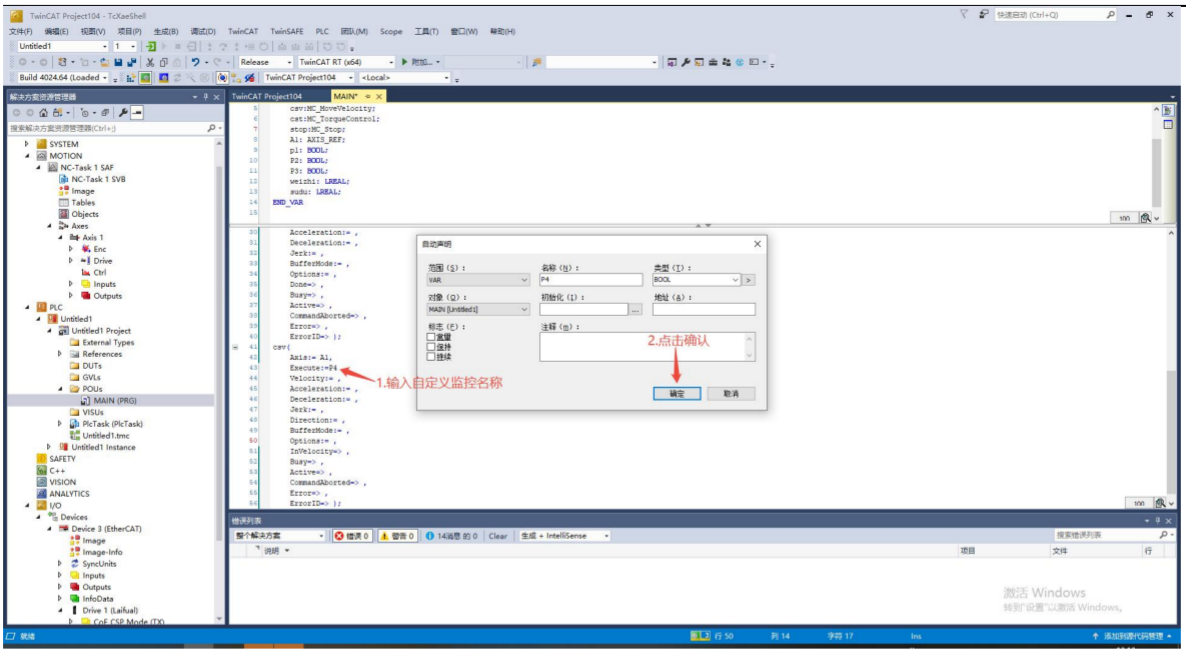


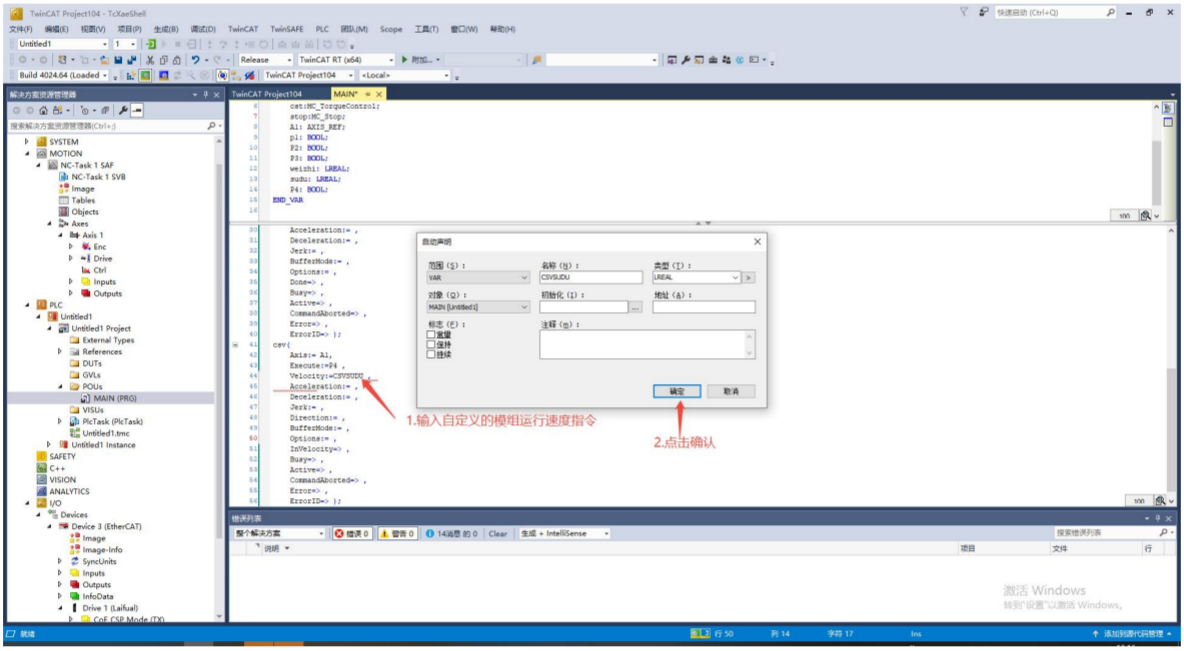
6.CSV Mode

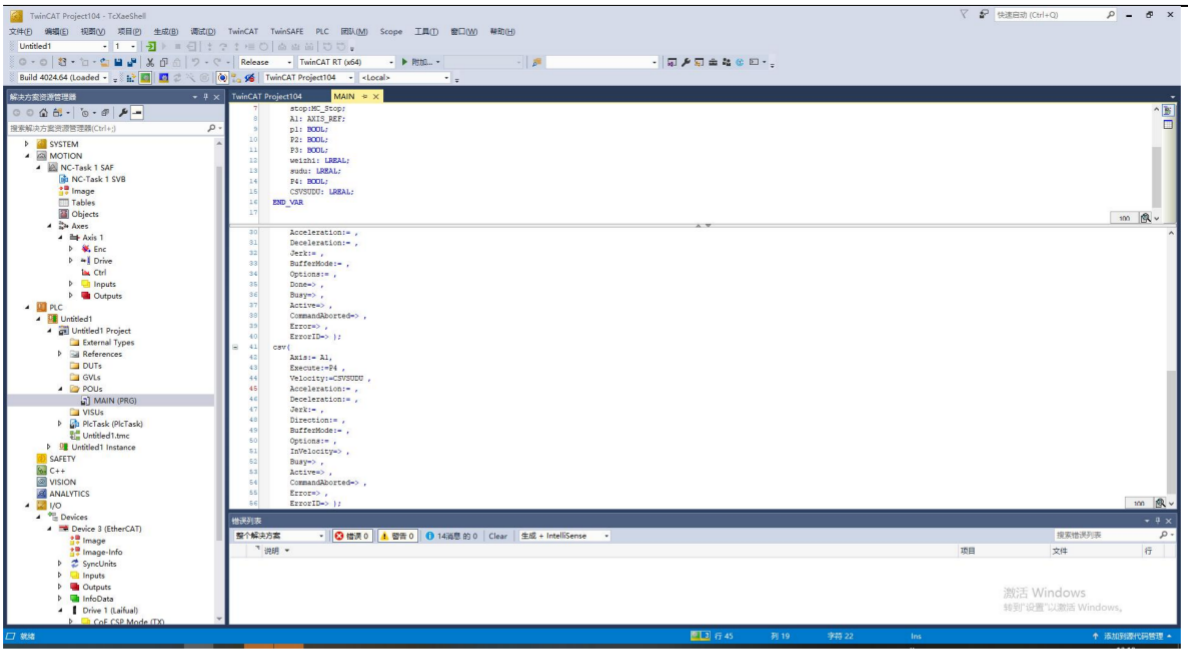
For CSV mode, add two output parameters: 6060 (Modes of Operation Selection), 60FF (Target Velocity). Add the input parameter 6061 (Actual Velocity).

(1) Invoke the CSV function- block command.

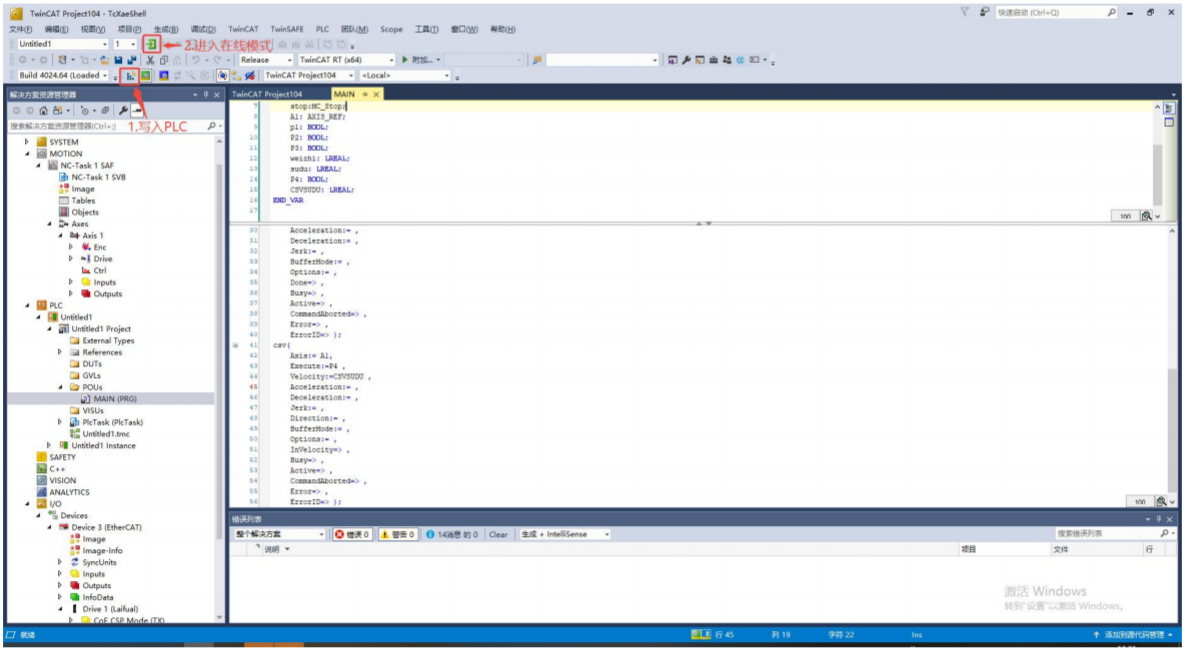


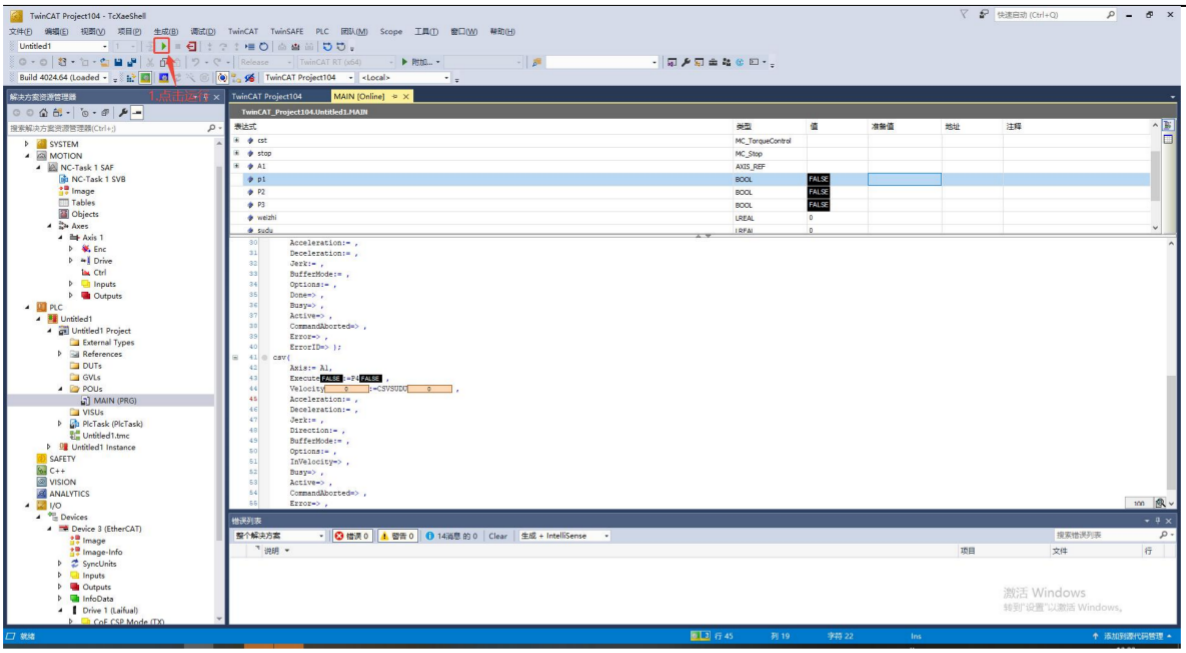

1.输入自定义监控名称
2.点击确认


1.输入自定义的模组运行速度指令
2.点击确认

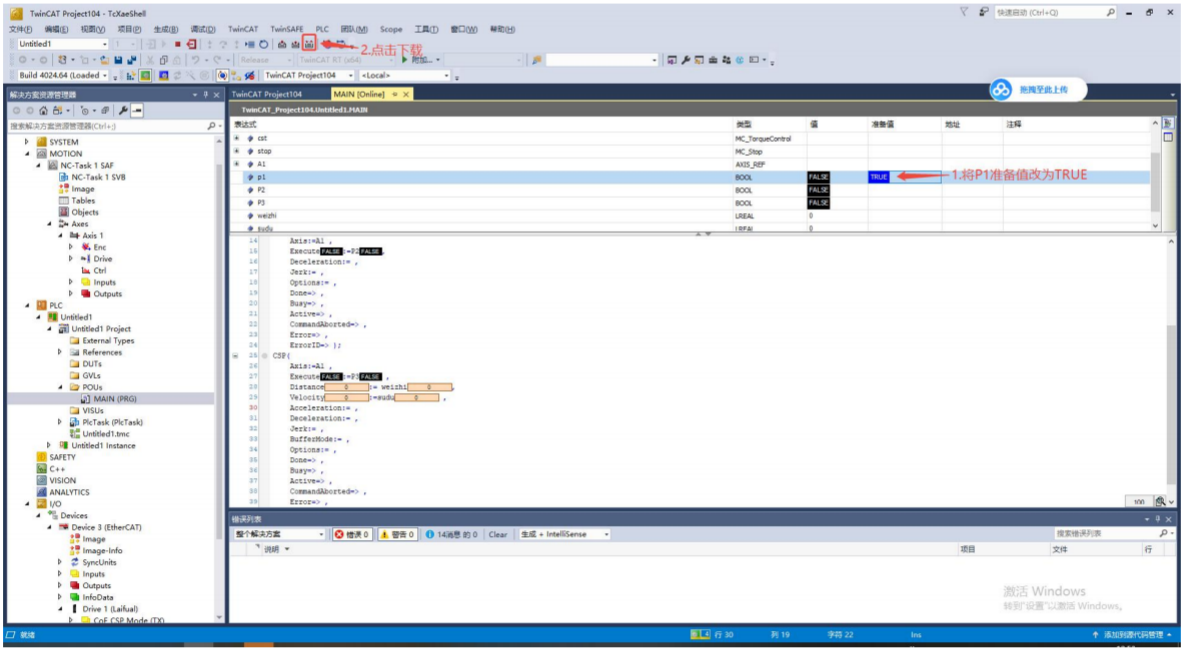


(2)Write the invoked CSV command into the PLC, then enter monitoring mode.

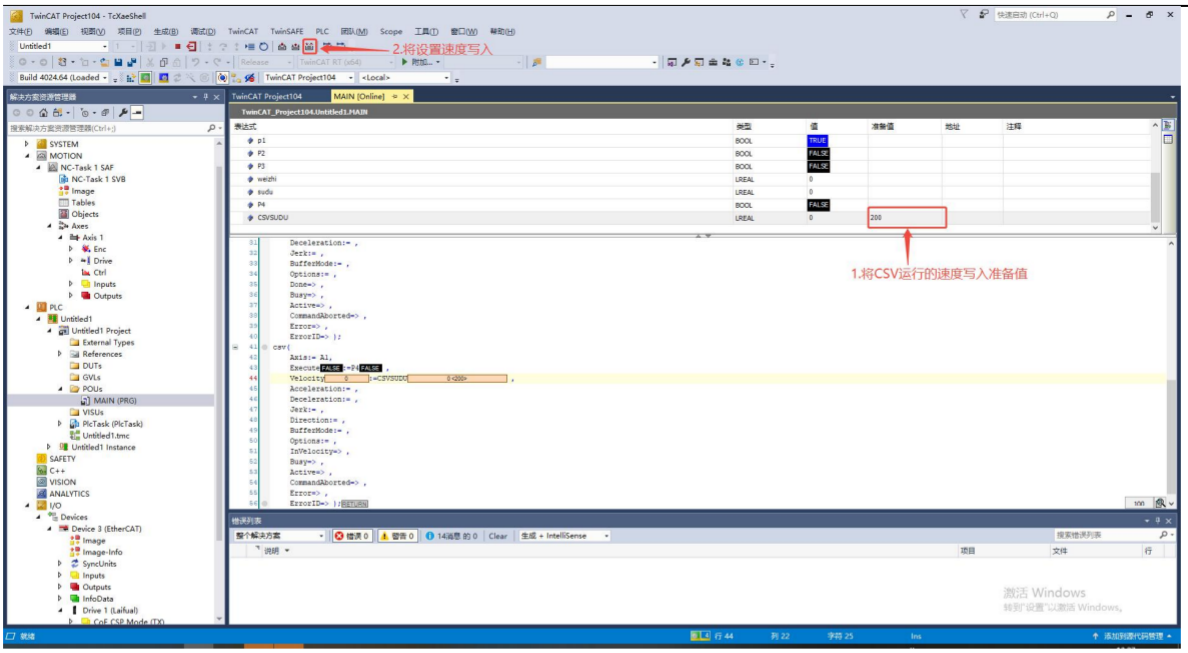


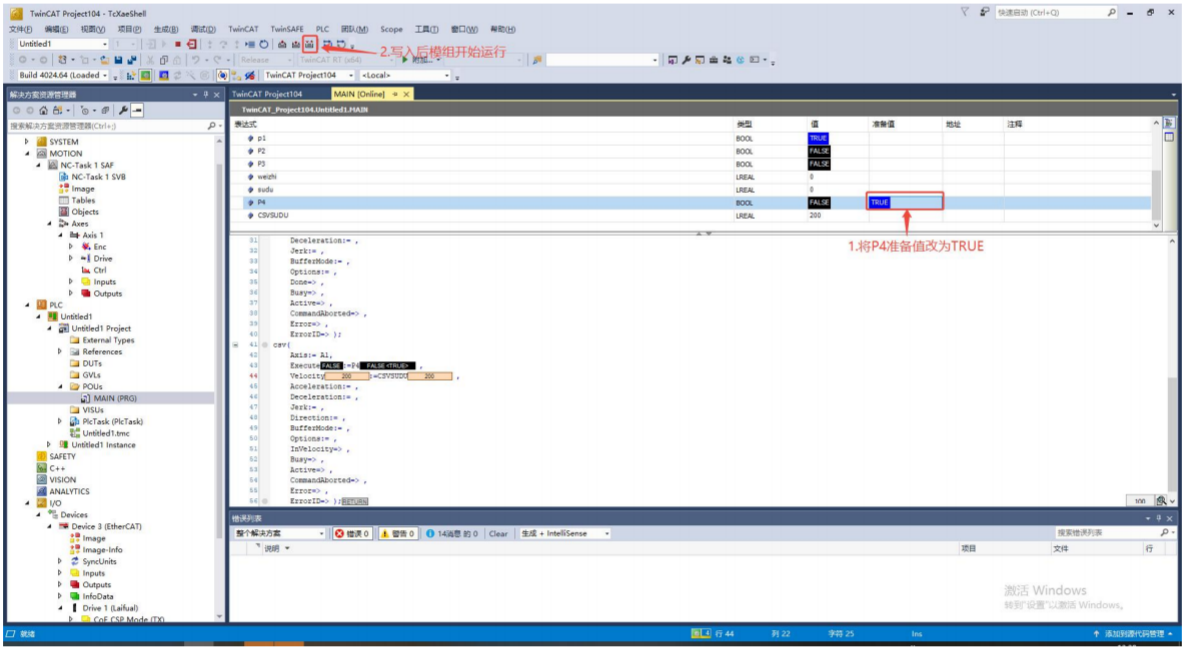


(3)Set the P1 ready value to TRUE; after writing, the actuator module gets powered- on.

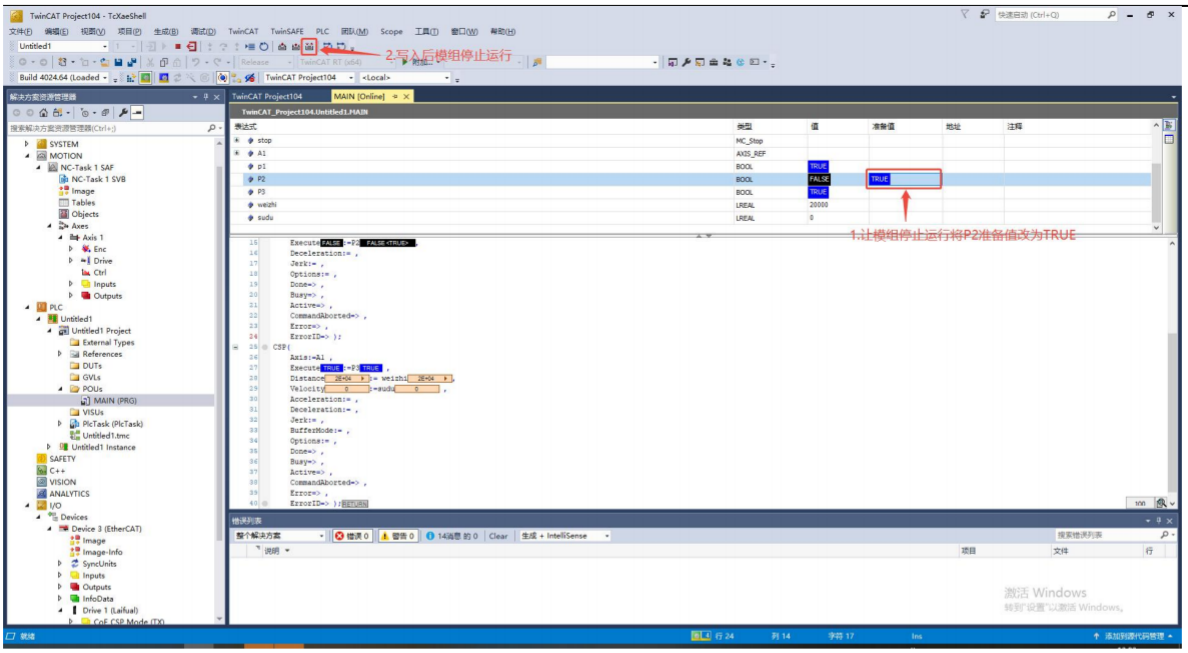


(4)Write the required operating velocity value and trigger the start.





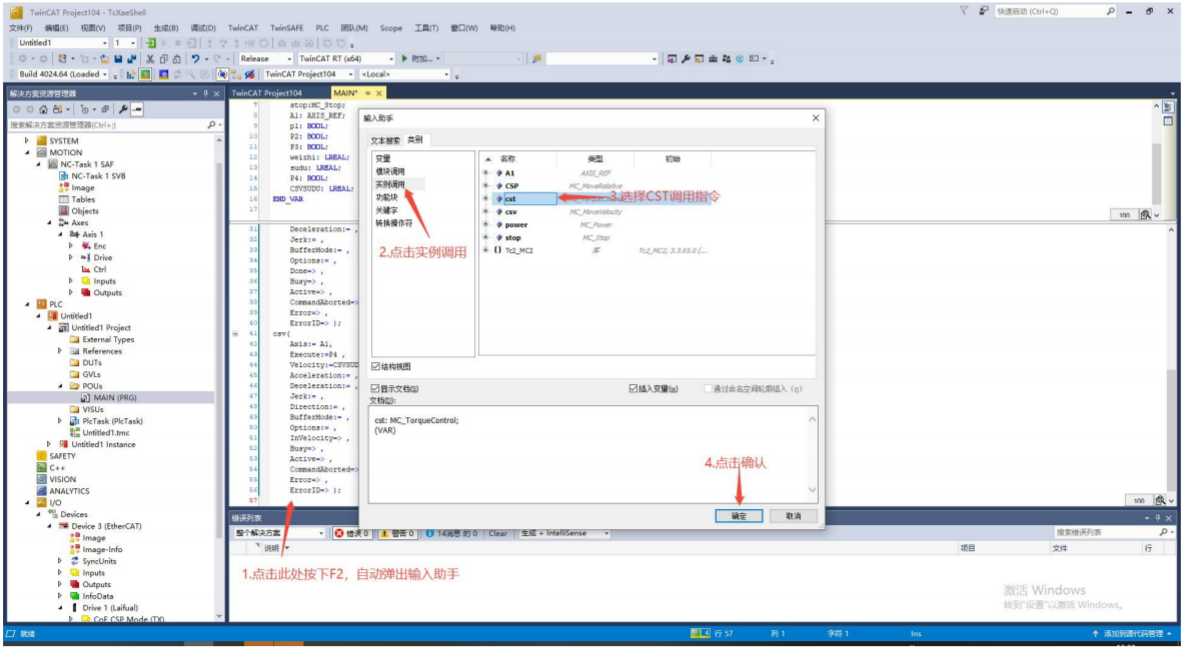
(5)If the module needs to stop, write TRUE to P2; the module will stop running.



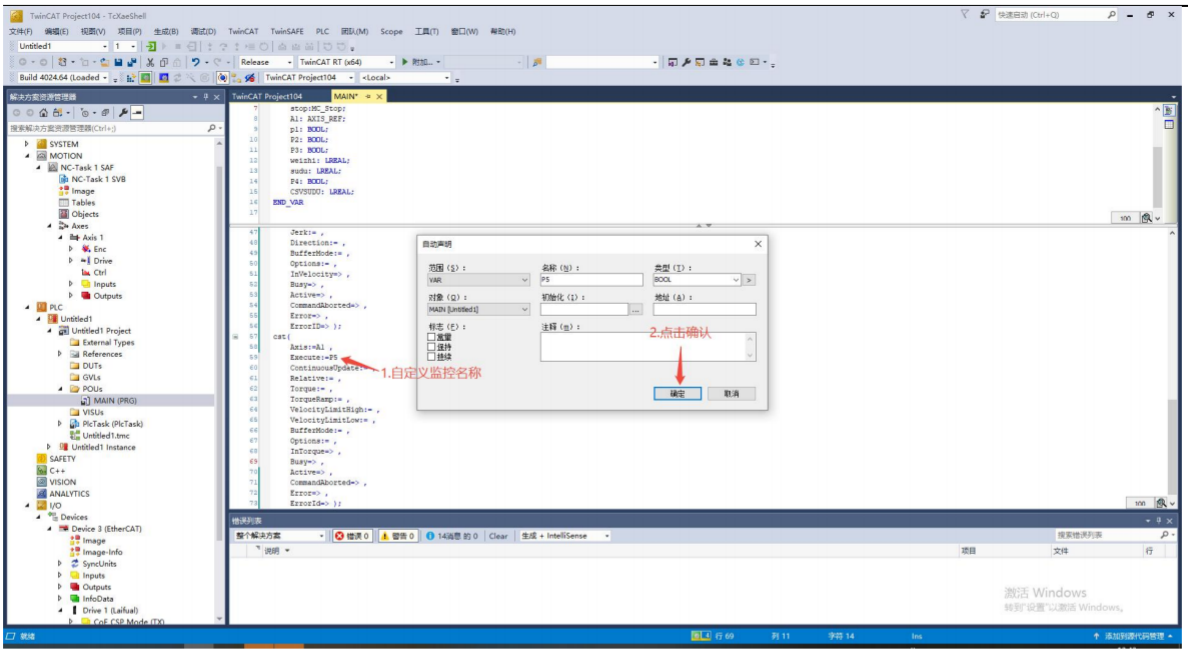
7.CST Mode

CST mode requires three output parameters: 6060 (Modes of Operation Selection), 6040 (Control Word: enable, reset, stop), and 6071 (Target Torque). Configure the following input parameters: 6041 (Status Word feedback), 6061 (Active Operation Mode), and 6077 (Actual Torque).

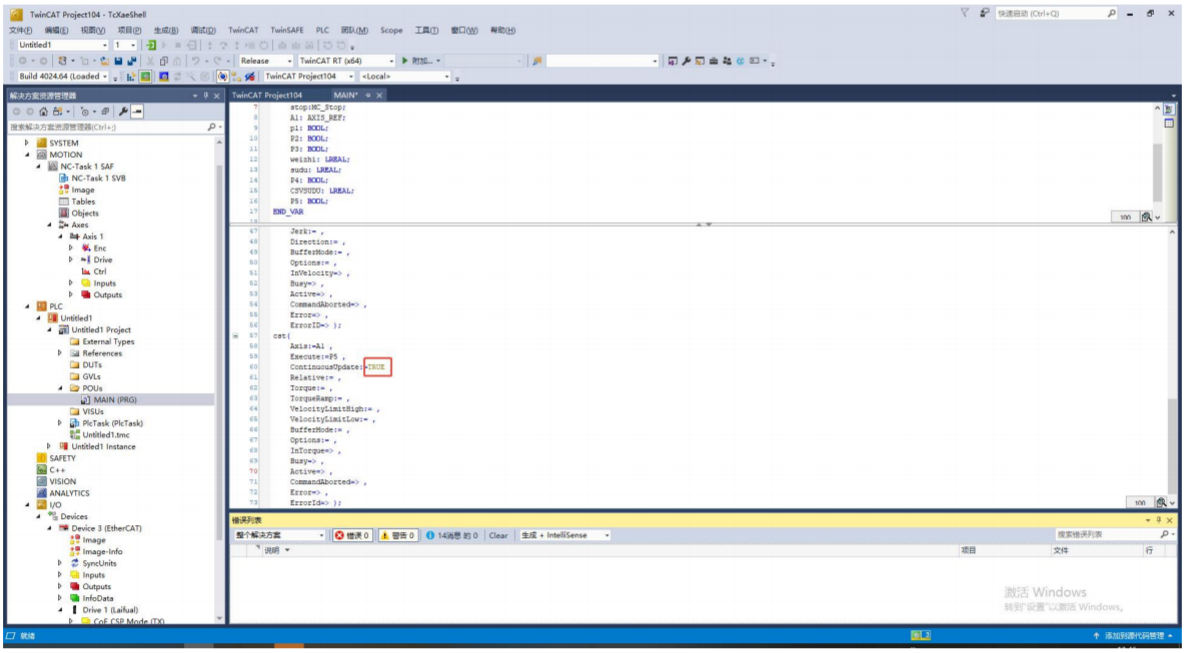
(1)Press F2 in the blank area to pop up the input assistant automatically, select Instance invocation, and choose the CST operating mode.



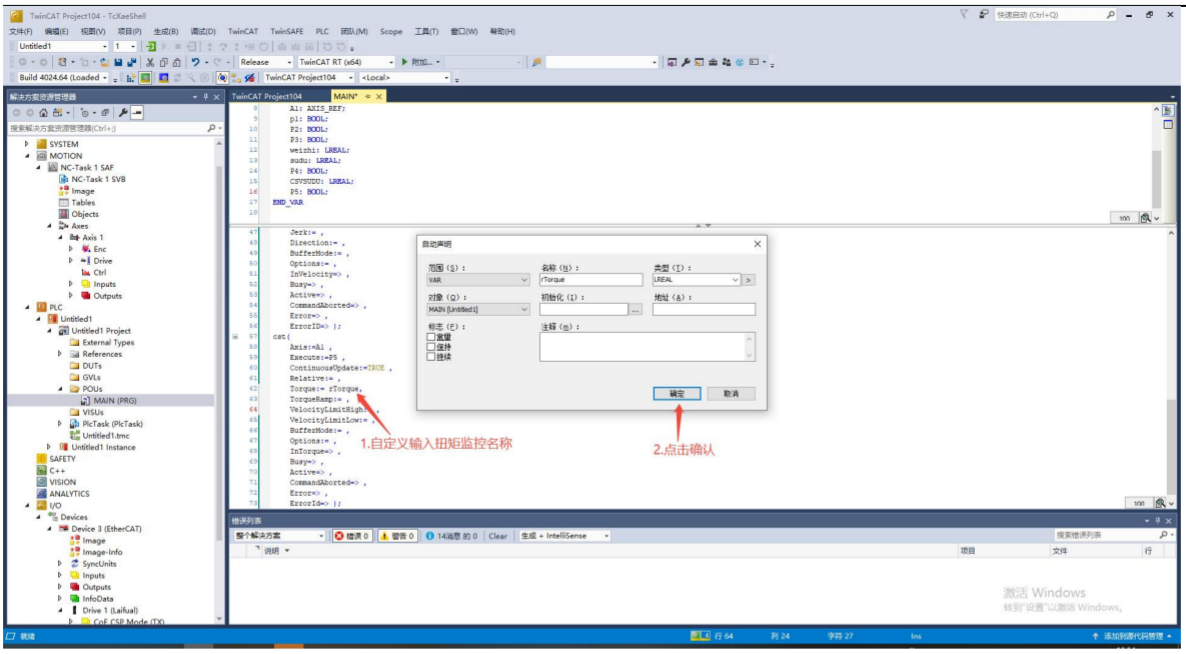
（2）Add the custom name of the module and custom monitoring name.



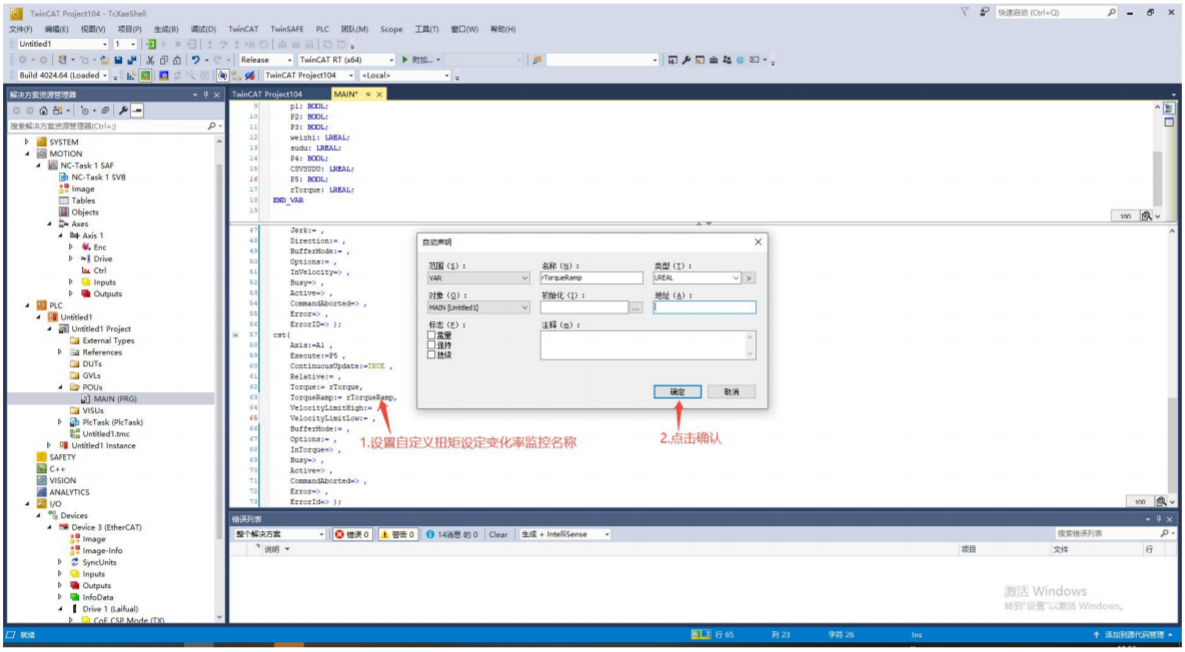
(3) Set ContinuousUpdate to TRUE, so that other input commands can be modified during operation (required for module stop).



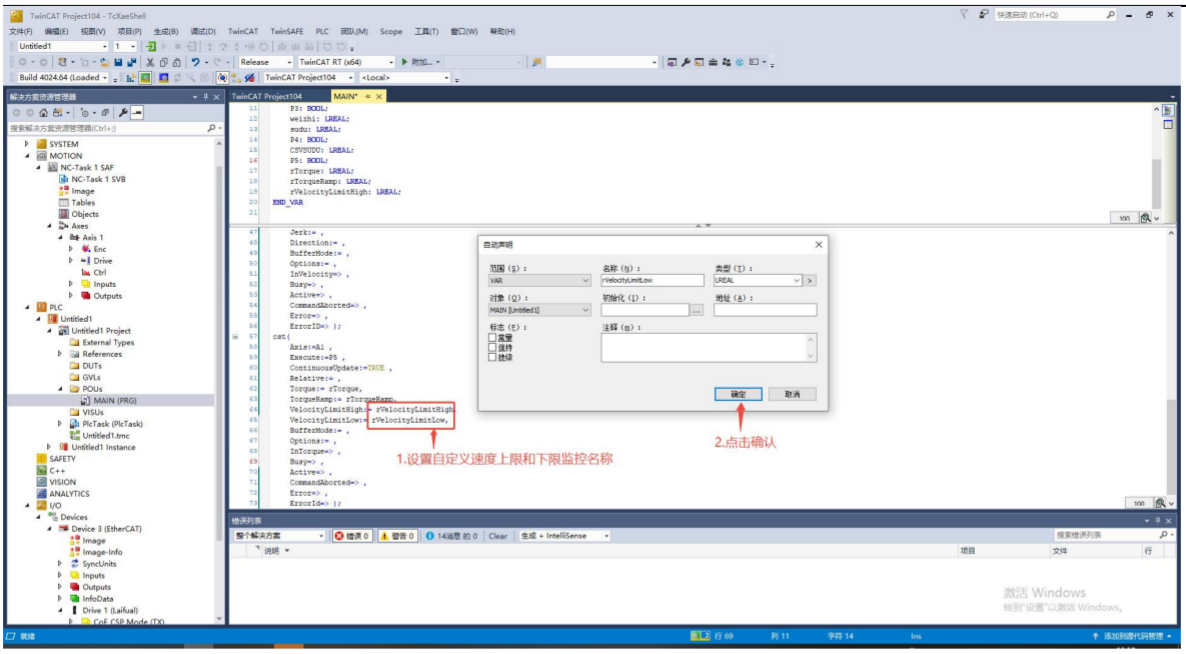
(4) Set the custom name for input torque.



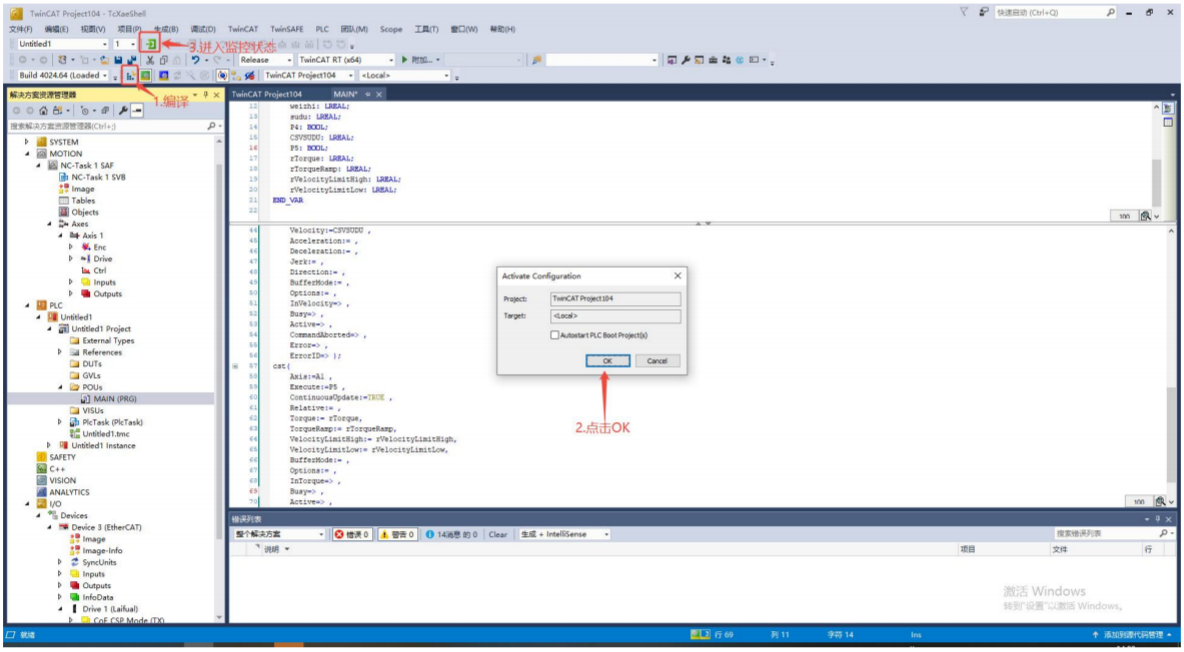
(5) Set the monitoring name for custom torque- setting change rate.

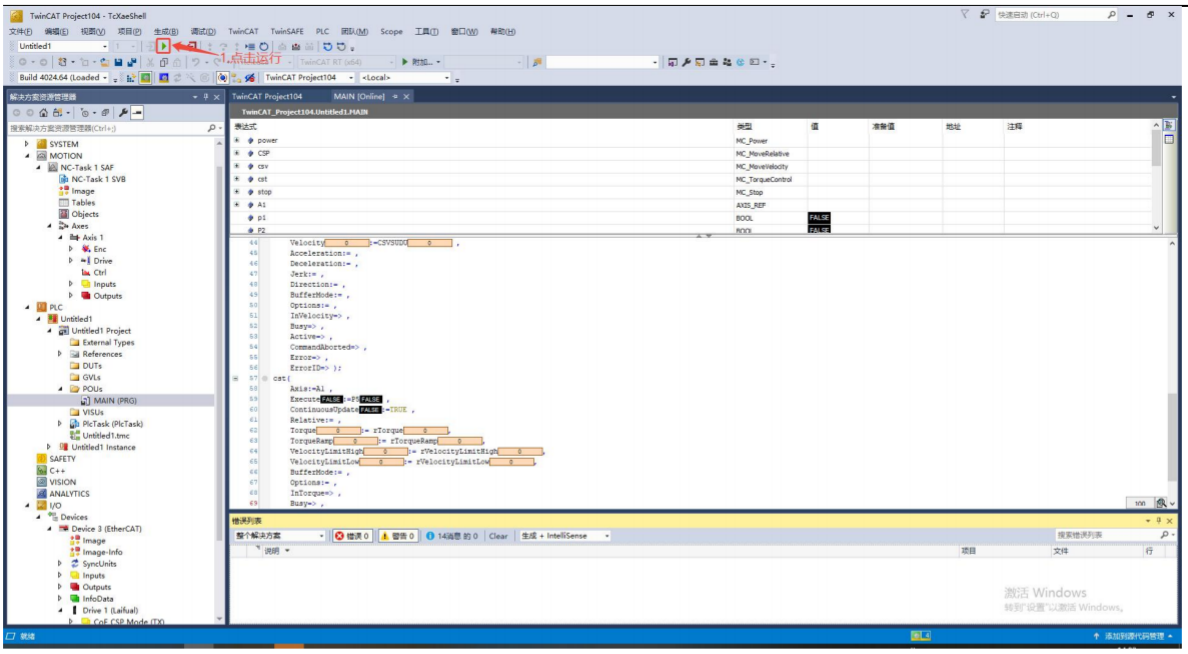


(6) Set the monitoring names for custom upper and lower speed limits.

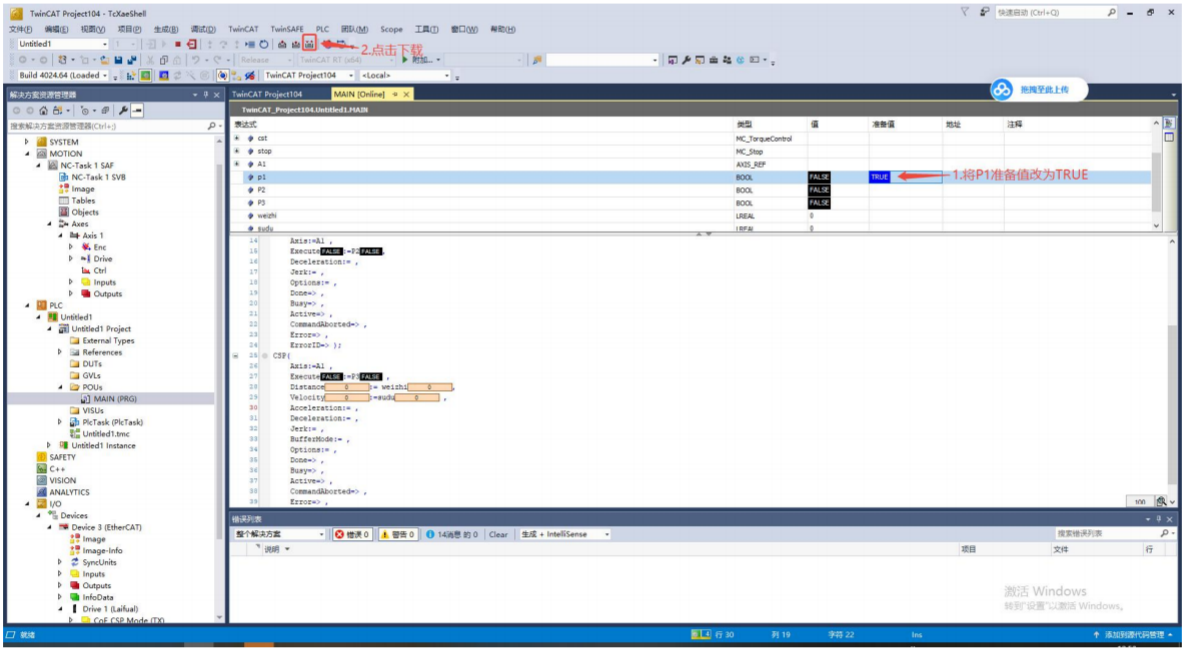


(7) Compile the program and enter monitoring mode.

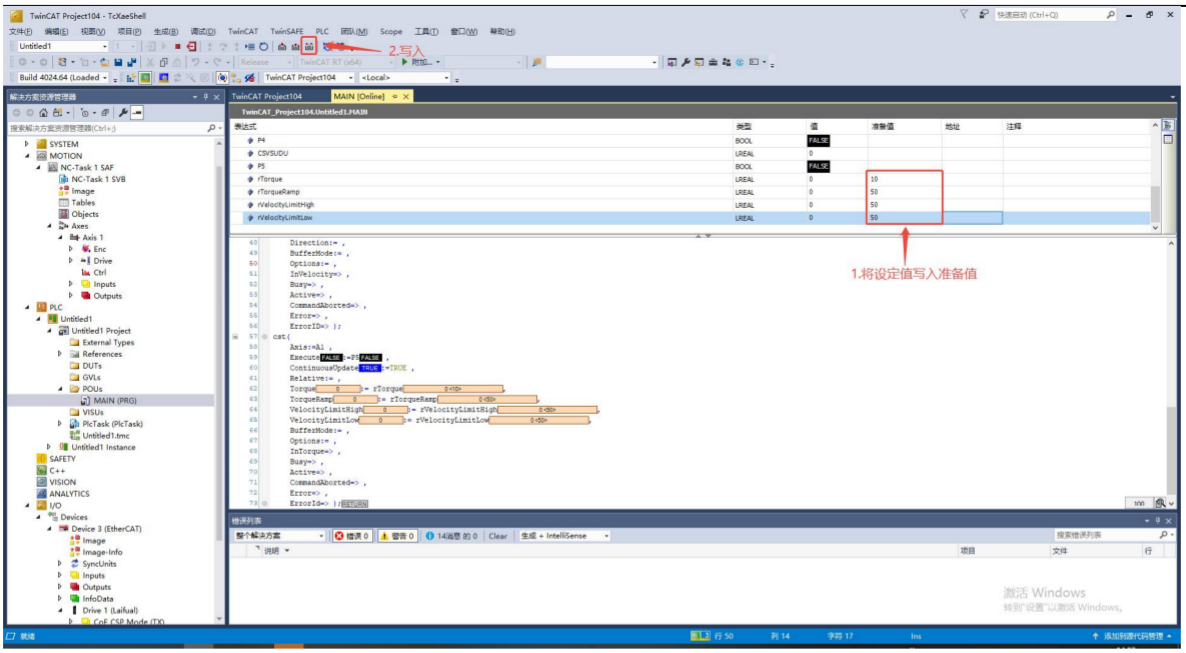




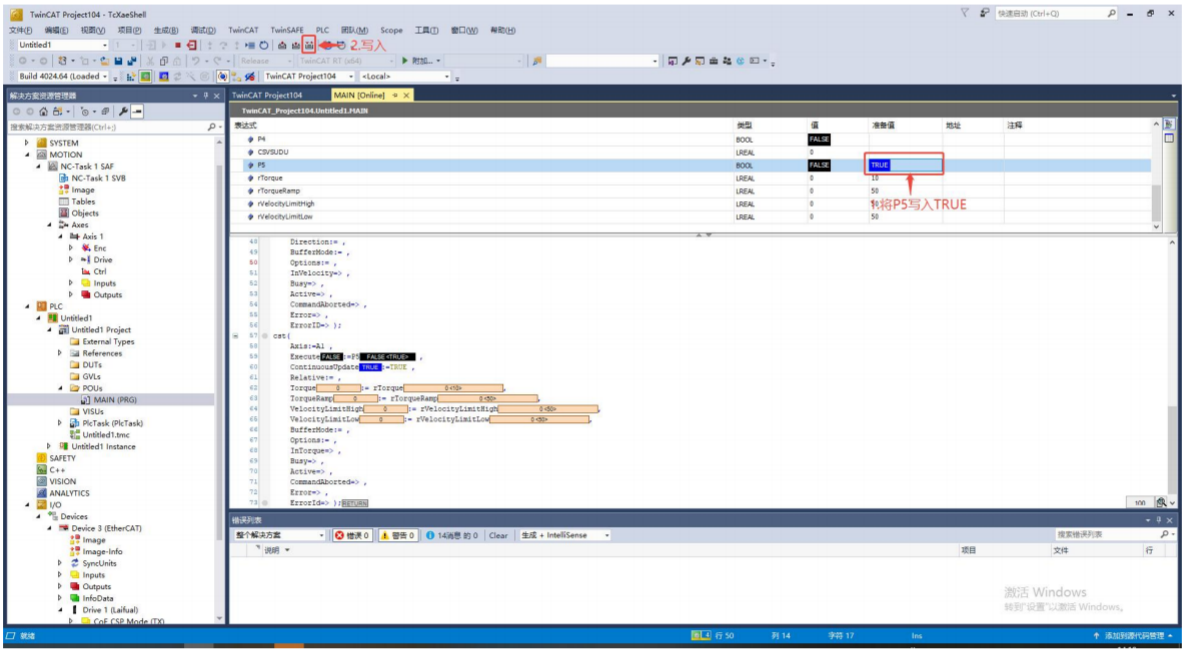
(8) Set the P1 ready value to TRUE; after writing, the module gets powered- on.



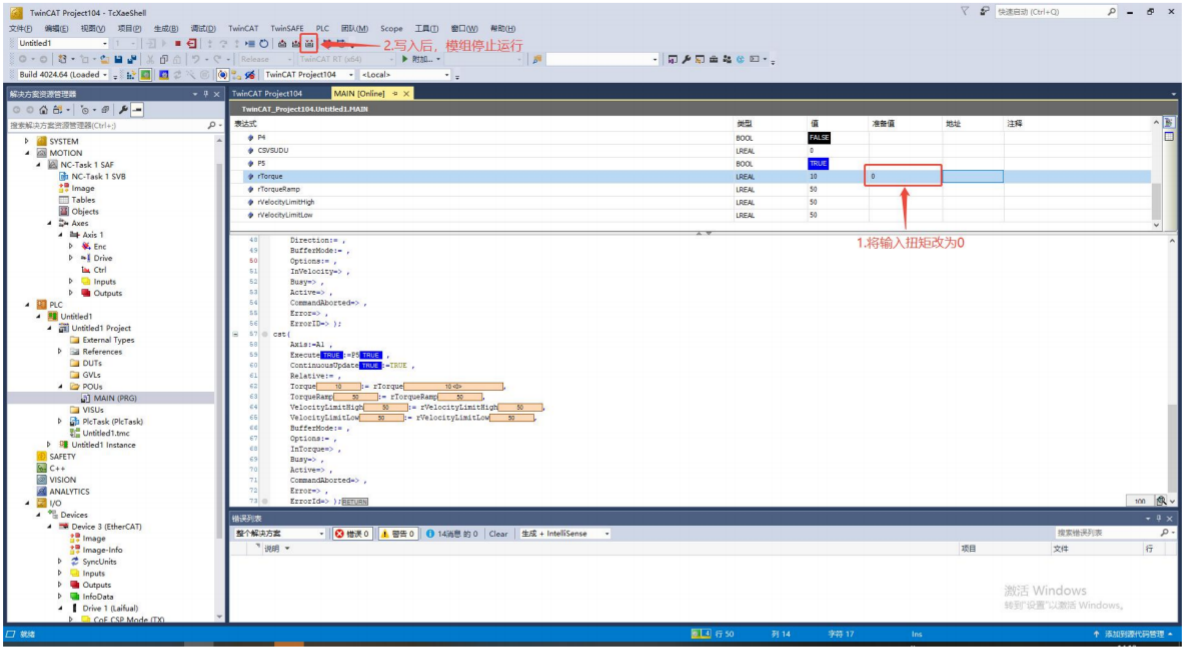
(9) Configure the operating torque of the module, upper/lower speed limits and torque- setting change rate. Write the set values into the ready values and download them to the PLC.



(10) Write TRUE to P5, the trigger value for the custom-named CST operating mode; the actuator module starts running.



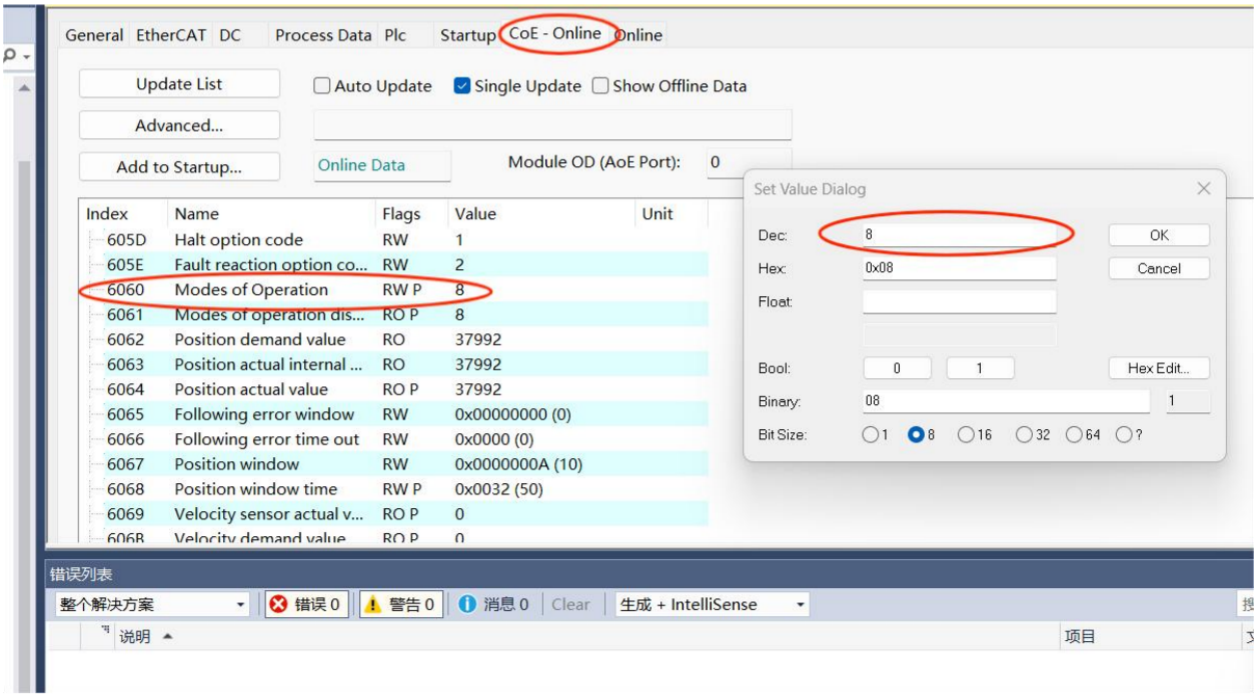
(11) If the actuator module needs to stop running, write 0 to the input torque; the actuator module stops operation.



8.JOG Mode

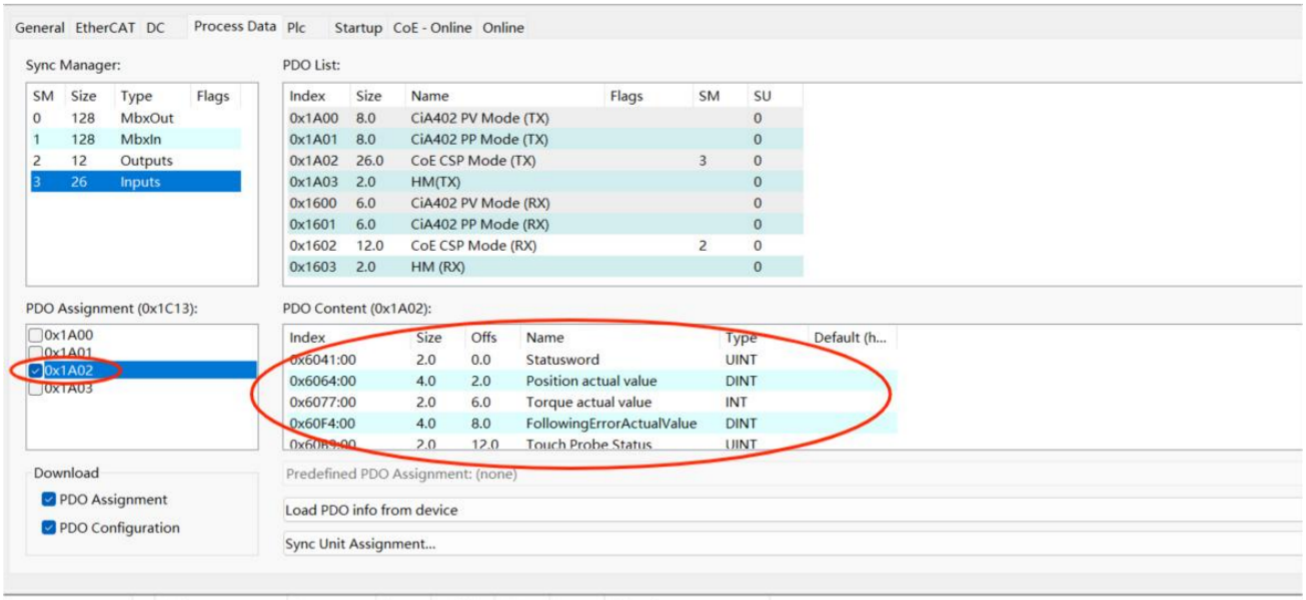
Servo Parameter Configuration

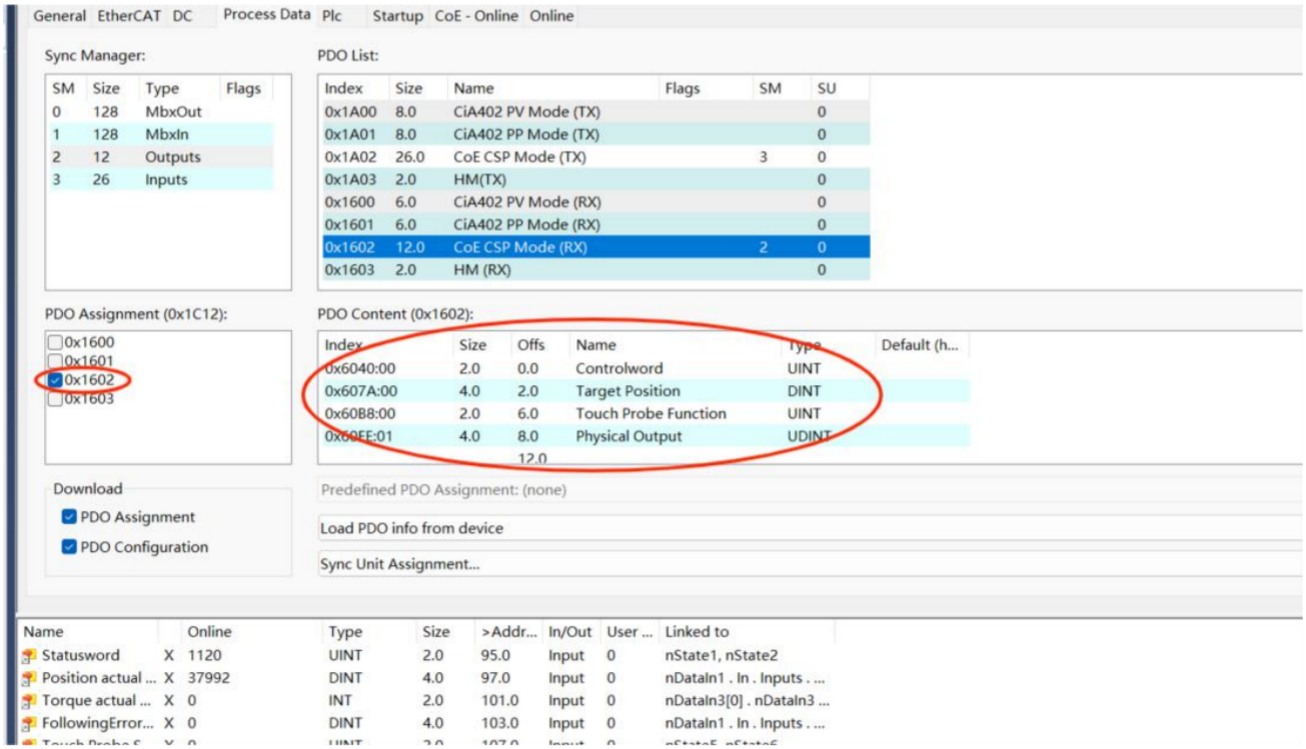
In the "CoE-Online" interface, set the parameters through SDO communication. For example, change 6060h to Sync Position Mode (8), and the steps are as follows:

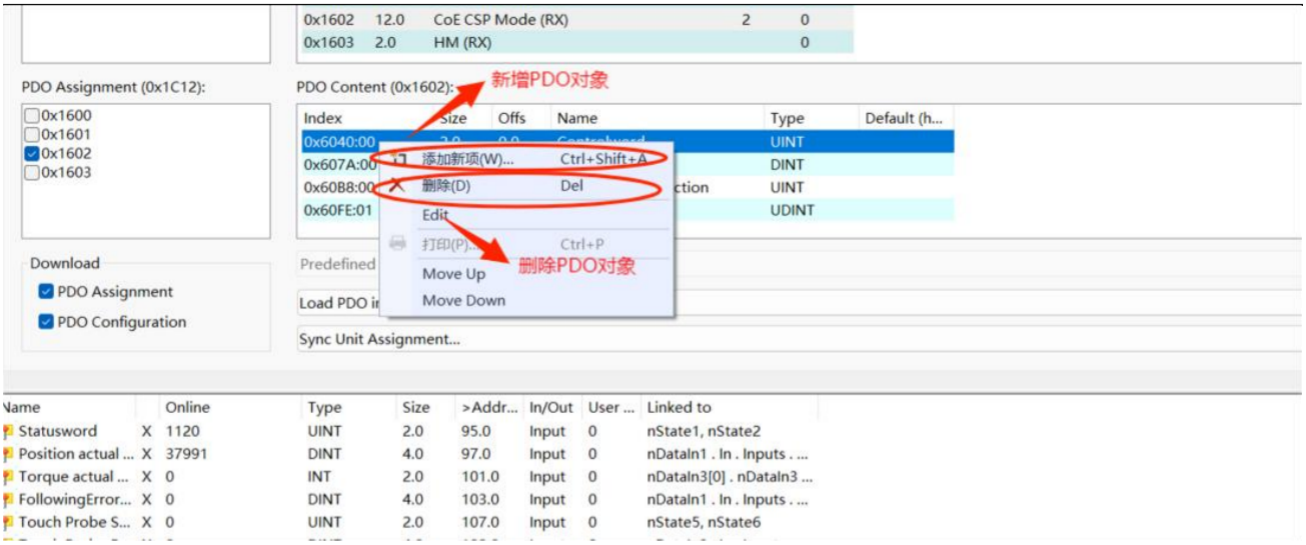


PDO Configuration

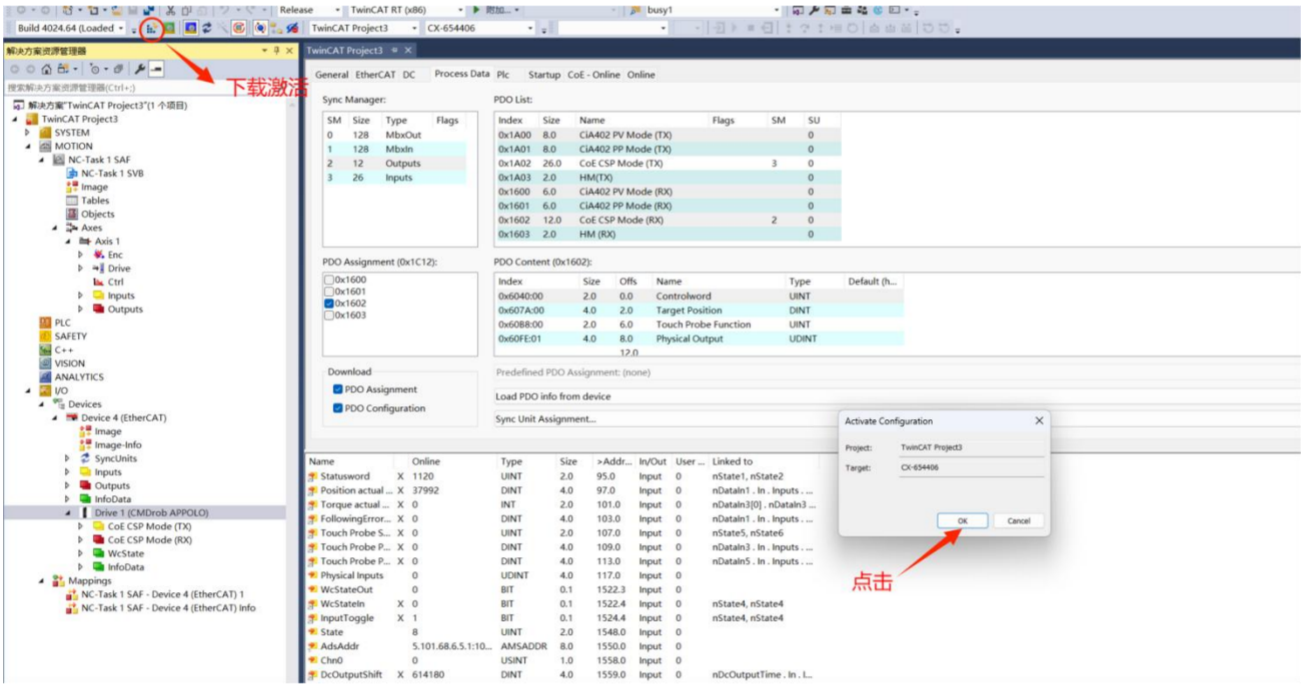
As shown in the figure, check 0x1602 and 0x1A02 for the axis. If the current PDO meets your requirements, there is no need to change it. Otherwise, you need to modify the PDO list to fit your mode. If you need to modify it, right-click in the PDOContent window, select "Del" to delete the unnecessary default PDOs, and "Add New Item" to add the required PDO.

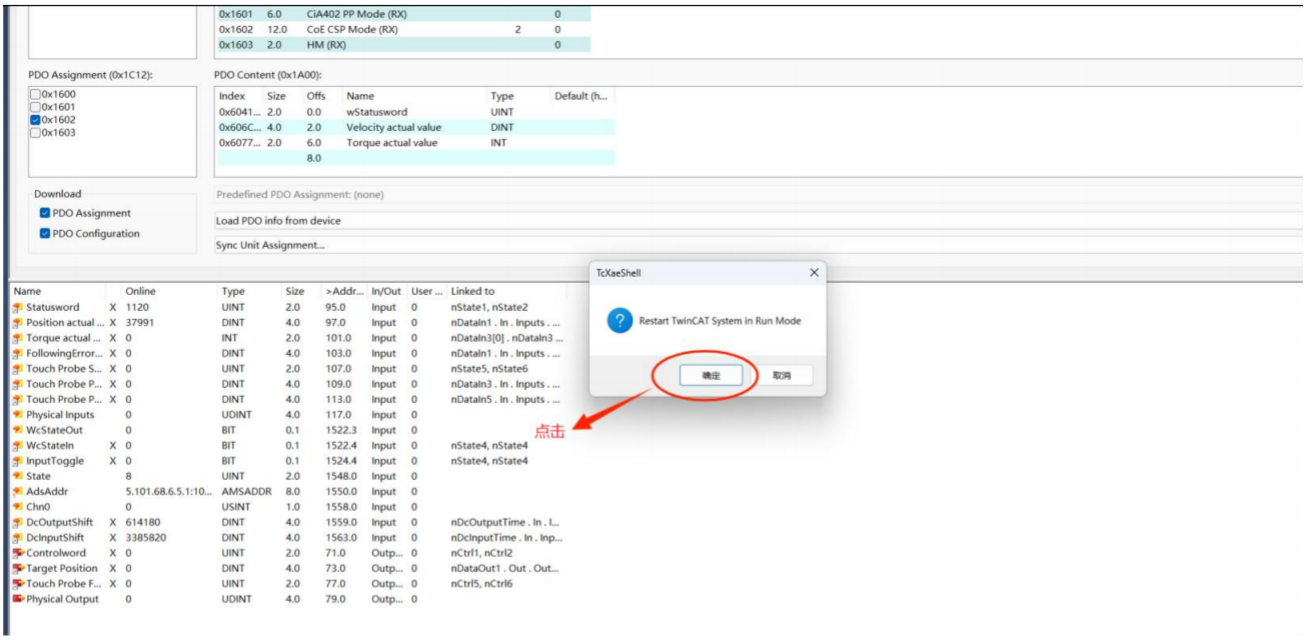




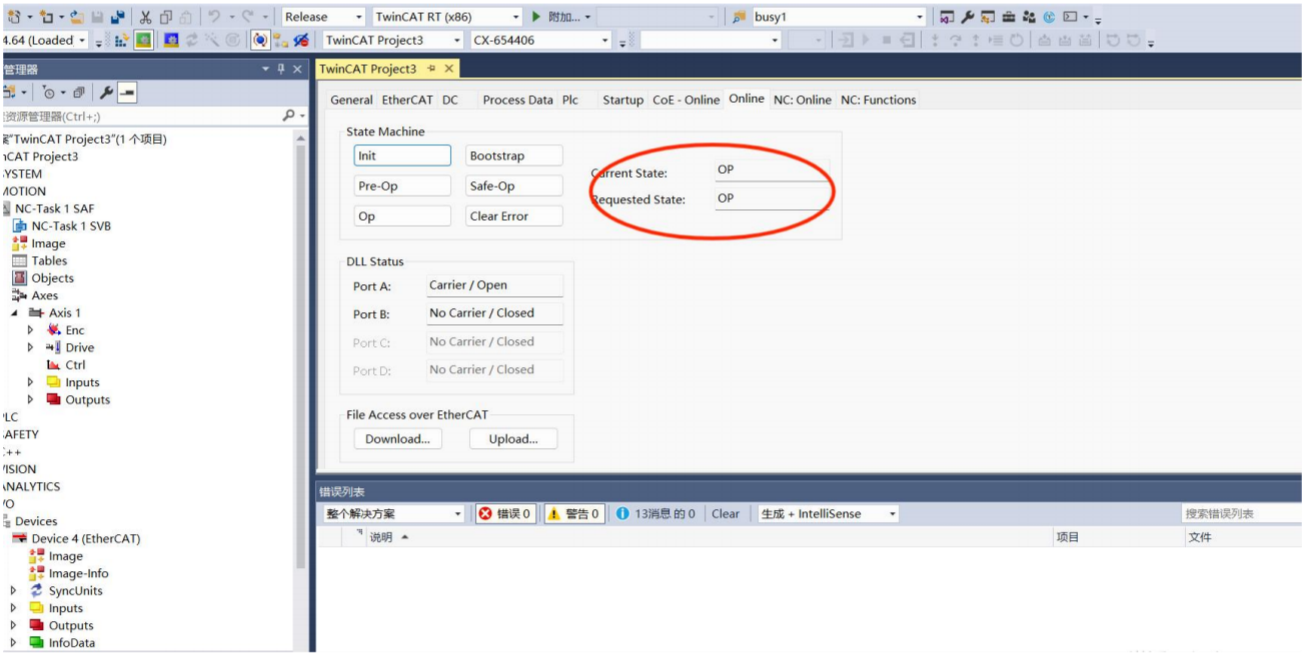


Activate Configuration and Switch to Run Mode





After completing the configuration, you can observe that the device enters the OP state in the "Online" interface.

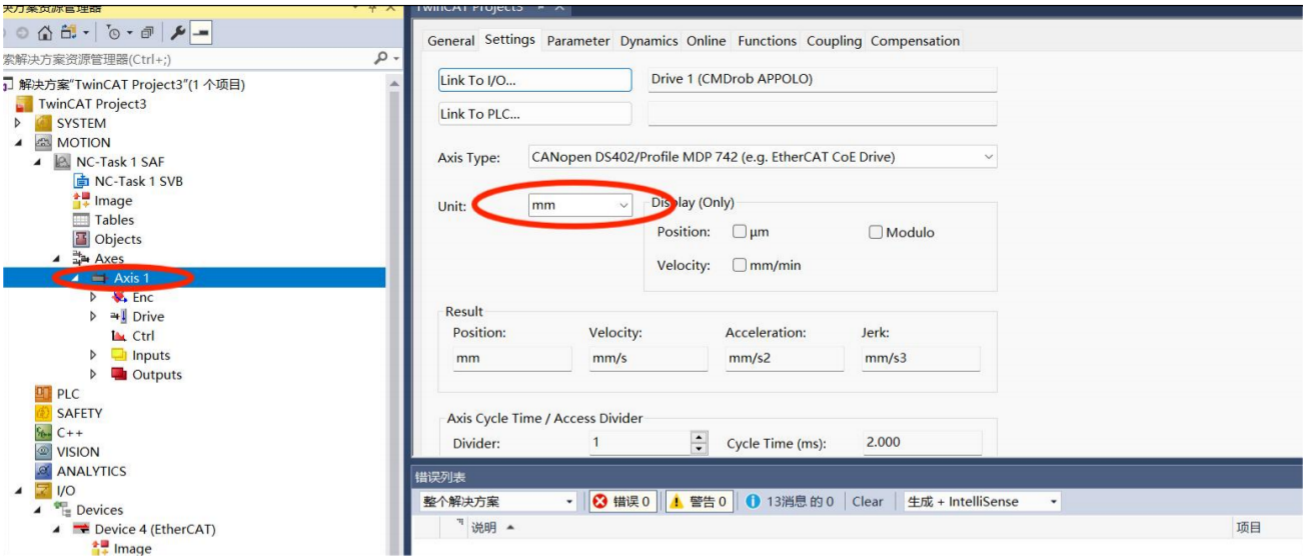


Control Servo Operation

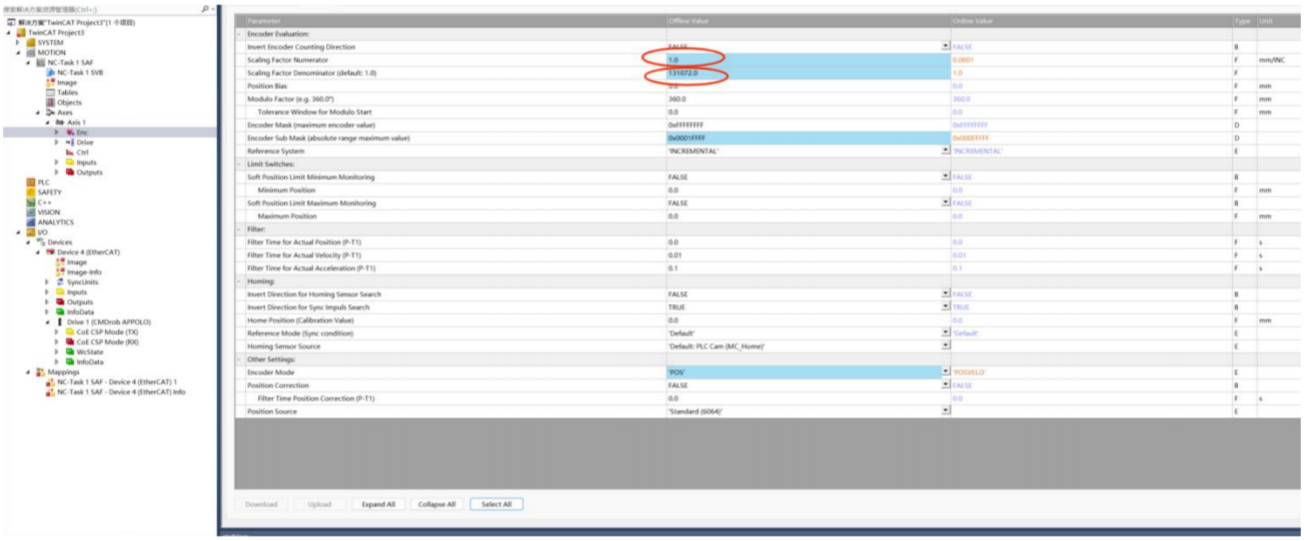
Control the servo via NC:

Operate the servo in Cyclic Synchronous Position (CSP) mode.

a. Set units. Select mm as the unit for testing.



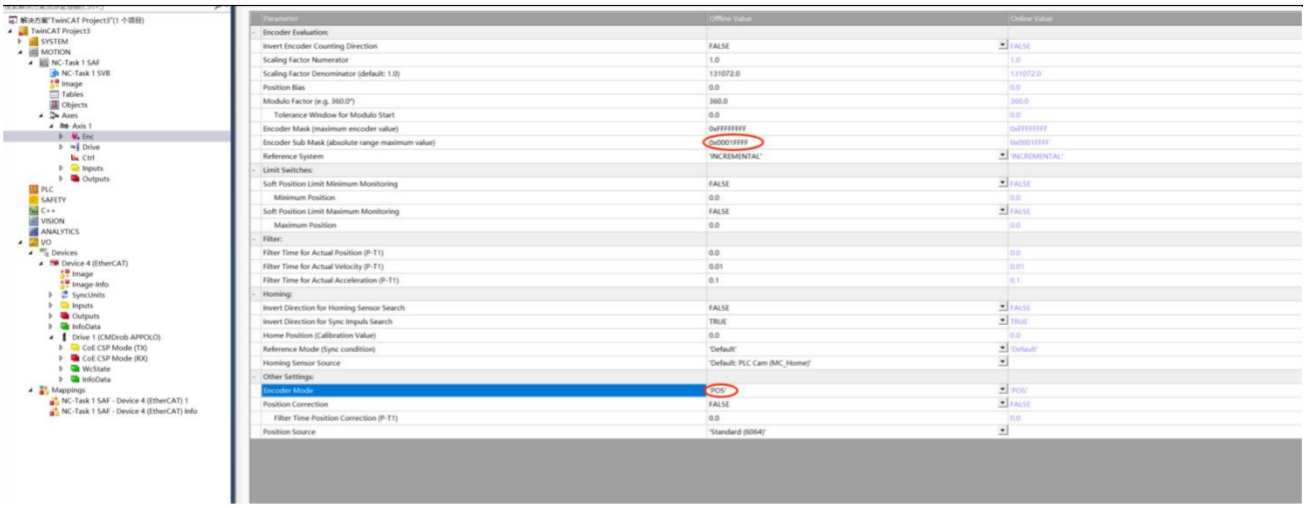
b. Set Quantization Factor



ScalingFactor: The distance corresponding to each position feedback pulse from the encoder.

For example, if the motor rotates 131072 pulses per revolution, and one revolution corresponds to 1mm, then the Scaling Factor Numerator should be 1 mm/Inc, and the Scaling Factor Denominator (default 1.0) should be 131072.

c. Set Encoder Feedback Mode to Pos



Encoder Sub Mask (absolute range maximum value): Based on the encoder's single-turn resolution of 131072, set it to 1FFFF.

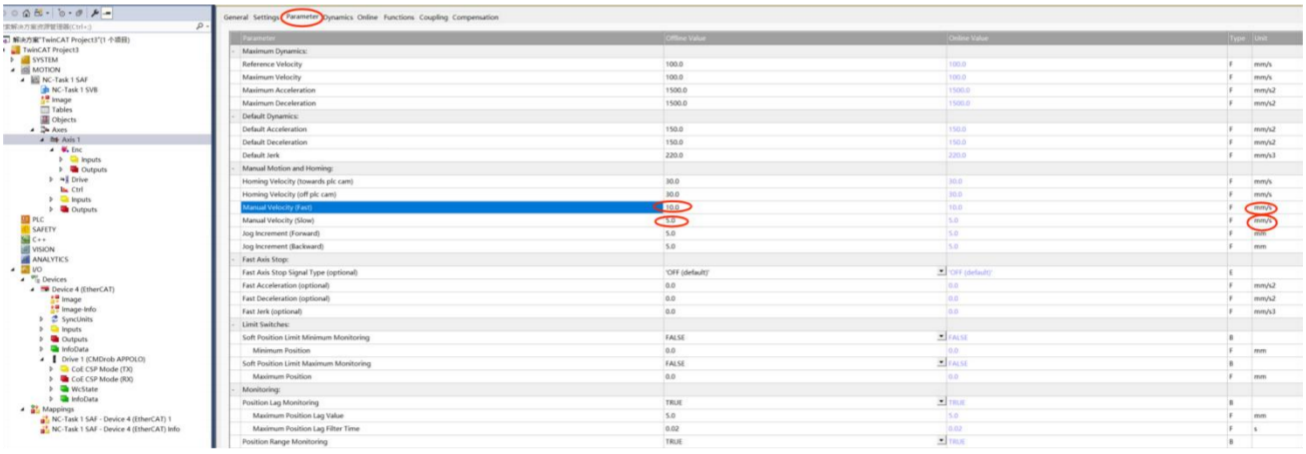
Other Settings Description:

EncoderMode: Encoder mode, with the following three options:

Pos: Encoder is used only for position calculation when the position loop is inside the servo driver.

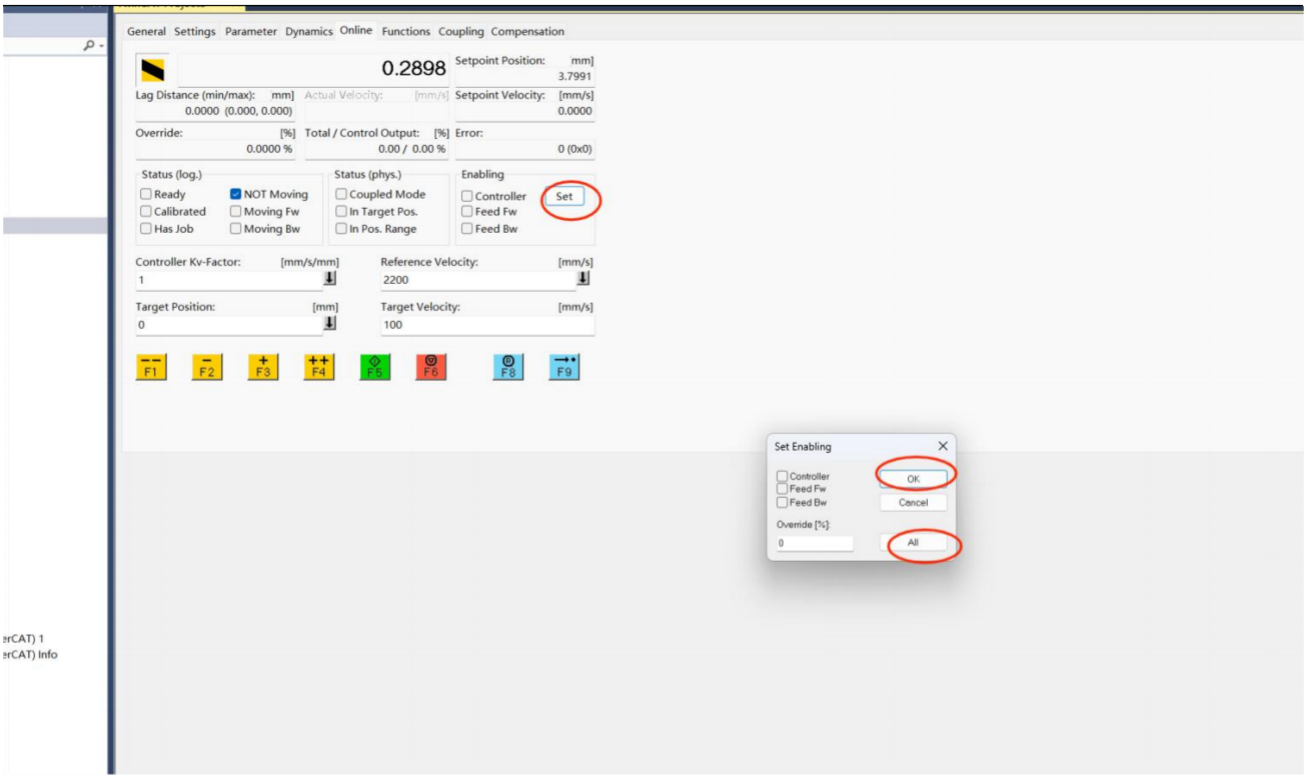
PosVelo: Encoder is used for both position and velocity calculation when the position loop is inside TwinCAT NC.

d. Set Jog Speed



Set the "Manual Velocity (Fast)" jog speed to 10 mm/s and "Manual Velocity (Slow)" to 5 mm/s.

e. Jog Test



Click "Set" to open the dialog, then click "All". At this point, the servo driver is enabled. Jogging operation can be performed using F1~F4.

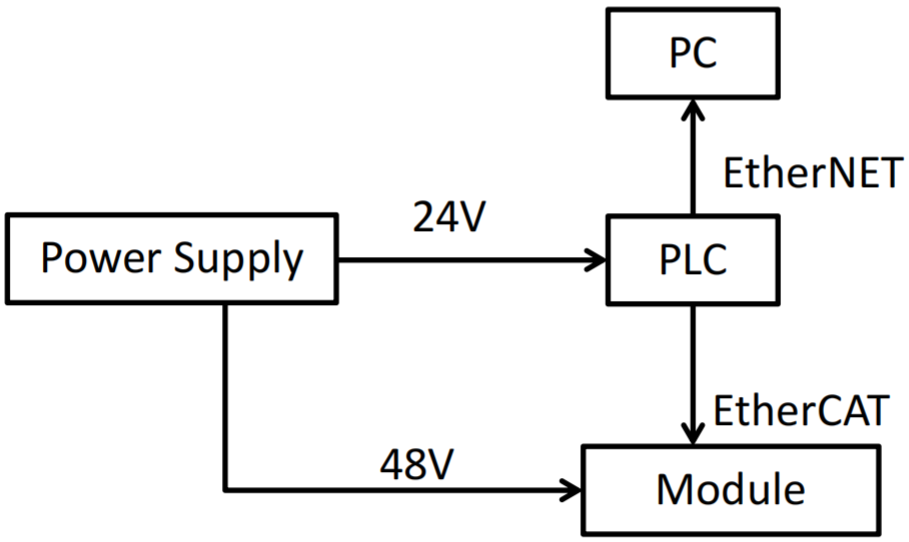
EtherCAT Configuration Operation Case for Inovance Controller

1.Software Installation

Visit the official website of Inovance Technology (www.inovance.com/), select the required PLC model, then go to the Software & Debugging Tools section to download the compressed package.

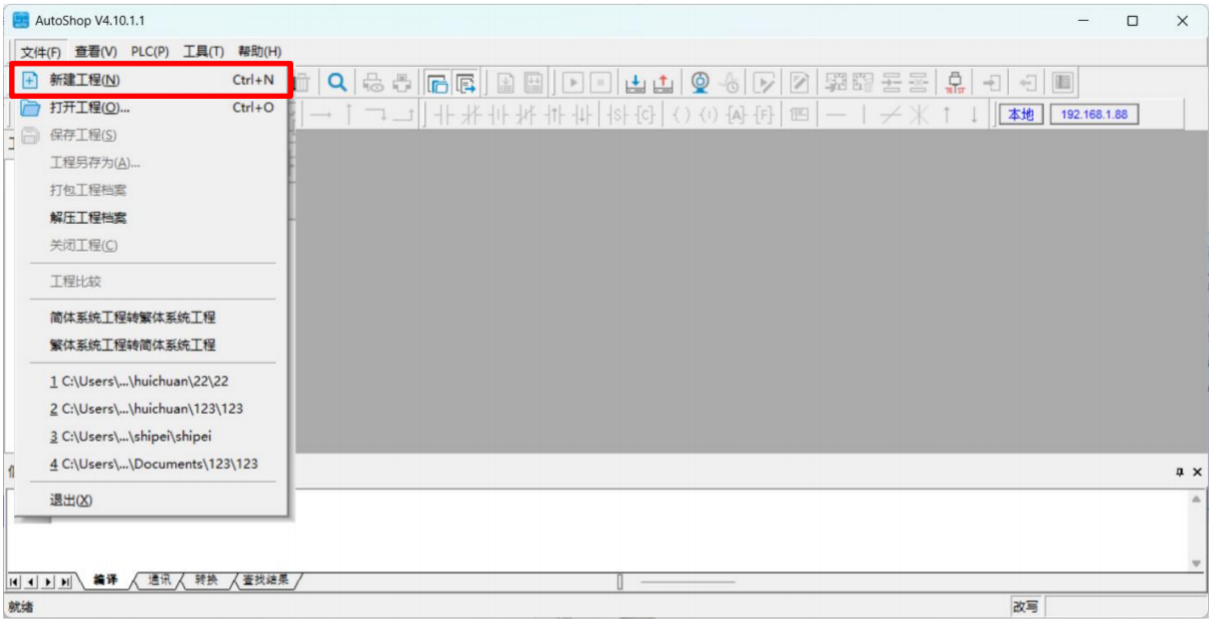


2.Hardware Connection



3.Create a New Project

Open AutoShop with administrator privileges, click File and select New Project, then choose the corresponding PLC model. The model used in this case is the H5U-A8 series.



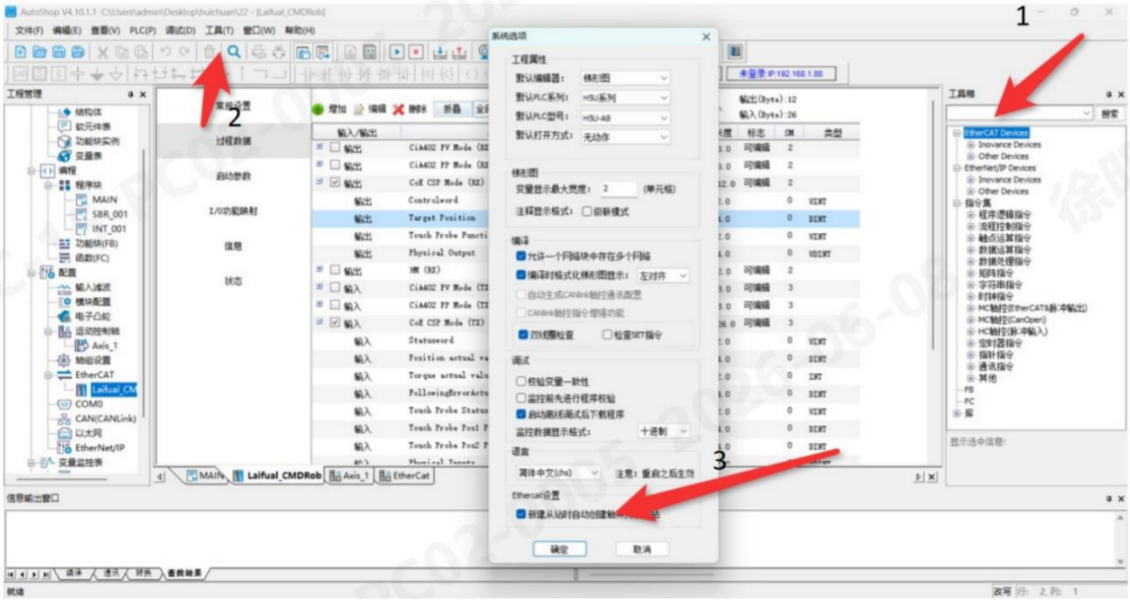


4.Communication and Program Debugging

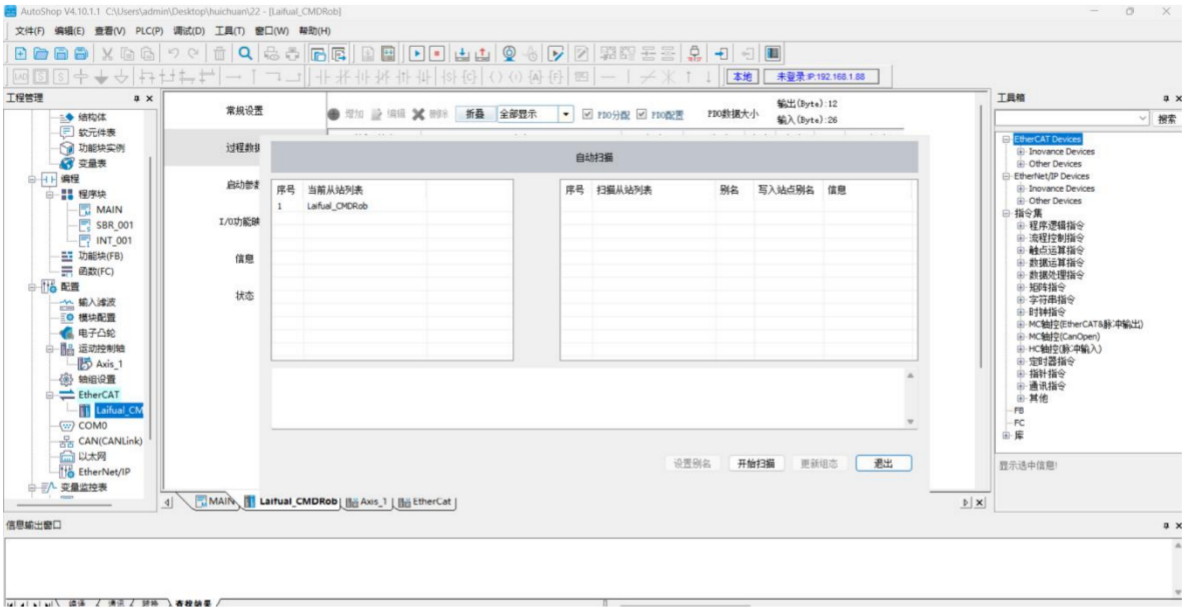
(1) PLC connection established successfully



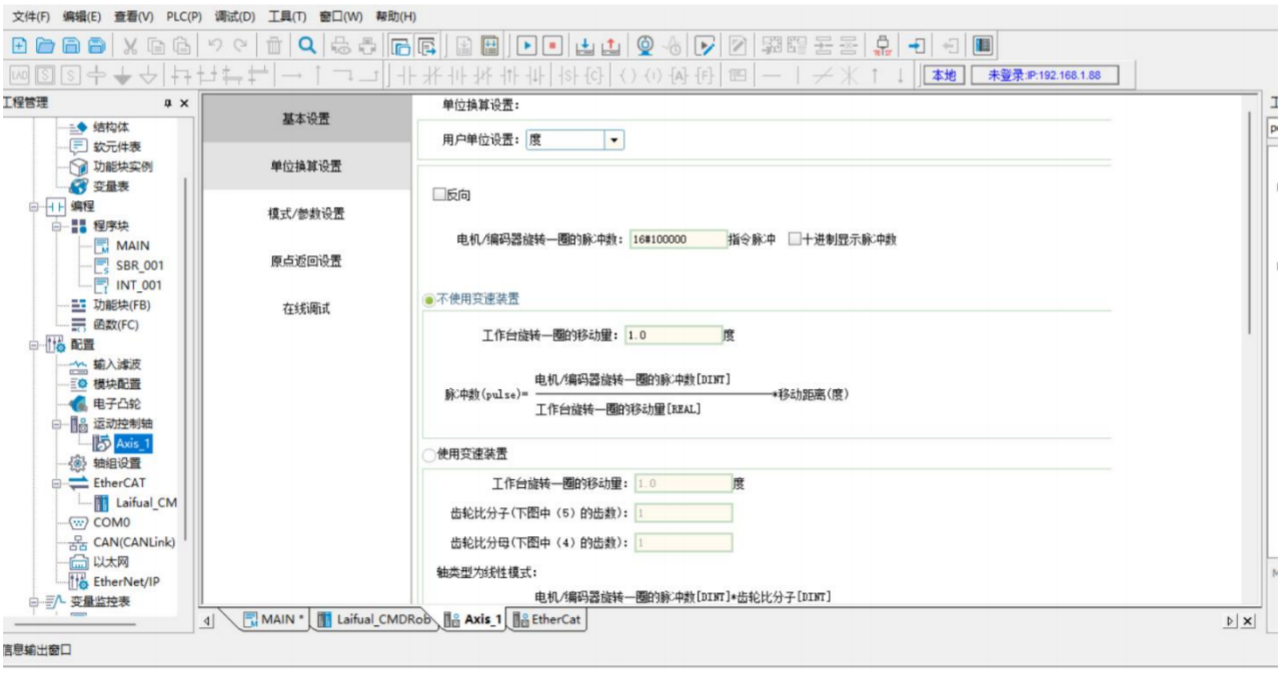
（2）Connect to EtherCAT and import the XML file. Next, click Tools and select System Options, then enable the option to automatically create slaves when adding new ones and confirm the setting.



（3）In the project tree on the left, right-click EtherCAT and select Auto Scan. In the pop-up interface as shown in the figure, click Scan. After the slaves are detected, update the configuration.



（4）Select Motion Control Axes in the left project tree, and set the unit to degree in unit conversion settings



5.CSP Mode

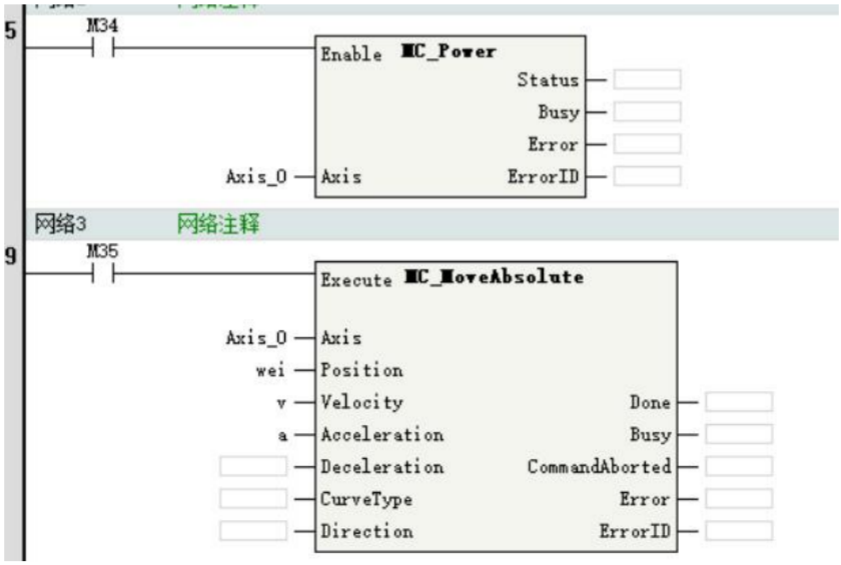
（1）Select EtherCAT in the left project tree, then choose CSP mode under Process Data. Click Add to add required parameters as needed. For CSP mode, add the following output objects:

输入/输出	名字	索引	子索引	长度	标志	SM	类型
输出	CiA402 PV Mode (RX)	16#1600	16#00	6.0	可编辑	2	
输出	CiA402 PP Mode (RX)	16#1601	16#00	6.0	可编辑	2	
输出	CoE CSP Mode (RX)	16#1602	16#00	15	可编辑	2	
输出	Modes of Operation	16#6060	16#00	1.0		0	SINT
输出	Controlword	16#6040	16#00	2.0		0	UINT
输出	Target Position	16#607A	16#00	4.0		0	DINT
输出	Target torque	16#6071	16#00	2.0		0	INT
输出	Max profile velocity	16#607F	16#00	4.0		0	UDINT
输出	Touch Probe Function	16#60B8	16#00	2.0		0	UINT
输出	MM (RX)	16#1603	16#00	2.0	可编辑	2	
输入	CiA402 PV Mode (TX)	16#1A00	16#00	8.0	可编辑	3	
输入	CiA402 PP Mode (TX)	16#1A01	16#00	8.0	可编辑	3	
输入	CoE CSP Mode (TX)	16#1A02	16#00	22	可编辑	3	
输入	Statusword	16#6041	16#00	2.0		0	UINT
输入	Velocity actual value	16#606C	16#00	4.0			DINT
输入	Position actual value	16#6064	16#00	4.0		0	DINT
输入	Touch Probe Pos1 Pos Value	16#60BA	16#00	4.0		0	DINT
输入	Touch Probe Pos2 Pos Value	16#60BC	16#00	4.0		0	DINT
输入	Physical Inputs	16#60FD	16#00	4.0		0	UDINT

（2）Implement bus control under CSP mode via function blocks to drive the module.

The MC_MoveAbsolute function block for position mode is adopted. As a standard motion control instruction for absolute positioning, it is used to move the axis to the target mechanical absolute coordinate position. First enable the module axis, then configure parameters for MC_MoveAbsolute: bind the corresponding motion axis, write the target position, and set motion velocity and acceleration.

The running effect is that the joint module moves to the target position at the preset velocity and acceleration and then stops. Meanwhile, the running mode can be checked as CSP in the monitoring window at the bottom.

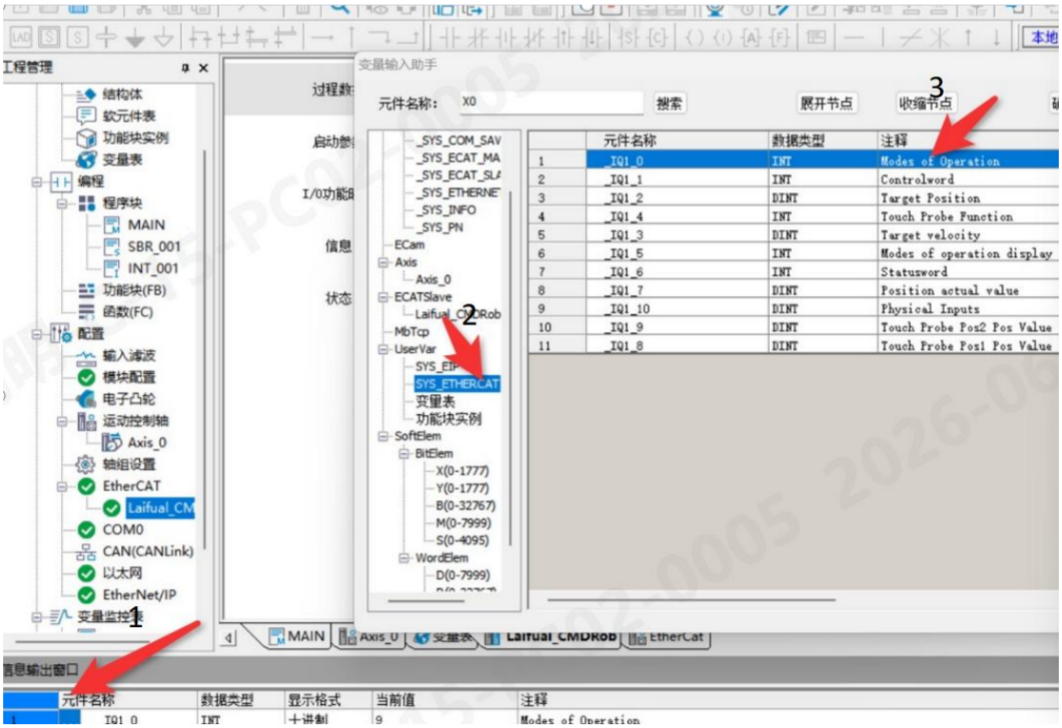


6.CSV Mode

（1） For operation under CSV mode, PDO configuration for CSV must be completed first via EtherCAT Slave – Process Data. Configure two parameters in the output section: 6060 (Modes of Operation Selection) and 60FF (Target Velocity). Configure parameter 6061 (Actual Velocity) in the input section to read the current running speed.

输出	CoE CSP Mode (RX)	16#1602	16#00	13.0	可编辑	2	
输出	Modes of Operation	16#6060	16#00	1.0		0	SINT
输出	Controlword	16#6040	16#00	2.0		0	UINT
输出	Target Position	16#607A	16#00	4.0		0	DINT
输出	Target velocity	16#60FF	16#00	4.0		0	DINT
输出	Touch Probe Function	16#60B8	16#00	2.0		0	UINT
输出	MM (RX)	16#1603	16#00	2.0	可编辑	2	
输入	CiA402 PV Mode (TX)	16#1A00	16#00	8.0	可编辑	3	
输入	CiA402 PP Mode (TX)	16#1A01	16#00	8.0	可编辑	3	
输入	CoE CSP Mode (TX)	16#1A02	16#00	19	可编辑	3	
输入	Modes of operation display	16#6061	16#00	1.0			SINT
输入	Statusword	16#6041	16#00	2.0		0	UINT
输入	Position actual value	16#6064	16#00	4.0		0	DINT
输入	Touch Probe Pos1 Pos Value	16#60BA	16#00	4.0		0	DINT
输入	Touch Probe Pos2 Pos Value	16#60BC	16#00	4.0		0	DINT
输入	Physical Inputs	16#60FD	16#00	4.0		0	UDINT
输入	MM(TX)	16#1A03	16#00	2.0	可编辑	3	

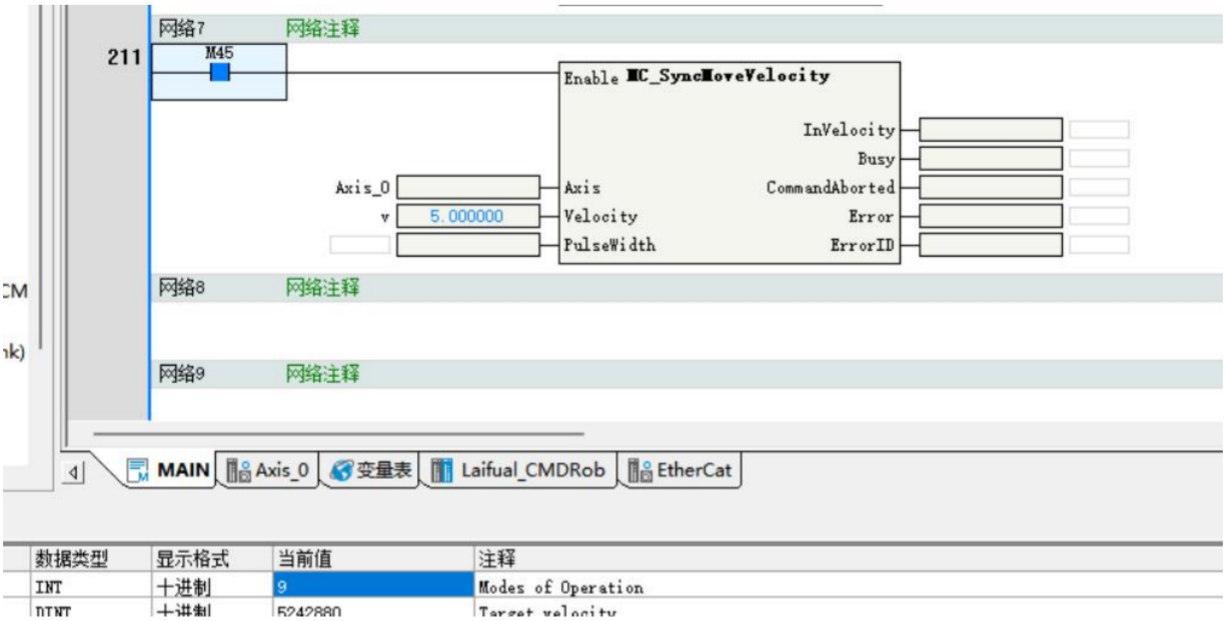
（2）Open the online monitoring window first, then select the operation mode monitoring option following the specified sequence to check the actual motion mode of the module triggered by control commands.



（3）Add the MC_SyncMoveVelocity function block to enable motion after activation. This dedicated function block is designed for CSV (Cyclic Synchronous Velocity) mode. It forces the servo to switch to CSV mode (6060h = 9) and sends the target velocity (60FFh) in real time via each EtherCAT synchronization cycle. It is applicable to high-speed continuous speed regulation, speed following and electronic gearing applications.

After adding this instruction, configure the corresponding motion axis and target velocity.

After power-on, the joint module will accelerate to the target velocity and operate stably. The velocity value can be modified online, and the module will adjust to the updated velocity and maintain steady operation accordingly. The monitoring window at the bottom will show that the mode is automatically switched to CSV. Note that pulse control cannot be used since the system adopts EtherCAT bus control.



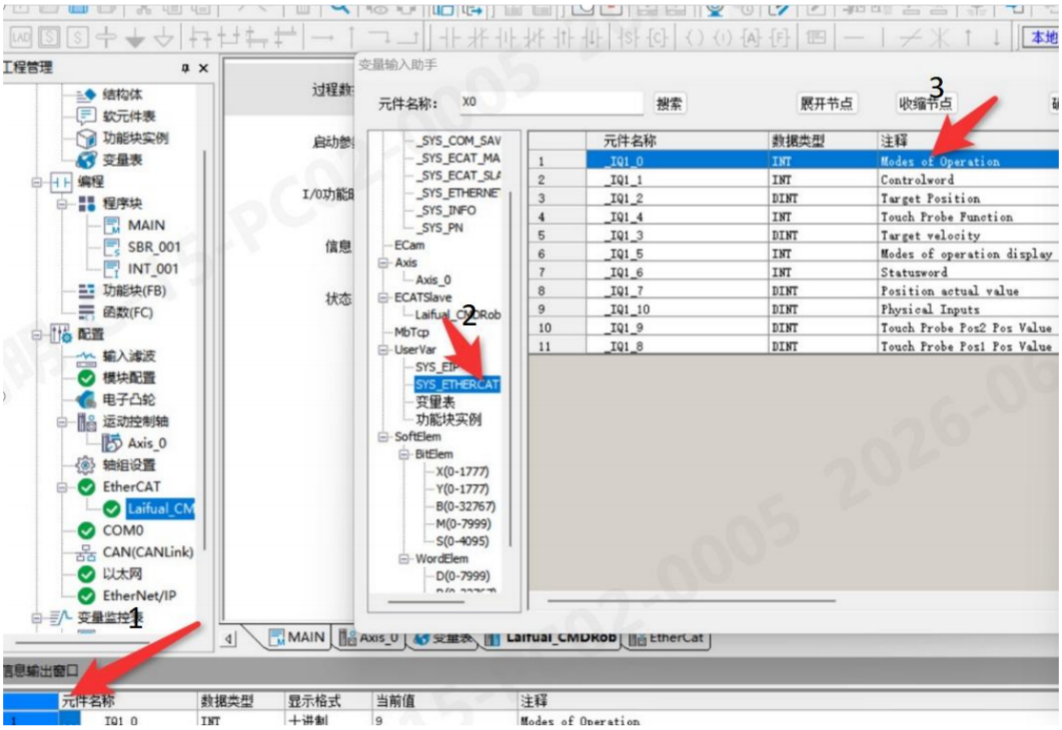
7.CST Mode

（1）CST Mode Similarly, PDO configuration for CST mode shall be completed first under EtherCAT Slave - Process Data. Three parameters need to be configured in the output area: 6060 (Modes of Operation Selection), 6040 (Control Word: axis enable, fault reset, stop), and 6071 (Target Torque). Configure the following parameters in the input area: 6041 (Status Word feedback), 6061 (Active Operation Mode), and 6077 (Actual Torque).



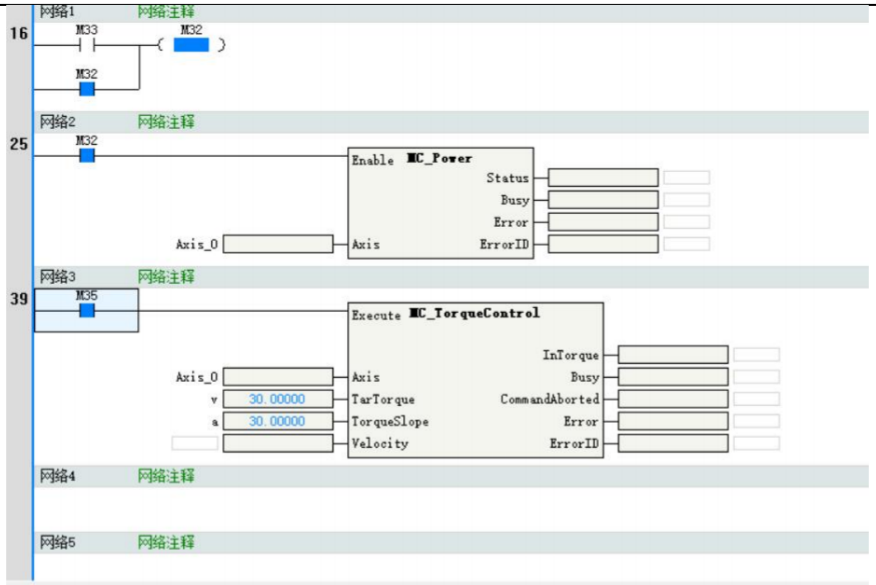
输入/输出	名字	索引	子索引	长度	标志	SM	类型
输出	CiA402 PP Mode (RX)	16#1601	16#00	6.0	可编辑	2	
输出	CoE CSP Mode (RX)	16#1602	16#00	15	可编辑	2	
输出	Modes of Operation	16#6060	16#00	1.0			SINT
输出	Controlword	16#6040	16#00	2.0		0	UINT
输出	Target torque	16#6071	16#00	2.0			INT
输出	Target Position	16#607A	16#00	4.0		0	DINT
输出	Touch Probe Function	16#60B8	16#00	2.0		0	UINT
输出	Physical Output	16#60FE	16#01	4.0		0	UDINT
输出	HM (RX)	16#1603	16#00	2.0	可编辑	2	
输入	CiA402 PV Mode (TX)	16#1A00	16#00	8.0	可编辑	3	
输入	CiA402 PP Mode (TX)	16#1A01	16#00	8.0	可编辑	3	
输入	CoE CSP Mode (TX)	16#1A02	16#00	23	可编辑	3	
输入	Modes of operation display	16#6061	16#00	1.0			SINT
输入	Statusword	16#6041	16#00	2.0		0	UINT
输入	Position actual value	16#6064	16#00	4.0		0	DINT
输入	Torque actual value	16#6077	16#00	2.0		0	INT
输入	FollowingErrorActualValue	16#60F4	16#00	4.0		0	DINT
输入	Touch Probe Status	16#60B9	16#00	2.0		0	UINT
输入	Position actual internal value	16#6063	16#00	4.0			DINT

（2）Open the online monitoring window and select the operation mode monitoring option in the specified order.



（3）Add the MC_TorqueControl instruction to perform torque control after activation. This function block is dedicated to CST (Cyclic Synchronous Torque) mode, which directly sets the servo operating mode to 6060h=10. It transmits torque commands and receives status information through EtherCAT process data (PDO).

After enable, configure the motion axis, target torque and torque ramp first. Once the output torque reaches the target value, the actual torque will be nearly equal to the set torque with stable torque output, and the module will run steadily. The active operation mode can be viewed in the monitoring area at the bottom.



显示格式	当前值	注释
十进制	10	Modes of Operation

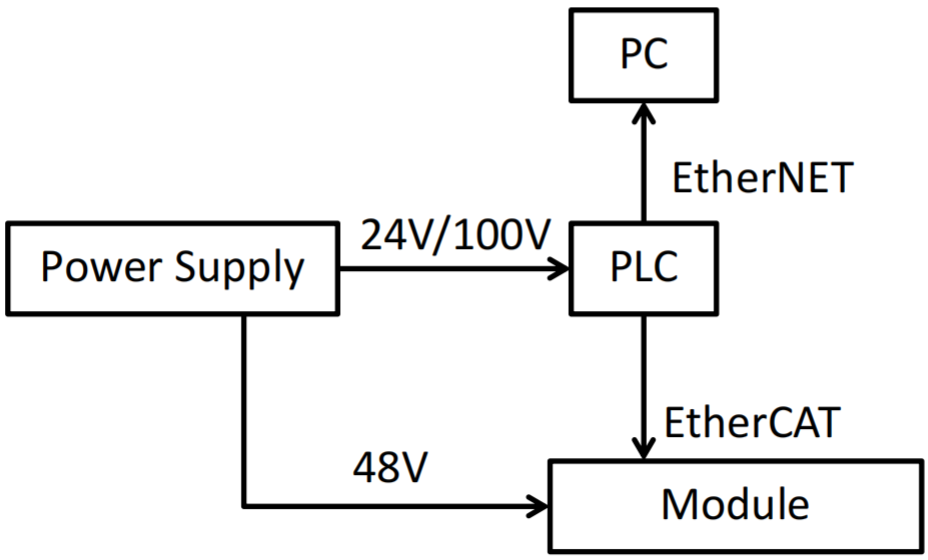
EtherCAT Configuration Operation Case for Xinje Controller

1.Software Installation

Access the official Xinje website (www.xinje.com), navigate to the Service & Support section, and click Download Center. Search for "XDPPro", then download the PLC programming software XDPPro V3.8.1a for XD/XG/XL Series PLCs.

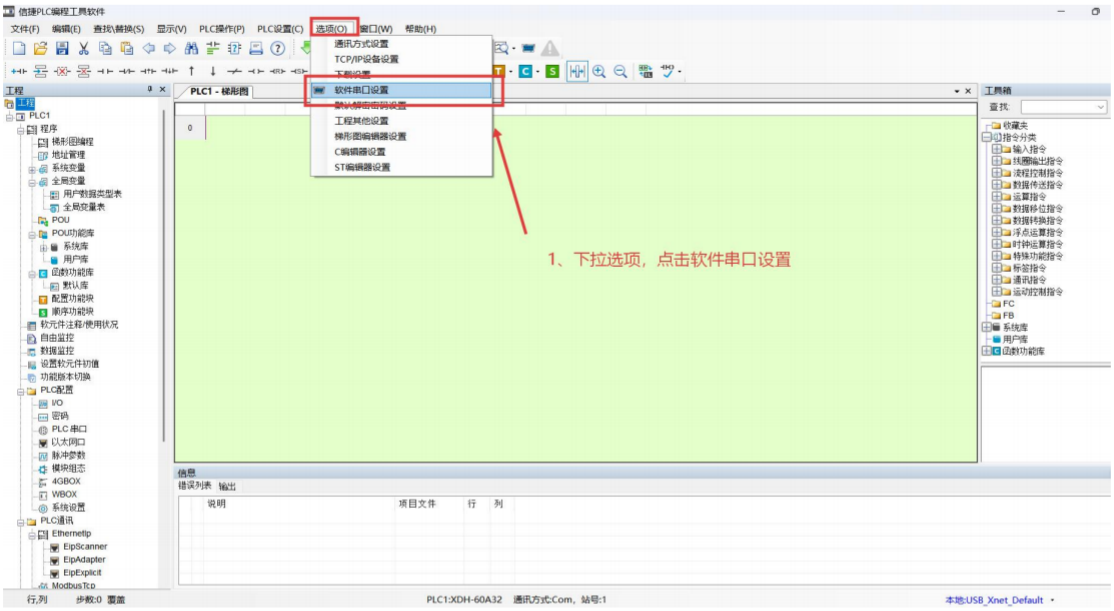


2.Hardware Connection

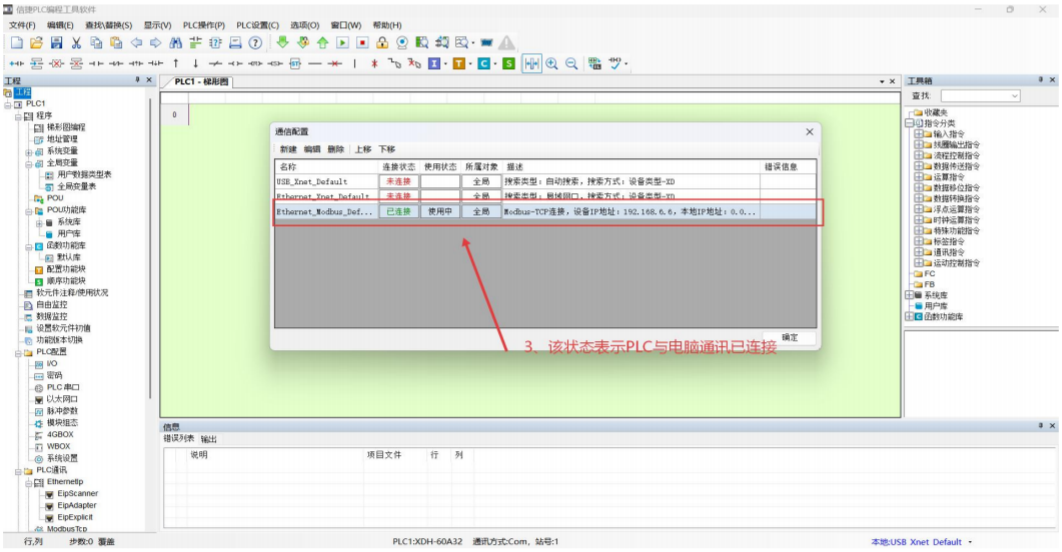


3.Create a New Project

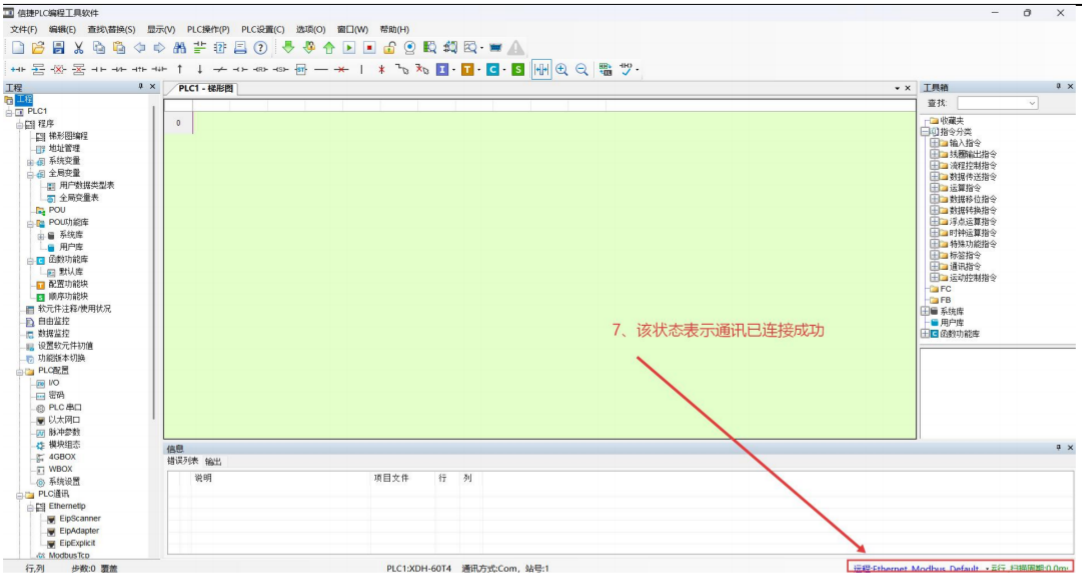
(1)Launch the XDPPro software, click the Options dropdown menu, then select Software Serial Port Settings to open the configuration window.



(2)Connection Status in the Box: Connected; Usage Status: In Use, which indicates that communication between the PLC and PC has been established.

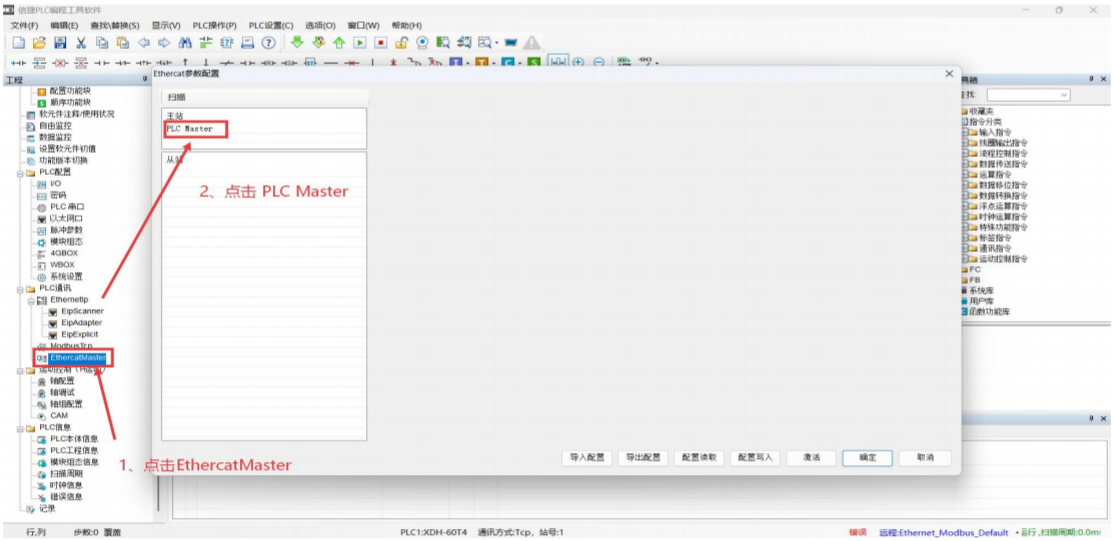


(3)This indicates that PLC communication has been successfully established.

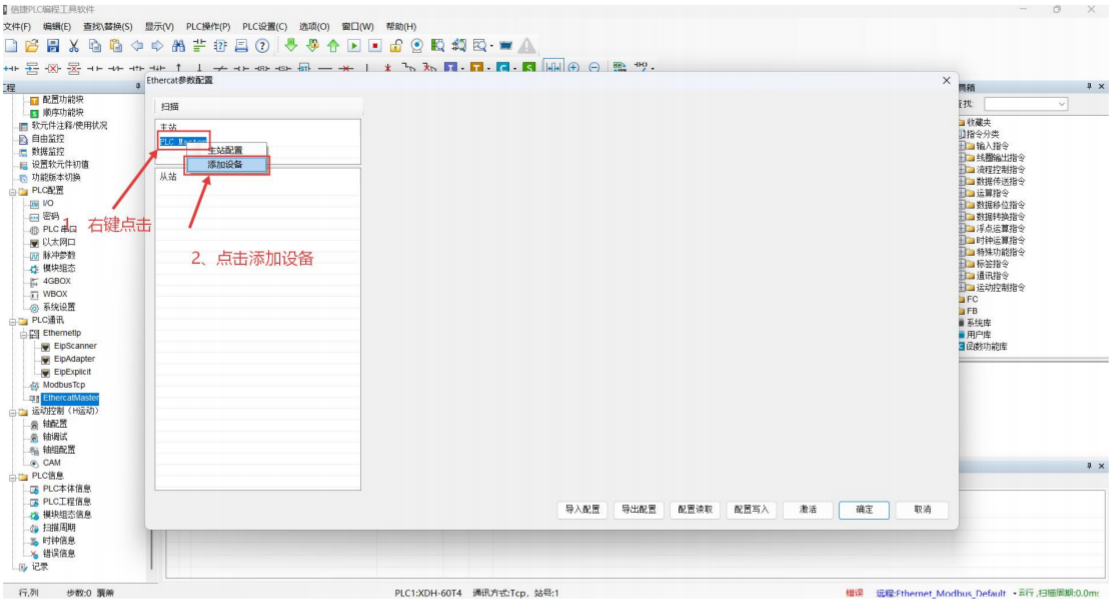


4.Servo Drive Parameter Configuration

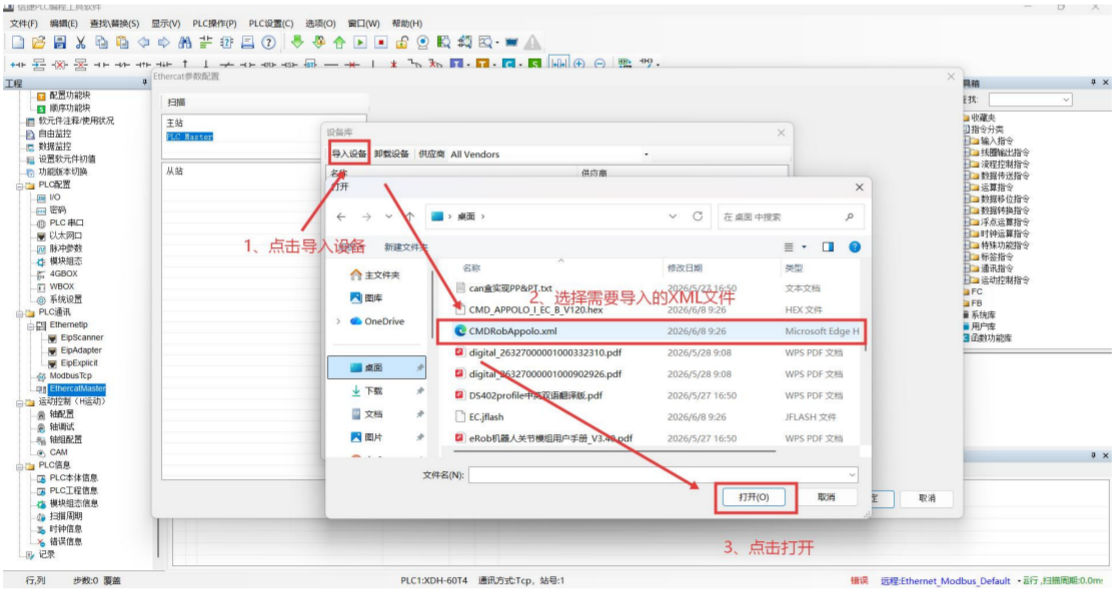
(1) Import XML File: First click EthercatMaster, then right-click PLC Master.



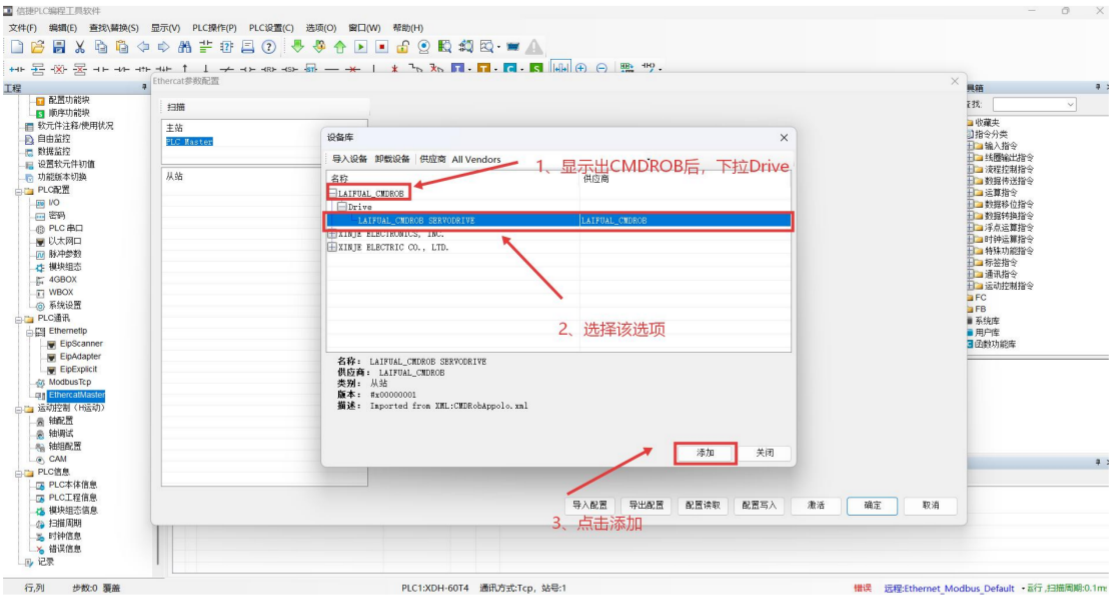
(2) Right-click and select Add Device, then click Add Device.



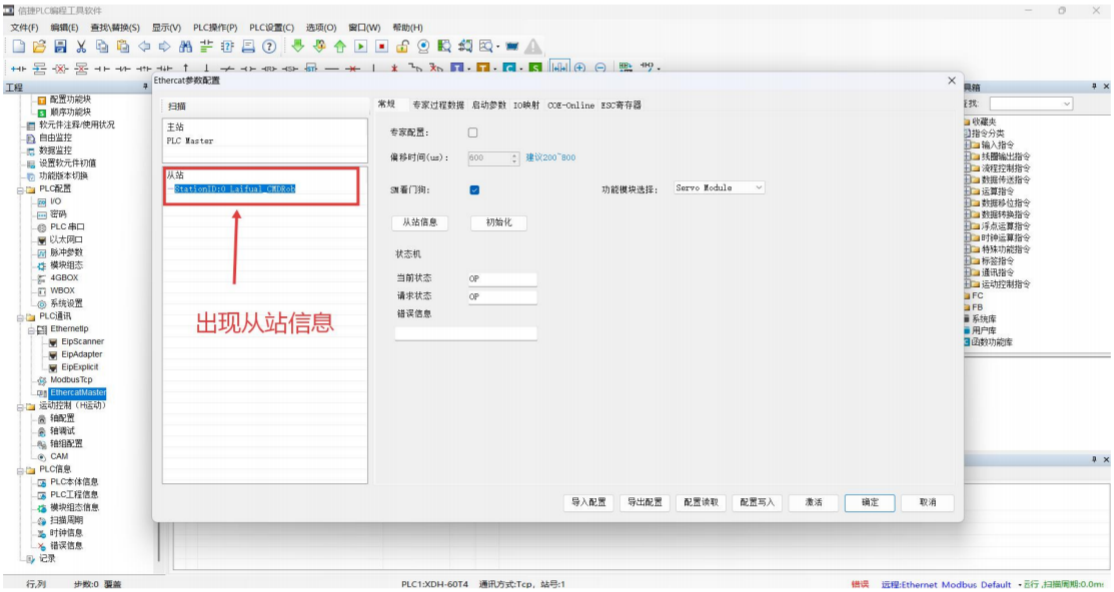
(3) Click Import Device and select the XML file to import. Note: The name of the XML file must not contain symbols, numbers or other special characters.



(4)After importing the XML file, a device with the suffix CMDROB will be displayed. Expand the Drive dropdown, select the item in the box, and click Add.

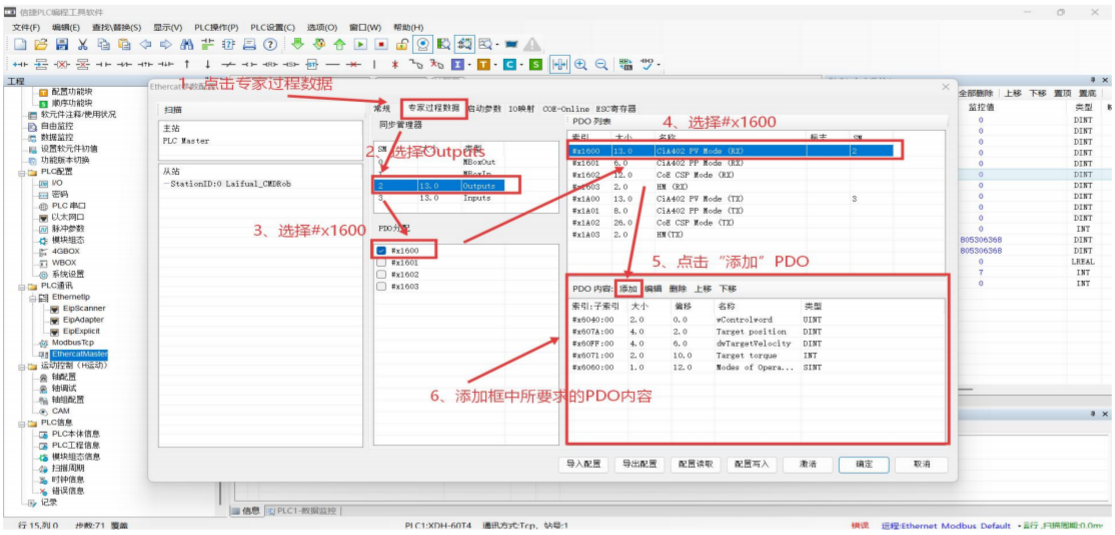


(5) The appearance of slave station information in the slave station box indicates that the XML file has been imported successfully.

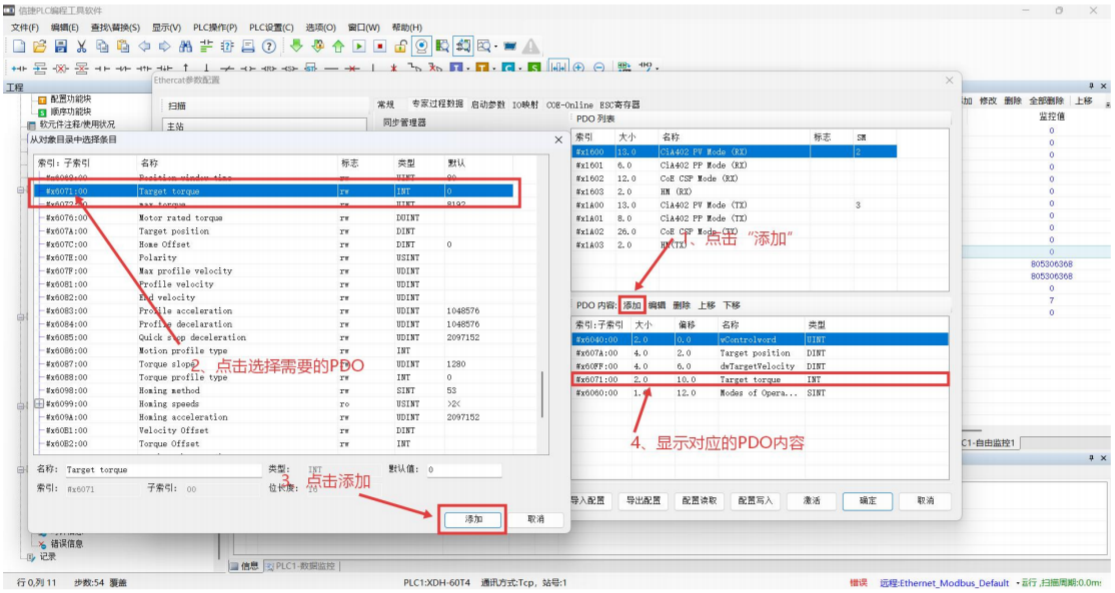


PDO Configuration

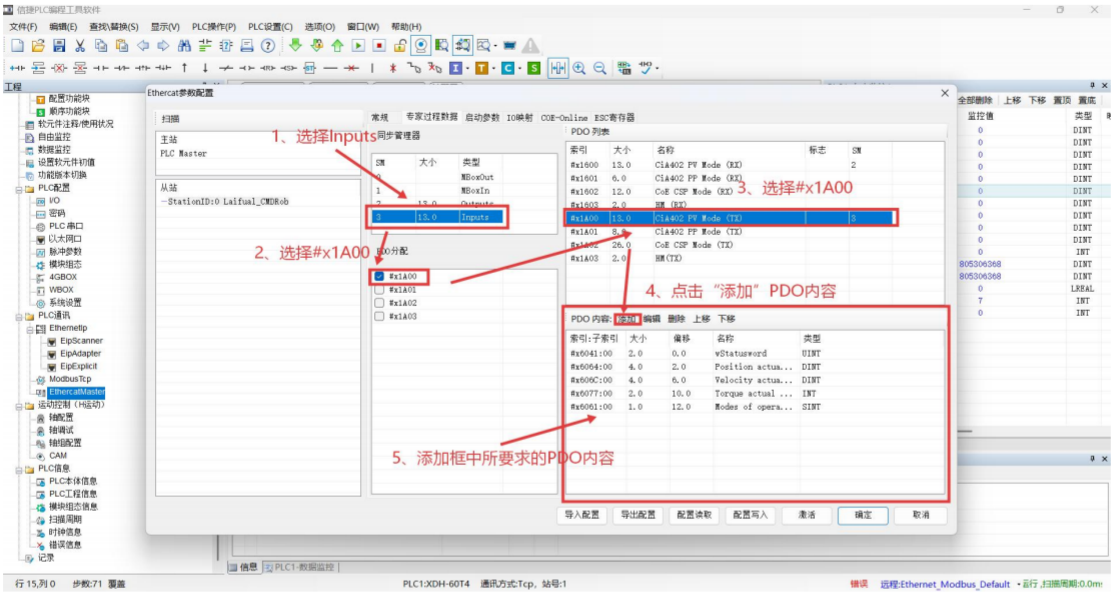
(1) Specify the PDO objects to be mapped from the object dictionary. These objects perform cyclic data exchange via PDOs. Under Outputs, select the #x1600 PDO and add the following objects: 6040h (Control Word), 607Ah (Target Position), 6060h (Operating Mode), 60FFh (CSV Target Velocity), 6071h (CST Target Torque).



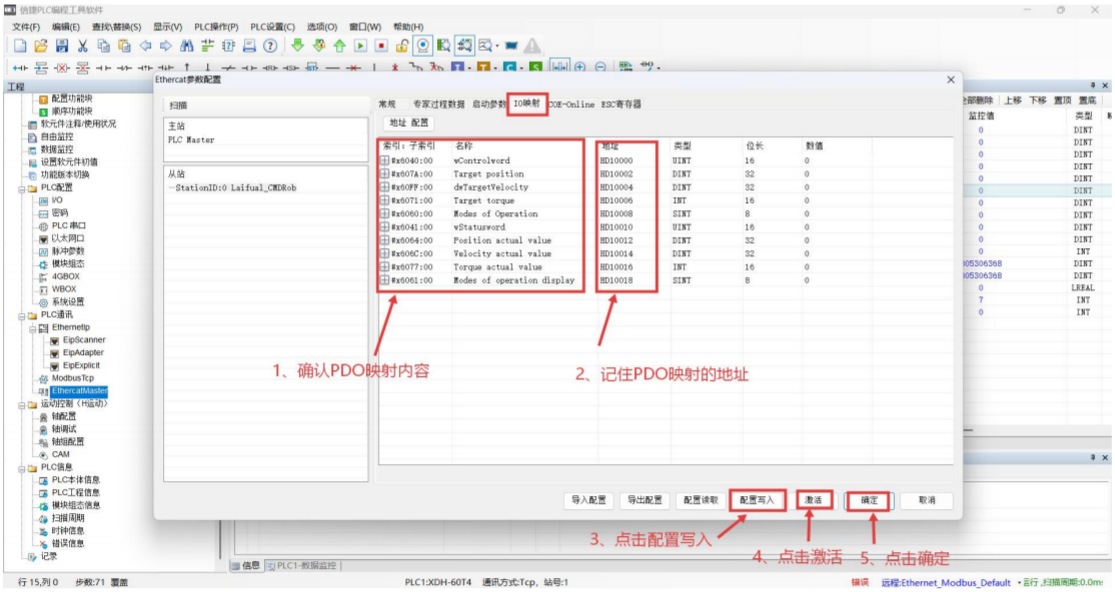
(2) Adding Steps: Click Add, select the required PDO in the pop-up window, then click Add again.



(3) Select the #x1A00 PDO under Inputs, and add the following objects: 6041h (Status Word), 6064h (Actual Position Value), 606Ch (Actual Velocity Value), 6077h (Actual Torque Value), 6061h (Display Operating Mode).

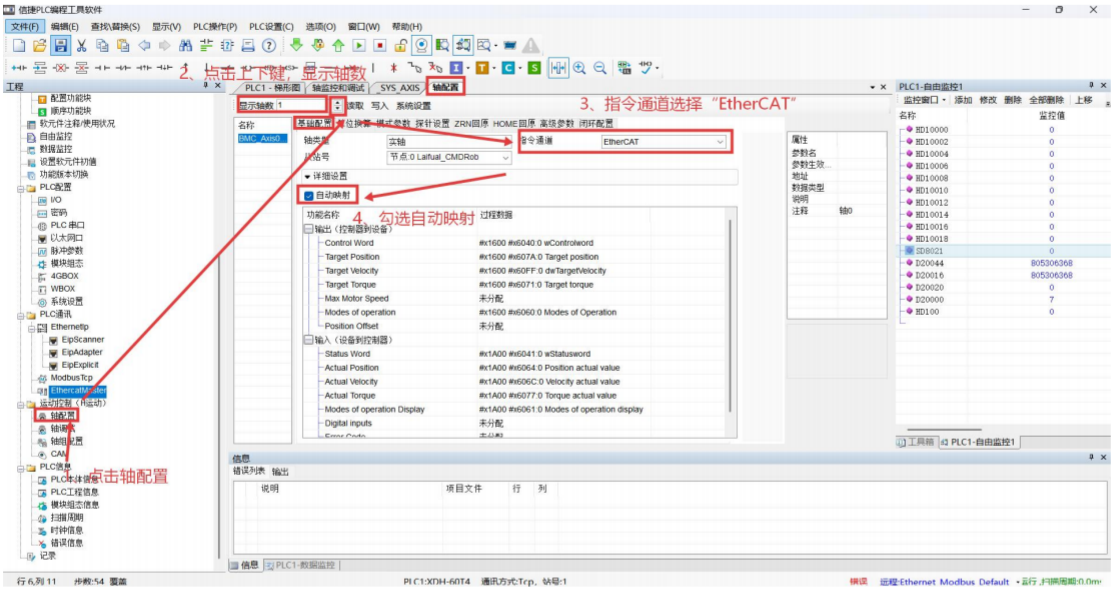


(4) Confirm the PDO mapping contents and note down the PDO mapping addresses. The axis status can be monitored via these mapping addresses.

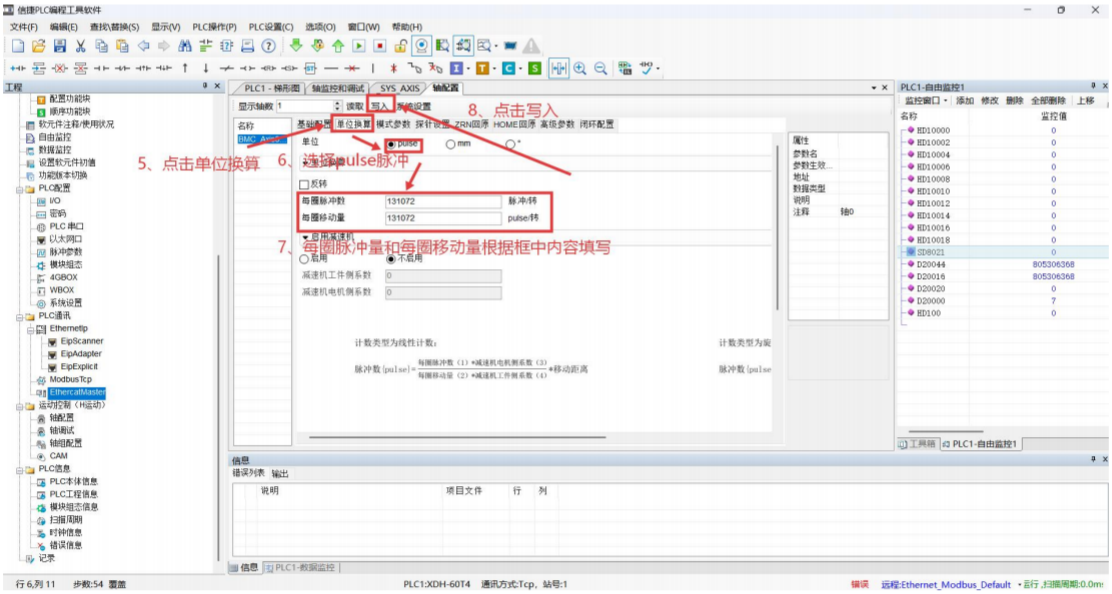


Axis Configuration

(1) Click Axis Configuration first. Select the number of axes matching the actual physical axes, then click Write to save the default parameter settings.



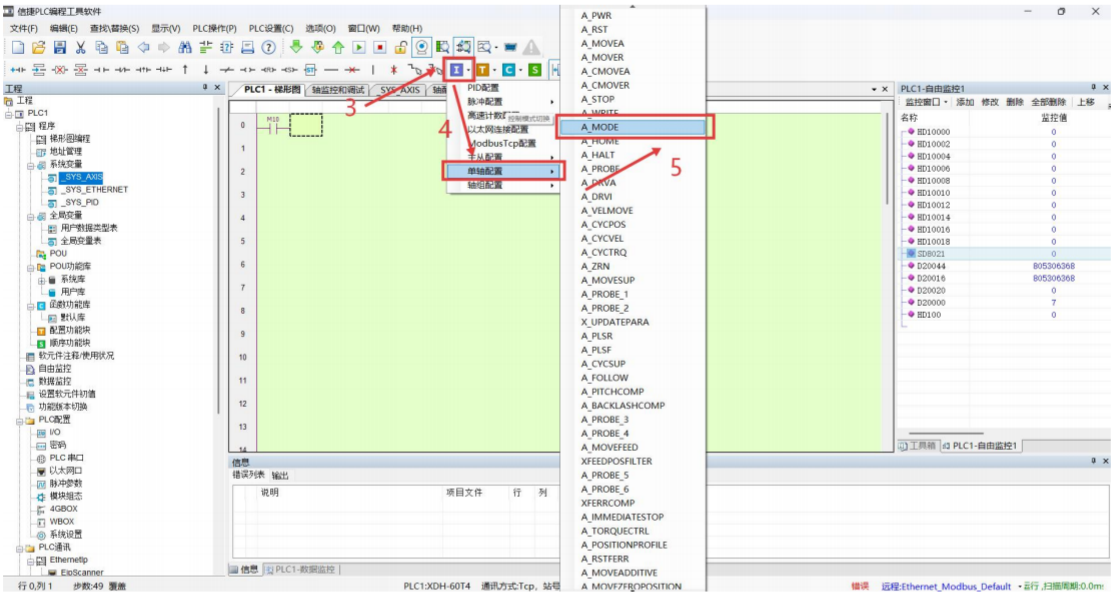
(2) Select pulse unit on the unit conversion page, enter 131072 pulses, and finish the axis configuration procedure.



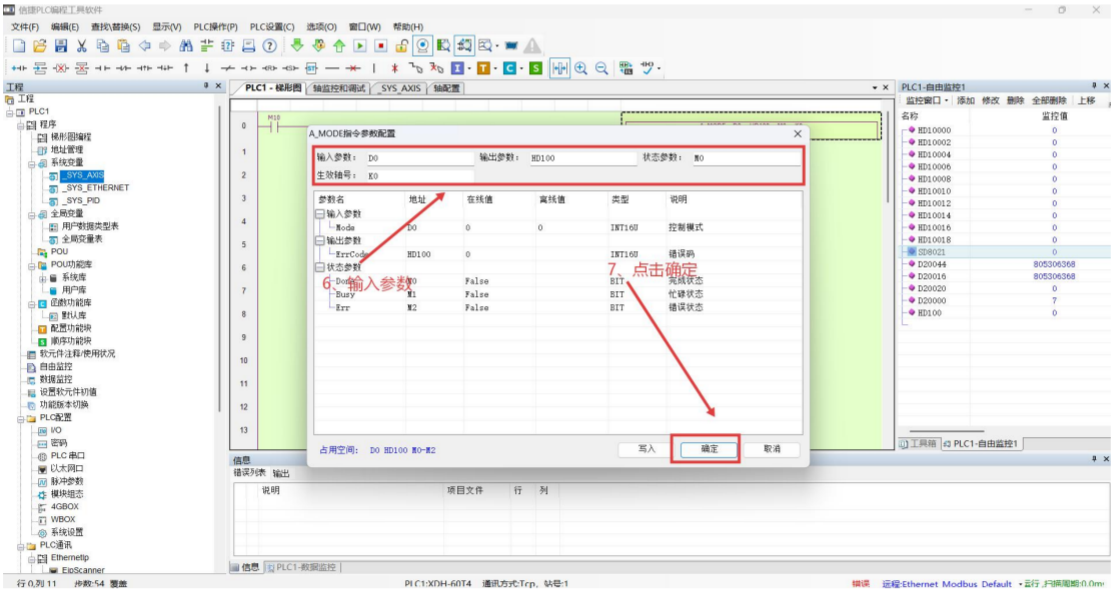
5. Program Debugging and Monitoring

Ladder Diagram Programming

(1) Write the corresponding ladder diagram program, click Single Axis Configuration, and select A_MODE for mode switching.

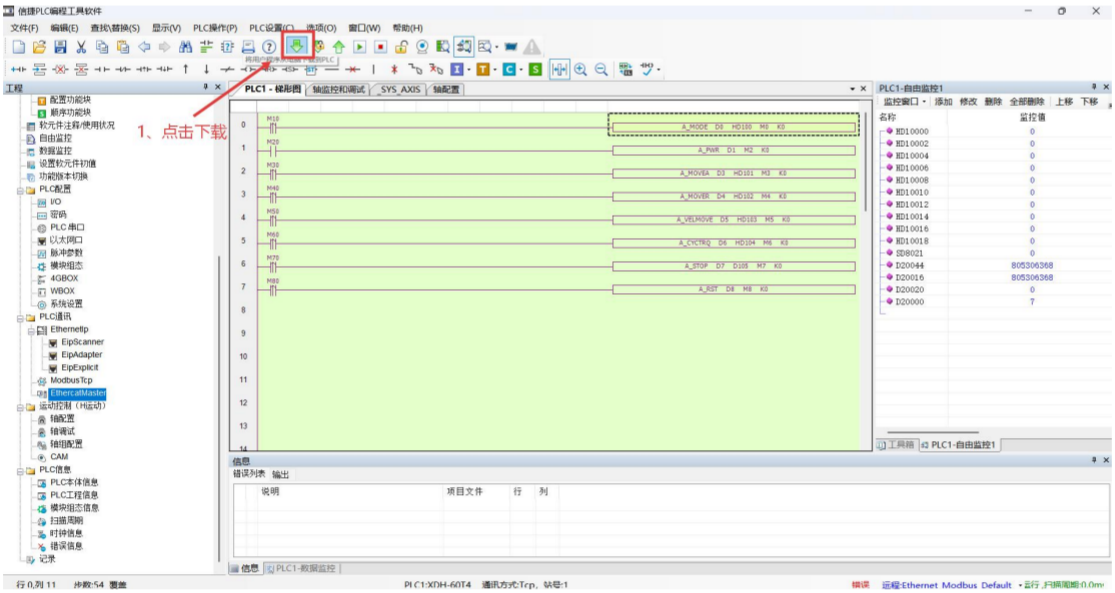


(3) The input parameters must be even numbers. This is because the word status address under "System Settings" in Axis Configuration or Axis Group Configuration is required to be even; odd register addresses are not supported. Otherwise, an error code 115 or 1046 will be triggered.



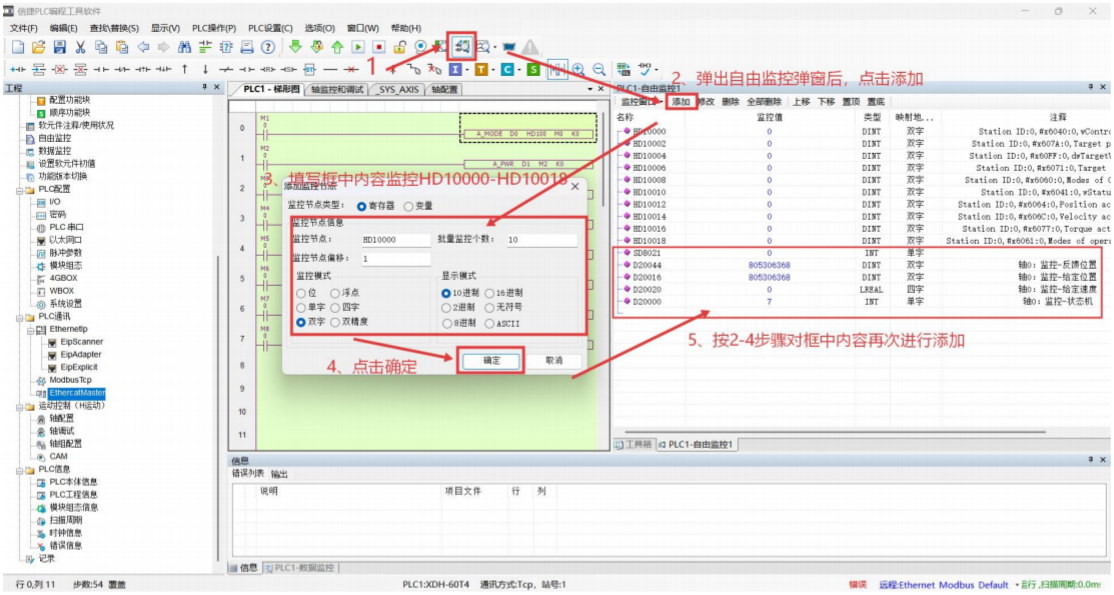
(4) Write the ladder diagram program content shown in the box of the figure, then download the program.





Free Monitoring

(1) The PDO mapping addresses range from HD10000 to HD10018. Add addresses HD10000 to HD10018 to the monitoring list for real-time viewing of PDO mapping status.



(2)Add the following registers: SD8021, D20044, D20016, D20020, D20000.

SD8021: Indicates the slave communication status. A value of 8 represents the OP state, under which drive enable commands can be issued.

D20044: Actual motion position of the axis. This position feedback value is converted from D20040 based on configured parameters such as electronic gear ratio, travel per revolution and pulses per revolution.

D20016: Current target position of the motion command.

D20020: Target velocity of the motion command.

D20000: Axis status of the motion command.

PLC1-自由监控1

监控窗口 | 添加 修改 删除 全部删除 | 上移 下移 置顶 置底

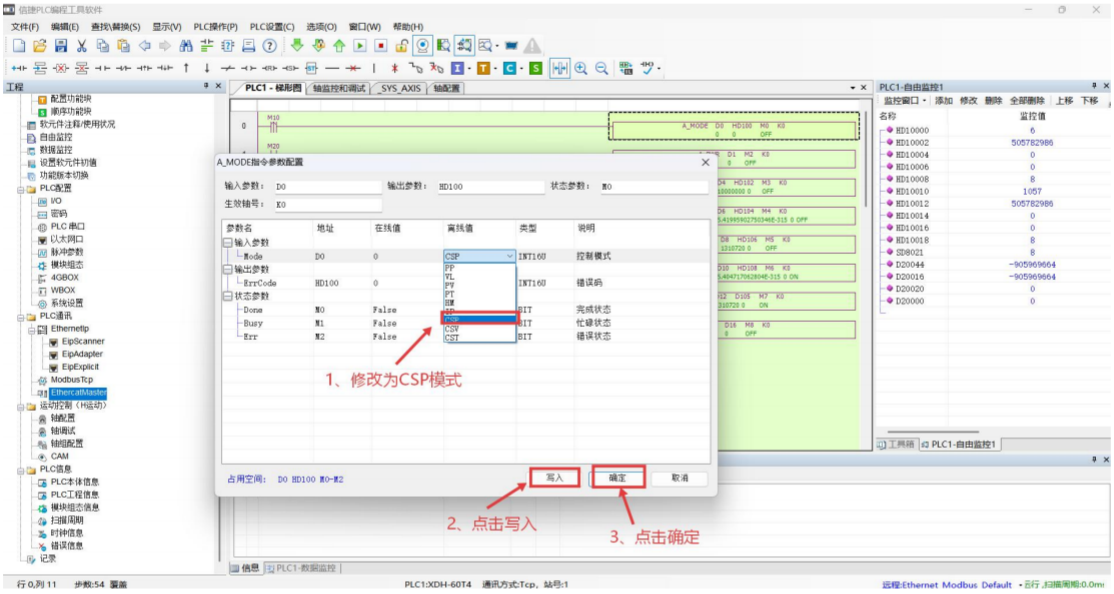
名称	监控值	类型	映射地...	注释
HD10000	0	DINT	双字	Station ID:0, #x6040:0, wControlword
HD10002	0	DINT	双字	Station ID:0, #x607A:0, Target position
HD10004	0	DINT	双字	Station ID:0, #x60FF:0, dwTargetVelocity
HD10006	0	DINT	双字	Station ID:0, #x6071:0, Target torque
HD10008	0	DINT	双字	Station ID:0, #x6060:0, Modes of Operation
HD10010	0	DINT	双字	Station ID:0, #x6041:0, wStatusword
HD10012	0	DINT	双字	Station ID:0, #x6064:0, Position actual value
HD10014	0	DINT	双字	Station ID:0, #x606C:0, Velocity actual value
HD10016	0	DINT	双字	Station ID:0, #x6077:0, Torque actual value
HD10018	0	DINT	双字	Station ID:0, #x6061:0, Modes of operation display
SD8021	0	INT	单字	
D20044	805306368	DINT	双字	轴0：监控-反馈位置
D20016	805306368	DINT	双字	轴0：监控-给定位置
D20020	0	LREAL	四字	轴0：监控-给定速度
D20000	7	INT	单字	轴0：监控-状态机

6.CSP Mode

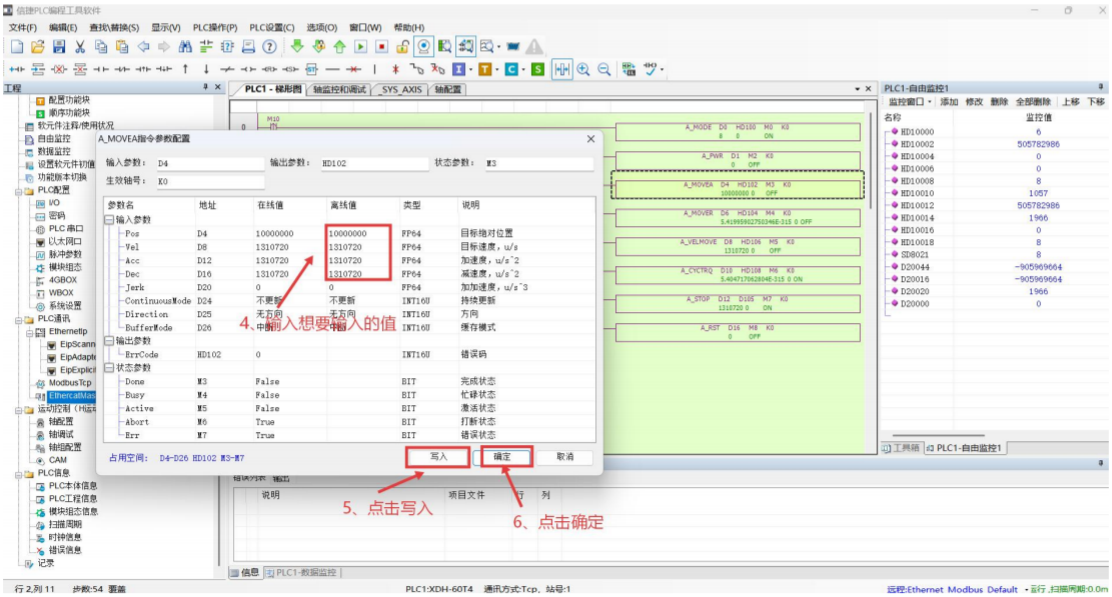
Under CSP mode, specify the PDO objects to be mapped from the object dictionary. Select the #x1600 PDO under Outputs and add the following entries: 6040h (Control Word), 607Ah (Target Position), 6060h (Operating Mode).

Absolute Position Motion

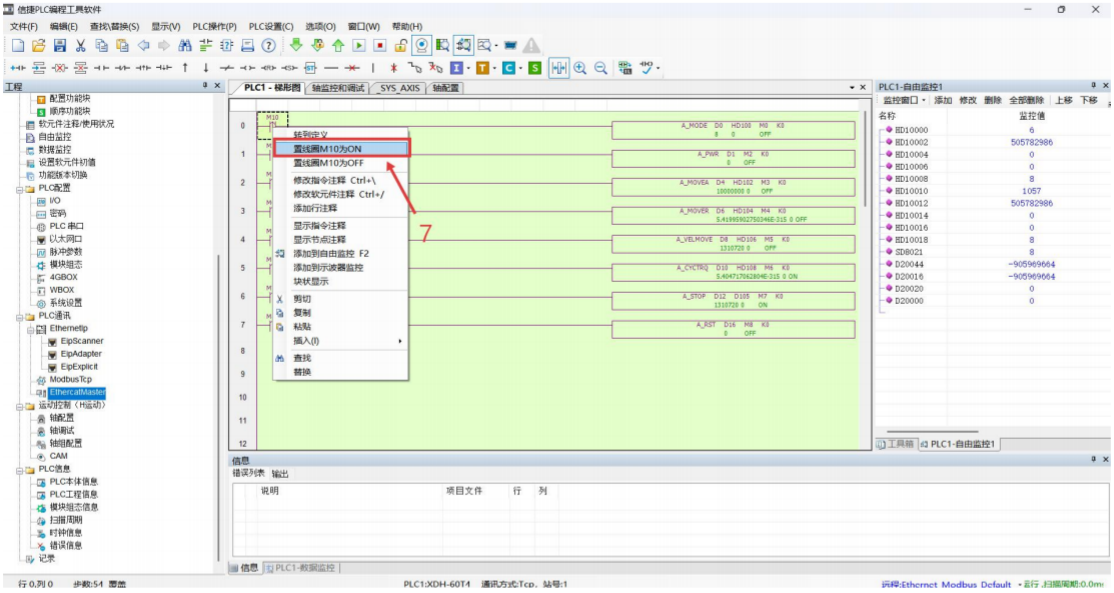
(1) Right-click A_MODE (Operating Mode), click Command Parameter Configuration, select CSP Position Mode for Mode, then click Write.



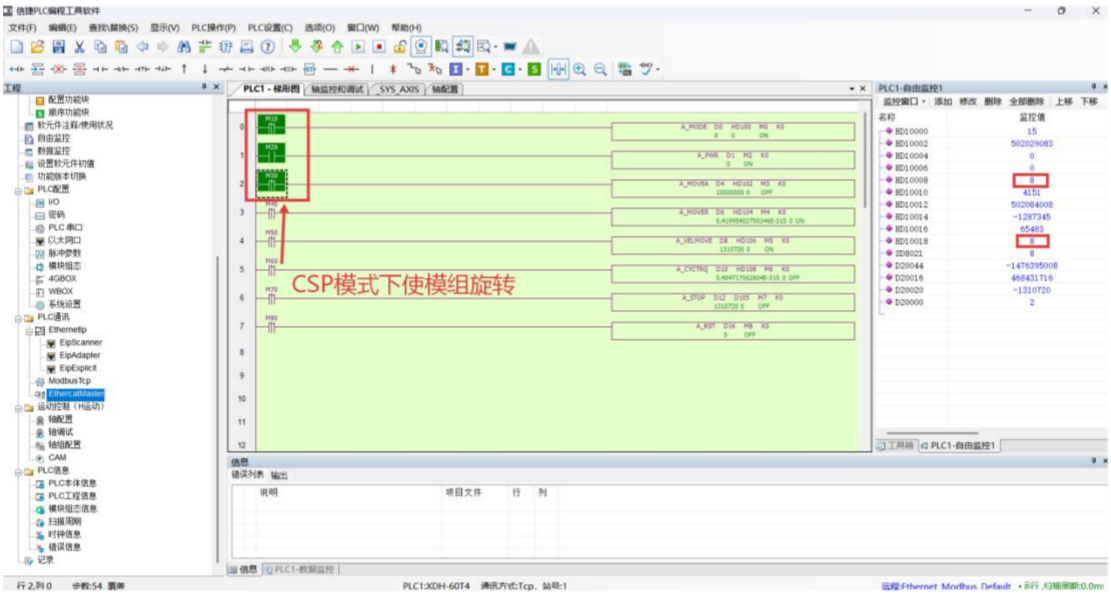
(2) A_MOVEA is the absolute position motion instruction, and its input parameters must be even numbers. Fill in appropriate values for target absolute position, target velocity, acceleration and deceleration according to unit conversion parameters to drive the module to move.



(3) Under PLC online mode, right-click the rising edge switch M10 to set it ON to trigger the switch of A_MODE operating mode.

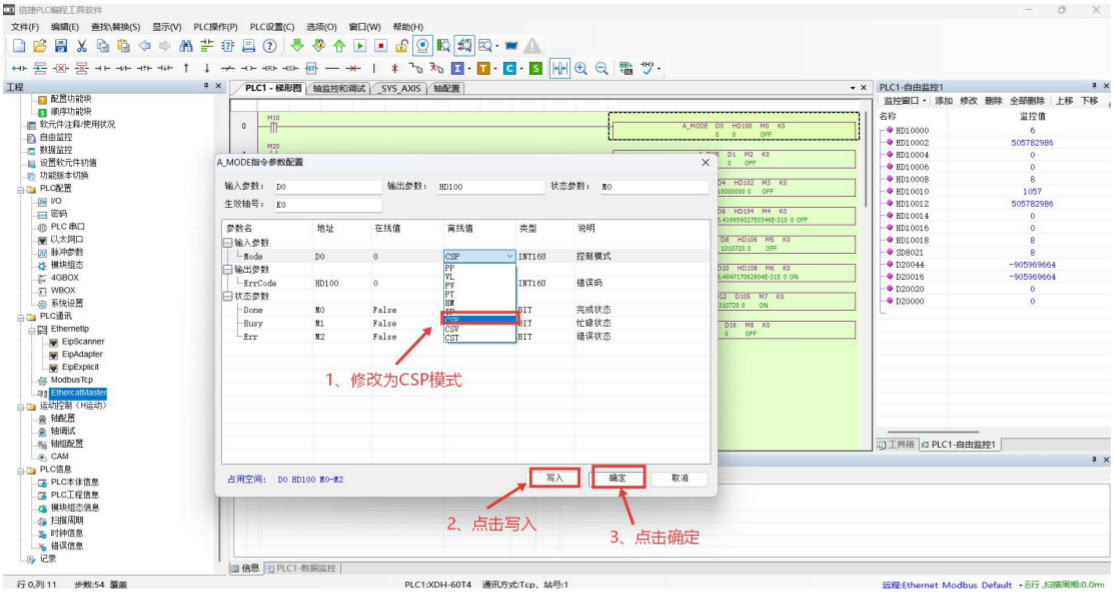


(4) Set M20 to ON to activate the A_PWR enable command; set M30 to ON to trigger A_MOVEA, so that the module runs in absolute position mode.

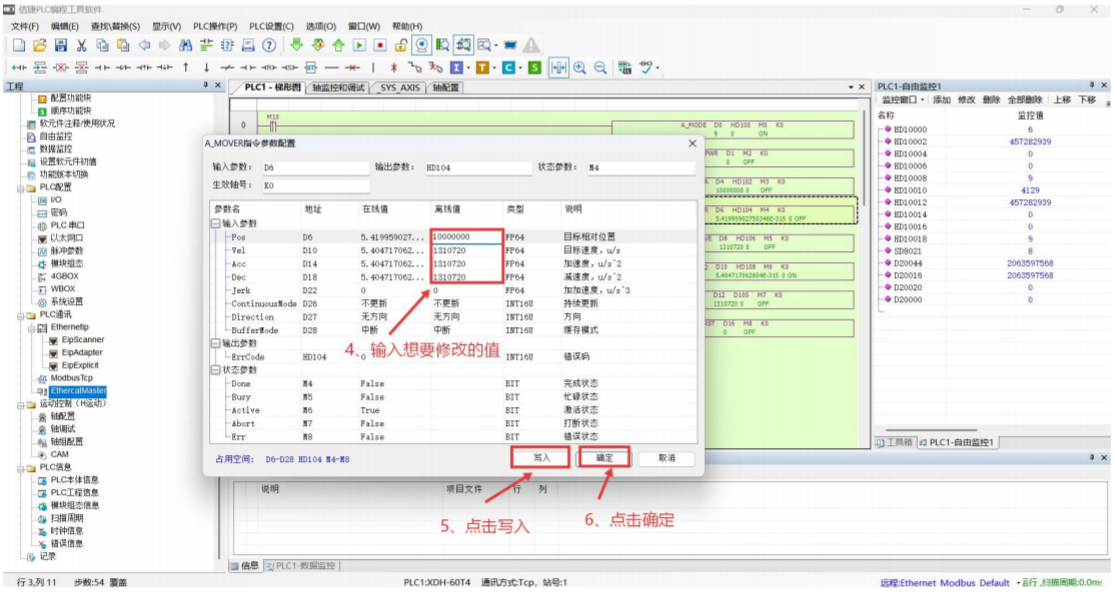


Relative Position Motion

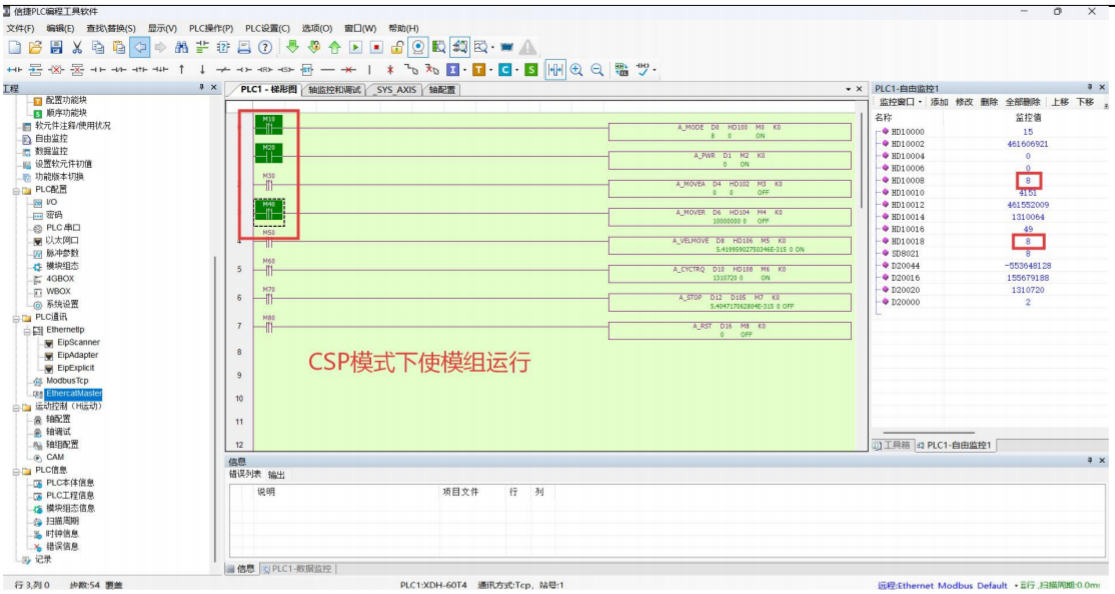
(1) Right-click A_MODE (Operating Mode), click Command Parameter Configuration, select CSP Position Mode for Mode, then click Write.



(2) A_MOVER is the relative position motion instruction, whose input parameters must be even numbers. Fill in appropriate values of target relative position, target velocity, acceleration and deceleration according to unit conversion to drive the module to move.



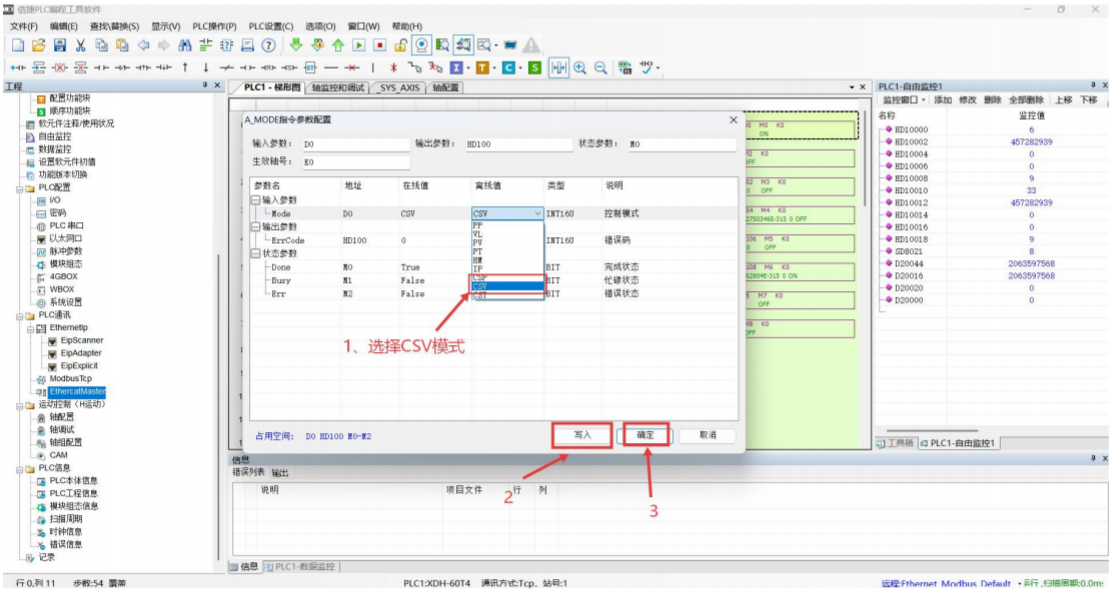
(3) Set M10 to ON and M20 to ON to activate the A_PWR enable command; set M40 to ON to trigger A_MOVER, so the module operates in relative position mode.



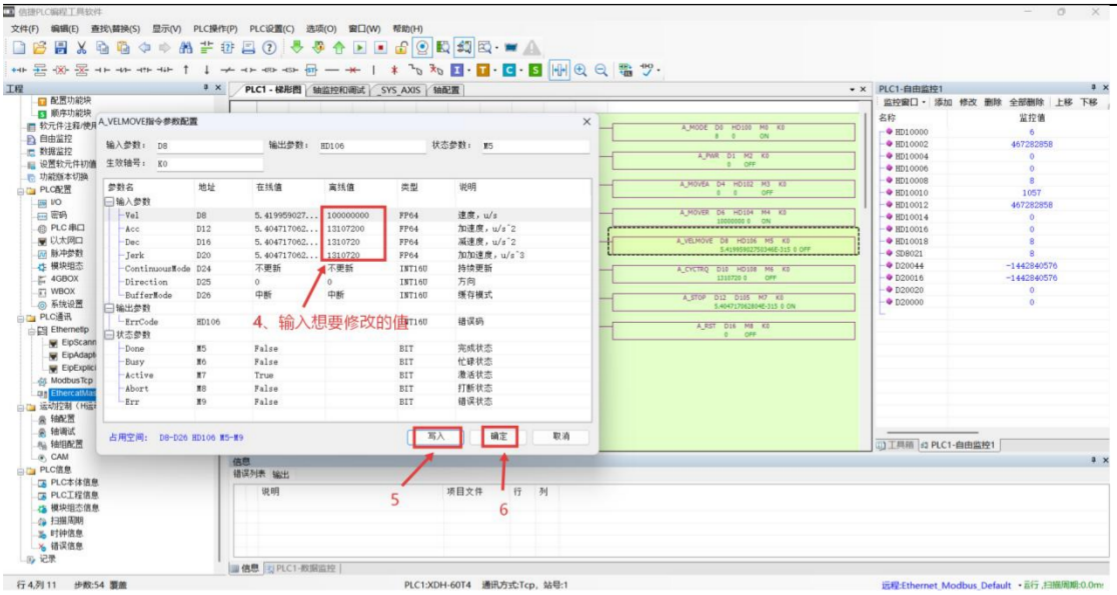
7.CSV Mode

Specify the PDO objects to be mapped from the object dictionary when working under CSV mode. Select the #x1600 PDO under Outputs and add the following objects: 6040h (Control Word), 607Ah (Target Position), 6060h (Operating Mode), 60FFh (CSV Target Velocity).

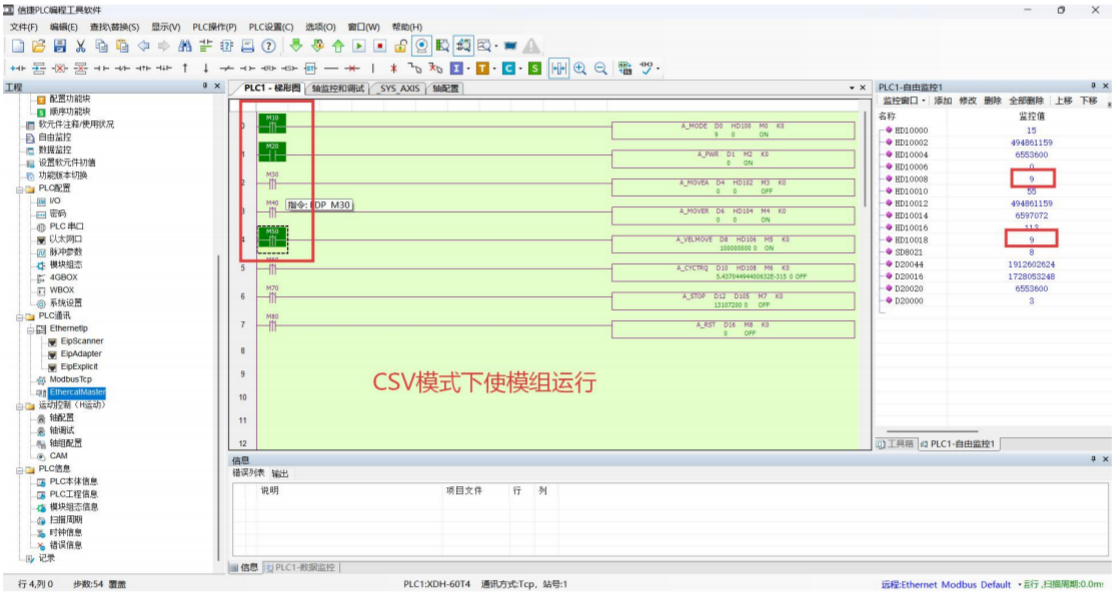
(1) Select CSV Mode for A_MODE operating mode, then click Write to confirm.



(2) A_VELMOVE is the velocity motion instruction, and its input parameters must be even numbers. Fill in proper values for velocity, acceleration and deceleration based on unit conversion to drive the module to move.



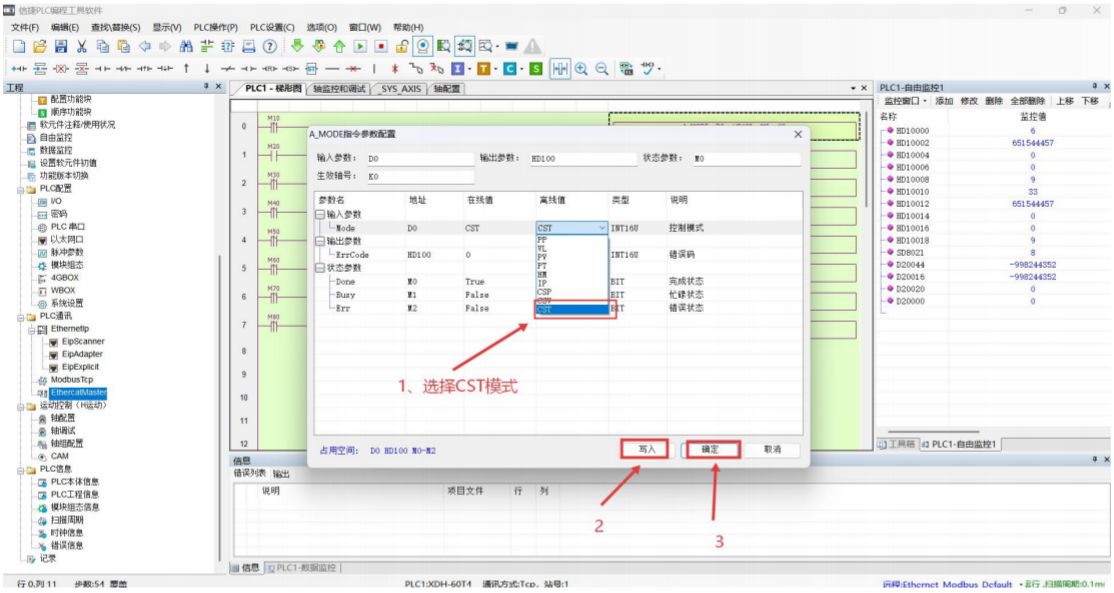
(3) Turn M10 ON to switch the operating mode to CSV velocity mode, and HD10008 will change to 9. Turn M20 ON to activate the A_PWR enable command, then turn M50 ON to trigger A_VELMOVE, so the module runs in velocity mode.



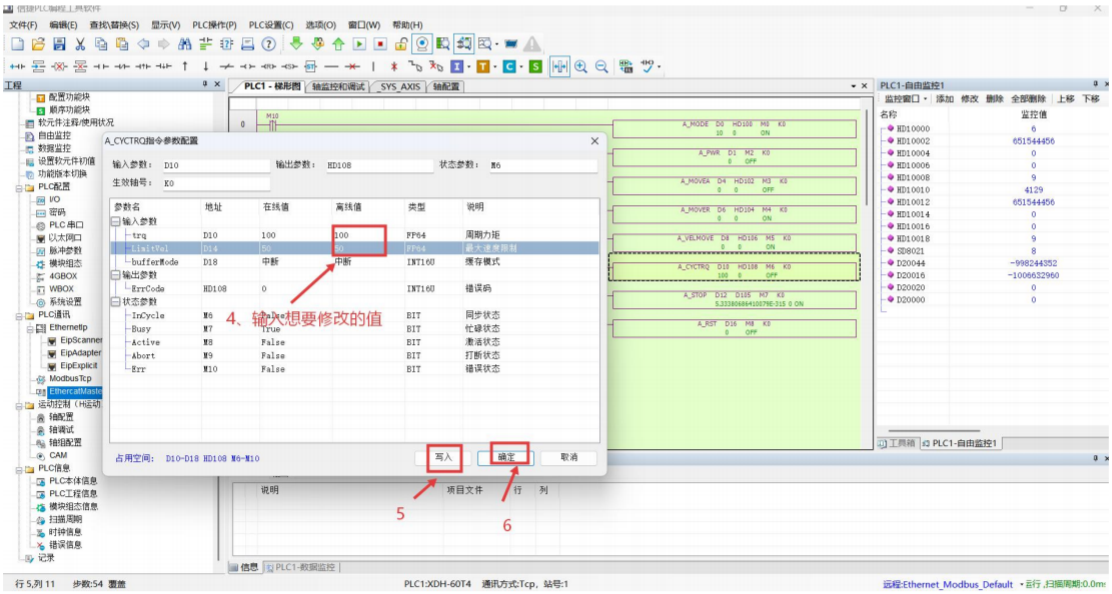
8.CST Mode

Specify the PDO objects to be mapped from the object dictionary for CST mode. Select the #x1600 PDO under Outputs and add the following objects: 6040h (Control Word), 607Ah (Target Position), 6060h (Operating Mode), 6071h (CST Target Torque).

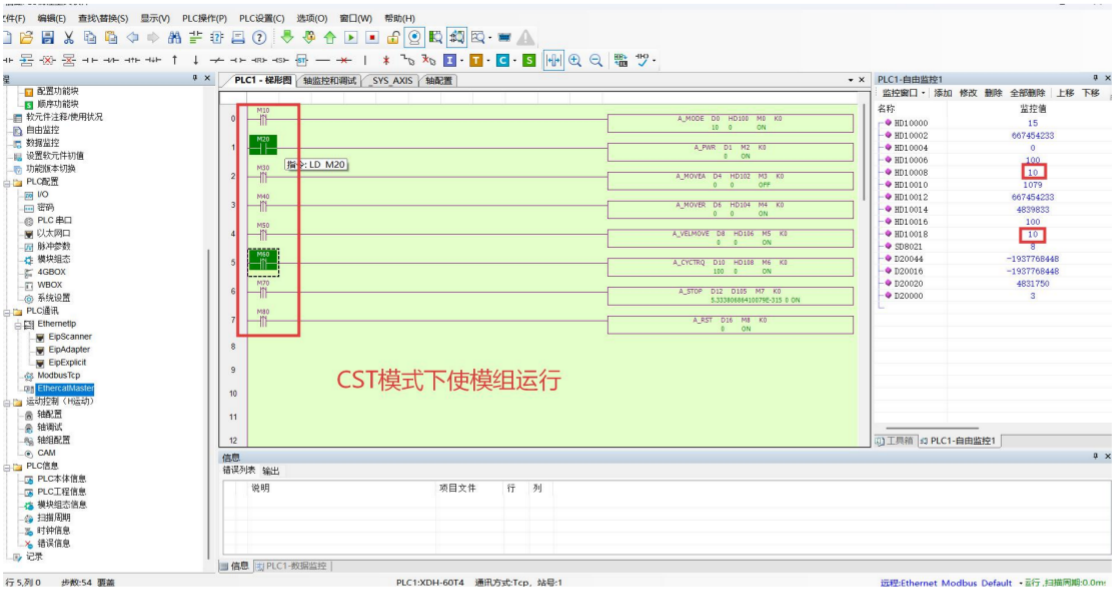
(1) Select CST Torque Mode for the A_MODE operating mode, then click Write to confirm.



(2) A_CYCTRQ is the cyclic torque motion instruction, and all its input parameters must be even numbers. Fill in appropriate values for cyclic torque and maximum speed limit according to unit conversion to drive the module to move.



(3) Set M10 to ON to switch the operating mode to CST torque mode, and HD10008 will become 10. Set M20 to ON to activate the A_PWR enable command, then set M60 to ON to trigger A_CYCTRQ, so that the module operates in torque mode.



Chapter 14 CAN FD Message Description

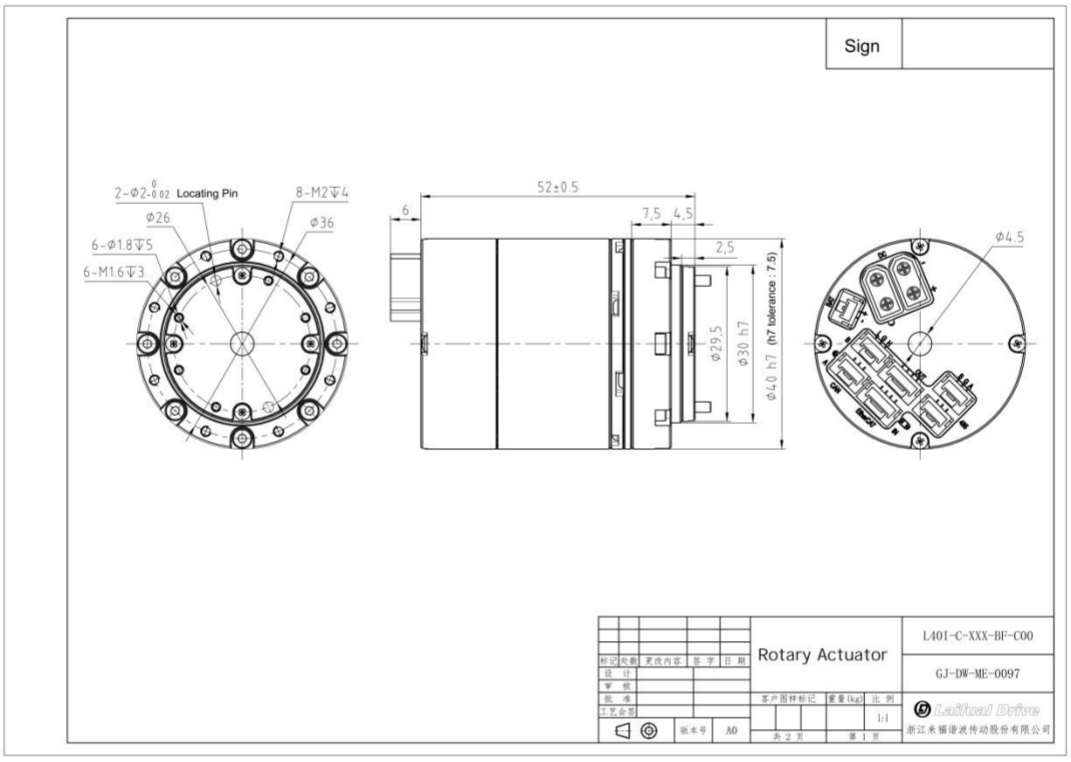
	Tx (Master → Slave)	Rx (Master ← Slave)
0	CRC Value High Byte	CRC Value High Byte
1	CRC Value Low Byte	CRC Value Low Byte
2	Counter High Byte	Counter High Byte
3	Counter Low Byte	Counter Low Byte
4	Reserved	Reserved
5	Reserved	Reserved
6	Reserved	Reserved
7	Reserved	Reserved
8	Speed Loop P High Byte	Speed Loop P High Byte
9	Speed Loop P Low Byte	Speed Loop P Low Byte
10	Speed Loop I High Byte	Speed Loop I High Byte
11	Speed Loop I Low Byte	Speed Loop I Low Byte
12	Position Loop P High Byte	Position Loop P High Byte
13	Position Loop P Low Byte	Position Loop P Low Byte
14	bit0: Speed Loop Setting (0/1) bit1: Write to ROM/RAM bit2: Position Loop Setting (0/1) bit3: Write to ROM/RAM bit4: Encoder Zero Offset Setting (0/1) bit5: Write to ROM/RAM	Reserved
15	Position Planning Acceleration High 2	Position Planning Acceleration High 2
16	Position Planning Acceleration High 1	Position Planning Acceleration High 1
17	Position Planning Acceleration Low 1	position Planning Acceleration Low 1
18	Position Planning Acceleration Low 2	Position Planning Acceleration Low 2
19	Position Planning Deceleration High 2	Position Planning Deceleration High 2
20	Position Planning Deceleration High 1	Position Planning Deceleration High 1
21	Position Planning Deceleration Low 1	Position Planning Deceleration Low 1
22	Position Planning Deceleration Low 2	Position Planning Deceleration Low 2
23	Speed Planning Acceleration High 2	Speed Planning Acceleration High 2
24	Speed Planning Acceleration High 1	Speed Planning Acceleration High 1
25	Speed Planning Acceleration Low 1	Speed Planning Acceleration Low 1
26	Speed Planning Acceleration Low 2	Speed Planning Acceleration Low 2
27	Speed Planning Deceleration High 2	Speed Planning Deceleration High 2
28	Speed Planning Deceleration High 1	Speed Planning Deceleration High 1
29	Speed Planning Deceleration Low 1	Speed Planning Deceleration Low 1
30	Speed Planning Deceleration Low 2	Speed Planning Deceleration Low 2
31	bit0: Position Acceleration Setting (0/1) bit1: Write to ROM/RAM bit2: Position Deceleration Setting (0/1) bit3: Write to ROM/RAM bit4: Speed Acceleration Setting (0/1) bit5: Write to ROM/RAM bit6: Speed Deceleration Setting (0/1) bit7: Write to ROM/RAM	Reserved
32	Multi-turn Encoder Zero Offset Command High 2	Multi-turn Encoder Homing Command 35 High 2

	Tx (Master → Slave)	Rx (Master ← Slave)
33	Multi-turn Encoder Zero Offset Command High 1	Multi-turn Encoder Homing Command 35 High 1
34	Multi-turn Encoder Zero Offset Command Low 1	Multi-turn Encoder Homing Offset Command 35 Low 1
35	Multi-turn Encoder Zero Offset Command Low 2	Multi-turn Encoder Homing Offset Command 35 Low 2
36	Command: Write Current Multi-turn Position to ROM as Motor Zero (0/1)	Motor Temperature
37	Motor Enable Control	Voltage Value
38	Motor Stop Command: Speed = 0, Keep Enabled	
39	Control Command 1: Torque Closed-Loop Control 2: Speed Closed-Loop Control 3: Absolute Position Closed-Loop Control 4: Relative Position Closed-Loop Control	Motor Operation Mode1: Torque Closed-Loop Control2: Speed Closed-Loop Control3: Absolute Position Closed-Loop Control4: Relative Position Closed-Loop Control
40	Torque Current Control Value High Byte (Unit: ‰ of Rated)	Torque Current High Byte
41	Torque Current Control Value Low Byte	Torque Current Low Byte
42	Speed Command High Byte (Unit: 0.1 rpm)	Motor Speed High Byte
43	Speed Command Low Byte	Motor Speed Low Byte
44	Speed Limit High Byte (Position Control Mode, Unit: 0.1 rpm)	Error Code
45	Speed Limit Low Byte (Position Control Mode)	
46	Position Command High Byte 2	Multi-turn Encoder Position Command High Byte 2
47	Position Command High Byte 1	Multi-turn Encoder Position Command High Byte 1
48	Position Command Low Byte 1	Multi-turn Encoder Position Command Low Byte 1
49	Position Command Low Byte 2	Multi-turn Encoder Position Command Low Byte 2
50	Brake Command 0: Brake Release 1:Brake Clamp 2:Brake Release	Brake Status
51	CAN ID Setting	

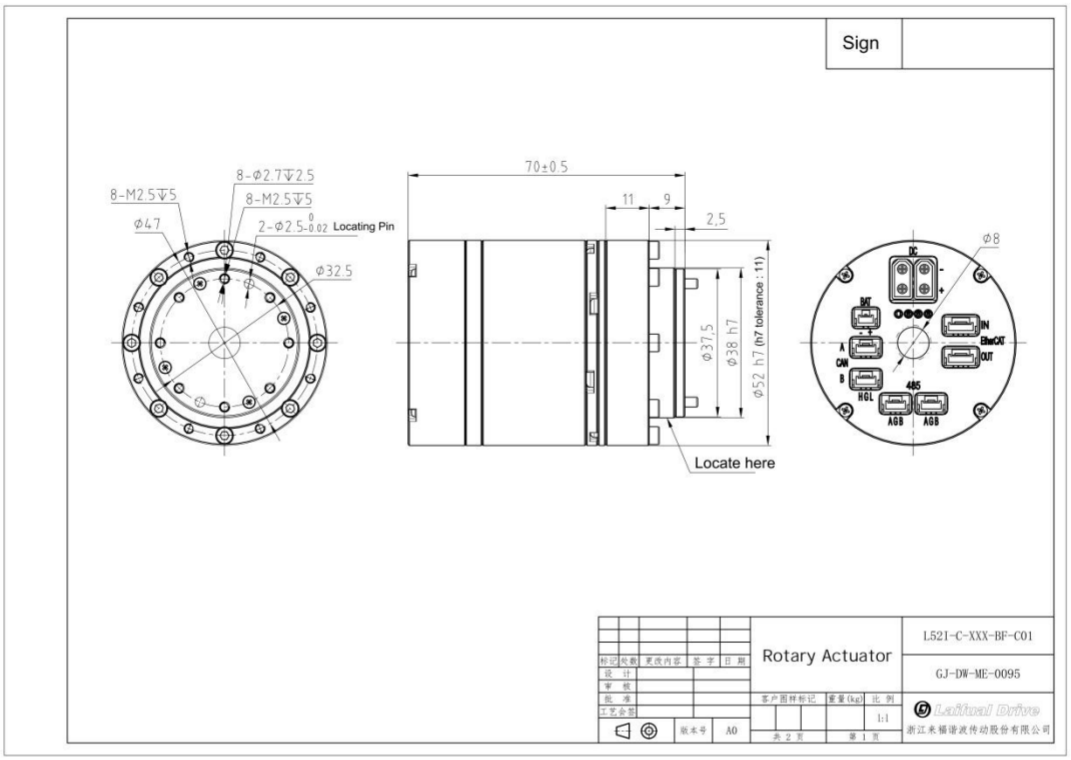
	Tx (Master → Slave)	Rx (Master ← Slave)
52	Positive Position Limit Command High Byte 2	Multi-turn Encoder Raw Position Command High Byte 2
53	Positive Position Limit Command High Byte 1	Multi-turn Encoder Raw Position Command High Byte 1
54	Positive Position Limit Command Low Byte 1	Multi-turn Encoder Raw Position Command Low Byte 1
55	Positive Position Limit Command Low Byte 2	Multi-turn Encoder Raw Position Command Low Byte 2
56	Negative Position Limit Command High Byte 2	Software Version High Byte
57	Negative Position Limit Command High Byte 1	Software Version Low Byte
58	Negative Position Limit Command Low Byte 2	Motor Model I/T/S
59	Negative Position Limit Command Low Byte 1	
60	Error Reset Command	

Appendix 1 Module Dimension Drawing

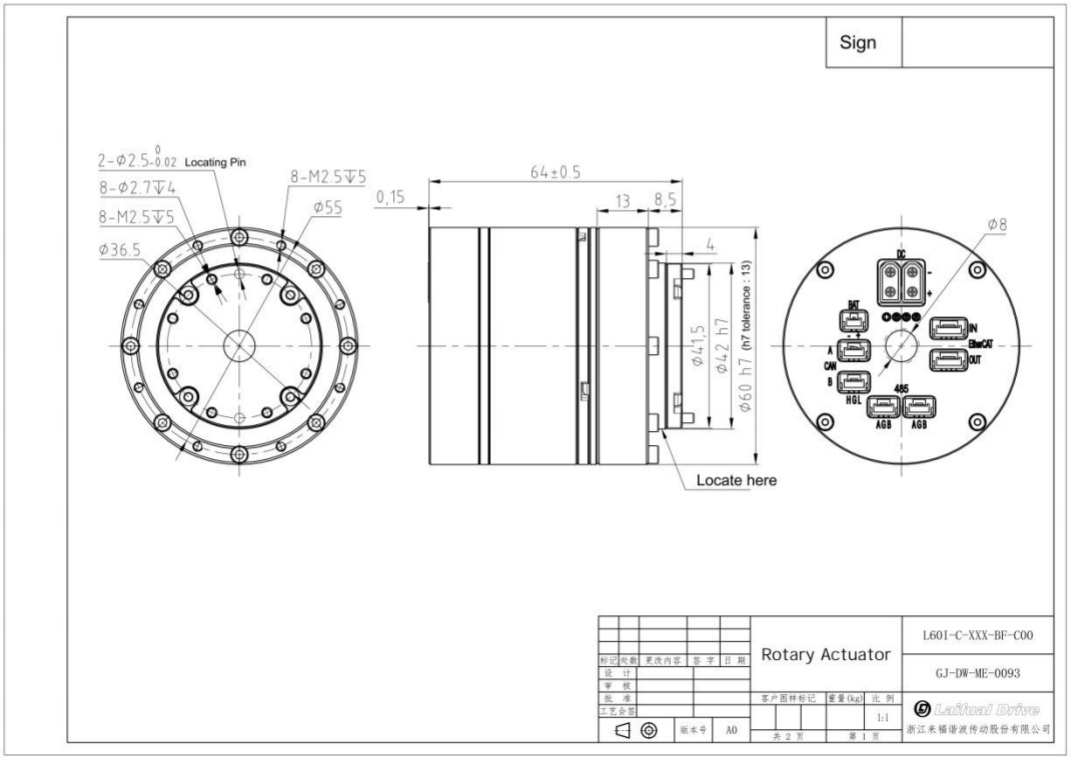
L-40-I-XX



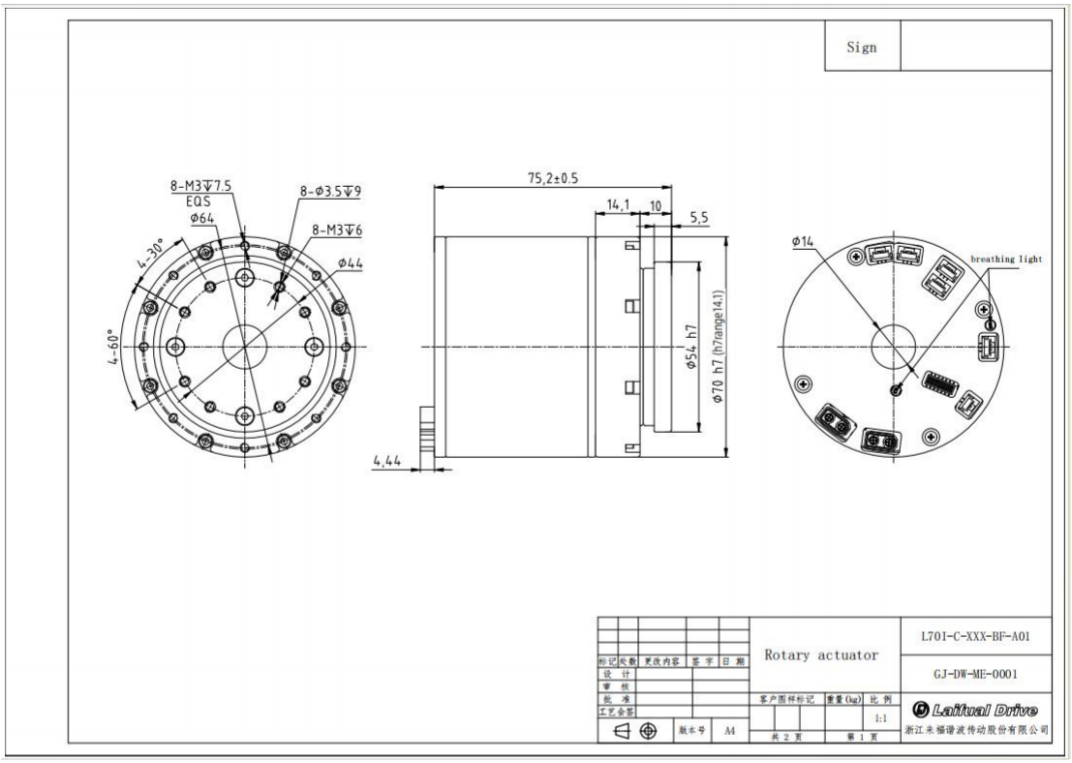
L-52-I-XX



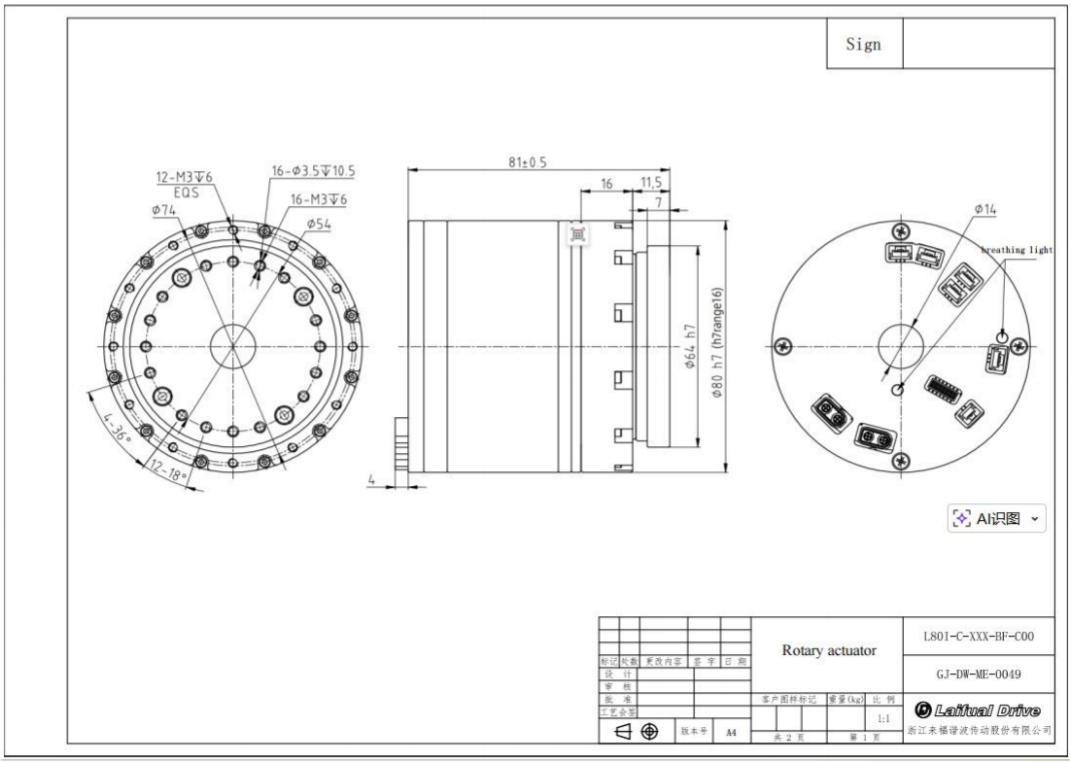
L-60-I-XX



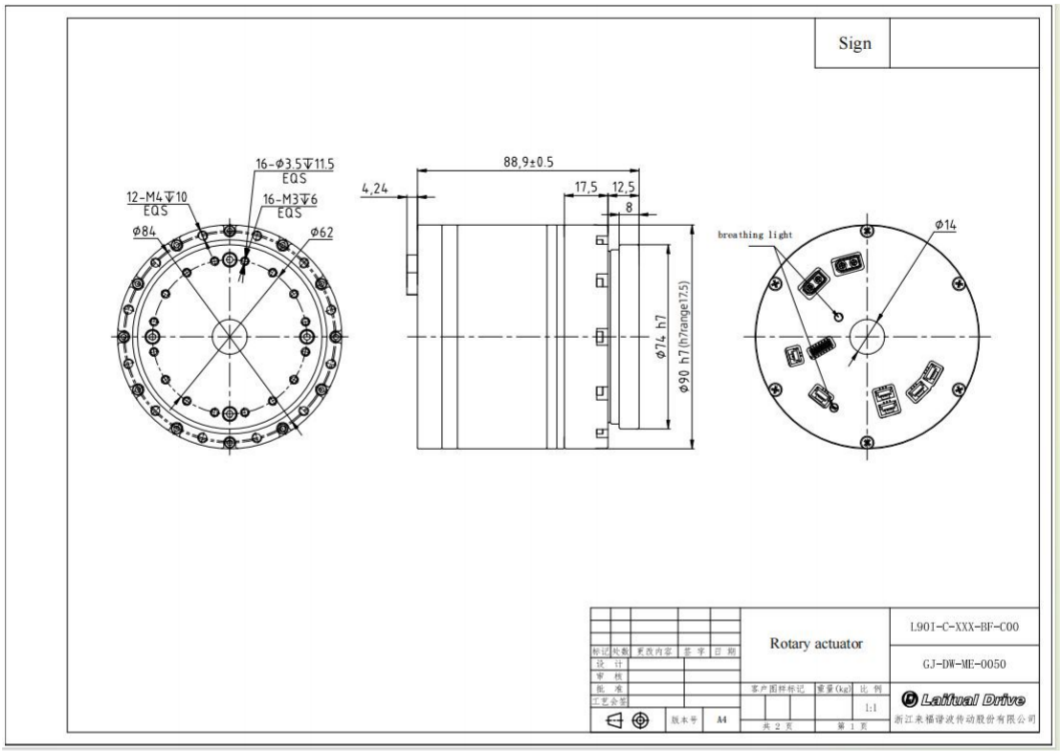
L-70-I-XX



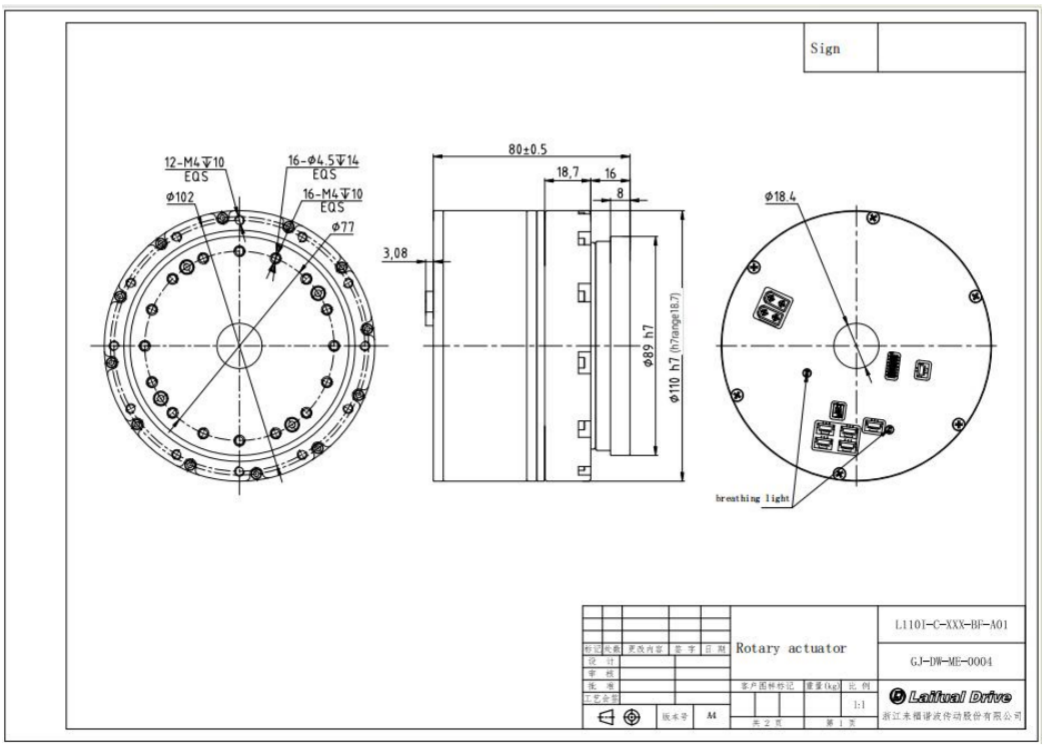
L-80-I-XX



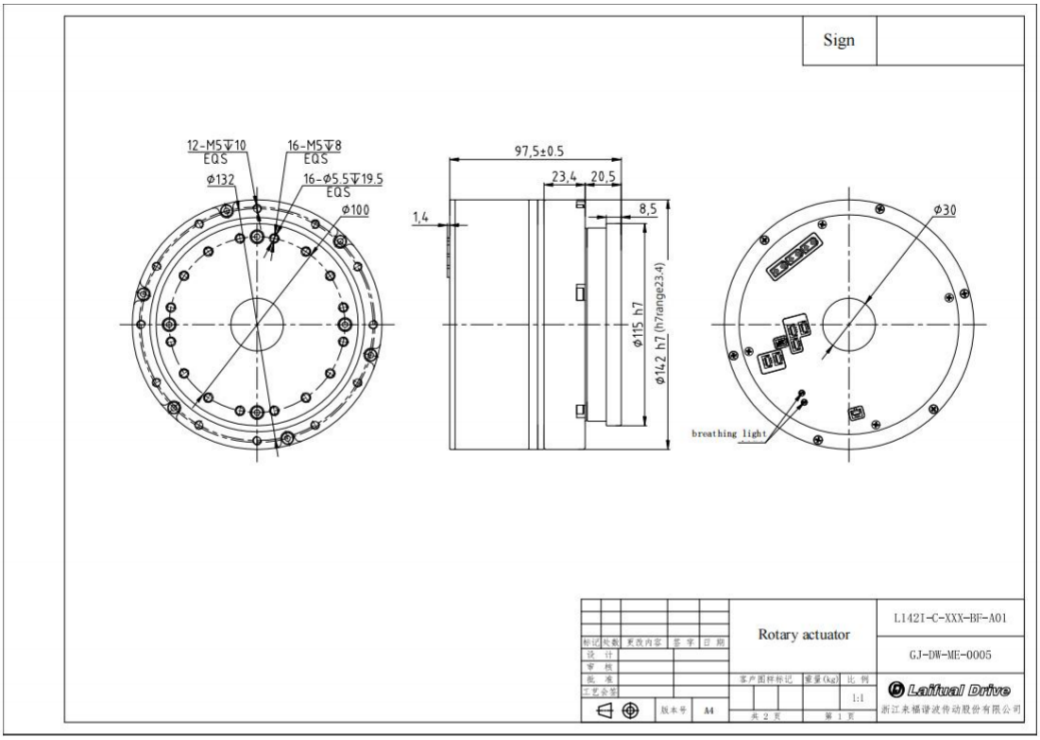
L-90-I-XX



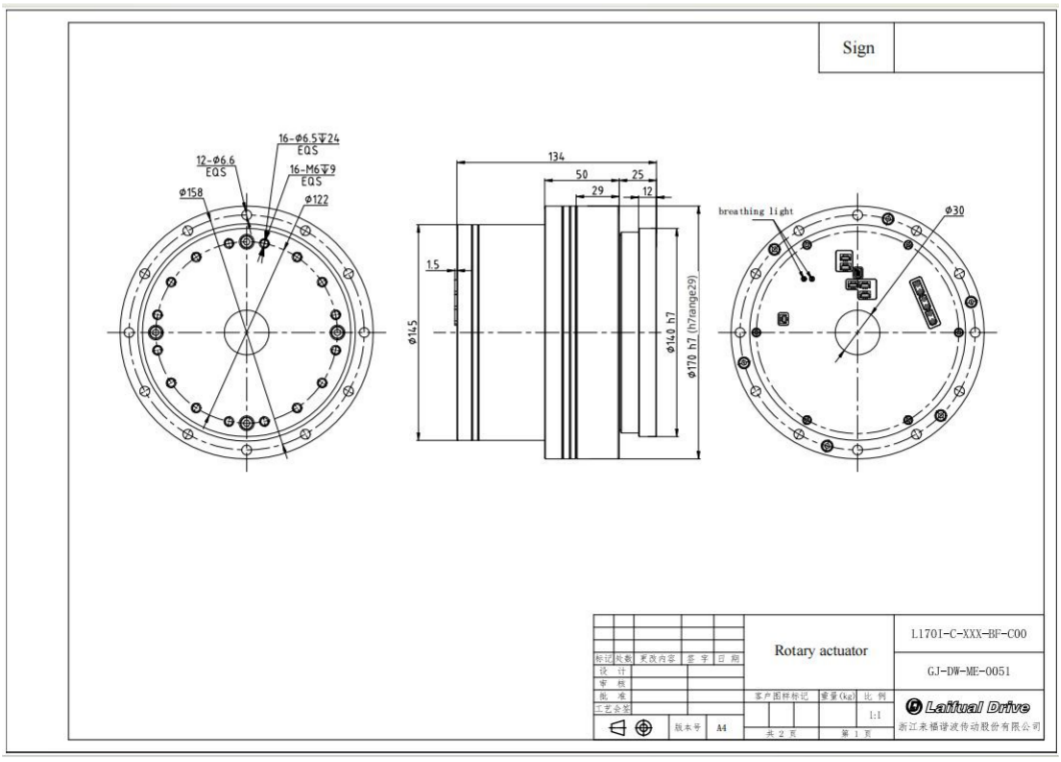
L-110-I-XX



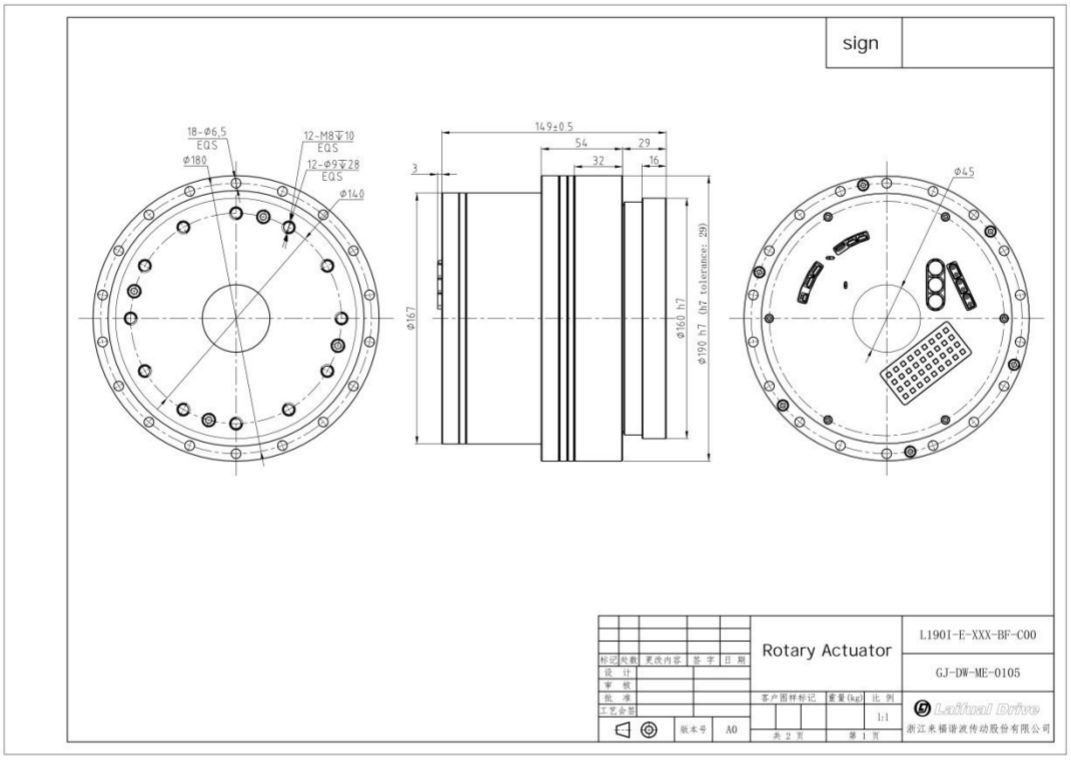
L-142-I-XX



L-170-I-XX



L-190-I-XX



Note: Please check the attached drawing for confirmation or contact us for any unshown dimensional tolerances.

Appendix 2 Parameters

Firmware Parameters

Parameter No.	Object Dictionary Address	Communication Protocol	Parameter Name	Parameter Description	Parameter Unit	Minimum Value	Maximum Value	Default Value	Effective After Restart
P0.00	0x3000	CANOpen&EtherCAT	Motor Type	[0] 81Ratio [1] 51Ratio [2] 101Ratio [3] 121Ratio	—	0	3	0	NEED REBOOT
P0.01	0x3001	CANOpen&EtherCAT	Motor Type	Selected Motor Parameter table [0] T Joint [1] I Joint	—	0	3	0	NEED REBOOT
P0.02	0x3002	CANOpen&EtherCAT	Encoder Type	[0] Signle-turn [1] Signle-turn+ Multi-turn	—	0	1	1	NEED REBOOT
P0.03	0x3003	CANOpen&EtherCAT	Drive Type	[0] 14 [1] 17 [2] 20 [3] 25 [4] 32 [5] 40	—	0	15	0	NEED REBOOT
P0.04	0x3004	CANOpen&EtherCAT	Motor Positive Rotation Direction	[0]Counterclockwise Positive Rotation Direction [1] Clockwise Positive Rotation Direction。	—	0	1	0	NEEDREBOOT
P0.05	0x3005	CANOpen&EtherCAT	Control mode rotation	[C] Position control (contact command) [D] Speed control (parameter command)	—	0	13	13	NEEDREBOOT
P0.06	0x3006	CANOpen&EtherCAT	Internal enable command	[0]External S-ON valid [1] External S-ON invalid — motor excitation signal will be automatically activated after S-RDY output.	—	0	1	0	NEED REBOOT
P0.07	0x3007	CANOpen&EtherCAT	Full closed-loop enable	Full closed-loop enable	—	0	1	0	NEED REBOOT
P0.08	0x3008	CANOpen&EtherCAT	UV commutation	Swap the UV phase sequence.	—	0	1	0	NEED REBOOT
P0.09	0x3009	CANOpen&EtherCAT	Module ratio	Reducer Ratio	—	50	200	81	NEED REBOOT
P1.00	0x300A	CANOpen&EtherCAT	Position loop gain	This value determines the gain of the position loop. Increasing it enhances servo stiffness in position control, but excessive gain may cause oscillation。	1/s	0	1000	40	NEED REBOOT

P1.01	0x300B	CANOpen&EtherCAT	2nd Position Loop Gain	This value determines the gain of the position loop. Increasing it enhances servo stiffness in position control, but excessive gain may cause oscillation。	1/s	0	1000	40	NEED REBOOT
P1.05	0x300F	CANOpen&EtherCAT	Position command filter time constant	This value is used for smoothing the input pulses. A larger value results in better smoothing effect, but an excessively large value will cause signal lag. Unit: 0.1 ms	0.1ms	0	32767	0	NEED REBOOT
P1.06	0x3010	CANOpen&EtherCAT	Position command filter type selection	[0]: First-order filter [1]: Second-order filter	—	0	1	0	NEEDREBOOT
P1.07	0x3011	CANOpen&EtherCAT	Speed bias	This value is set to shorten positioning time. However, if set too high or not properly coordinated with Pn112, it may cause vibration. It is related to the speed command, deviation counts, and Pn500 (positioning error).	rpm	0	300	0	NEED REBOOT
P1.08	0x3012	CANOpen&EtherCAT	Velocity feedforward percentage	Used to set the position feedforward value. A higher value results in faster position response and smaller position deviation. Setting this value too high may cause overshoot and oscillation.	%	0	100	0	NEED REBOOT
P1.09	0x3013	CANOpen&EtherCAT	Velocity feedforward filter time	Mechanical shock caused by smooth torque feedforward.	0.1ms	0	640	0	NEED REBOOT
P1.0A	0x3014	CANOpen&EtherCAT	Deviation counter reset method	[0]Deviation counter resets when S-OFF; does not reset on overtravel. [1] Deviation counter does not reset. [2] Deviation counter resets on S-OFF or overtravel (except zero clamp).	—	0	2	0	NEED REBOOT
P1.0B	0x3015	CANOpen&EtherCAT	Deviation counter overflow alarm	When the deviation counter value exceeds this setting, it is considered an overflow and triggers an alarm signal.	256puls	1	32767	1024	NEED REBOOT
P1.0C	0x3016	CANOpen	Positioning time	This value sets the time required to complete positioning. Unit: 0.1 ms	0.1ms	0	60000	30000	NEED REBOOT
P2.00	0x3017	CANOpen&EtherCAT	Velocity loop gain	This value determines the gain of the velocity loop. Ensure Pn106 (load inertia percentage) is set correctly.	rad/s	1	4000	500	NEED REBOOT
P2.01	0x3018	CANOpen&EtherCAT	Velocity loop integration	Reducing this value can shorten positioning time and	0.1ms	1	4096	400	NEED REBOOT

			time	improve velocity response.					
P2.02	0x3019	CANOpen	2nd Speed Loop Gain	This value determines the magnitude of the speed loop gain, when the load inertia percentage Pn106 is set correctly.	0.1ms	1	4096	400	NEED REBOOT
P2.03	0x301A	CANOpen	2nd Speed Loop Integration Time	Reducing this value can shorten positioning time and improve speed response.	rad/s	1	4000	250	NEED REBOOT
P2.04	0x301B	CANOpen	Parameter speed	This parameter can be set positive or negative. When control mode Pn005.1 = D, it determines the motor speed. Unit: rpm	rpm	-6000	6000	50	NEED REBOOT
P2.05	0x301C	CANOpen	JOG speed	Sets the speed during JOG operation; the direction is determined by the button. Unit: rpm	rpm	0	6000	50	NEED REBOOT
P2.06	0x301D	CANOpen	Soft start acceleration time	Time required to accelerate 1000 rpm under ramped speed command. Unit: ms	ms	0	10000	100	NEED REBOOT
P2.07	0x301E	CANOpen	Soft start deceleration time	Time required to decelerate 1000 rpm under ramped speed command. Unit: ms	ms	0	10000	100	NEED REBOOT
P2.08	0x301F	CANOpen	Velocity filtering time constant	Speed command primary filter time constant. Unit: ms	ms	0	10000	0	NEED REBOOT
P2.09	0x3020	CANOpen	Speed command curve form	Speed command curve form [0] ramp [1] S-curve [2]first-order filte [3] second-order filte	—	0	3	0	NEEDRE BOOT
P2.0A	0x3021	CANOpen	S-curve selection	This value determines the transition curve of the S-curve.	—	0	3	0	NEED REBOOT
P2.0B	0x3022	CANOpen	S-curve rise time	The time required to transition from one velocity point to another in an S-curve manner.	ms	0	10000	0	NEED REBOOT
P2.0C	0x3023	CANOpen	Percentage of load inertia	load inertia to motor rotor inertia. Setpoint = (Load inertia / Rotor inertia) * 100	%	0	20000	0	NEED REBOOT
P2.0D	0x3024	CANOpen &EtherCAT	Torque feedforward form	[0]General torque feedforward. [2] High-speed torque feedforward is used.	—	0	3	0	NEEDRE BOOT
P2.0E	0x3025	CANOpen &EtherCAT	Torque feedforward percentage	This is used to set the torque feedforward value to improve speed response. To use this function in manual tuning mode, please correctly set the load moment of inertia ratio Pn106.	%	0	100	0	NEED REBOOT
P2.0F	0x3026	CANOpen &EtherCAT	Torque feedforward filter time	Mechanical shock caused by smooth torque feedforward.	0.1ms	0	640	0	NEED REBOOT

P2.10	0x3027	CANOpen	Low-speed speed measurement filter	This value setting is used for filtering during low-speed speed measurement. If this value is set too high, the speed measurement will lag during low-speed speed measurement.	0.1ms	0	100	0	NEED REBOOT
P2.11	0x3028	CANOpen	Zero clamp speed	When the input analog speed is less than this value, the motor will be locked at the current position.	rpm	0	3000	10	NEED REBOOT
P3.00	0x3030	CANOpen&EtherCAT	EC Synchronization Function Disable	[0]Enable EC synchronization function [1] Disable EC synchronization function	—	0	1	0	NEED REBOOT
P3.01	0x3031	CANOpen &EtherCAT	Torque command filter constant	Setting up torque filtering can eliminate or reduce mechanical vibration, but improper settings can sometimes introduce mechanical vibration.	0.01ms	0	2500	0	NEED REBOOT
P3.02	0x3032	CANOpen	2nd Torque Command Filter Time Constant	Torque filter setting can eliminate or mitigate mechanical vibration. However, improper configuration may introduce mechanical vibration.	0.01ms	0	2500	100	NEED REBOOT
P3.05	0x3035	CANOpen&EtherCAT	Forward internal torque limit	Motor output torque limit value (parameter setting range is based on actual overload capacity).	%	0	400	200	NEED REBOOT
P3.06	0x3036	CANOpen&EtherCAT	Reverse internal torque limit	—	%	0	400	200	NEED REBOOT
P3.07	0x3037	CANOpen&EtherCAT	Stall Current Coefficient	Stall Current Coefficient	-	0	100	45	NEED REBOOT
P3.08	0x3038	CANOpen&EtherCAT	Stall Detection Period	[0]Disable stall detection [1]Calibration time [2] Other time	ms	0	2000	1	NEED REBOOT
P3.09	0x3039	CANOpen	Plugging Braking Torque Limit	–	%	0	300	300	NEED REBOOT
P3.0B	0x303B	CANOpen	Torque Control Delay Time	–	0.1ms	1	2000	100	NEED REBOOT
P3.0C	0x303C	CANOpen	Torque Control Speed Hysteresis	–	rpm	10	1000	50	NEED REBOOT
P4.00	0x303D	CANOpen	Stop Mode	[0]Dynamic braking, brake release after standstill [1]Coast stop [2] DB when servo OFF; plugging braking stop & servo OFF on overtravel [3] Coast stop when servo OFF; plugging braking stop	-	0	5	1	NEED REBOOT

				& servo OFF on overtravel [4] DB when servo OFF; zero clamp after plugging braking stop on overtravel [5] Coast stop when servo OFF; zero clamp after plugging braking stop on overtravel					
P4.03	0x3040	CANOpen	Electronic Gear Switching Mode	—	—	0	1	0	NEED REBOOT
P4.04	0x3041	CANOpen	16-bit 1st Electronic Gear Numerator	Pn009.2 set to 0: valid when 16-bit electronic gear parameter is selected. Electronic gear maps command pulses to corresponding motor travel. The host controller does not need to consider mechanical reduction ratio and encoder pulse count. Essentially, it is a setting for frequency multiplication or frequency division of command pulses.	—	1	65535	1	NEED REBOOT
P4.05	0x3042	CANOpen	16-bit Electronic Gear Denominator	—	—	1	65535	1	NEED REBOOT
P4.06	0x3043	CANOpen	16-bit 2nd Electronic Gear Numerator	—	—	1	65535	1	NEED REBOOT
P4.07	0x3044	CANOpen	Save the torque when enabled	Save the torque when disable	—	-32768	32768	0	NEED REBOOT
P4.08	0x3045	CANOpen&Ether CAT	Enable torque function under inhibit hold	Enable torque function under inhibit hold. This function can effectively solve the problem of manipulator dropping after servo enable.	—	0	9999	0	NEED REBOOT
P4.0D	0x304A	CANOpen	P/PI Switch Parameter: P/PI Switch Condition	[0]Torque Command Percentage [1] Deviation Counter Value [2] Set Acceleration Value [3] Set Velocity Value [4] Fixed PI	—	0	4	4	NEED REBOOT
P4.0E	0x304B	CANOpen	P/PI Switch Parameter: Torque Switch Threshold	Torque threshold for switching from PI control to P control	%	0	300	200	NEED REBOOT
P4.0F	0x304C	CANOpen	P/PI Switch Parameter: Deviation Counter Switch Threshold	Deviation counter threshold for switching from PI control to P control	puls	0	10000	0	NEED REBOOT

P4.10	0x304D	CANOpen	P/PI Switch Parameter: Set Acceleration Switch Threshold	Acceleration threshold for switching from PI control to P control	10rpm/s	0	3000	0	NEED REBOOT
P4.11	0x304E	CANOpen	P/PI Switch Parameter: Set Velocity Switch Threshold	Velocity threshold for switching from PI control to P control	rpm	0	10000	0	NEED REBOOT
P4.12	0x304F	CANOpen	Dual Gain Switch Parameter: Gain Switch Condition	[0]Fixed to 1st Gain Set [1]External Switch Gain Switching (G-SEL) [2]Torque Percentage [3] Deviation Counter Value [4] Set Acceleration Value (10 rpm/s) [5] Set Velocity Value [6] Position Command Input Present [7] Motor Actual Speed [8] Position Command (Pn123) + Actual Velocity (Pn124)	—	0	8	0	NEED REBOOT
P4.13	0x3050	CANOpen	Dual Gain Switch Parameter: Switch Delay Time	Time required for gain switching after the switch condition is satisfied	0.1ms	0	20000	0	NEED REBOOT
P4.14	0x3051	CANOpen	Dual Gain Switch Parameter: Switch Threshold Level	Trigger level for gain switching	—	0	20000	0	NEED REBOOT
P4.15	0x3052	CANOpen	Dual Gain Switch Parameter: Actual Velocity Threshold	Valid when Pn121=8	rpm	0	20000	0	NEED REBOOT
P4.16	0x3053	CANOpen	Dual Gain Switch Parameter: Position Gain Switching Time	This parameter enables smooth transition when there is a large difference between the two gain sets	0.1ms	0	20000	0	NEED REBOOT
P4.17	0x3054	CANOpen	Dual Gain Switch Parameter: Switch Hysteresis	This value sets the hysteresis for gain switching action.	—	0	20000	0	NEED REBOOT
P4.18	0x3055	CANOpen &EtherCAT	Servo On Waiting Time	These parameters are only effective when the port output parameters are configured to have /BK output. These parameters control the timing of the holding brake (to prevent	ms	-2000	2000	-1000	NEED REBOOT

				gravity-induced slippage or continuous external force acting on the motor).					
P4.19	0x3056	CANOpen &EtherCAT	Basic waiting process	—	10ms	0	500	20	NEED REBOOT
P4.1A	0x3057	CANOpen &EtherCAT	Braking waiting speed	—	rpm	10	100	100	NEED REBOOT
P4.1B	0x3058	CANOpen &EtherCAT	Braking waiting time	—	10ms	0	100	0	NEED REBOOT
P4.1C	0x3059	CANOpen	Dynamic braking time	—	ms	50	2000	1250	NEED REBOOT
P5.00	0x305C	CANOpen	Assign Input Signal 1 to Port	—	—	0	15	0	NEED REBOOT
P5.01	0x305D	CANOpen	Input Signal 1 Invert	—	—	0	1	0	NEED REBOOT
P5.02	0x305E	CANOpen	Assign Input Signal 2 to Port	—	—	0	15	1	NEED REBOOT
P5.03	0x305F	CANOpen	Input Signal 2 Invert	—	—	0	1	0	NEED REBOOT
P5.04	0x3060	CANOpen	Assign Input Signal 3 to Port	—	—	0	15	2	NEED REBOOT
P5.05	0x3061	CANOpen	Input Signal 3 Invert	—	—	0	1	0	NEED REBOOT
P5.06	0x3062	CANOpen	Assign Input Signal 4 to Port	—	—	0	15	3	NEED REBOOT
P5.07	0x3063	CANOpen	Input Signal 4 Invert	—	—	0	1	0	NEED REBOOT
P5.08	0x3064	CANOpen	Assign Input Signal 5 to Port	—	—	0	15	4	NEED REBOOT
P5.09	0x3065	CANOpen	Input Signal 5 Invert	—	—	0	1	0	NEED REBOOT
P5.0A	0x3066	CANOpen	Assign Input Signal 6 to Port	—	—	0	15	5	NEED REBOOT
P5.0B	0x3067	CANOpen	Input Signal 6 Invert	—	—	0	1	0	NEED REBOOT
P5.0C	0x3068	CANOpen	Assign Input Signal 7 to Port	—	—	0	15	6	NEED REBOOT
P5.0D	0x3069	CANOpen	Input Signal 7 Invert	—	—	0	1	0	NEED REBOOT
P5.0E	0x306A	CANOpen	Assign Input Signal 8 to Port	—	—	0	15	7	NEED REBOOT
P5.0F	0x306B	CANOpen	Input Signal 8 Invert	—	—	0	1	0	NEED REBOOT
P5.10	0x306C	CANOpen	Input Port Filter	—	0.2ms	0	1000	1	NEED REBOOT
P5.11	0x306D	CANOpen	Forward Rotation Disable Input Signal (P-OT)	[0]External P-OT Enabled. When travel limit is triggered, operate according to the sequence set by Pn004.0. [1] External P-OT Disabled.	—	0	1	1	NEED REBOOT

P5.12	0x306E	CANOpen	Reverse Rotation Disable Input Signal (N-OT)	[0]External N-OT Enabled. When travel limit is triggered, operate according to the sequence set by Pn004.0. [1] External N-OT Disabled	—	0	1	1	NEED REBOOT
P5.13	0x306F	CANOpen	Assign Output Signal 0 to Port	—	—	0	11	4	NEED REBOOT
P5.14	0x3070	CANOpen	Brake test	This bit is used for testing. When this parameter is set to 4, the brake is enabled [4]: the brake is released [other].	—	0	11	1	NEEDRE BOOT
P5.15	0x3071	CANOpen	Assign output signal 2 to the port	—	—	0	11	2	NEEDRE BOOT
P5.16	0x3072	CANOpen	Output port signal inversion 1	—	—	0	1	0	NEEDRE BOOT
P5.17	0x3073	CANOpen	Output port signal inversion 2	—	—	0	1	0	NEEDRE BOOT
P5.18	0x3074	CANOpen	Output port signal inversion 3	—	—	0	1	0	NEEDRE BOOT
P5.1B	0x3077	CANOpen	Positioning error	If the deviation counter value is less than this value, the positioning is considered to have been achieved.	puls	0	5000	100	NEED REBOOT
P5.1C	0x3078	CANOpen	Same speed error	If the error between the speed command value and the speed feedback value is less than the set value of this parameter, then the speed is considered to have been reached.	rpm	0	100	10	NEED REBOOT
P5.1D	0x3079	CANOpen	Rotary detection speed	When the motor speed exceeds this value, the motor is considered to have stabilized and is rotating.	rpm	0	3000	20	NEED REBOOT
P6.00	0x307F	CANOpen	JPOS0 Point control position pulse (high level)	—	10000 pulses	-9999	9999	0	NEED REBOOT
P6.01	0x3080	CANOpen	JPOS0 Point control position pulse (low bit)	—	puls	-9999	9999	0	NEED REBOOT
P6.20	0x309F	CANOpen	JPOS0 Point Control Speed	—	rpm	0	6000	500	NEED REBOOT
P6.30	0x30AF	CANOpen	JPOS0 point control filter time	—	0.1ms	0	32767	0	NEED REBOOT
P6.40	0x30BF	CANOpen	JPOS0 Point Control Stop Time	—	50ms	0	300	10	NEED REBOOT
P6.4F	0x30CE	CANOpen	JPOS15	—	50ms	0	300	10	NEED

			Point Control Stop Time						REBOOT
P6.50	0x30CF	CANOpen	Choose between single-cycle and loop-based options, and select the start/reference point.	Select Single/Loop [0] Looping [1] When running a single multi-point loop, after the step change is completed at the end point, the next step change will start from the starting point; when running a multi-point single, the point control program will not perform a step change when it reaches the end point.	—	0	3	0	NEED REBOOT
P6.51	0x30D0	CANOpen	Step change and start-up methods	Step change and start-up methods [0]Delayed step change, no start signal required, delayed start after S-ON [2] Delayed step change, start signal required, canceling the start signal can immediately shut down the internal pulse, and return to the program start point during restart.	—	0	3	0	NEED REBOOT
P6.52	0x30D1	CANOpen	Step-change input signal mode	Step-change input signal valid mode [0]Step-change input signal level mode [1] Step-change input signal pulse mode	—	0	1	0	NEED REBOOT
P6.53	0x30D2	CANOpen	Programming method	Programming methods [0]: Incremental programming [1]: Absolute value programming Incremental programming: relative displacement (position from the current position to the next point) programming; Absolute value programming: absolute displacement (displacement between the worktable and the reference point) programming.	—	0	1	0	NEED REBOOT
P6.54	0x30D3	CANOpen	Programming Start Steps		—	0	15	0	NEED REBOOT
P6.55	0x30D4	CANOpen	Programming termination step		—	0	15	1	NEED REBOOT
P6.56	0x30D5	CANOpen	Search trip speed	Under position contact control, this is the "search travel speed"; under position zeroing control, it's the "speed when finding a reference point".	rpm	0	3000	1500	NEED REBOOT

P6.57	0x30D6	CANOpen	Exit limit switch speed	Under position contact control, it refers to the "speed when leaving the limit switch"; under position zeroing control, it refers to the "speed when finding the reference point".	rpm	0	200	30	NEED REBOOT
P7.00	0x30D7	CANOpen	Bus Mode	[0]No bus [1]Fieldbus	—	0	3	3	NEED REBOOT
P7.01	0x30D8	CANOpen	MODBUS communication baud rate	[0]4800 [1]9600 [2]19200	—	0	2	1	NEED REBOOT
P7.02	0x30D9	CANOpen	Modbus Communication Protocol	[0] 7N2 [1] 7E1 [2] 7O1 [3] 8N2 [4] 8E1 [5] 8O2	—	0	8	8	NEED REBOOT
P7.03	0x30DA	CANOpen							
P7.04	0x30DB	CANOpen	MODBUS axis address	—	—	1	247	1	NEED REBOOT
P7.05	0x30DC	CANOpen	CAN synchronization time	Change according to the communication time set by the controller	ms	2	15000	200	NEEDREBOOT
P7.06	0x30DD	CANOpen	CAN communication rate	[0]50 kbps [1]100 kbps [2]125 kbps [3]250 kbps [4] 500 kbps [5]1000 kbps	—	0	5	5	NEED REBOOT
P7.07	0x30DE	CANOpen	CAN communication node	—	—	1	127	1	NEED REBOOT
P7.10	0x30E7	CANOpen	DP Communication Jog Speed	Communication speed for bus jogging	rpm	-6000	6000	500	NEED REBOOT
P7.13	0x30EA	CANOpen	Homing Mode Setting	—	—	0	111	0	NEED REBOOT
P7.14	0x30EB	CANOpen	Oscilloscope pre-trigger point setting	In the oscilloscope settings, specify the number of sampling points before the trigger condition is met.	—	0	1000	400	NEED REBOOT
P7.15	0x30EC	CANOpen	Torque Sensor Setting	[0]Enable Torque Sensor [1]Disable Torque Sensor	—	0	0	0	NEED REBOOT
P8.00	0x30F7	CANOpen	Real-time Auto-tuning Module: Auto-tuning Mode Selection	[0]Manual Parameter Adjustment [1]Auto-tune Standard Parameters [2] Auto-tune Stability Parameters [3] Auto-tune Positioning Parameters Note: Auto-tuning may not operate effectively under the following conditions: ■ When the maximum speed of the servo motor	—	0	3	0	NEED REBOOT

				during movement is less than 100 rpm ■ When the acceleration/deceleration of the servo motor is less than 5000 rpm/s ■ For machinery with low load stiffness prone to minor vibration or high friction ■ When the load varies significantly at different speeds during motion ■ When there is substantial mechanical backlash during motion					
P8.01	0x30F8	CANOpen	Real-time Auto-tuning Module: Load Inertia Setting Selection	[0]Manually set load inertia percentage [1, 2, 3] Normal mode for online inertia identification [4, 5, 6] Vertical mode for online inertia identification [1, 4] Load inertia has no variation [2, 5] Load inertia varies slightly [3, 6] Load inertia varies greatly	—	0	6	0	NEED REBOOT
P8.02	0x30F9	CANOpen	Real-time Auto-tuning Module: Load Stiffness Setting	This value determines the response speed of the servo system. Normally, the stiffness should be set as high as practicable. However, an excessively high setting may cause mechanical shock. Reduce this value when severe mechanical vibration occurs. This parameter only takes effect during auto-tuning.	—	0	36	5	NEED REBOOT
P8.03	0x30FA	CANOpen	Speed Gain during Real-time Tuning	The multiplication factor for the speed loop gain under identical stiffness during real-time auto-tuning. The larger this value is set, the higher the speed loop gain during real-time auto-tuning.	—	0	3	3	NEED REBOOT
P8.04	0x30FB	CANOpen	Overload Boost	[0]No overload boost function [1] Overload boost function enabled. This function enhances overload capacity for transient loads exceeding 2 times the rated load, and is applied in scenarios with frequent start-stop operations.	—	0	1	0	NEED REBOOT
P8.05	0x30FC	CANOpen	Low-frequency Vibration	[0] Disable low-frequency vibration suppression	—	0	1	0	NEED REBOOT

			Suppression Switch	function[1] Enable low-frequency vibration suppression function					
P8.06	0x30FD	CANOpen	Low-frequency Vibration Frequency	Frequency value of low-frequency vibration on the load	0.1Hz	50	500	100	NEED REBOOT
P8.07	0x30FE	CANOpen	Low-frequency Vibration Damping	Attenuation damping for load low-frequency vibration	—	0	200	25	NEED REBOOT
P8.08	0x30FF	CANOpen	Friction Load	Compensation for friction load or constant load	0.10%	0	3000	0	NEED REBOOT
P8.09	0x3100	CANOpen	Friction Compensation Speed Hysteresis Zone	Threshold for activating friction compensation	rpm	0	100	0	NEED REBOOT
P8.0A	0x3101	CANOpen	Viscous Friction Load	Viscous damping proportional to speed	0.1%/ 1000rpm	0	1000	0	NEED REBOOT
P8.13	0x310A	CANOpen	Serial Encoder Filter	[0]Remove glitches via serial encoder measurement method [1] Actua	—	0	1	0	NEED REBOOT
P9.00	0x310B	CANOpen	Absolute Encoder Selection	[0] Detect absolute encoder related alarms[1] Do not detect absolute encoder related alarms	—	0	1	0	NEED REBOOT
P9.01	0x310C	CANOpen&EtherCAT	Overvoltage Detection Threshold	Overvoltage detection threshold	V	0	200	55	NEED REBOOT
P9.02	0x310D	CANOpen&EtherCAT	Undervoltage Detection Threshold	Undervoltage detection threshold	V	0	200	40	NEED REBOOT
P9.03	0x310E	CANOpen&EtherCAT	A68 Alarm	Synchronization error alarm masking	—	0	1	1	NEED REBOOT
P9.04	0x310F	CANOpen	Over-tolerance alarm enable	[0]Out-of-tolerance alarm disabled [1] Out-of-tolerance alarm enabled, alarm when the deviation counter value is greater than the value corresponding to Pn504.	—	0	3	0	NEED REBOOT
P9.05	0x3110	CANOpen&EtherCAT	Serial Encoder Error Allowable Time	—	0.1ms	0	10000	3	NEED REBOOT
P9.07	0x3112	CANOpen &EtherCAT	A 14 Alarm Shielding	Low voltage alarm shield bit [0]No alarm shielding [1]Shield alarm	—	0	1	0	NEED RE BOOT
P9.08	0x3113	CANOpen &EtherCAT	A 13 alarm shielding	Overvoltage alarm (A13\A15) Shield bit [0] Unshield alarm [1] Shield alarm	—	0	1	1	NEED REBOOT
P9.09	0x3114	CANOpen &EtherCAT	CAN communication related alarm shielding	Communication alarm related shielding bit [0]Detects A66, A67, A68, A69 [1] Detects A68, A69, shields A66, A67 [2] Detects A66, A67,	—	0	3	3	NEED REBOOT

				shields A68, A69 [3] Shields all CAN alarms					
P9.0A	0x3115	CANOpen &EtherCAT	Hardware detection alarm shielding	Hardware alarm enable bit [0]: Do not mask hardware-related alarms: A15, A13, A14 [1] : Shield hardware-related alarms: A15, A13, A14	—	0	1	0	NEED REBOOT
P9.0C	0x3117	CANOpen &EtherCAT	A 18 alarm shielding	CPU over-temperature alarm masking [0]Enable A18 alarm detection [1]Shield A18 alarm detection	—	0	1	0	NEED REBOOT
P9.0D	0x3118	CANOpen &EtherCAT	A19 alarm shielding	NTC over-temperature alarm shield [0]Enable A19 alarm detection [1]Shield A19 alarm detection	—	0	1	0	NEED REBOOT
P9.0E	0x3119	CANOpen &EtherCAT	Overload alarm threshold	—	%	100	150	100	NEED REBOOT
P9.0F	0x311A	CANOpen &EtherCAT	A18 temperature threshold	—	℃	50	180	95	NEED REBOOT
PA.00	0x311B	CANOpen	Motor automatic recognition function enable position	[0] Disable automatic identification function [1] Enable automatic identification function (automatically obtain Drive Motor , EncoderType , and load servo parameters based on these Types , without reading Motor parameters from Pn parameters at this time .)	—	0	1	0	NEED REBOOT

CANopen Alarm Code

Servo error alarm numbers and descriptions (CANopen)				
Alarm number	Alarm Name	Alarm Description	Solutions	Shielding position
A.01	Parameter out of range	Parameter out of range		
A.03	speeding	Exceeding the rated speed		
A.04	Motor stall alarm	Motor stall alarm		P3.08=0 shielding
A.05	Position deviation counter overflow	Error counter overflow		

A.06	Deviation Overflow			P9.04=0 shielding
A.07	Electronic gear ratio setting error	The electronic gear ratio setting is unreasonable.		
A.08	U-phase current detection abnormal	U-phase current sampling voltage reference abnormal		
A.09	abnormal V-phase current detection	V-phase current sampling voltage reference abnormal		
A.10	U-phase overcurrent	Phase U is outside the sampling range		
A.11	V-phase overcurrent	Phase V is outside the sampling range.		
A.12	Overcurrent	IPM module current is too high		
A.13	Overvoltage warning	Bus voltage > 58V		P9.08=1 can be shielded
A.14	undervoltage	Bus voltage <40V		P9.07=1 can be shielded
A.15	Overvoltage alarm	Bus voltage > 73V		P9.08=1 can be shielded
A.16	W-phase overcurrent	Phase W is outside the sampling range		
A.18	Motor overheat alarm	The MCU temperature is too high, exceeding the value of parameter P9.0F.		P9.0C=1 can be shielded
A.46	Encoder Multi-turn position error	Magnetic ring displacement		P9.06=1 can be shielded
A.47	Encoder low battery alarm	Encoder battery voltage <3.05V		P9.06=2 can be shielded
A.48	Encoder Low Battery Warning	Encoder battery voltage <3.15V		P9.06=2 can be shielded
A.49	First (Motor-side) Encoder exception	Encoder SPI communication timeout	Confirm whether SW1 is ON	
A.50	Second (reducer end) Encoder exception	Encoder SPI communication timeout	Confirm whether SW1 is ON	
A.54	Encoder verification configuration error	Data configuration bit width error	Re-verify Encoder	
A.55	Encoder position jump	Encoder position jump	Power off and restart	
A.56	Encoder Value Abnormal	Encoder Value Abnormal	Power off and restart	
A.66	CAN communication error	CAN communication errors caused by connection abnormalities or interference	P9.09=0, 2 can be enabled	P9.09=3 can be shielded
A.67	Heart bit timeout		P9.09=0, 2 can be enabled	P9.09=3 can be shielded

A.68	Synchronization frames too early		P9.09=0, 1 can be enabled	P9.09=3 can be shielded
A.69	Synchronization frame timeout		P9.09=0, 1 can be enabled	P9.09=3 can be shielded
A.133	Firmware incompatibility	Motor Type and Drive Type do not match		

CAN FD Alarm Code

Servo error alarm numbers and descriptions (CAN FD)				
Alarm number	Alarm Name	Alarm Description	Solutions	Shielding position
A.01	Parameter out of range	Parameter out of range		
A.03	speeding	Exceeding the rated speed		
A.04	Motor stall alarm	Motor stall alarm		P3.08=0 shielding
A.05	Position deviation counter overflow	Error counter overflow		
A.06	Excess overflow			P9.04=0 shielding
A.07	Electronic gear ratio setting error	The electronic gear ratio setting is unreasonable.		
A.08	U-phase current detection abnormal	U-phase current sampling voltage reference abnormal		
A.09	abnormal V-phase current detection	V-phase current sampling voltage reference abnormal		
A.10	U-phase overcurrent	Phase U is outside the sampling range		
A.11	V-phase overcurrent	Phase V is outside the sampling range.		
A.12	Overcurrent	IPM module current is too high		
A.13	Overvoltage warning	Bus voltage > 55V		P9.08=1 can be shielded
A.14	undervoltage	Bus voltage <40V		P9.08=1 can be shielded
A.15	Overvoltage alarm	Bus voltage > 80V		P9.08=1 can be shielded
A.16	W-phase overcurrent	W-phase current sampling voltage reference abnormal		
A.18	Motor overheat alarm	The MCU temperature is too high, exceeding the value of parameter P9.0F.		P9.0C=1 can be shielded
A.46	Encoder Multi-turn position error	Magnetic ring displacement		P9.06=1 can be shielded

A.47	Encoder low battery alarm	Encoder battery voltage <3.05V		P9.06=2 can be shielded
A.48	Encoder Low Battery Warning	Encoder battery voltage <3.15V		P9.06=2 can be shielded
A.49	First (Motor-side) Encoder exception	Encoder SPI communication timeout	Confirm whether SW1 is ON	
A.50	Second (reducer end) Encoder exception	Encoder SPI communication timeout	Confirm whether SW1 is ON	
A.54	Encoder verification configuration error	Data configuration bit width error	Re-verify Encoder	
A.56	Encoder value error	Encoder value error	Power off and restart	
A.100	Message value out of range	Message value out of range	Check the message value	
A.133	Firmware incompatibility	Motor Type and Drive Type do not match		

EtherCAT Alarm Code

Servo error alarm numbers and descriptions (EtherCAT)				
Alarm number	Alarm Name	Possible reasons	Solutions	Shielding position
A.01	Parameter error	Storage application parameter error		
A.02	watchdog Timeout Alarm	watchdog Timeout Alarm	Restart	
A.03	speeding	Exceeding the rated speed		
A.04	Overload or Stalling	Stalling		P3.08=0 can be shielding
A.05	Position deviation counter overflow	Error counter overflow		
A.06	Excess overflow			P9.04=0 can be shielding
A.07	Electronic gear ratio setting error	The electronic gear ratio setting is unreasonable.		
A.08	U-phase current detection abnormal	U-phase current sampling voltage reference abnormal		
A.09	abnormal V-phase current detection	V-phase current sampling voltage reference abnormal		
A.10	U-phase overcurrent	Phase U is outside the sampling range		
A.11	V-phase overcurrent	Phase V is outside the sampling range.		
A.12	Hardware overcurrent	IPM module current is too high		

A.13	Overvoltage warning	Bus voltage > 55V		P9.08=1 can be shielded
A.14	undervoltage	Bus voltage <40V		P9.07=1 can be shielded
A.15	Overvoltage alarm	Bus voltage > 80V		P9.08=1 can be shielded
A.16	W-phase overcurrent	Phase W is outside the sampling range		
A.18	Motor overheat alarm	The MCU temperature exceeds the value of parameter P9.0F.		P9.0C=1 Can be shielded
A.19	NIC overheating	NTC temperature exceeds 85 degrees Celsius		P9.0D=1 Can be shielded
A.46	Encoder Multi-turn position error	Magnetic ring displacement		P9.09=1/3 can be shielded
A.47	Encoder low battery alarm	Encoder battery voltage <3.05V		P9.09=2/3 can be shielded
A.48	Encoder Low Battery Warning	Encoder battery voltage <3.15V		P9.09=2/3 can be shielded
A.49	First (Motor-side) Encoder exception	Encoder SPI communication timeout	Confirm whether SW1 is ON	
A.50	Second (reducer end) Encoder exception	Encoder SPI communication timeout	Confirm whether SW1 is ON	
A.54	Encoder Calibration Configuration Abnormality	Data configuration bit width error	Re-verify Encoder	
A.56	Encoder Communication Abnormality			Restart
A.66	Watchdog Timeout			
A.67	DC synchronization error			
A.68	Synchronization event timeout			
A.133	Firmware incompatibility	Motor Type and Drive Type do not match		

Appendix 3 Battery Safety Precautions

1. Do not place batteries arbitrarily to avoid short circuits.
2. Do not heat batteries or expose them to temperatures above 85°C.
3. Do not attempt to charge the batteries.
4. Do not disassemble or dissect the batteries.
5. Do not reverse the battery polarity.
6. Do not solder directly onto the battery surface or expose it to high-temperature objects.
7. Do not perform compression, impact, or other environmental/safety tests without proper protection.
8. Do not immerse batteries in water, or use/store them unprotected in humid environments.
9. If the battery becomes hot, emits odor, changes color, deforms, or shows any other abnormality during use or storage, stop using it immediately.
10. Dispose of batteries according to local environmental regulations; do not bury them underground or soak them in saltwater.
11. If battery liquid comes into contact with skin, eyes, or clothing, rinse immediately with plenty of water and seek medical attention.
12. Keep batteries away from static environments during use and storage.
13. Store batteries away from heat sources, corrosive gases, and direct sunlight; ensure storage areas are clean, cool, dry, and well-ventilated.
14. During transport, avoid exposure to sunlight, fire, rain, or water, and keep batteries away from corrosive substances.
15. Minimize impacts and vibrations during handling and transport.
16. For long-distance transportation by ship, keep batteries away from engines; in summer, avoid storing them for long periods in non-ventilated areas.

Appendix 4 Frequently Asked Questions (FAQ)

Q: What is the difference between T-type and I-type low-voltage modules?
A: The difference lies in their appearance and installation method.

Q: What is the acceptable power supply range for low-voltage modules?
A: 48V ± 10% (43.2–52.8V)

Q: How can parameters of low-voltage modules be modified?
A: First, connect the module ’s 485 communication port to a PC via a 485-USB converter. Then, use the Athena PC software to upload the parameter table and modify the corresponding parameters.

Q: Does the encoder currently support embedding into the control board?
A: No, it is not supported at present.

Q: Do low-voltage joint modules support 24V, or can a custom 24V version be provided?
A: Currently, 24V supply is not supported. A transformer or other method can be used to step up the voltage to 48V for use.

Q: Can dual encoders retain single-turn values without power and without a battery?
A: The single-turn encoder is absolute, so it will not lose its single-turn position without a battery. However, since the encoder is mounted on the motor side, the motor ’s single-turn movement corresponds to a very small range at the output. It is recommended to use a battery to store multi-turn positions.

Q: How can the firmware software and user manual be obtained?
A: They can be downloaded from the official website: www.laifualdrive.com

Chapter 15 Document Revision Record

Document Revision Record

Revision Previous Version	Page No.	Chapter	Revision Summary	Revision Date
V1.00	Total Pages: 70	Total Chapters: 11	First Edition	2025/05/06
V1.01	Total Pages: 75	Total Chapters: 12	Added Upper Computer Parameter Table and Error Code Table Added Key Parameter Confirmation Table	2025/08/01
V1.02	Total Pages: 75	Total Chapters: 12	Format Revision	2025/09/28
V1.03	Total Pages: 80	Total Chapters: 12	Added Discharge Module Selection, Connection, Electrical Interface and Instructions	2025/10/20
V1.04	Total Pages: 83	Total Chapters: 12	Revised Upper Computer Operation Process for Key Parameters	2025/10/22
V1.05	Total Pages: 112	Total Chapters: 13	Added Multi-Joint Connection Configuration, Brake, Encoder Description, Rigidity, and Common	2025/11/13

			Problems QA	
V1.06	Total Pages: 112	Total Chapters: 13	Added Alarm Codes	2025/12/8
V1.07	Total Pages: 113	Total Chapters: 13	Selection and Connection of Additional Discharging Module	2026/1/28
V1.08	Total Pages: 120	Total Chapters: 13	Added parameters and technical drawings for L52I and L62I modules, multi-joint connection configuration diagram, and CAN FD related content.	2026/3/10
V1.09	Total Pages: 176	Total Chapters: 15	Add Overturning Moment Calculation & Configuration Examples for Beckhoff, Xinje, Inovance	2026/6/30
V1.10	Total Pages: 179	Total Chapters: 15	Revise naming format, add parameters and drawings for L40, L60 and L190 modules.	2026/9/16

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