INOVANCE

FORWARD, ALWAYS PROGRESSING



IR-TP200 Series Industrial Robot Teach Pendant

User Guide

Industrial Automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

Data code 19012798A00

Preface

Introduction

The application of robot technology is becoming increasingly widespread, bringing unprecedented efficiency improvements and innovation possibilities to various industries. The teach pendant serves as a bridge for communication and control between technicians and robots. With its flexible operation and precise programming capabilities, the teach pendant is key to achieving efficient robot operation and complex task programming, playing a vital role in maximizing the performance and functionality of robots. This manual aims to provide you with comprehensive, detailed, and easy-to-understand guidance to help you quickly become familiar with and master the operation of the robot teach pendant, including but not limited to basic operations, function settings, programming examples, and solutions to common issues, to meet the needs of different application scenarios.

More Data

Data Name	Data Code	Description
<IR-TP200 Series Industrial Robot Teach Pendant User Guide>	19012798	This guide introduces software-related operations of the robot teach pendant. Contact Inovance technical support to obtain this guide.

Revision History

Revision Date	Document Version	Revision
2025.08	A00	Initial release

Access to the Guide

This guide is not delivered along with the product. You can visit www.inovance.com to download the PDF document.

Contents

1 Safety Disclaimer 13
1.1 Precautions for Robot Operation 13
1.2 Users 14
1.3 Emergency Safety Information 15
1.3.1 Emergency Stop and Stop 15
1.3.2 Emergency Stop Modes 16
1.3.3 Recovery from Emergency Stop State 18
1.4 Operation Mode Declaration 19
1.4.1 Manual Low Speed Mode 19
1.4.2 Manual High Speed Mode 19
1.4.3 Auto Mode 19
1.5 Disclaimer 19
2 Concepts and Terms 20
2.1 Classification of Robots 20
2.2 Frames 20
2.2.1 Joint Frame 21
2.2.2 Base Frame 21
2.2.3 World Frame 22
2.2.4 Tool Frame 22
2.2.5 Workobject Frame 24
2.3 Position Variables 24
2.3.1 Overview 24
2.3.2 Storage Format of Position Variables 25
2.3.3 Attributes of Position Variables 26
2.4 Offset 30
2.4.1 Offset Along the Current Tool Pose 30
2.4.2 Offset in a Cartesian Reference Frame 30
2.5 Interpolation and Transition 31
2.6 Singular Position 33
2.7 Motion Range and Interference Zone 34
3 Product Introduction 36
3.1 Overview 36
3.2 Hand-held Teach Pendant IR-TP200 36
3.2.1 Model and Nameplate 36
3.2.2 Components 37
3.2.3 Button Function Table 38
3.2.4 Key Switch 39

3.2.5 Outline Dimensions · · · · · 40
3.2.6 Operation Mode · · · · · 40
3.2.7 Specifications · · · · · 42
3.2.8 Physical Environment Requirements · · · · · 42
3.2.9 Precautions for Using the Teach Pendant · · · · · 43
3.2.10 Software Acquisition and Upgrade · · · · · 43
3.3 Connection Between Hand-held Teach Pendant and Controller · · · · · 44
3.3.1 Wiring to the Controller · · · · · 44
3.3.2 Cable Description · · · · · 45
3.3.2.1 Connecting Cable · · · · · 45
3.3.2.2 Extension Cable · · · · · 46
3.3.2.3 Teach Pendant Adapter · · · · · 47
3.3.3 Aviation Connector Definition · · · · · 48
3.3.4 Dual Circuit Enable · · · · · 49
3.4 PC-based Teach Pendant InoRobotTP · · · · · 49
3.4.1 Operating Environment · · · · · 49
3.4.2 Software Acquisition and Upgrade · · · · · 50
3.4.3 Software Connection to Multiple Controllers · · · · · 50
3.4.4 Version Description · · · · · 50
4 Getting Started · · · · · 51
4.1 Programming Flowchart · · · · · 51
4.2 Connection · · · · · 52
4.2.1 Connecting the Teach Pendant to the Controller · · · · · 52
4.2.2 User Login · · · · · 52
4.2.3 Status Check · · · · · 53
4.3 Programming and Debugging Example · · · · · 53
4.3.1 Controlling Robot Motion Through Axis Control (Manual) · · · · · 54
4.3.2 Robot Programming Example · · · · · 56
5 Teach Pendant InoRobotTP Menu · · · · · 61
5.1 Home Page · · · · · 61
5.2 Programming · · · · · 61
5.3 Monitor · · · · · 62
5.4 Settings · · · · · 62
6 Status Bar Window · · · · · 64
6.1 Shortcut Navigation · · · · · 64
6.1.1 Recent · · · · · 64
6.1.2 Quick Access · · · · · 64
6.2 Authority · · · · · 65
6.2.1 User Login · · · · · 65

6.2.2 Changing the Password 69
6.2.3 Retrieving the Password 69
6.3 Control Authority 70
6.4 Log 73
6.5 Notification 74
6.6 Control Panel 74
6.6.1 Speed Panel 75
6.6.2 Mechanical Unit Control Panel 76
6.6.2.1 Dynamic Brake 77
6.6.2.2 Orientation Alignment 78
6.6.2.3 Singularity Crossing 80
6.7 Status Display Light 82
6.8 Version 83
7 Virtual Physical Panel 84
7.1 Operation Mode 85
7.2 Shortcuts for PC-based Teach Pendant 86
8 Programming and Debugging 88
8.1 Programming 88
8.1.1 Programming Interface 88
8.1.1.1 Save 89
8.1.2 Program Operation 90
8.1.3 Instruction Edit 92
8.1.4 Point Operation 97
8.2 Project Manager 99
8.2.1 Project List 99
8.2.2 Project Details 101
8.2.3 Project File Operations 103
8.2.4 Projects Editing Operations 104
8.2.4.1 Editing the Program 104
8.2.4.2 Editing the Point 104
8.2.4.3 Editing the Labels 110
8.2.4.4 Editing the User Alarm 112
8.2.4.5 Project Configuration 113
8.3 Debugging 115
8.3.1 Debugging Page 115
8.3.2 Debugging Running 117
8.3.3 Run Cursor 119
8.3.4 Task Status 120

8.3.5 Task Debugging · · · · · 121
8.3.6 Debugging Operations · · · · · 122
8.3.7 Variable Monitor · · · · · 123
8.3.8 Global Variable Monitor · · · · · 127
8.3.9 I/O Monitor · · · · · 131
8.3.10 Modify Point · · · · · 135
8.4 Multitasking · · · · · 136
8.4.1 Task Type and Specification Description · · · · · 136
8.4.2 Use of Multitasking · · · · · 138
8.4.3 Multitasking Alarm · · · · · 140
9 Monitor · · · · · 141
9.1 General Operation Introduction · · · · · 141
9.2 Global Variable Monitor · · · · · 141
9.2.1 B/R/D Variable · · · · · 141
9.2.2 PR Offset Variable · · · · · 142
9.2.3 String Variable · · · · · 142
9.2.4 P/JP Variable · · · · · 143
9.2.5 Global Variables Search · · · · · 144
9.3 I/O Monitor · · · · · 144
9.3.1 Concept of Robot Bus Addresses · · · · · 144
9.3.2 Use of I/O Monitor · · · · · 145
9.3.2.1 IN · · · · · 145
9.3.2.2 OUT · · · · · 148
9.3.2.3 AD/DA · · · · · 149
9.3.2.4 System I/O · · · · · 150
9.3.2.5 Meaning of Colors in I/O Monitor · · · · · 153
9.4 Communication Status · · · · · 153
9.4.1 Equipment Connection · · · · · 153
9.4.2 Bus Monitoring · · · · · 155
9.4.2.1 Modbus · · · · · 155
9.4.2.2 EtherNet/IP · · · · · 156
9.4.2.3 EtherCAT · · · · · 156
9.4.2.4 MC · · · · · 157
9.5 Servo Status · · · · · 157
9.6 Work Condition Monitor · · · · · 158
10 Settings · · · · · 159
10.1 Robot Settings · · · · · 159

10.2 Zero Point Settings 159
10.2.1 Setting the Absolute Zero Point 159
10.2.2 Setting the Work Origin 160
10.2.2.1 Triggering Signal Output when Approaching Work Origin 160
10.2.3 Zero Point Calibration 161
10.2.3.1 Four-Axis Zero Point Calibration 161
10.2.3.1.1 Preparation 162
10.2.3.1.2 Homing Steps 163
10.2.3.1.3 Notes 168
10.3 Installation Parameters Settings 168
10.3.1 Setting the Tools 168
10.3.2 Setting the Workobject 176
10.3.3 Setting the Load 181
10.3.4 Setting the Arm Load 182
10.3.5 Setting the Environmental Parameters 182
10.3.6 Setting the Installation Form 183
10.3.7 Setting Auto Warm-up 184
10.4 Peripheral Configuration 187
10.4.1 Fieldbus Switch Settings 187
10.4.1.1 Slave 187
10.4.1.2 Master 193
10.4.2 I/O Mapping 195
10.4.3 Project Number Configuration 199
10.4.4 Point File Configuration 200
10.4.5 IR-Link Settings 203
10.4.6 Mechanical Unit Configuration 207
10.4.6.1 External Axis Linked Motion 208
10.4.6.2 External Axis Coordination 214
10.4.6.3 External Axis Supported Servo Gantry Synchronization Function 234
10.4.7 Safety I/O Action 235
10.4.7.1 Steps 236
10.5 Motion Parameters Settings 240
10.5.1 Teach Parameter Settings 240
10.5.2 Run Parameter Settings 240
10.5.3 Axis Parameter Settings 242
10.5.4 Collision Detection Settings 242
10.5.5 Collision Response 249
10.5.5.1 Overview 249

10.5.5.2 Plan to Stop ····· 249
10.5.5.2.1 Description ····· 250
10.5.5.2.2 Steps ····· 250
10.5.5.3 Immediate Rollback ····· 250
10.5.5.3.1 Description ····· 250
10.5.5.3.2 Steps ····· 250
10.5.5.3.3 Notes ····· 250
10.5.5.4 Stop Immediately ····· 251
10.5.5.4.1 Description ····· 251
10.5.5.4.2 Steps ····· 251
10.5.5.4.3 Notes ····· 251
10.5.5.5 Priority of Actions Triggered by Instruction Settings and Interface Settings ····· 251
10.5.6 Trajectory Recovery Settings ····· 252
10.5.7 Closed-loop vibration Control ····· 254
10.5.8 Self-learning Vibration Control ····· 255
10.5.8.1 Function Introduction ····· 255
10.5.8.2 Related Instructions ····· 255
10.5.8.3 Backup, Load, Restoring, and Clear of Self-learning Data ····· 261
10.5.8.4 Application Example ····· 265
10.5.9 Torque Model Correction ····· 266
10.5.10 Soft Float Function ····· 267
10.5.10.1 Overview ····· 267
10.5.10.2 Steps ····· 268
10.5.10.3 Notes ····· 269
10.6 System Settings ····· 270
10.6.1 Connection ····· 270
10.6.2 Communication Settings ····· 271
10.6.2.1 Network Configuration ····· 271
10.6.2.2 Communication Manager ····· 272
10.6.3 System Backup and Load ····· 275
10.6.3.1 Configuration File Backup ····· 275
10.6.3.2 Load Configuration File ····· 276
10.6.3.3 Memory Card Backup ····· 276
10.6.3.4 Load Memory Card ····· 278
10.6.3.5 Format Memory Card ····· 278
10.6.3.6 Load Point File ····· 279
10.6.3.7 System Upgrade ····· 279
10.6.3.8 Restore Factory Settings ····· 280

10.6.3.9 Clear Historical Alarms ····· 281
10.6.4 Time Settings ····· 281
10.6.5 Start/Step Into Buttons ····· 281
10.6.6 Safety Door-Triggered Stop Mode ····· 283
10.6.6.1 Safety Door Activation ····· 283
10.6.6.2 Safety Door Use ····· 284
10.6.7 Quick Stop Trigger Method ····· 285
10.6.8 Emergency Stop Mode ····· 286
10.6.9 Flying Trigger I/O ····· 286
10.6.9.1 Overview ····· 287
10.6.9.2 Case Description ····· 287
10.6.10 Program Quantity Setting ····· 288
10.6.11 Remote Line Number Reset ····· 289
10.6.12 Remote Stop Policy ····· 289
10.6.13 Robot Maintenance ····· 290
10.7 Workspace ····· 295
10.7.1 Axis Limit Settings ····· 295
10.7.2 Interference Zone Settings ····· 295
10.7.2.1 Overview ····· 296
10.7.2.2 Steps ····· 296
10.7.2.3 Notes ····· 303
10.8 Debug ····· 303
10.8.1 Network Debug ····· 303
10.8.2 Controller Debug ····· 304
10.8.3 System Diagnostics ····· 306
10.8.4 COM Switch ····· 307
10.8.5 Log Settings ····· 307
10.8.6 Controller Universality ····· 308
10.8.6.1 Functions and Operating Steps ····· 308
10.8.6.2 Notes ····· 315
10.8.7 Release Brake ····· 315
10.9 Teach Pendant Settings ····· 318
10.9.1 Display Settings ····· 319
10.9.1.1 Screen Brightness Settings ····· 319
10.9.1.2 Screen Saver Function ····· 319
10.9.1.3 Screen Off Function ····· 320
10.9.1.4 Screen Calibration ····· 320
10.9.2 Teach Pendant Reboot ····· 321

11 Process Application 322
11.1 Conveyor Tracking 322
11.1.1 Overview 322
11.1.1.1 Workflow 322
11.1.1.2 Position Description System 323
11.1.1.3 Function Specifications 324
11.1.1.4 Configuration Flowchart 325
11.1.2 Hardware Configuration 325
11.1.2.1 Connecting the Encoder 325
11.1.2.2 Connecting the Photoelectric Sensor 326
11.1.2.3 Vision Device 326
11.1.3 Frame Settings 326
11.1.4 Parameter Settings 329
11.1.4.1 Basic Parameter Settings 330
11.1.4.2 Encoder Calibration 331
11.1.4.3 Workobject Height Calibration 332
11.1.4.4 Boundary Parameter Settings 333
11.1.4.5 Detection Parameter Setting 335
11.1.5 Notes 342
11.1.6 Application Cases 344
11.1.6.1 Dynamic Grasping 344
11.1.6.2 Dynamic Sorting 345
11.1.7 Auxiliary Functions 347
11.1.7.1 Accuracy Verification 347
11.1.7.2 One-Drive-Many Vision Function 348
11.1.7.3 Monitoring Interface 356
11.2 Vision Calibration 358
11.2.1 Overview 358
11.2.2 Vision Calibration of SCARA Robots 360
11.2.3 Vision Calibration of 6-Axis Robots 360
11.2.3.1 Steps 361
11.2.3.2 Result Verification 362
11.2.4 Eye-to-Hand Overlook Calibration 362
11.2.4.1 Installation Condition 362
11.2.4.2 Calibration Steps 362
11.2.4.3 Camera Communication Test 364
11.2.5 Eye-to-Hand Look Up Calibration 369
11.2.5.1 Installation Condition 369
11.2.5.2 Calibration Steps 370

11.2.6 Eye-in-Hand J2 Calibration 371
11.2.6.1 Installation Condition 371
11.2.6.2 Calibration Steps 372
11.2.7 Eye-in-Hand J4 Calibration 374
11.2.7.1 Installation Condition 375
11.2.7.2 Calibration Steps 375
11.2.8 Eye-in-Hand J5 Calibration 375
11.2.8.1 Installation Condition 376
11.2.8.2 Calibration Steps 376
11.2.9 Eye-in-Hand J6 Calibration 376
11.2.9.1 Installation Condition 377
11.2.9.2 Calibration Steps 377
11.2.10 Vision Process Calibration Examples and Result Verification 379
12 Function Application 391
12.1 Optimal Trajectory 391
12.1.1 Function Introduction 391
12.1.2 Debugging Steps 391
12.1.3 Application Example 392
12.2 ECP Function 392
12.2.1 Overview 392
12.2.2 Calibration of the ECP Frame 393
12.2.3 Motion in ECP Mode 393
12.2.4 Jog Motion in ECP Mode 394
12.2.5 Notes 395
12.3 Free Curve 396
12.3.1 Overview 396
12.3.2 Steps 396
12.3.3 Configuration of Curve Parameters 396
12.3.4 Notes 401
12.4 Load Auto-Tuning 405
12.4.1 Function Introduction 405
12.4.1.1 Opening Load Auto-Tuning 405
12.4.1.2 Tool Load Auto-Tuning 405
12.4.1.3 Grip Load Auto-Tuning 412
12.4.2 Notes 419
12.5 Independent Axis Function 420
12.5.1 Overview 420
12.5.2 Function Introduction 421
12.5.3 Steps 422

12.5.4 Notes ····· 425
12.6 Current Protection and Temperature Rise Protection ····· 426
12.6.1 Current Protection ····· 426
12.6.1.1 Application Scenario ····· 426
12.6.1.2 Monitoring and Debugging Method ····· 427
12.6.1.3 Setting the Limit Coefficient ····· 428
12.6.2 Temperature Rise Protection ····· 430
12.6.2.1 Application Scenario ····· 431
12.6.2.2 Software Interface and Function Description ····· 431
13 Robot Alarms and Handling Method ····· 436

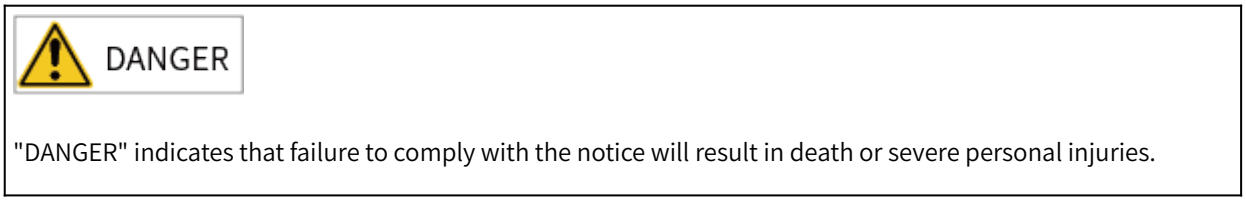
1 Safety Disclaimer

1.1 Precautions for Robot Operation

Safety Disclaimer

- This chapter presents essential safety instructions for a proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to observe the safety instructions may result in death, personal injuries, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" items in this guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- Use this product according to designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions



"DANGER" indicates that failure to comply with the notice will result in death or severe personal injuries.



"WARNING" indicates that failure to comply with the notice may result in death or severe personal injuries.



"CAUTION" indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Power-On
 Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted. Check that the power supply meets equipment requirements before power-on to prevent equipment damage or a fire. Do not open the cabinet door or protective cover of the product, touch any wiring terminal of the product, or remove any part of the product with power on. Failure to comply can result in an electric shock.
 After the completion of wiring and parameter setting, perform a robot test run to confirm that the robot can operate safely. Failure to comply may result in personal injuries or equipment damage. Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire accident. Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in death or personal injury.
Operation
 The equipment must be operated only by professionals. Failure to comply can result in death or personal injury. Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply can result in an electric shock.
 Do not touch the equipment enclosure, fan, or resistor with bare hands to sense the temperature. Failure to comply may result in personal injury. Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

1.2 Users

Personnel classification	Job responsibilities	Remarks
Operator	• Perform daily power supply OFF/ON operations for the robot system. • Perform emergency stop operation in emergency situation. • Monitor the normal operation of the robot program.	Shall not perform tasks inside the safety fence.
Programmer	• Perform normal operations of the robot. • Perform programming and commissioning operations for the robot program. • Perform teaching operations for the robot.	Can perform tasks inside the safety fence.
Maintenance personnel	• Perform normal operations of the robot. • Perform maintenance and repair operations on the robot.	Can perform tasks inside the safety fence.

1.3 Emergency Safety Information

1.3.1 Emergency Stop and Stop

Emergency stop

When someone is in danger within the robot working area or the robot is damaging equipment, immediately press any emergency stop button.

When the emergency stop button for the robot is pressed, the motor power is cut off, and the braking system stops the robot in the shortest possible distance.

Use the emergency stop button in the emergency situations.	Do not use the emergency stop button in the non-emergency situations.
If any of the following abnormalities or emergency situations occur during robot operation, immediately press the emergency stop button: • There are personnel within the robot working area. • The robot injures personnel or damages equipment.	Do not use the emergency stop button in non-emergency situations during normal robot operation: • Frequent braking can shorten the lifespan of the motor brake release switch. • Pressing the emergency stop button when the robot is operating at high speed and under heavy load may cause the robot accuracy to exceed the specified range, and in severe cases, may damage the robot. • The normal operating trajectory of the robot may be disrupted, leading to incorrect actions and, in severe cases, collisions with nearby objects, causing dangerous accidents.



Stop

To stop the robot in non-emergency situations, press the stop button on the teach pendant. In this case, the motor power is not cut off, and the brake release switch remains open, which does not affect its lifespan.



1.3.2 Emergency Stop Modes

The emergency stop is implemented in accordance with the standards GB 11921.1 / ISO 10218-1 and IEC 60204-1. Emergency stop is the highest level of stop mode, which cuts off the power supply to the motor and provides the fastest deceleration to maximumly avoiding other hazards. The emergency stop is effective in all operation modes.

Emergency stop mode

- Class 0 stop is an uncontrolled stop mode, corresponding to Category 0 stop according to IEC 60204-1:2005. The drive stops output and dynamic braking is applied. When the speed decreases, the brake release switch is closed.
- Class 1 stop is a controlled stop mode, corresponding to Category 1 stop according to IEC 60204-1:2005. The stop is planned by the controller. When the planning is complete, the drive is disabled and the brake release switch is closed.

Emergency stop trigger mode

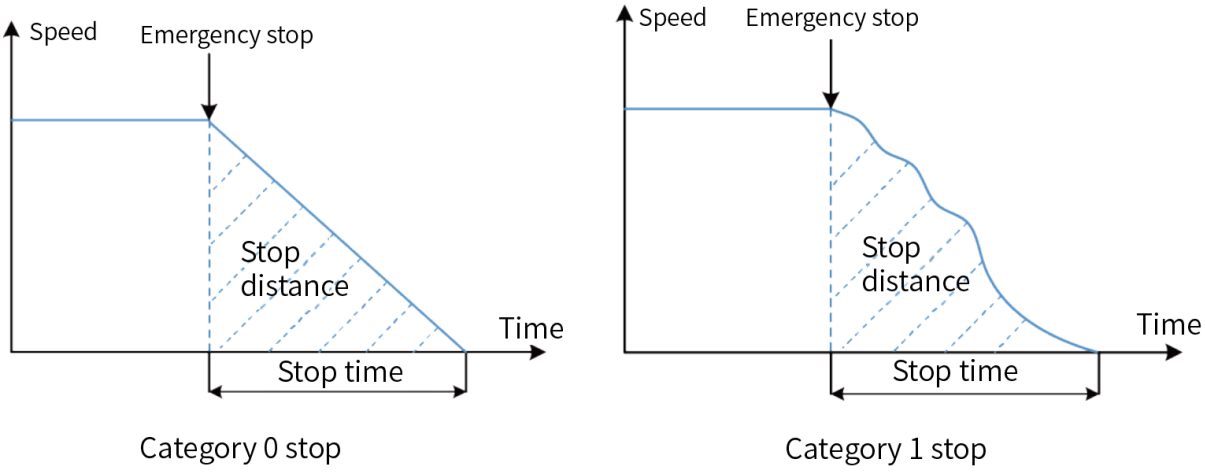
- Mode 1: Use the emergency stop button on the hand-held teach pendant.
- Mode 2: Use the emergency stop button on the PC-based teach pendant or on the InoRobotLab software.
- Mode 3: Use the external wiring (SAFETY terminal, safety door, etc.). Emergency stop modes can be configured according to the controller model. Except for the emergency stop button on the PC teach pendant, which defaults to Category 1 stop, the emergency stop function of other modes is a Category 0 stop. When the emergency stop is configured as a Category 0 stop, the emergency stop is an uncontrolled stop, and a corresponding stopping distance should be reserved in the robot's workspace.



- Mode 2 of triggering an emergency stop is implemented via network communication, which may increase the response time due to poor communication. It is recommended to use mode 1 or 3.
- Emergency stop is for emergency situations only and cannot replace normal program stop. Frequent emergency stops of an operating robot via the emergency stop button can lead to robot failure and reduce its lifespan.
- During system troubleshooting, maintenance, or grip installation, the emergency stop cannot replace the powering off to the controller . External misoperations may cause risks of emergency stop recovery, which could lead to the motor being powered on, resulting in safety accidents.
- The stopping distance and stopping time for Category 1 stop are longer than those for Category 0 stop. When using Category 1 stop, it is necessary to conduct a thorough risk assessment of the system, considering the increased stopping distance and stopping time.

Inertial travel distance during emergency stop

When the control system enters a robot emergency stop, the robot does not stop immediately due to kinetic energy. There is a stopping time and stopping distance after the emergency stop is activated. The stopping time (inertial travel time) and stopping distance (inertial travel angle) during an emergency stop vary depending on the stop mode. The stopping time and stopping distance during an emergency stop are determined by the stop mode and stop parameters of different robot models.

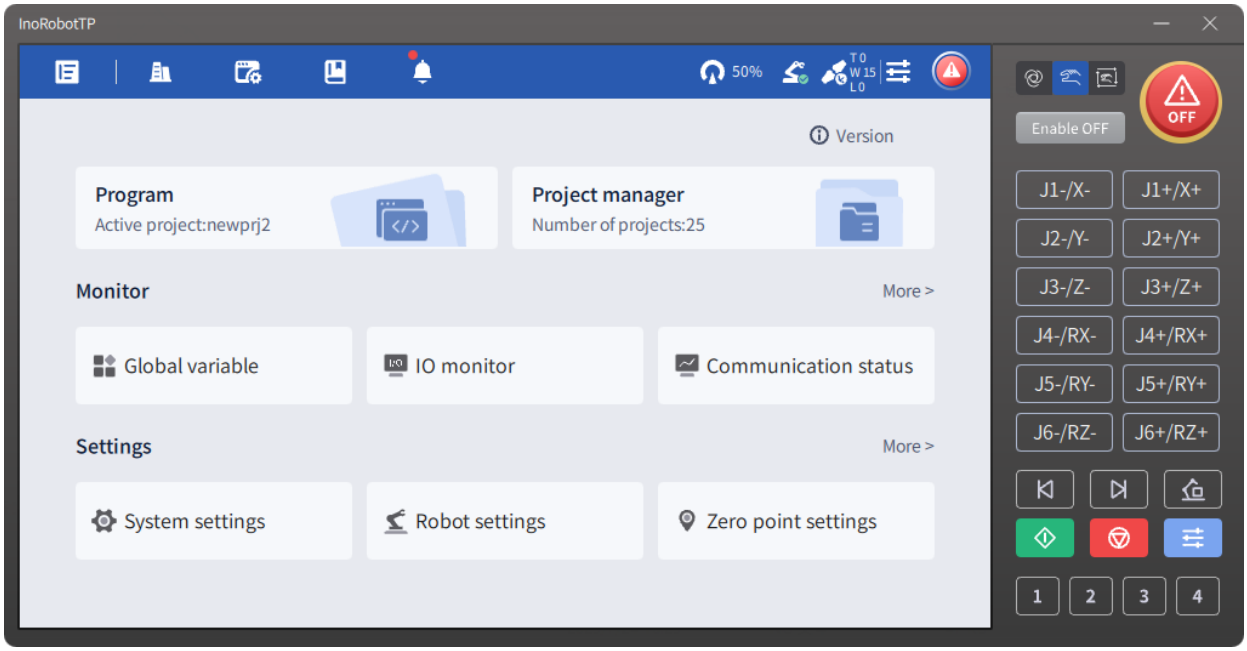


Release of the emergency stop state

Recovery from the emergency stop state must be performed manually by the operator according to safety standards.

The detailed operations are as follows:

1. Check if the robot system and peripheral equipments allow the release of the emergency stop state.
2. If the emergency stop state can be released, the following methods can be used:
   - Release the emergency stop button on the teach pendant.
   - Click the emergency stop icon again on the PC-based teach pendant.
   - Restore the level through the external wiring.
   - Resolve system faults to return to a non-emergency stop state.
3. After recovery from the emergency stop state, the controller remains in an alarm state. You can clear the alarm to resume normal operation.



1.3.3 Recovery from Emergency Stop State

- After the fault is cleared, manually rotate the emergency stop button to release the emergency stop state.

- When starting the robot and resuming operation from a fault state, after powering on the motor, the operator should keep their hand on the emergency stop switch to immediately cut off the motor power in case of any abnormal situation.

1.4 Operation Mode Declaration

1.4.1 Manual Low Speed Mode

The manual low speed mode imposes safety speed limits on robot motion, providing high flexibility for project modifications, teaching and debugging. It subjects to the following safety restrictions:

- The robot motion speed does not exceed 250 mm/s.
- Debugging supports hold-to-run only.
- The enable switch must be kept half-pressed continuously during teaching or debugging.

1.4.2 Manual High Speed Mode

The manual high speed mode further relaxes speed limits on the basis of manual low speed mode. It is used only for debugging, and does not support excessive function modifications. It subjects to the following safety restrictions:

- Project cannot be edited.
- Debugging supports hold-to-run only.
- The initial speed after each switch to manual high speed mode is 1%.
- Speed adjustments can only be made in the enabled state. The speed will automatically return to the initial speed after the enabled state is canceled for more than 5 minutes.

1.4.3 Auto Mode

Auto mode is used for running programs with speed limits released, and does not support multi-function modifications. It subjects to the following safety restrictions:

- Project cannot be edited.
- Axis motion teaching is not allowed.
- Only the start, operation, and stop of the program are supported.

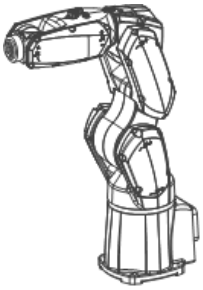
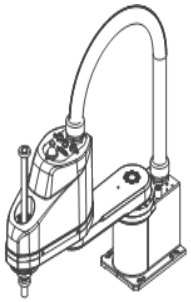
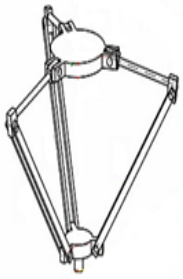
1.5 Disclaimer

- All operators must complete safety training and comply with safety regulations before operating the robot. Failure to comply may result in personal injury or damage to the industrial robot and other equipment.
- No information regarding safety contained in this manual shall be construed as a warranty by Inovance Technology that following all safety instructions will prevent injury or damage to personnel or the industrial robot.

2 Concepts and Terms

2.1 Classification of Robots

Robots can be classified based on the number of axes, series/parallel characteristics, etc. The following table lists several common robots:

Name	Type	Number of axes	Serial/ Parallel	Description	Application
6-axis robot		6	Serial	Extremely flexible and suitable for working with virtually any trajectory or angle.	Loading, painting, measuring, arc welding, spot welding, packaging, assembly, forging, casting, etc.
SCARA robot		4	Serial	Lightweight structure and fast response	Mechanical assembly, material distribution, etc., assembly, labeling, patching, dispensing, etc. in 3C industry.
Delta robot		4	Parallel	High precision, fast speed	Handling, sorting, etc. of pharmaceutical and food products.

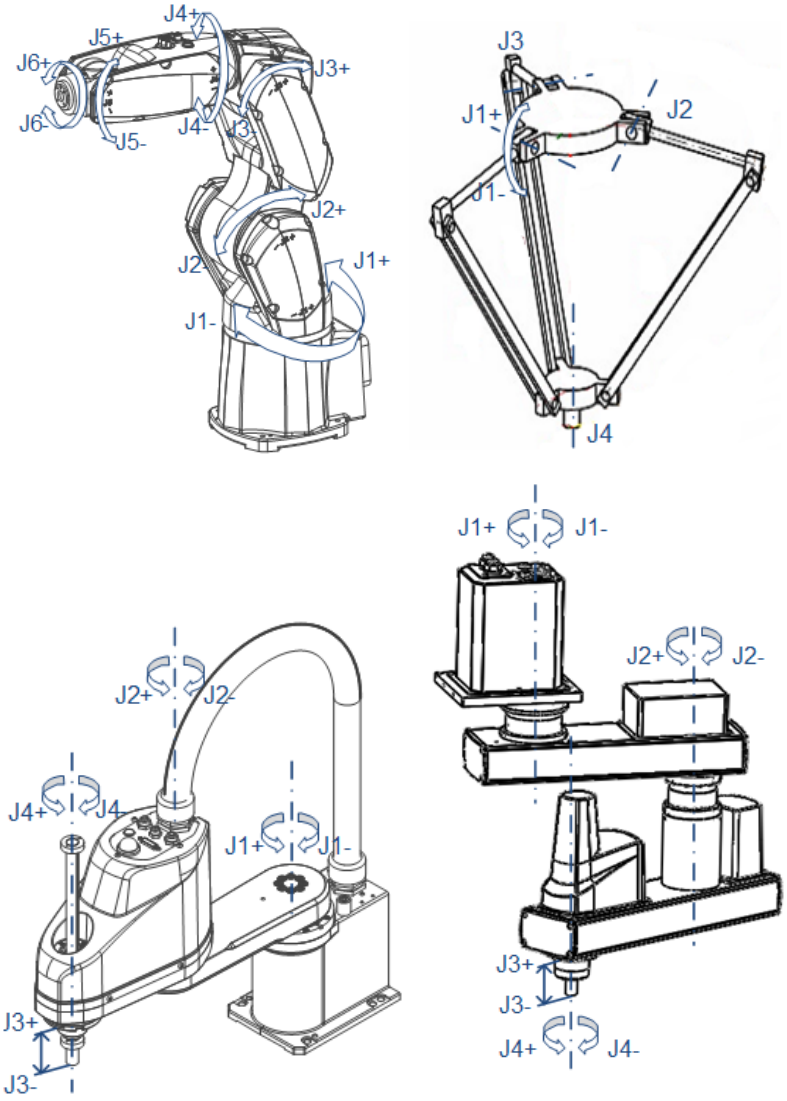
2.2 Frames

Five frames are available in Inovance robot system.

Frame No.	Frame name	Definition
1	Joint frame	A frame defined at each joint of the robot, which is a direct description of the motion of the robot joints.
2	Base frame	A frame defined on the base of the robot, often used as a reference for motion.
3	World frame	The absolute frame of the system.
4	Tool frame	A frame defined on the tool, which can be customized.
5	Workobject frame	A frame defined on the work object, which can be customized.

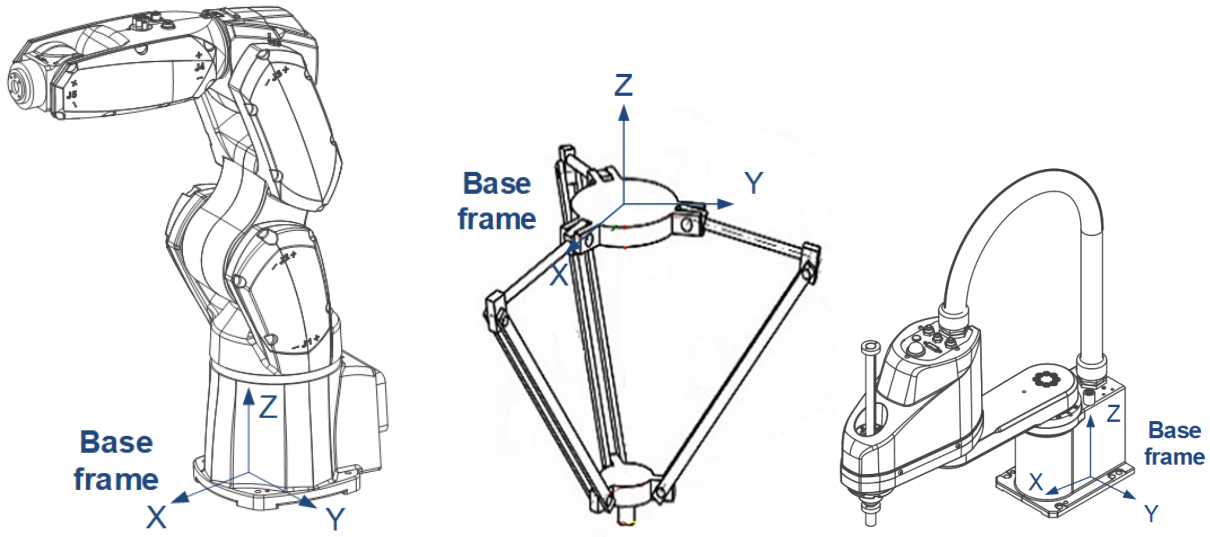
2.2.1 Joint Frame

The joint frame is located at the joints of the robot.

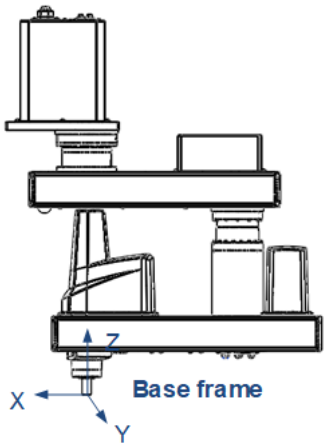


2.2.2 Base Frame

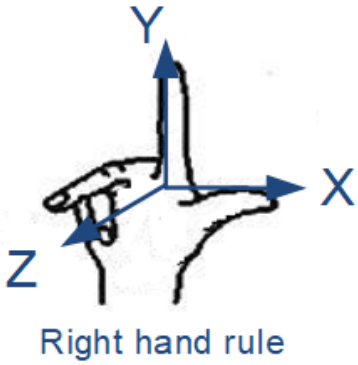
The base frame is also called the robot frame and is generally located at the base of the robot.



The base frame of inverted SCARA robot is located on the flange at the zero point and does not move with the flange.

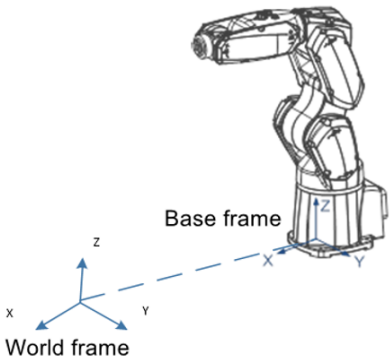


The base frame is a Cartesian frame. (The world, tool and workobject frames are also Cartesian frames.) The X and Z directions can be determined first, and then the Y direction can be determined by the right-hand rule.



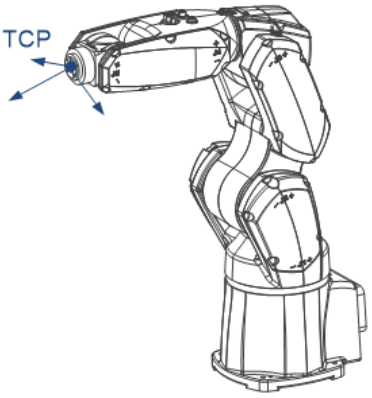
2.2.3 World Frame

The world frame does not depend on other references. It is often defined as the absolute origin and used as the reference position of other frames (except for the grip tool). When the robot is not fixed (i.e., mounted on the guide rail), the world frame cannot be coincident with the base frame. It is often necessary to describe the position of the robot in the base frame relative to the world frame.

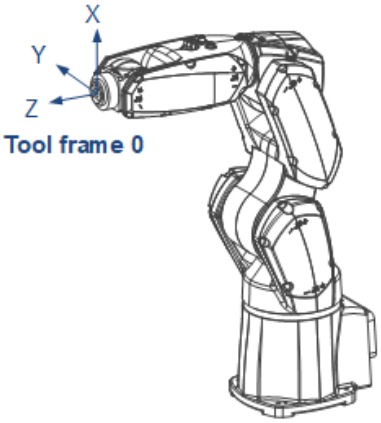


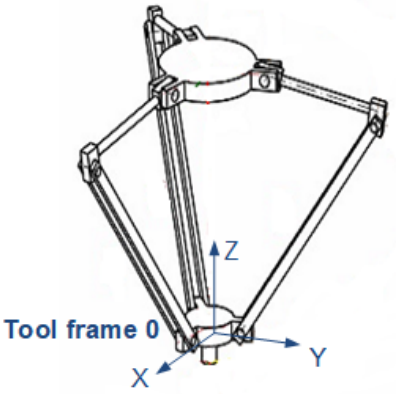
2.2.4 Tool Frame

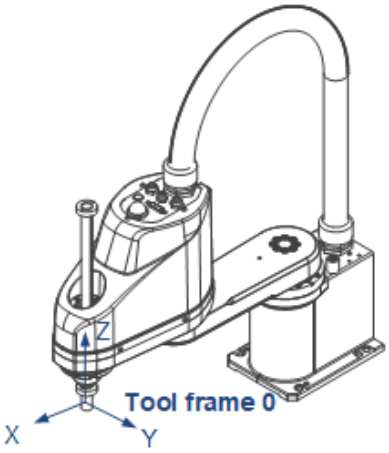
The tool frame is attached to a tool. The tool center point (TCP) is a reference point for a position where the robot reaches. The tool endpoint is generally taken as the TCP and the direction can be freely defined.

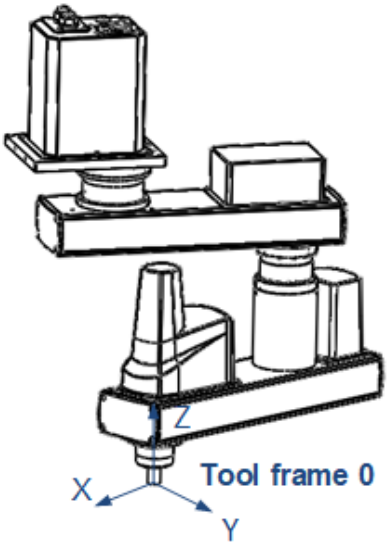


Up to 16 tool frames can be defined in Inovance robot control system. Tool 0 indicates that no tool is used, in which case, the tool frame is located at the end of the manipulator.

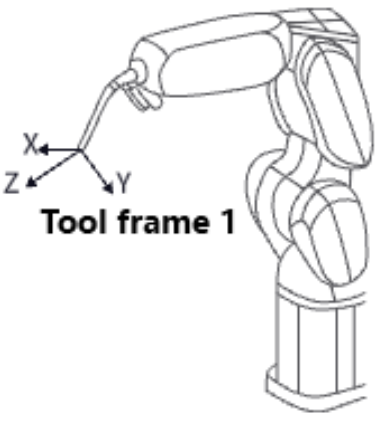






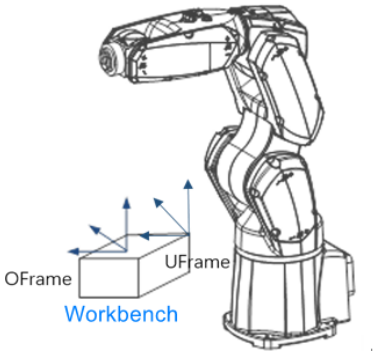


Tools 1-15 can be user defined.



2.2.5 Workobject Frame

The workobject frame is a user-defined frame. The workobject frame can be set arbitrarily and is generally set on specific objects, such as a workbench or a work object.



Up to 16 workobject frames can be defined in Inovance robot control system. User 0 indicates that no additional workobject frame is used. In this case, the workobject frame coincides with the world frame. Workobjects 1 to 15 can be defined by the user. A workobject includes two pose relationships (UFrame, OFrame). Parameters within UFrame indicate the relationship of the {UFrame} frame to the world frame or the flange end. Parameters within OFrame indicate the relationship of the {OFrame} frame to the {UFrame} (related to User Frame).

2.3 Position Variables

2.3.1 Overview

In Inovance robot control system, points in space are represented by "position variables". Points are divided into joint points and position points in terms of type. A joint point stores the robot joint value and the external axis value. A position point stores the coordinate value, arm parameter, and external axis value. In terms of scope, the position variables are divided into global position variables and local position variables.

Global points:

- The scope of the global position variables is a single project. That is, the global position variables can be used in all programs within a single project.
- The global position points are denoted by P and stored in the global point file XX.pts. One project contains up to 10,000 global position points from P[0] to P[9999].
- The global joint points are denoted by JP and stored in the global point file XX.pts. One project contains up to 10,000 global joint points from JP[0] to JP[9999].

Local points:

- The scope of the local position variables is a single program file. That is, the local position variables can be used only in the current program file. The local points are denoted by LP[***].
- The local position points are stored in the program file in the project. One program file contains up to 10,000 joint points from LP[0] to LP[9999].
- There are no local joint points.

Usage of points

For convenience, the joint point JP is referred to as point J, and the position point P and LP are collectively referred to as point P.

2.3.2 Storage Format of Position Variables

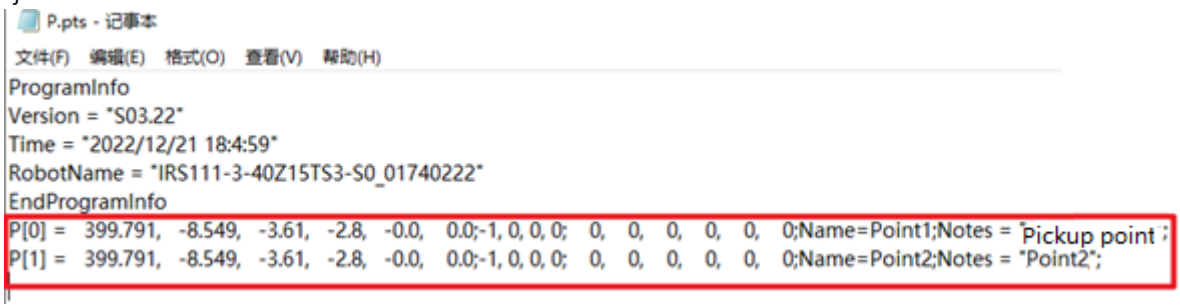
- The position variables are stored in the following format:

P[0] = 399.791, -8.549, -3.61, -2.8, -0.0, 0.0; -1, 0, 0, 0; 0, 0, 0, 0, 0, 0; Name=Point1; Notes = "Pickup point" ;

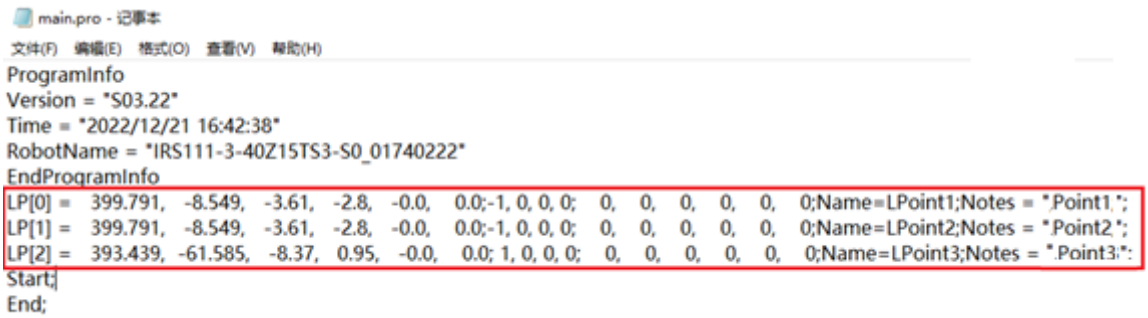
① ② ③ ④ ⑤

No.	Name	Delimiter	End character	Description
①	Coordinate data	English comma ","	English semicolon ";"	The number of data is always 6.
②	Arm parameter	English comma ","	English semicolon ";"	None
③	External axis value	English comma ","	English semicolon ";"	None
④	Label	None	English semicolon ";"	The label should be less than 20 characters, start with letters and contain only letters, numbers and underscores. When there is no label, this item does not exist.
⑤	Remarks	None	English semicolon ";"	The remarks must not exceed 100 characters, with no restrictions on Chinese and English characters. Equal sign is not allowed. (Chinese input is not supported on the hand-held device, but display is supported). When there is no remark, this item does not exist.

The global position variables are stored in the project file P.pts and are common to all programs within the project.



The local position variables are stored in the robot program and are at the beginning of the file before the START instruction. See the following figure.



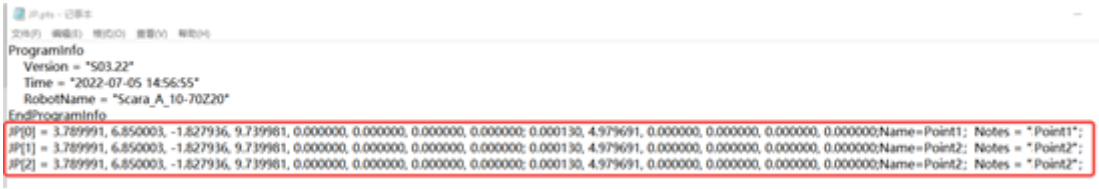
- The joint points are stored in the following format:

The position variables are stored in the following format:

JP[0] = 300, 50, -3.61, -2.8, -0.0, 0.0; 0, 0, 0, 0, 0, 0; Name=Point1; Notes = “Pickup point” ;
① ② ③ ④

No.	Name	Delimiter	End character	Description
①	Coordinate data	English comma ","	English semicolon ";"	The number of data is 6 or 8 (extra axis values are 0)
②	External axis value	English comma ","	English semicolon ";"	None
③	Label	-	English semicolon ";"	The label should be less than 20 characters, start with letters and contain only letters, numbers and underscores. When there is no label, this item does not exist.
④	Remarks	-	English semicolon ";"	The remarks must not exceed 100 characters, with no restrictions on Chinese and English characters. Equal sign is not allowed. (Chinese input is not supported on the hand-held device, but display is supported). When there is no remark, this item does not exist.

The global Joint position variables are stored in the project file JP.pts and are common to all programs within the project.



2.3.3 Attributes of Position Variables

Coordinate value

- For the J point, always take the current joint value under the joint frame.
- For the P point, take the TCP point of the current tool under the current workobject frame.

> **CAUTION**
>
> In the P point taken, the tool number and workobject number are not included. Therefore, when using the P point, ensure that the tool number and workobject number are the same as those used for taking the point.

Arm parameters:

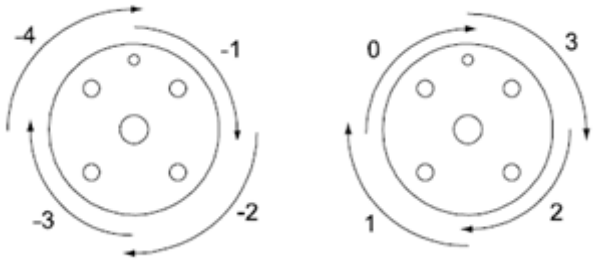
The robot can reach the same orientation in many ways. Arm parameters are used to distinguish these ways.

For a 6-axis serial robot:

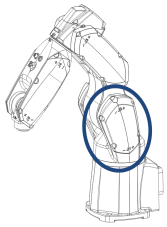
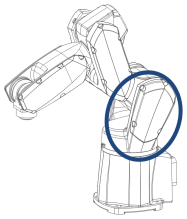
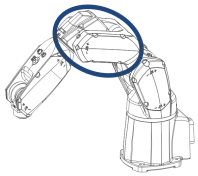
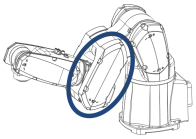
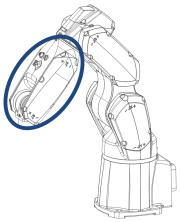
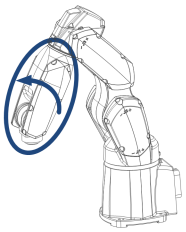
- ArmType[0] represents multiple turns of J1.

- ArmType[1] represents multiple turns of J4.
- ArmType[2] represents multiple turns of J6.
- ArmType[3] represents a combination of different configurations of the waist joint, elbow joint, and wrist joint.

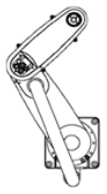
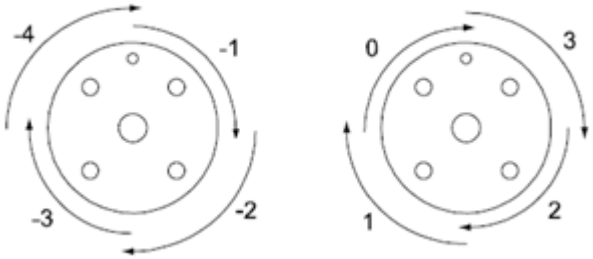
(This is only an illustration of the correspondence of the arm parameters. The range of arm parameter is defined separately.)

ArmType[0-2] (J1, J4, J6)							
-4	-3	-2	-1	0	1	2	3
[-360,-270)	[-270,-180)	[-180,-90)	[-90,0)	[0,90)	[90,180)	[180,270)	[270,360)
Increase or decrease by 1 every 90°, decrease clockwise, and increase counterclockwise. As shown in the figure below, "-1" is for -90° to 0°, "0" for 0° to 90°, "1" for 90° to 180°, and so on. 							

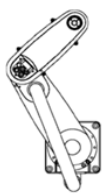
ArmType[3]								
Value of arm parameter 4	0	1	2	3	4	5	6	7
Waist arm type	Forward	Forward	Forward	Forward	Backward	Backward	Backward	Backward
Elbow arm type	Upward	Upward	Downward	Downward	Upward	Upward	Downward	Downward
Wrist arm type	Flipped	Not flipped	Flipped	Not flipped	Flipped	Not flipped	Flipped	Not flipped

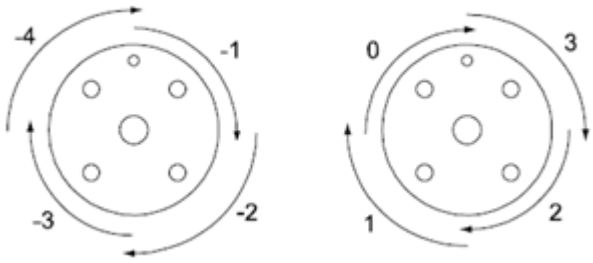
Waist forward	Waist backward	Elbow upward	Elbow downward	Wrist not flipped	Wrist flipped
					

For SCARA robots, the values of the arm parameters 1, 4 are valid (This is only an illustration of the correspondence of the arm parameters. The range of arm parameter is defined separately.)

ArmType[0]		ArmType[3] (value of joint coordinate J4)							
-1	1	-4	-3	-2	-1	0	1	2	3
Left arm	Right arm	[-360,-270)	[-270,-180)	[-180,-90)	[-90,0)	[0,90)	[90,180)	[180,270)	[270,360)
		Increase or decrease by 1 every 90°, decrease clockwise, and increase counterclockwise. For example, -90° to 0° is -1, 0° to 90° is 0, 90° to 180° is 1, and so on. 							

For inverted SCARA robots, arm parameters 1, 2, 3, 4 are all valid (This is only an illustration of the correspondence of the arm parameters. The range of arm parameter is defined separately.)

ArmType[0]		ArmType[1/2/3] (value of joint coordinate J1, J2, J4)							
-1	1	-4	-3	-2	-1	0	1	2	3
Left arm	Right arm	[-360,-270)	[-270,-180)	[-180,-90)	[-90,0)	[0,90)	[90,180)	[180,270)	[270,360)
		Increase or decrease by 1 every 90°, decrease clockwise, and increase counterclockwise. For example, -90° to 0° is -1, 0° to 90° is 0, 90° to 180° is 1, and so on.							

Definition of robot arm parameters:

Model	Arm parameter	Arm parameter range	Corresponding angle range
6-axis	ArmType[0]	[-5,4]	[-450, 450)
	ArmType[1]	[-5,4]	[-450, 450)
	ArmType[2]	[-∞, +∞]	[-∞, +∞]
	ArmType[3]	[0,7]	-
SCARA	ArmType[0]	-1.1	-
	ArmType[1]	[-5,4]	[-450, 450)
	ArmType[2]	[-5,4]	[-450, 450)
	ArmType[3]	[-9,8]	[-810, 810)
Inverted SCARA	ArmType[0]	-1.1	-
	ArmType[1]	[-5,4]	[-450, 450)
	ArmType[2]	[-5,4]	[-450, 450)
	ArmType[3]	[-9,8]	[-810, 810)

CAUTION

- Note: If arm parameters are modified after teaching, the robot will reach the same pose in an another arm type. This means a great change to the motion. Modify the arm parameters with caution!
- If you modify arm parameters directly by point editing or via instruction, the modified arm parameters may be inconsistent with the actual arm parameters the robot can reach. In this case, the robot will reach the position closest to the modified arm parameters.

For example, for the SCARA robots:

P[1] = (10,10,0,179,0,0); ## The arm parameter of P[1] is [1,0,0,1]

PR[1] = (0,-10,0,10,0,0);

P[2] = Offset(P[1], PR[1]); ## The arm parameter of P[2] is still [1,0,0,1], but the actual arm parameter corresponding to point P[2] can be [1,0,0,-2]. [1,0,0,2], [1,0,0,6]… When moving to target P[2], the robot will perform the motion according to the arm parameter [1,0,0,2] closest to [1,0,0,1].

2.4 Offset

Offset is used to describe the motion in space, which can be the motion of joints J1 - J6 described in joint frame, or the spatial change of a certain pose XYZABC relative to a certain frame in three-dimensional space.

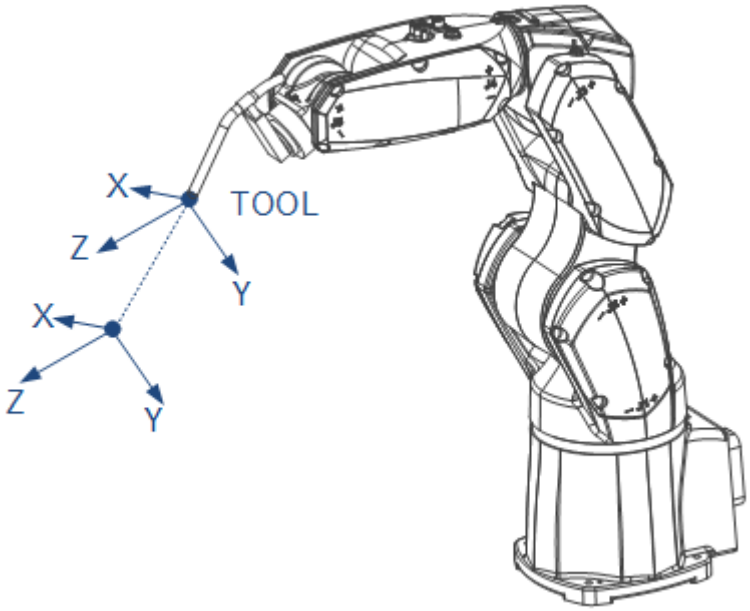
In the Inovance robot system, the offset is divided into the following two types.

- Offset along the current tool pose.
- Offset in a Cartesian reference frame.

2.4.1 Offset Along the Current Tool Pose

Function: Moves the robot along the current tool pose.

Instruction: OffsetT



2.4.2 Offset in a Cartesian Reference Frame

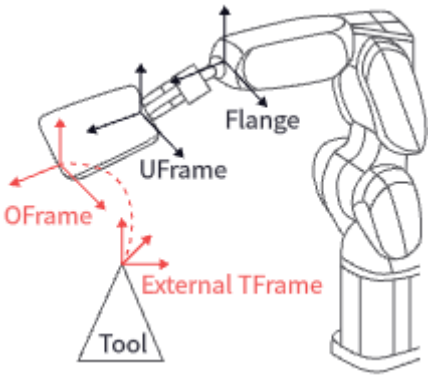
Function: Offset indicates offset of a target point in a Cartesian reference system. The target point may be the TCP or flange center point. The reference frame may be a user frame or a base frame.

In typical scenarios, for **grip tool:**

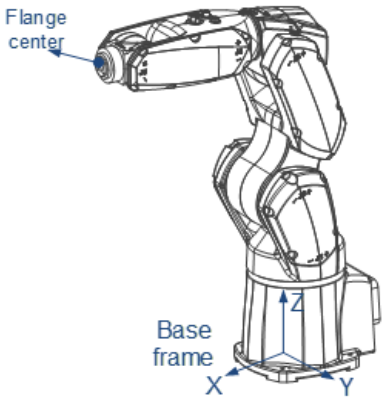
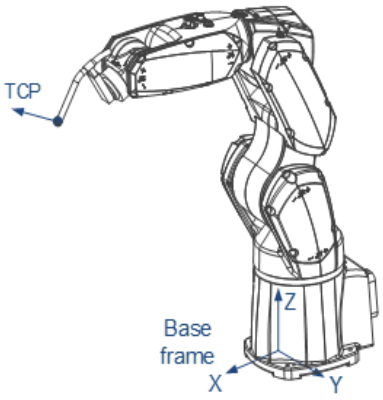
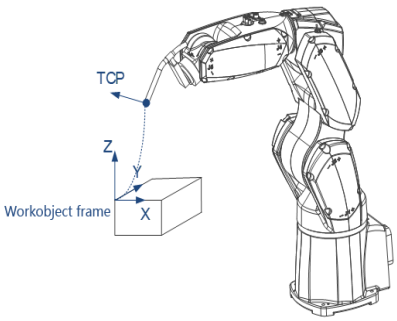
- Offset is the offset of TCP relative to the workobject frame.
- Movl Offset(P,PR) … Tool[2] ##Offset relative to wobj[0] (which is also the base frame).
- Movl Offset(P,PR) Tool[2] Wobj[3] ##Offset relative to Wobj[3].

In the case of ECP, for **external tool:**

It is also the movement of TCP relative to the workobject frame. The effect is that the workobject moves around a virtual frame established on the external TCP parallel to the workobject frame. (Offset can be considered as the workobject offsets along the direction of the workobject frame itself; while rotation can be considered as the workobject rotates around the virtual frame.)



Instruction: Offset

Some types of Offset		
		

2.5 Interpolation and Transition

Interpolation is the basic form of robot motion, and complex motion is made up of a series of interpolation motions. There are three types of interpolation, depending on the interpolation trajectory.

Interpolation type	Trajectory	Description
Joint interpolation (Movj, MovAbsj)		Point-to-point interpolation, the fastest interpolation in which each joint moves at the fastest speed. The motion trajectory is unpredictable. It is often used for applications such as spot welding and transportation.
Linear interpolation (Movl)		The motion trajectory is straight. It is often used for applications such as track welding and surface mounting.
Arc Interpolation (Movc)		The trajectory is arc-shaped.

CAUTION

When executing Movl and Movc, the arm parameters of the robot are not allowed to change. If you need to change the arm parameters, insert the Movj instruction to complete the arm posture transition.

In the actual continuous motion process, in order to accelerate rhythm, precise arrival is not required. At this time, the intermediate point of the motion will show the form of trajectory approximation, which is called transition.

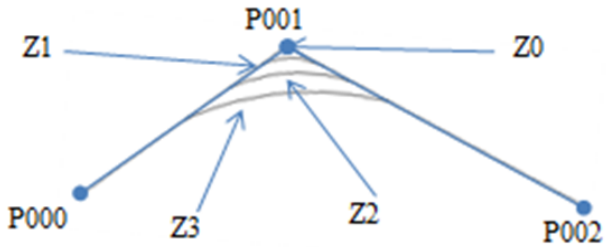
In Inovance robot system, the transition level parameters are set as follows: Fine, Z[0] to Z[200], Z[CP], Z[CP], and ZR[m].

- Fine: Indicates precise arrival. The robot is considered to achieve precise arrival when it enters and stays within the set arrival error range.
- Z[0] to Z[200]: The robot does not stop at the target point, but smooths through the set transition area. Transition length = transition level * transition unit length. (To set the transition unit length in InoRobotLab, go to "Settings" > "More" > "Motion parameters" > "Run parameter settings" > "Transition feature").
- Z[CP]: The robot does not stay at the target point and smooths through the set transition area with the maximum transition length.
- ZR[m]: Relative transition level, integer, value range 0 to 200, represents the percentage of maximum allowable transition length.

1. If the current instruction is MovJ/MovAbsJ/MovL/Movc, when the relative transition level m is equal to 100, it indicates that the maximum allowable transition length is half the motion length of the instruction, which is consistent with the effect of Z[CP]. When the relative transition level m is greater than 100, the maximum allowable transition length will exceed half the motion length of the instruction. When the ZR parameter is 200, the maximum allowable transition length is equal to the full motion length of the instruction.
2. If the current instruction is Jump/Jumpl and the additional parameter RH=0, the maximum allowable transition length will exceed half the motion length of the instruction when the relative transition level m is greater than 100. When the ZR parameter is 200, the maximum allowable transition length is equal to the full motion length of the instruction.
3. If the current instruction is Jump/Jumpl and the additional parameter RH≠0, the maximum allowable transition length is the total length of RH segment. At this time, ZR[100] is the total length of RH segment. When the ZR value is greater than 100, it is consistent with the effect of ZR[100].

CAUTION

- When the ZR parameter is 200, the robot completely transitions the current motion to the next motion, and the robot may not pass the original trajectory at all. Because the path of motion in the transition area cannot be guaranteed, make sure that the robot transition path does not interfere with surrounding objects at low speeds.
- Since the ZR parameter allows for a transition length longer than half the motion length of the instruction, in rare cases, the transition areas of the start and end points of the instruction may overlap. In this case, the robot will reduce the transition area that is more than half the motion length of the instruction to ensure that the two transition areas no longer overlap. In particular, if both transition areas at the beginning and end of the instruction are larger than half the motion length of the instruction, they will be reduced to half the motion length of the instruction at the same time.
- In particular, since the transition length specified by the ZR parameter is calculated by the percentage of the maximum allowable transition length of the instruction (usually half the motion length of the instruction), it is important to note that the theoretical transition length of the two instructions may be inconsistent when the displacement difference between two adjacent motion instructions is large. The robot may transition in an asymmetric transition path within the transition area specified by the user.



Interpolation precision

2.6 Singular Position

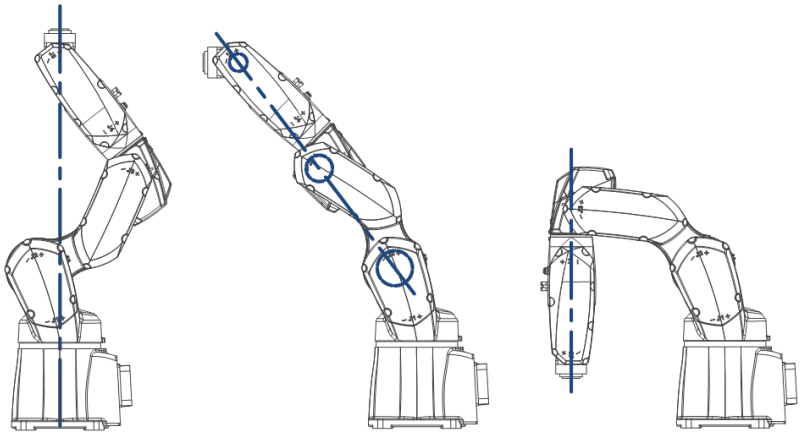
When moving in a non-joint frame, the robot may move to certain special positions where the robot loses some freedom of movement called singular positions.

In joint interpolation Movj, the singular position does not affect normal motion. In the process of linear interpolation Movl and arc interpolation Movc, the singular position prevents the robot from moving properly.

CAUTION

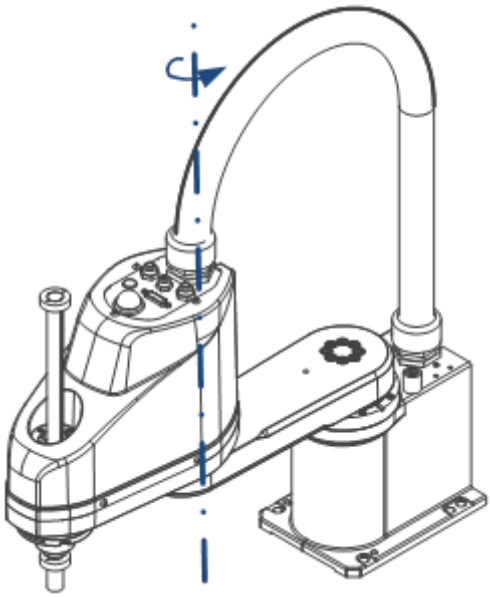
When a singular position alarm is encountered, the singular position can be exited using the joint motion mode.

There are three singular positions for the 6-axis robots, as shown in the figure below.



Overhead singularity	Extended singularity	Wrist singularity
Intersection of J4, J5, and J6 axes	Centers of J2, J3 and J5 axes	J4 and J6 axes are collinear
Located directly above J1	Collinear with the center	-

The SCARA robot has only one singular position, at J2= 0°, when the 1st and 2nd arms are in a straight line.

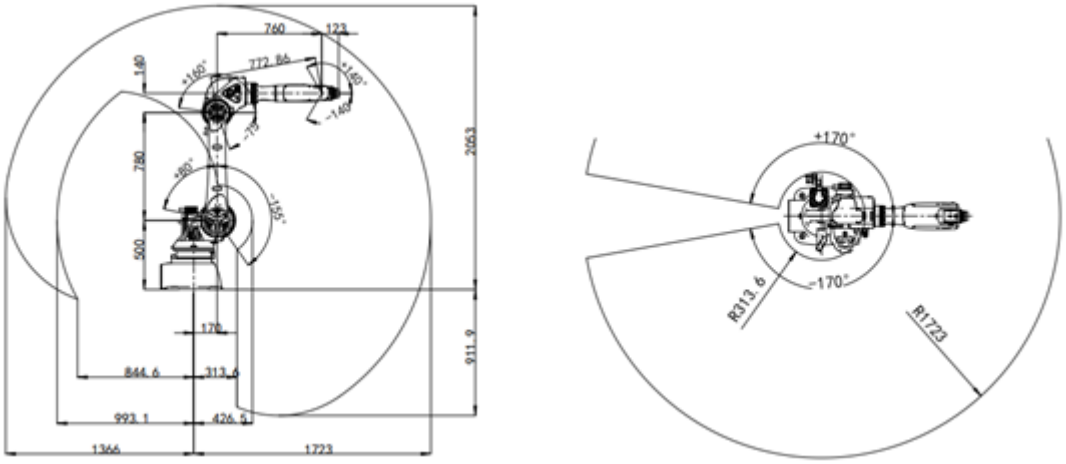


(SCARA singular position J2=0°)

The singular position of Delta robot is not in the working range, and there is no singular position.

2.7 Motion Range and Interference Zone

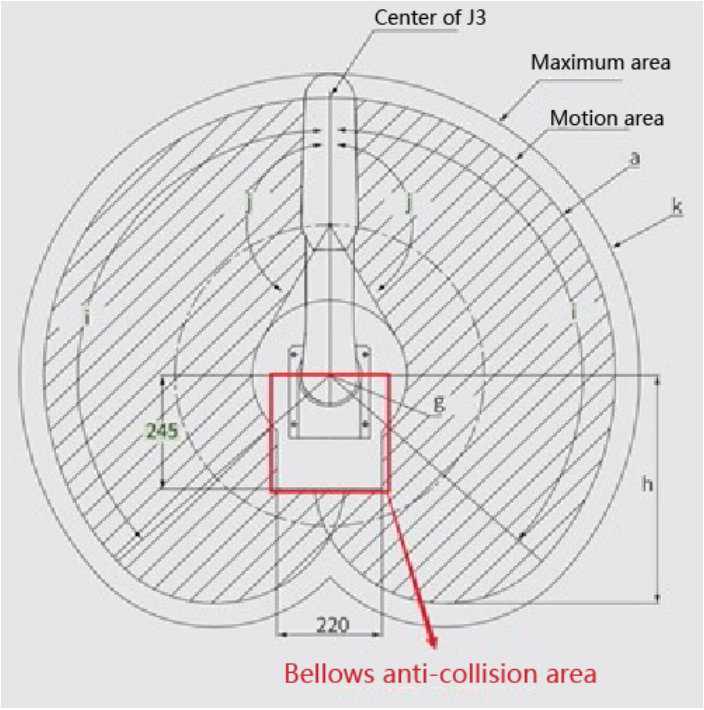
The range of motion of a robot is a collection of all points that can be reached by the end of the robot's arm. The range of motion is related to the length of the robot arm and the range of motion of the robot joints.



Interference zone: In the range of motion, there are often areas where the end actuator is prevented from reaching. When in these areas, the robot will collide with its own components or external devices. These areas are called interference zones.

You can customize the interference zone. For details, see 10.7.2 Interference Zone Settings.

For the 4kg/7kg/10kg series of SCARA 2.0, a bellows anti-collision function has been added: In the world frame, the base area of the SCARA robot is set as an interference zone. Regardless of motion mode (joint or Cartesian frame), the system will detect whether the end of the ball screw enters the interference zone defined in the world frame. If it enters, an alarm (0x2814 Robot entered non-movement areas) will be triggered and the motion will stop. The bellows anti-collision areas vary for different models. For details, see the "Inovance Robot Selection Guide".



3 Product Introduction

3.1 Overview

The robot system consists of human-machine interactive (HMI) software, controller, manipulator and secondary development software.



Components	Description
Hand-held Teach Pendant	7-inch simple hand-held teach pendant IR-TP200
HMI software	• PC-based teach pendant InoRobotTP • InoRobotLab programming platform software
Controller	It has various functions such as robot configuration, programming operation, and monitoring. You can control the motion of the robot through the HMI software or other control devices.
Manipulator	The actuator of the robot system, the motion of which is controlled through the controller.

This document describes operations performed on the teach pendant.

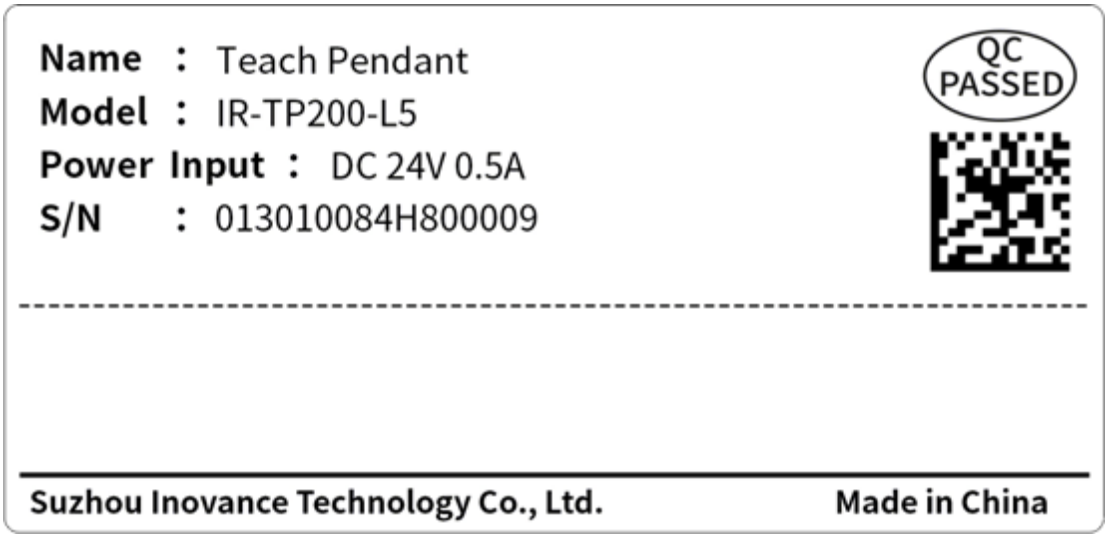
3.2 Hand-held Teach Pendant IR-TP200

3.2.1 Model and Nameplate

IR - TP200 - L5
① ② ③ ④

Parameter	Description
①	**Product family** IR: INOVANCE Robot
②	**Product type**

Parameter	Description
	TP: Teach Pendant
③	**Product series** 200: 200-button Teach Pendant
④	**Teach pendant cable/certification** L5: standard 5-meter cable teach pendant



3.2.2 Components





3.2.3 Button Function Table

Button	Name	Function
	Control panel	Open or close the control panel.
	Mechanical unit	Switch the current mechanical unit in sequence.
1	Custom 1	Reserved button
2	Custom 2	Reserved button
3	Custom 3	Reserved button
4	Custom 4	Reserved button
J1 X − / J1 X +	J1 axis motion button	Robot J1 axis motion in X axis direction
J2 Y − / J2 Y +	J2 axis motion button	Robot J2 axis motion in Y axis direction
J3 Z − / J3 Z +	J3 axis motion button	Robot J3 axis motion in Z axis direction

Button		Name	Function
J4 Rz−	J4 Rz+	J4 axis motion button	Robot J4 axis rotation motion in Z axis direction
J5 Ry−	J5 Ry+	J5 axis motion button	Robot J5 axis rotation motion in Y axis direction
J6 Rx−	J6 Rx+	J6 axis motion button	Robot J6 axis rotation motion in X axis direction
		Single-step execution	Single-step execution button for program debugging, no single-step backward function currently available
		Start and stop	Start/stop the robot operation. • Manual mode (hold to run):Press the "Start" button to run the robot, release the "Start" button to stop the robot. • Auto mode: Press the "Start" button to run the robot, press the "Stop" button to stop the robot.
Rear-positioned enable switch		Enable switch	Control the enabling of the robot. Three-position switch: • The de-enabling function is activated in the first or third position; • In the manual mode only, the enabling function is activated in the second position.
Knob		Knob	Control the scrolling display of program code, tables, and lists.
Emergency stop switch		Emergency stop switch	Control the emergency stop of the robot. Press to stop the robot in emergency, rotate and lift to release the emergency stop.

3.2.4 Key Switch

The rotary key switch features three distinct positions from left to right: auto mode, manual low speed mode, and manual high speed mode. Positional engagement is permitted ONLY when the physical key is inserted.

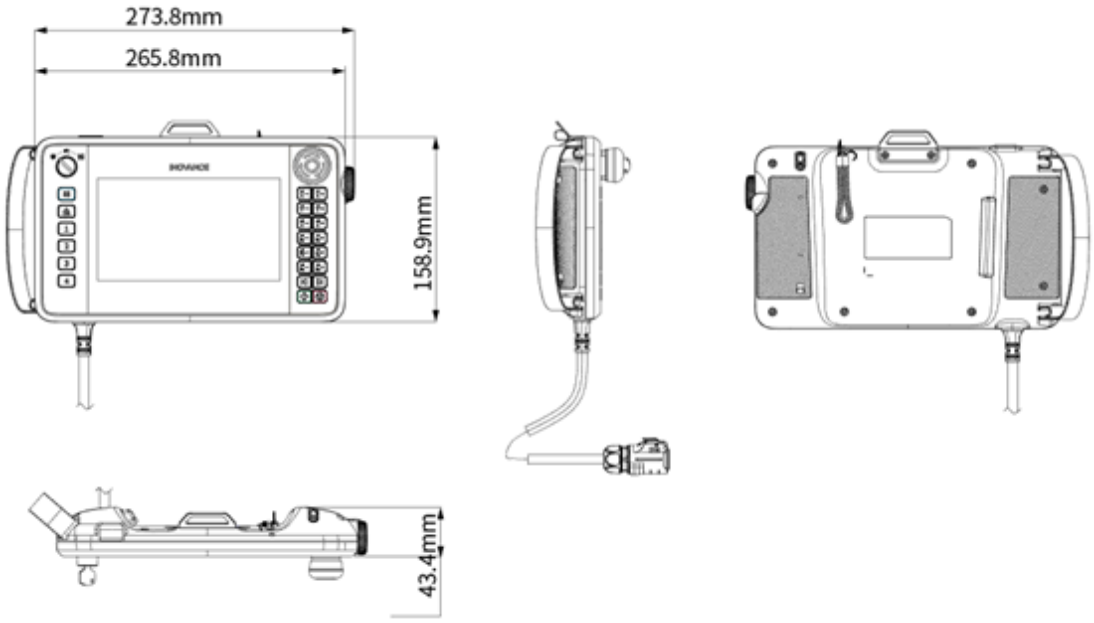
Diagram	Mode	Description
	Auto mode	Supports: No speed limit, start with a single press, no need to hold to run Restrictions: Unable to edit, teach, debug, or modify any robot parameter configurations
	Manual low speed mode	Supports: Programming, teaching, debugging, and modification of various robot system parameter configurations

Diagram	Mode	Description
		Restrictions: Speed limit of no more than 250 mm/s, robot debugging only supported with hold to run
	Manual high speed mode	Supports: Debugging and modification of various robot parameter configurations, no speed limit Restrictions: Projects cannot be edited; Robot debugging only supports hold to run; The initial speed after each mode switch is 1%; The speed automatically returns to the initial speed after de-enabled state for 5 minutes.



When the key switch on the teach pendant is not in use, always remove the key from the switch and store it properly to prevent damage or deformation of the key caused by accidental dropping.

3.2.5 Outline Dimensions

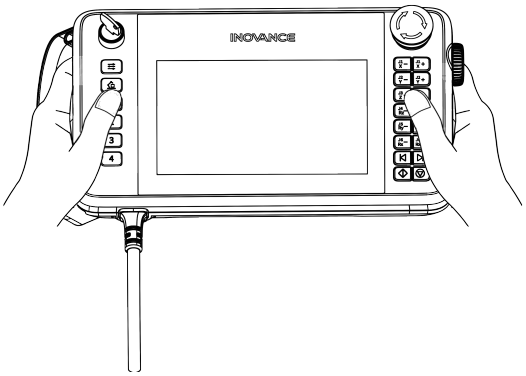


3.2.6 Operation Mode

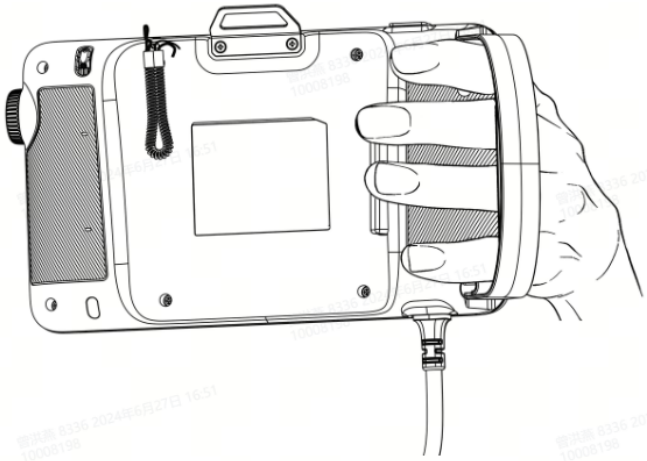
When operating the teach pendant, you usually hold the device in your hand. The device has two different holding operation modes: two-handed holding and one-handed holding.

Two-handed holding facilitates button operations, while one-handed holding is advantageous for the operator to observe the display or operate the stylus.

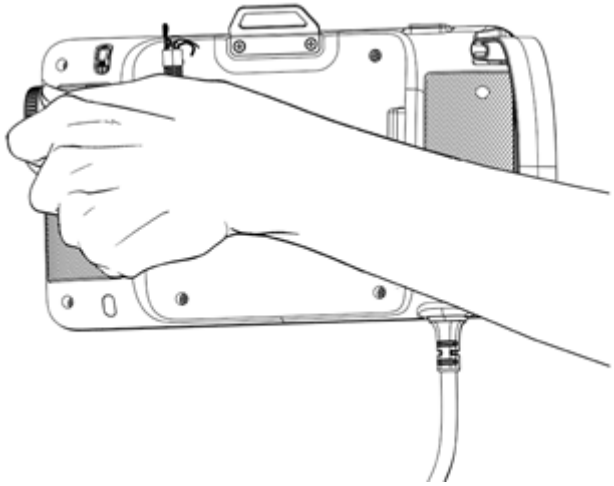
Screen operation tool specifications: Use the stylus for operations and avoid scratching the screen with hard sharp objects.



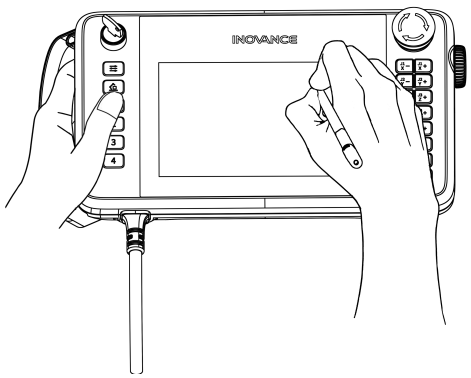
Two-handed holding



One-handed holding-1



One-handed holding-2



Stylus operation

3.2.7 Specifications

Category	Name	Description
Display	Display	7-inch TFT LCD screen
	Resolution	800 x 480
Panel	Touch panel	4-wire resistive touchscreen
	Button	22 function buttons
Processor	MCU	Cortex-A7 Quad-core 1.2 GHz
Storage	RAM	512 MB DDR3L
	ROM	512 MB
Communication	USB Host	USB 2.0 (Type A)
	Ethernet	1*10/100M auto-negotiation
Electrical components	-	Three-position enable switch, emergency stop button, three-position key switch, wheel
Operating environment	IP rating	IP54, IP54 not met if USB plug is removed or not securely inserted
	Storage temperature	-25°C to +55°C
	Operating temperature	-40°C to +70°C

3.2.8 Physical Environment Requirements

Place the teach pendant in an environment that meets the following conditions to ensure and maintain product performance and safe operation.

- Place it indoors.

- Use it in a place free from corrosive and inflammable gases and combustible materials, such as the hydrogen sulfide, chlorine, ammonia, sulphur gas, chlorine gas, acid, alkali and salt.
- When using the product in places with grinding fluid, oil mist, iron powders or cuttings, take protective measures.
- Keep it away from heating sources such as a heating stove.
- Do not use it in an enclosed environment, as this might cause high temperature of the controller and hence shorten its service life.
- Avoid direct sunlight.
- Avoid places with salt or moisture and other rust-prone places.
- Avoid impacts and vibrations, etc.
- Keep away from sources of electrical interference such as large inverters, high-power high-frequency generators, large contactors, welding machines, etc.

3.2.9 Precautions for Using the Teach Pendant

This product is a high-quality hand-held terminal, equipped with advanced electronic devices of high sensitivity. To avoid malfunctions or damage caused by improper operation, follow the instructions below during operations.

- Handle with care; Do not drop, throw, or strike the teach pendant with force. Doing so may cause damage or malfunctions.
- If the teach pendant is subjected to impact, be sure to verify and confirm that the enable switch and emergency stop switch are functioning properly and not damaged.
- Avoid stepping on the cable during the use and storage of the teach pendant.
- When the device is not in use, place it on a vertical wall rack to prevent accidental falling.
- Do not use sharp objects (such as screwdrivers or pen tips) to operate the touchscreen. Doing so may damage the touchscreen. Use your finger or stylus to operate the touchscreen.
- Clean the touchscreen regularly. Dust and small particles may block the touchscreen and cause malfunctions.
- Do not use solvents, detergents, or scouring sponges to clean the teach pendant. Use a soft cloth lightly dampened with water or a neutral cleaning agent for cleaning.
- Always cover the USB port with its protective cap when no USB device is connected. If the port is exposed to dust, it may cause interruption or malfunction.
- The disconnected teach pendant should be stored properly to avoid being mistaken as still connected to the controller.

3.2.10 Software Acquisition and Upgrade

The software for the teach pendant IR-TP200 is pre-installed on the hardware at the factory. No additional runtime environment configuration is required.

Teach pendant software acquisition and upgrade:

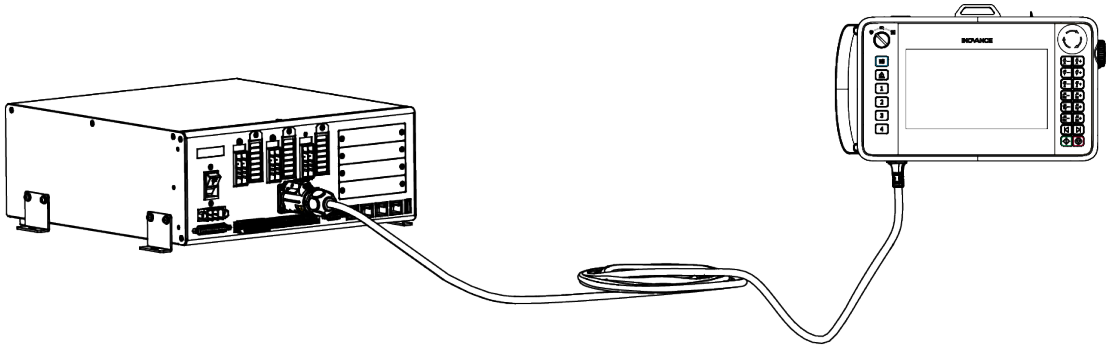
- Download the software upgrade package for free from Inovance official website (www.inovance.com) and copy the software upgrade package to a USB drive for upgrade.

- Insert the USB drive into the USB port of the teach pendant, and click "System settings > System backup and load > System > System upgrade" from the home page interface to open the software upgrade window and perform the upgrade. For details, see 10.6.3.7 System Upgrade.

3.3 Connection Between Hand-held Teach Pendant and Controller

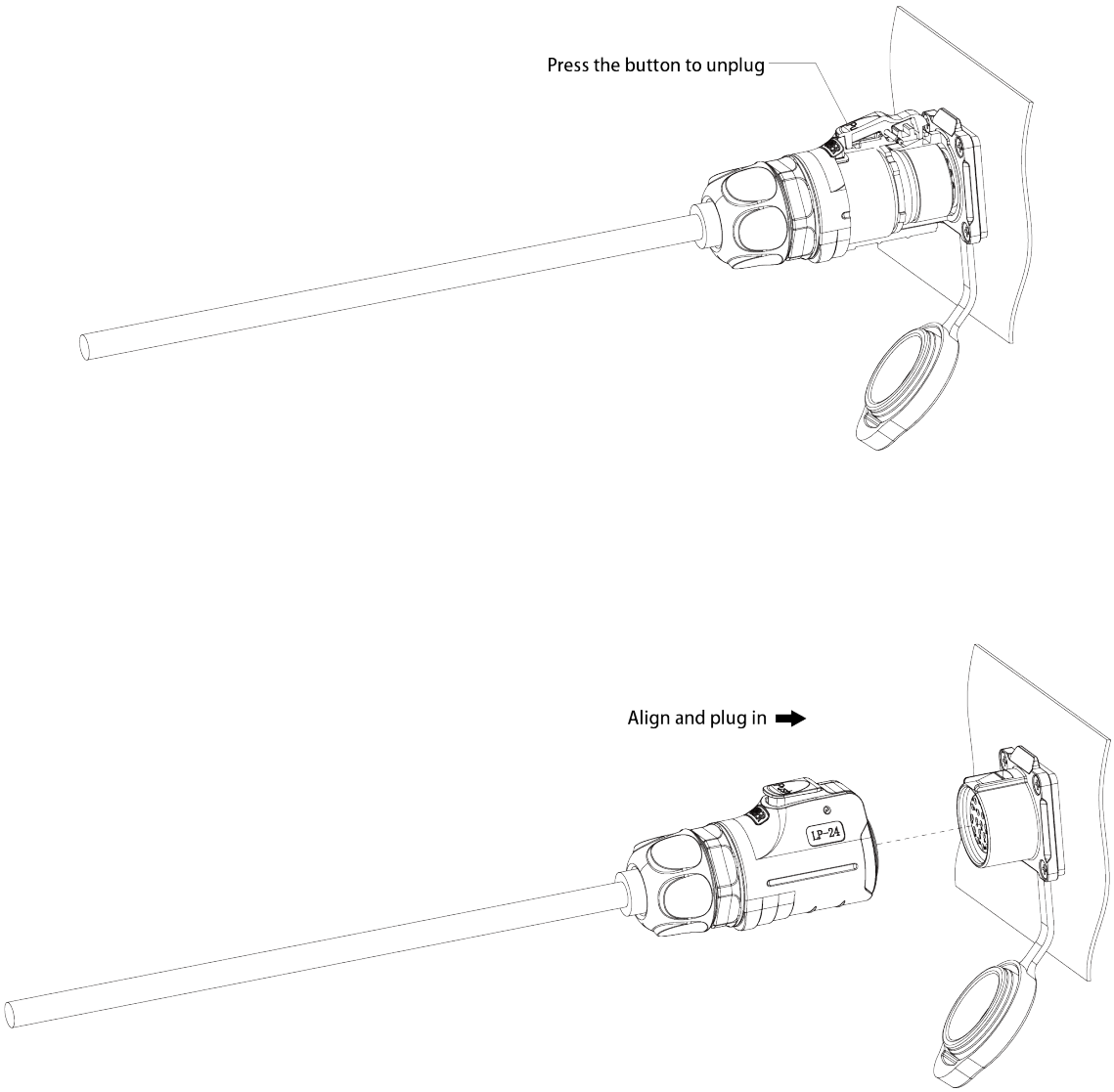
3.3.1 Wiring to the Controller

The IR-TP200 teach pendant is compatible with the IRCB501 series, IRCB501 high protection series, and IRCB101 high protection series controllers. The following takes the connection between the IRCB501 series controller and the teach pendant as an example.



You can unplug the aviation plug at any time except for the following two situations:

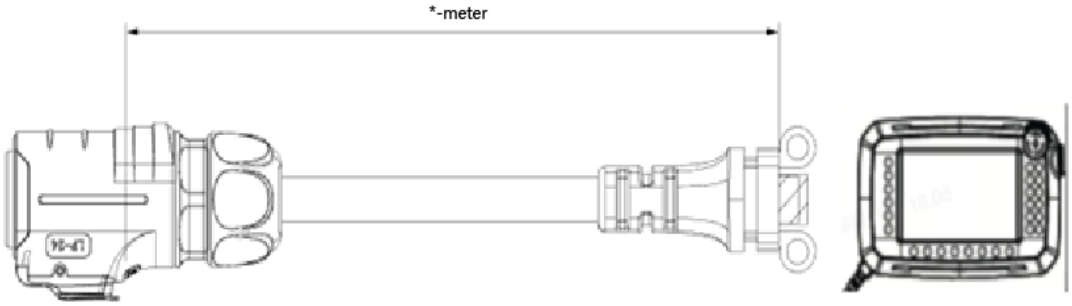
- The interface displays "Upgrade in progress, do not power off".
- The interface displays "Saving file, do not power off".



The above diagram shows the connection from the IR-TP200 teach pendant to the controller via the IR-TP200 teach pendant connector. When the IR-TP200 teach pendant connects to the controller connector that is designed for the IRTP80 teach pendant, an adapter is required. For details, see 3.3.2.3 Teach Pendant Adapter.

3.3.2 Cable Description

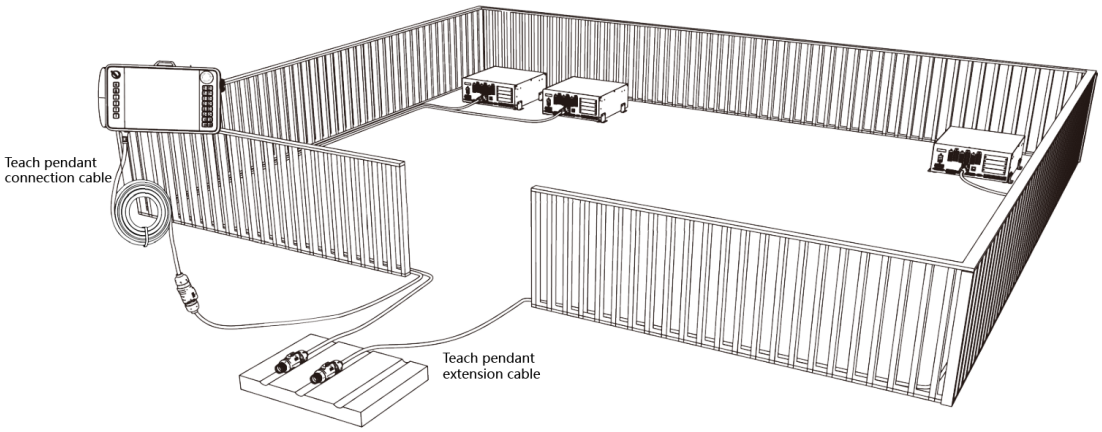
3.3.2.1 Connecting Cable

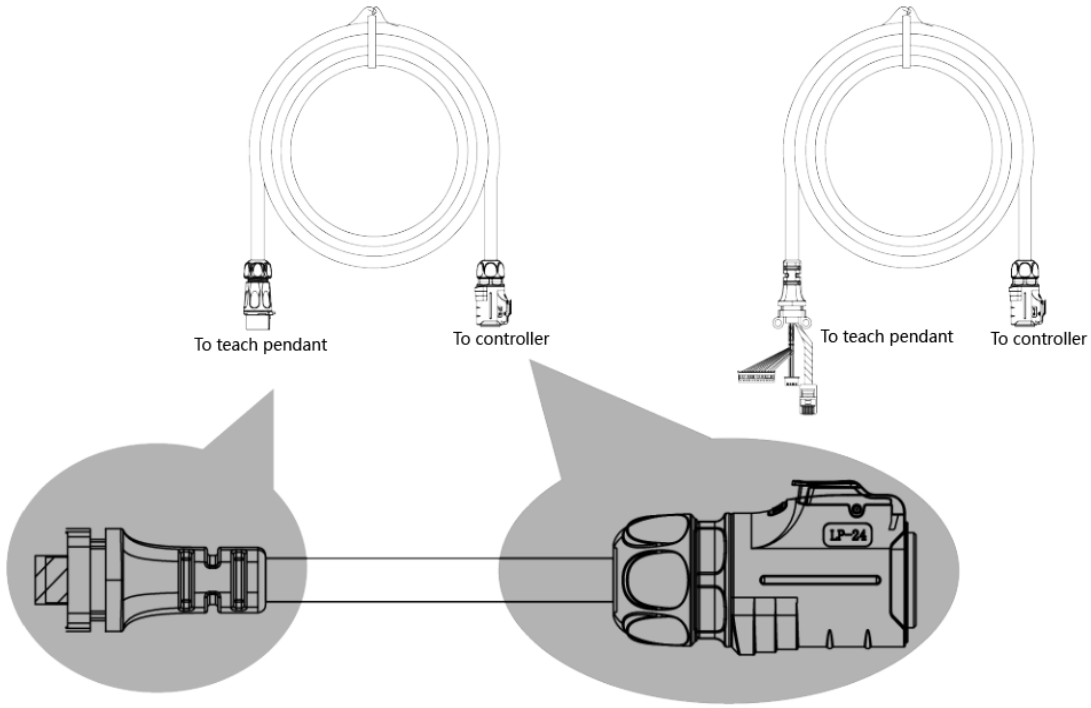


Material code	Description	Remarks
01640048	Teach Pendant-IR-TP200-L5: robot teach pendant with 5-meter connection cable	Cable length is the only difference.
01640054	Teach Pendant-IR-TP200-L10: robot teach pendant with 10-meter connection cable	
01640053	Teach Pendant-IR-TP200-L20: robot teach pendant with 20-meter connection cable	
01640052	Teach Pendant-IR-TP200-L30: robot teach pendant with 30-meter connection cable	

3.3.2.2 Extension Cable

In actual use scenarios, if the cable length of the teach pendant IR-TP200 is insufficient, an extension cable can be used for adaptation to meet on-site requirements.

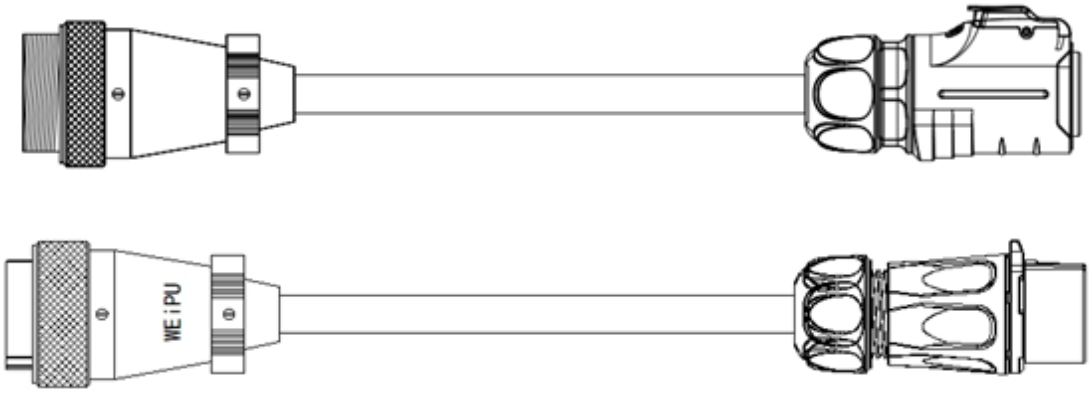




Material code	Description	Remarks
1504R444	IR-TP200-L5-Teach Pendant Extension Cable-5M (RoHS)	Cable length is the only difference.
1504R445	IR-TP200-L5-Teach Pendant Extension Cable-15M (RoHS)	
1504R446	IR-TP200-L5-Teach Pendant Extension Cable-25M (RoHS)	

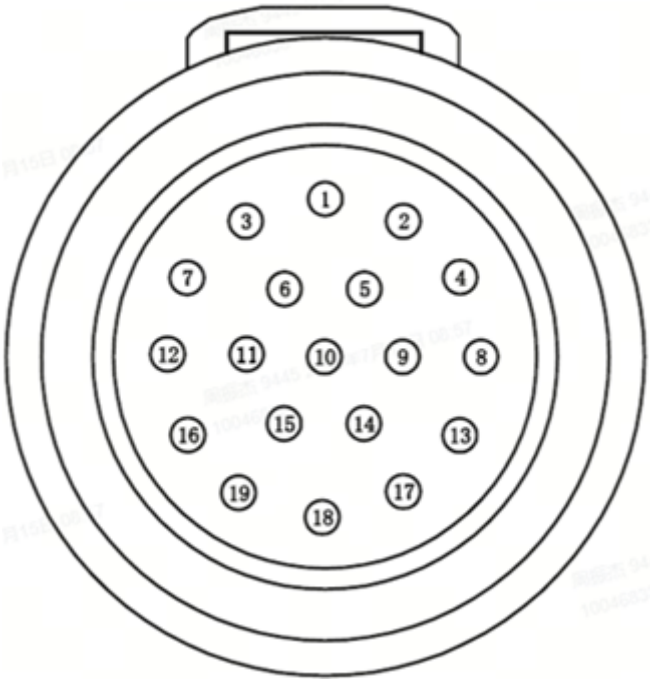
3.3.2.3 Teach Pendant Adapter

Aviation connector	Teach pendant type	Teach pendant adapter
IRTP80 teach pendant connector (aviation connector 1.0)	IRTP80 teach pendant (teach pendant 1.0)	No adapter required
IRTP80 teach pendant connector (aviation connector 1.0)	IR-TP200 teach pendant (teach pendant 2.0)	Adapter 1504R443 required
IR-TP200 teach pendant connector (aviation connector 2.0)	IRTP80 teach pendant (teach pendant 1.0)	Adapter 1504R442 required
IR-TP200 teach pendant connector (aviation connector 2.0)	IR-TP200 teach pendant (teach pendant 2.0)	No adapter required



Material code	Description
1504R442	Cable set - teach pendant 1.0 to controller aviation connector for teach pendant 2.0: Used for connecting the teach pendant 1.0 to the controller aviation connector for teach pendant 2.0
1504R443	Cable set - teach pendant 2.0 to controller aviation connector for teach pendant 1.0: Used for connecting the teach pendant 2.0 to the controller aviation connector for teach pendant 1.0

3.3.3 Aviation Connector Definition



No.	Signal	Definition	No.	Signal	Definition
①	PE	Shielding ground	⑪	Reserved	Reserved
②	24V	24 V power supply	⑫	PE	Shielding ground
③	ES_OUT1	Emergency stop signal OUT1	⑬	TP_TX+	Ethernet data TX+
④	GND	Power supply GND	⑭	TP_TX-	Ethernet data TX-
⑤	ES_OUT2	Emergency stop signal OUT2	⑮	TP_RX+	Ethernet data RX+
⑥	ES_IN2	Emergency stop signal IN2	⑯	TP_RX-	Ethernet data RX-
⑦	ES_IN1	Emergency stop signal IN1	⑰	Reserved	Reserved
⑧	DMS_NO1	Enable switch signal NO1	⑱	Reserved	Reserved
⑨	Reserved	Reserved	⑲	TP_LAN	Teach pendant network port selection input signal
⑩	DMS_NO2	Enable switch signal NO2	-	-	-

3.3.4 Dual Circuit Enable

When using the IR-TP200 teach pendant, enablement is only permitted after signal continuity is confirmed in both circuits. When the controller aviation connector is an IRTP80 teach pendant connector, a teach pendant adapter is required for connection, and it also supports dual circuit detection enabling.

Controller aviation connector	Enable
IRTP80 teach pendant connector	Enable after confirmation based on the first and sixth signals of system I/O.
IR-TP200 teach pendant connector	Enable after confirmation based on the first and eighth signals of system I/O.

3.4 PC-based Teach Pendant InoRobotTP

3.4.1 Operating Environment

The PC-based teach pendant software InoRobotTP is a portable version that requires no installation. The configuration requirements for the PC are as follows:

- Operating System: Windows 7 or later.
- System running memory: At least 2 GB.
- Resolution: 1024*768 and above.
- Runtime environment: Visual C++ Redistributable Package (Microsoft Visual C++ Redistributable Package.exe should be installed if the runtime environment is missing.)

3.4.2 Software Acquisition and Upgrade

You can acquire the PC-based teach pendant InoRobotTP software through the following methods:

- From Inovance agents.
- Inovance official website (www.inovance.com).
- For the PC-based teaching device, no installation is required. Unzip the zip package, locate and double-click the program file "InoRobotTP.exe" in the software directory to run the software.

It is recommended to update the software to the latest version due to continuous improvement on the product and documents.

3.4.3 Software Connection to Multiple Controllers

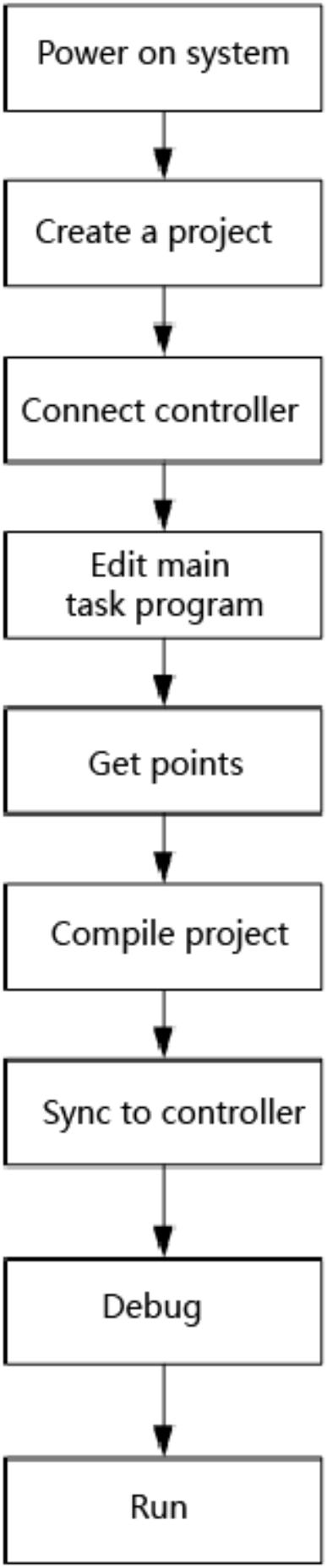
On the same PC, you can open multiple application programs "InoRobotTP.exe" from different software directories to achieve connection to multiple controllers.

3.4.4 Version Description

This is the first version; no revisions have been made yet.

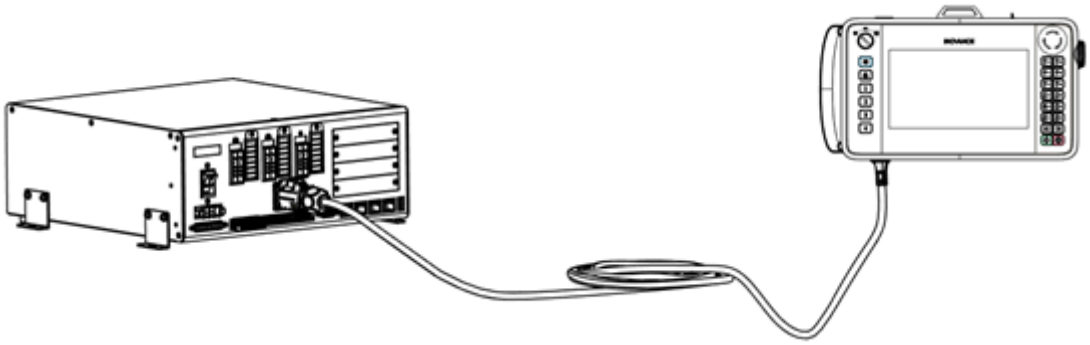
4 Getting Started

4.1 Programming Flowchart



4.2 Connection

4.2.1 Connecting the Teach Pendant to the Controller

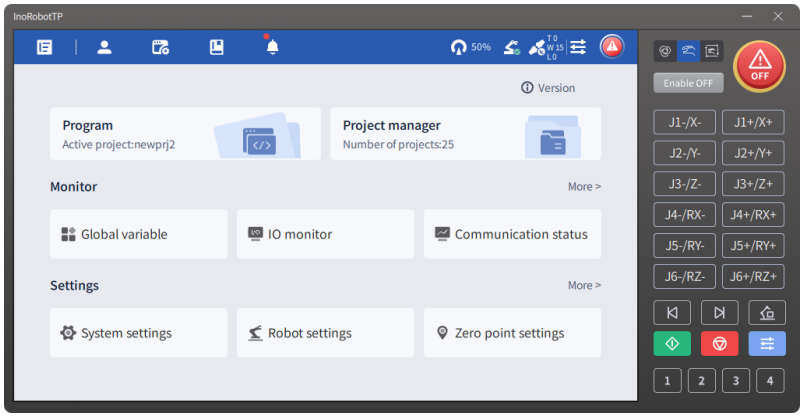


Operating procedure:

1. Locate the teach pendant connector on the controller.
2. Press the aviation plug button and insert the aviation plug.
3. Release the button and gently pull the connection cable back and forth to check if it is secured.
4. Power on the controller. The teach pendant will display the connection interface as shown below:



5. For the hand-held teach pendant, it will automatically connect after a short wait following power-on. For the PC-based teach pendant, you need to click the "Skip" button for the first connection, then navigate to "System settings" > "Connection", and enter the IP address to connect. After a successful connection, the main interface of the teach pendant will appear.

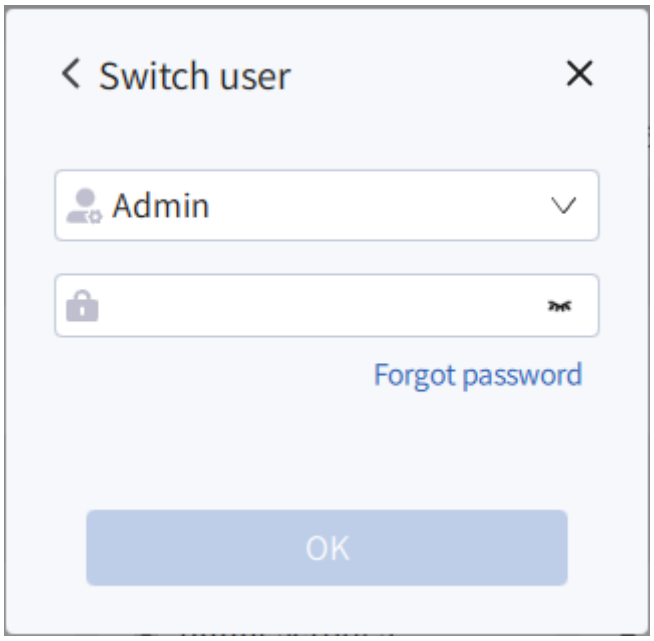


4.2.2 User Login

Log in by clicking the user login icon button on the status bar of the homepage:

1. Click the user login button  on the homepage status bar to open the user login window.

2. Click the "Switch user" button, select the user from the drop-down list, enter the corresponding password, and click the "OK" button to complete the user login.

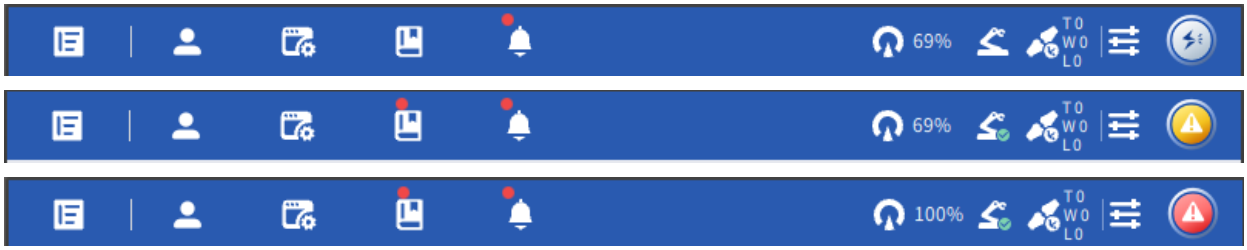


4.2.3 Status Check

After successful connection, check the state indicator at the upper right corner and the message bar at the bottom. It is normal only when the state indicator is in standby or enabled state.



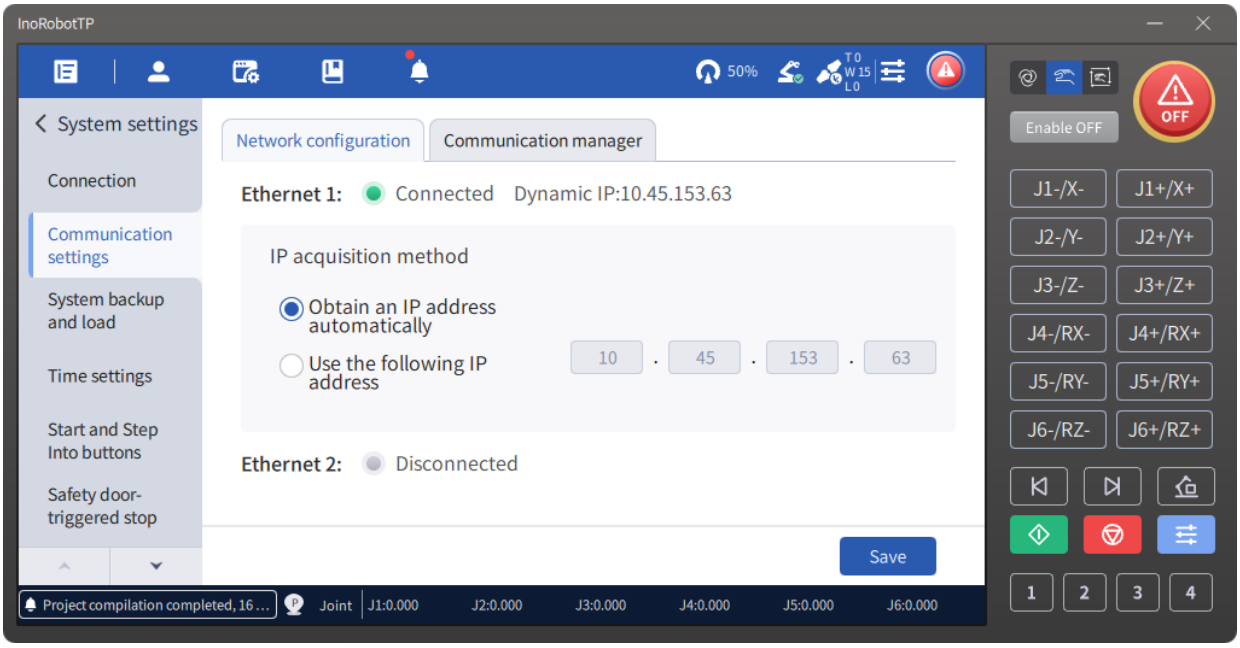
Any other states indicate an anomaly, and appropriate measures must be taken to resolve the issue before use.



4.3 Programming and Debugging Example

After completing the wiring between the controller and the robot, perform the following basic operations.

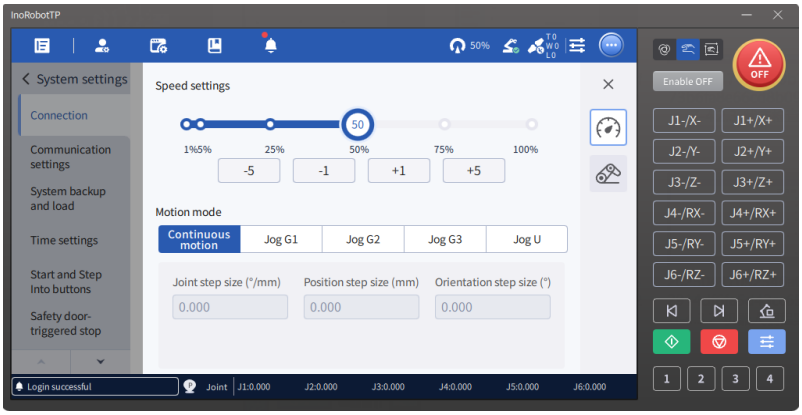
1. For the first connection, click the "Skip" button first, then go to "System settings" > "Communication settings" page, and enter the IP address to connect.
2. Subsequently, the PC-based teaching device software will automatically connect upon each startup, eliminating the need to click "Skip".



4.3.1 Controlling Robot Motion Through Axis Control (Manual)

Step 1: Select speed and motion mode.

Upon entering the interface, click the first button  on the right to select speed and motion mode. Here, we select a speed of 50% and "Continuous motion" mode.



You can increase or decrease the speed here, or directly select a speed point using the mouse.



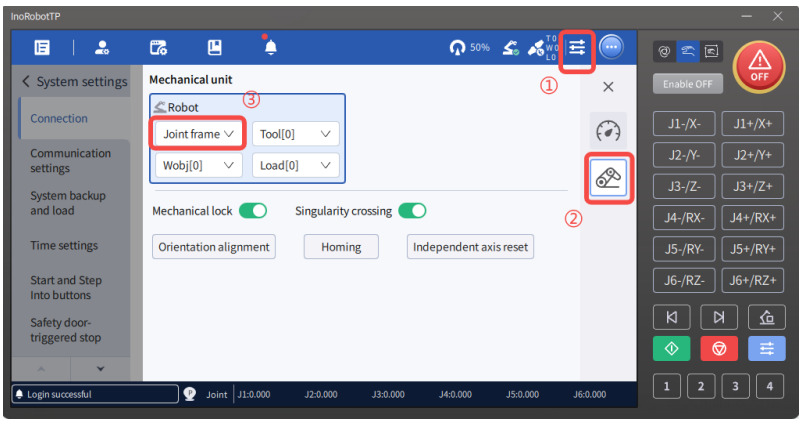
Motion modes are divided into "Continuous motion" and jogging. During continuous motion, holding down the axis movement button will keep the motion ongoing. For jogging, a single click of a jogging button will initiate a single movement.

You can set the custom jogging distance in the following interface.



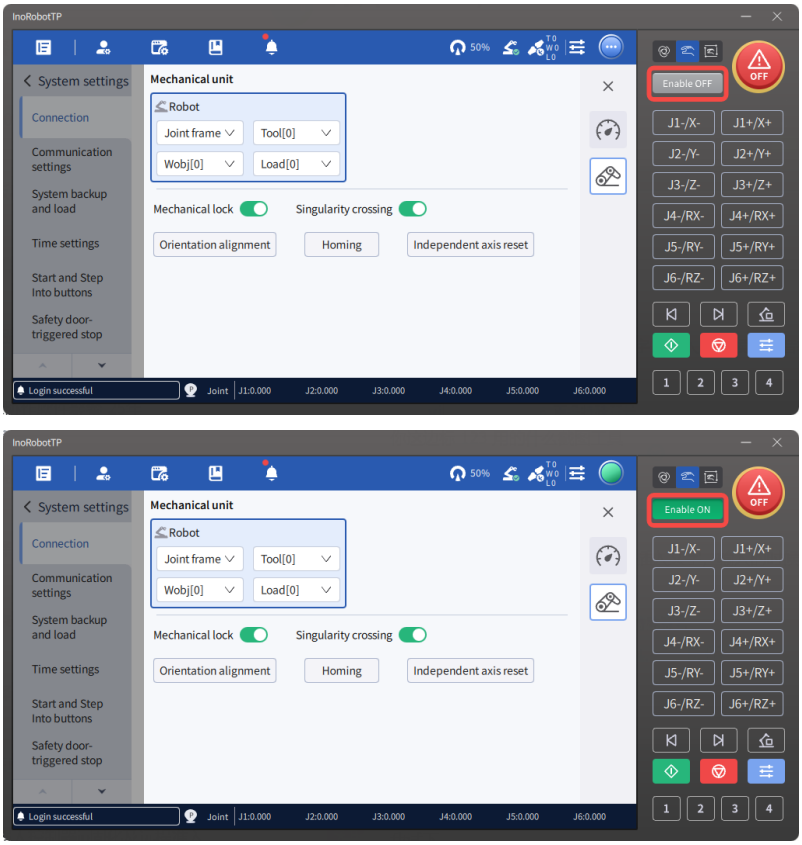
Step 2: Select joint frame.

The frame selection button is located in the upper right corner of the PC-based teach pendant. Click the buttons in sequence. Here, we select the joint frame.



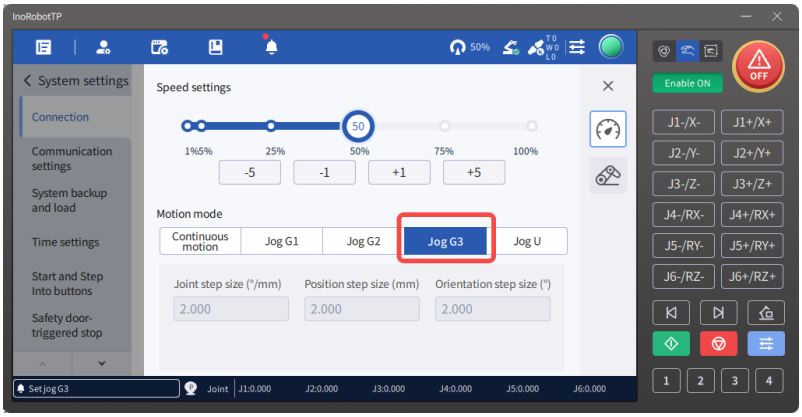
Step 3: Switch to "Enable ON".

Click the "Enable OFF" button on the right. The button will turn green and change to "Enable ON", indicating that the enable control is activated.



Step 4: Start motion.

If jogging is selected, click the Axis + or Axis - button each time for single joint jogging



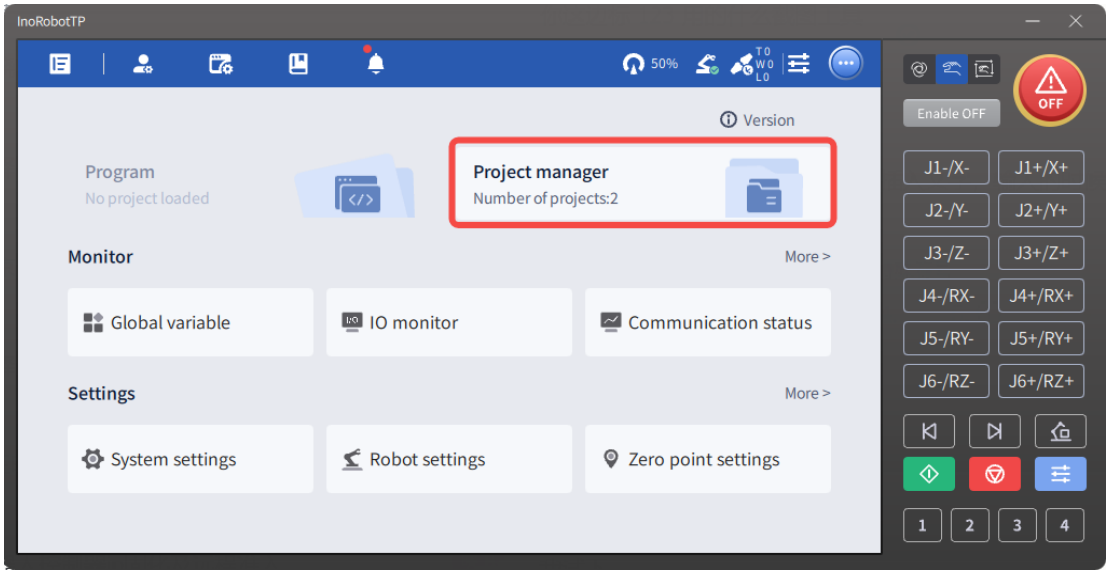
If continuous motion mode is selected, when the motion ends, check if the robot has stopped moving, or if the coordinates at the bottom of the PC-based teach pendant software have stopped changing.

4.3.2 Robot Programming Example

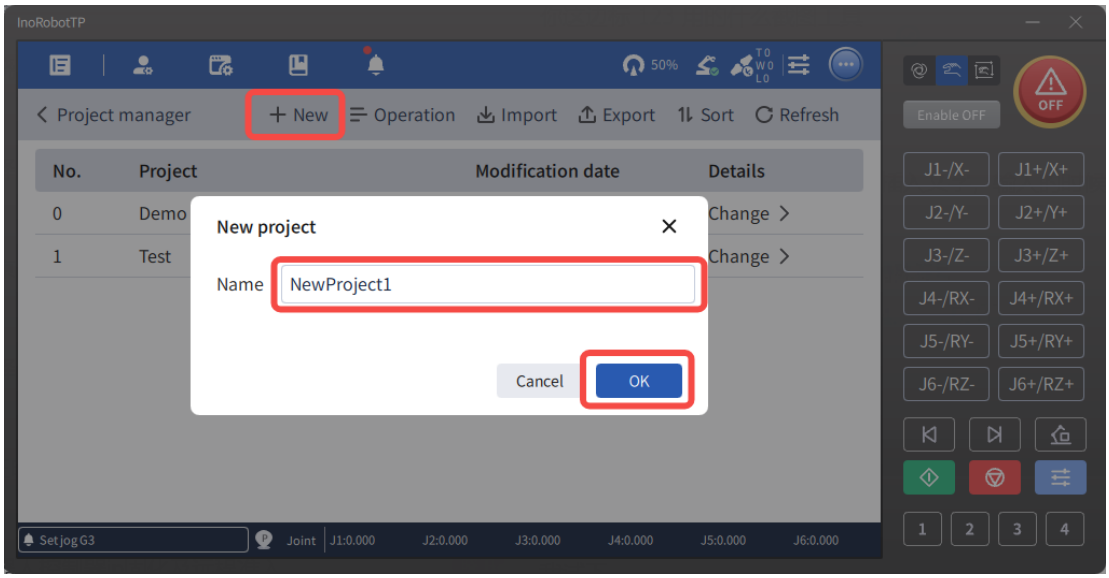
Operating procedure:

Step 1: Create a project.

Click "Project manager".



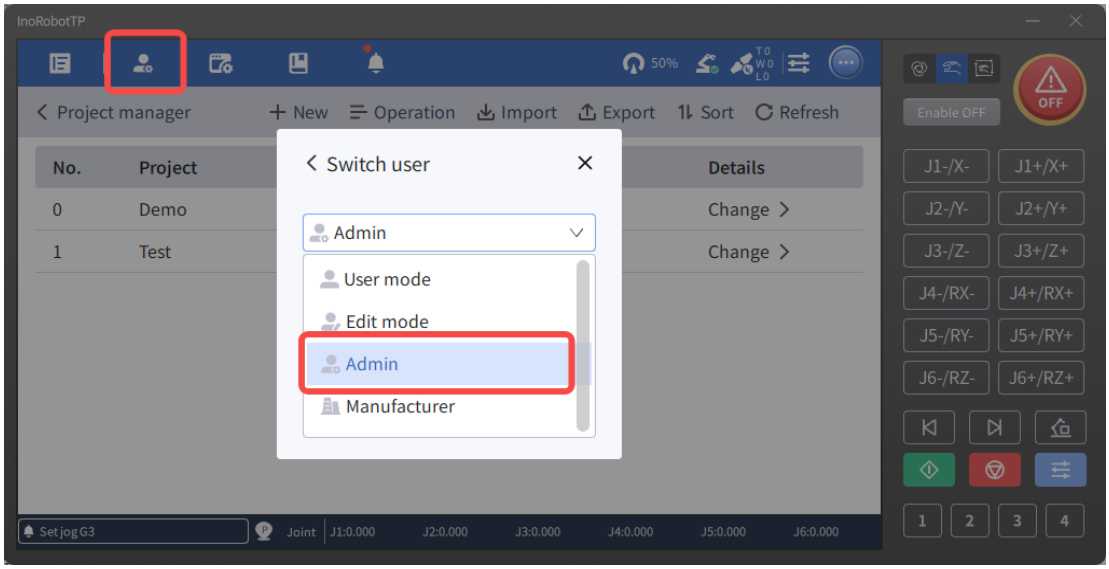
Click "New", enter the project name and then click "OK".



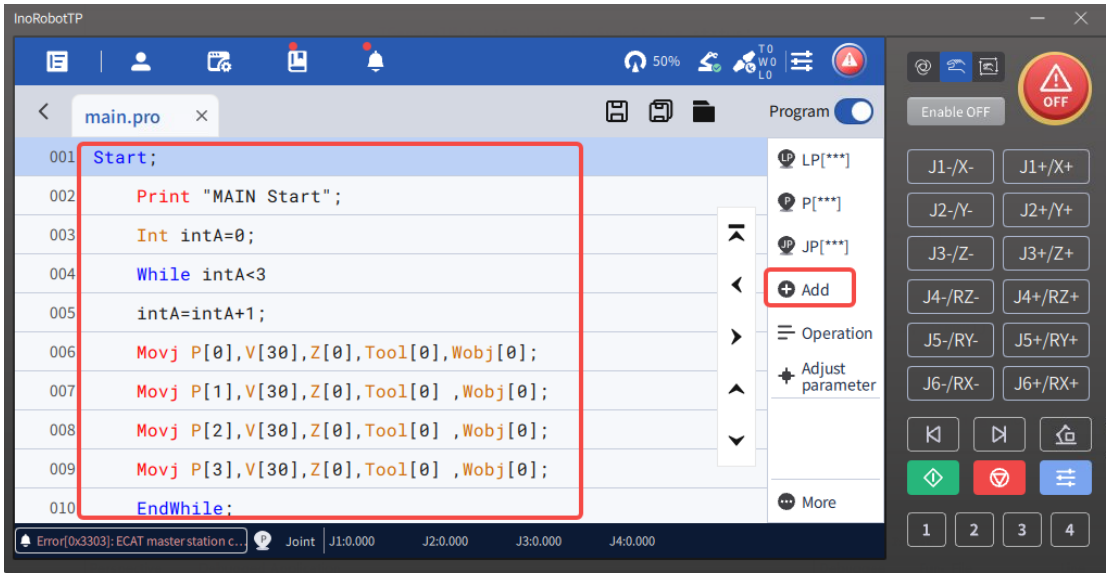
Step 2: Edit main task program.

Click user selection button in the top left corner of the screen and select "admin", with the password being 000000.

Click "View" to enter the project details interface of the current project.



Click "View" to open the programing window, and click the "Add" button in the right list for programming. The final result should be as follows:



The program is as follows:

```
Start;
  Print "MAIN Start";
  Int intA=0;
  While intA<3
   intA=intA+1;
   Movj P[0],V[30],Z[0],Tool[0],Wobj[0];
   Movj P[1],V[30],Z[0],Tool[0] ,Wobj[0];
   Movj P[2],V[30],Z[0],Tool[0] ,Wobj[0];
   Movj P[3],V[30],Z[0],Tool[0] ,Wobj[0];
EndWhile;
```

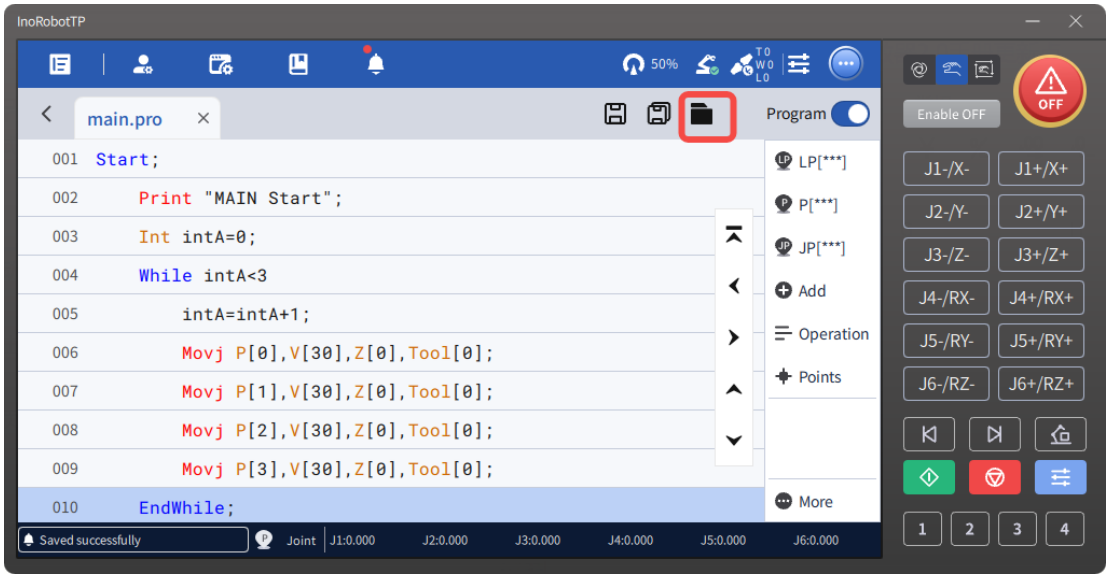
```
CloseClaw(1);

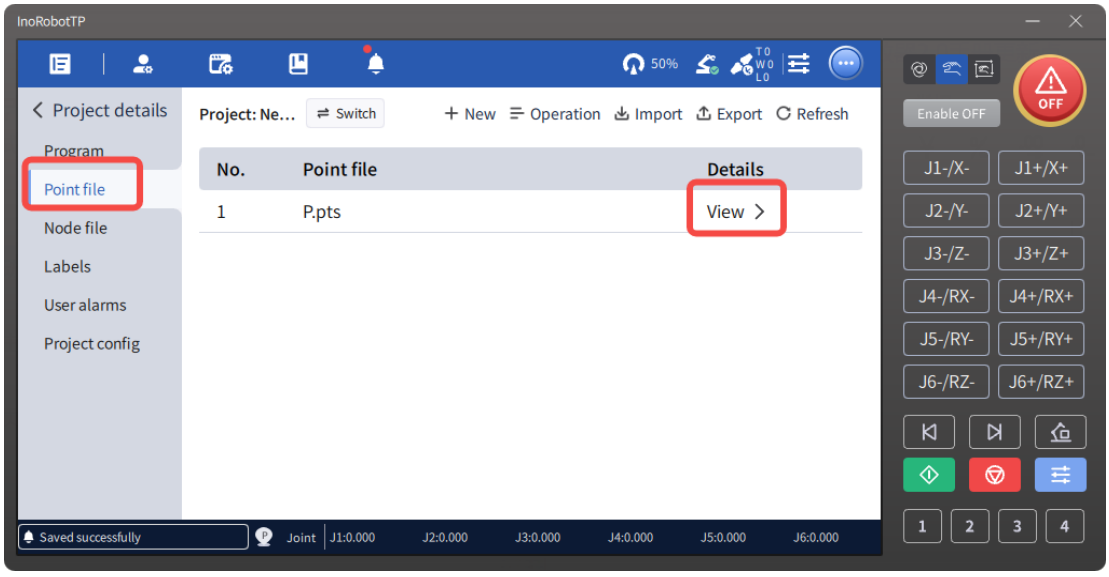
Print "MAIN End";

End;
```

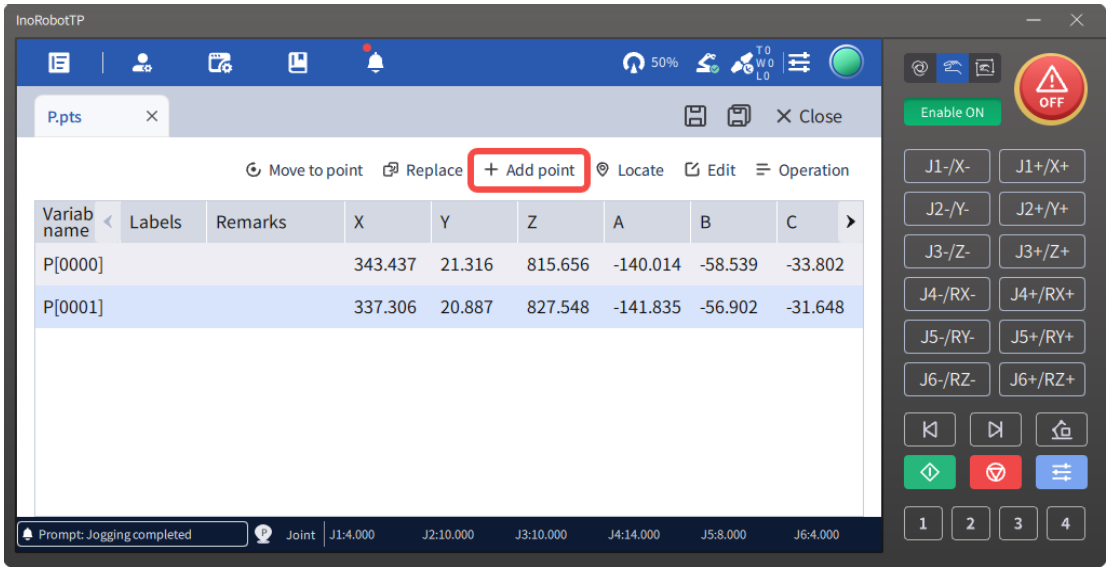
Step 3. Add points.

Click "Project manager" > "Project details" > "Point file".



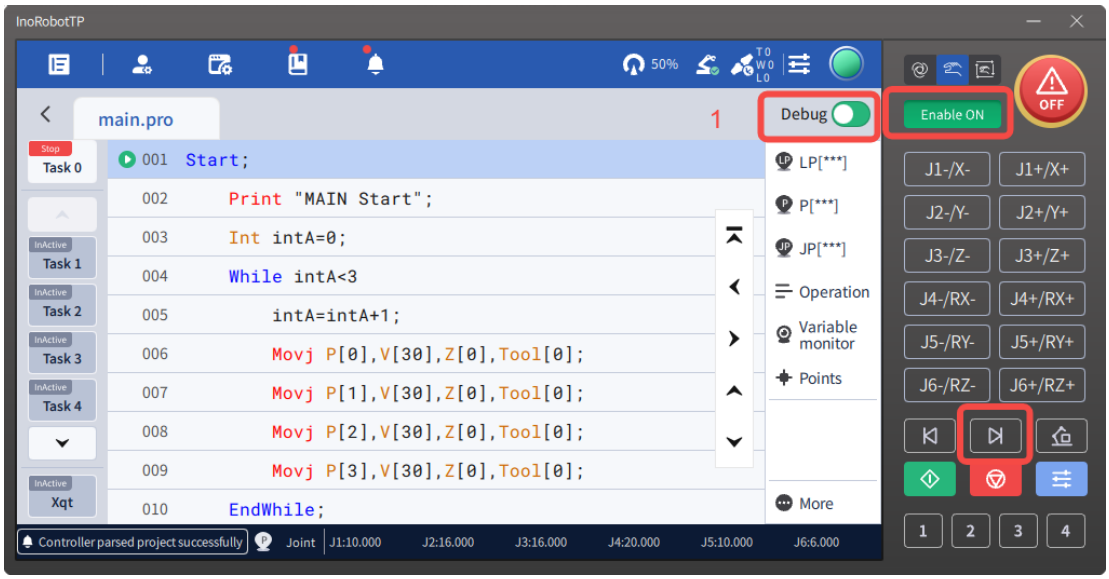


Enter the Point selection interface. For each motion to a point, click the "Add point" button to add a point. Add four points here.

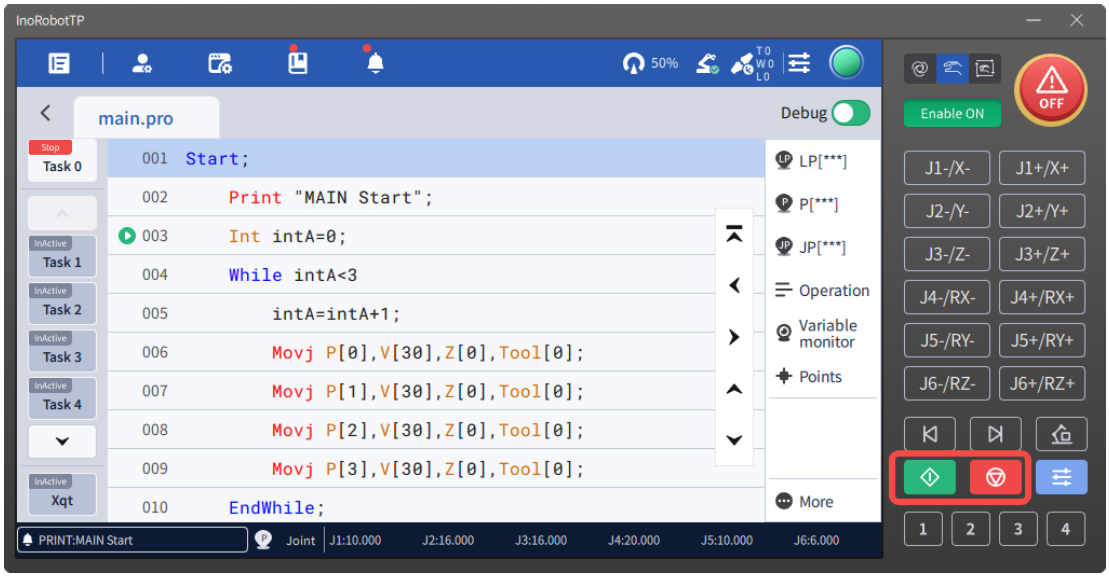


Step 4. Debug.

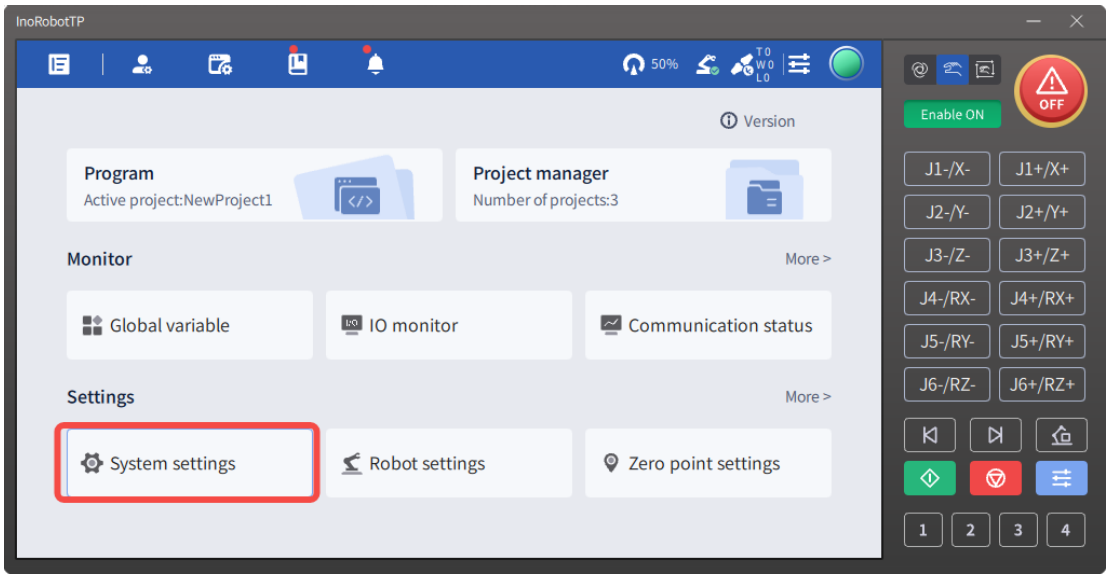
Return to the programing interface, switch the "program" button at the upper right corner of the interface to "Debug", then switch to "Enable ON" and click the arrow button below to debug step by step.

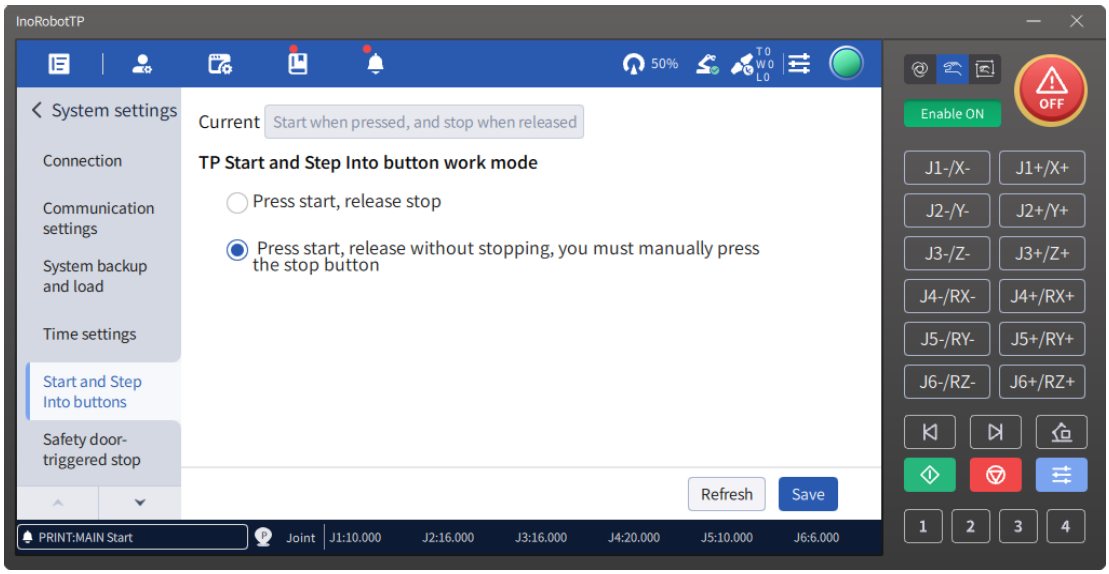


After observing and confirming that the robot movements are correct during single-step debugging, you can click the button at the lower right corner to start or stop the entire program. Click green button to start the program, and red button to stop.



Note: You can set the start and stop relationship in "System settings" > "Start and Step Into buttons", and click "Save" after setting.

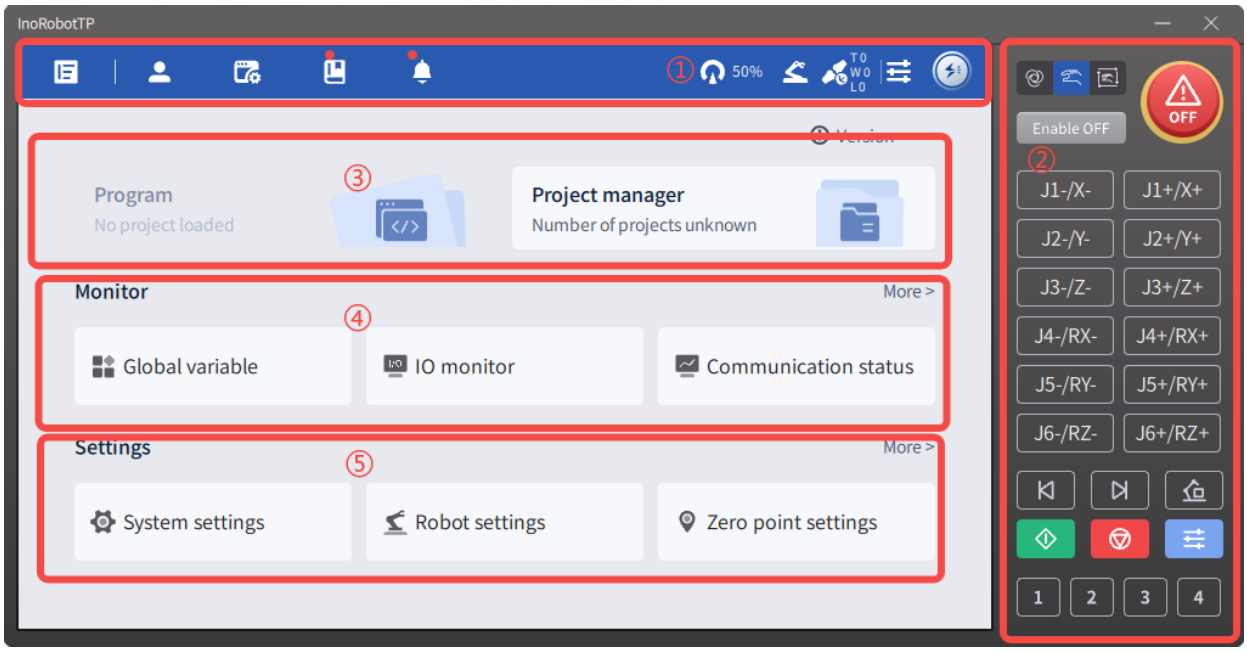




5 Teach Pendant InoRobotTP Menu

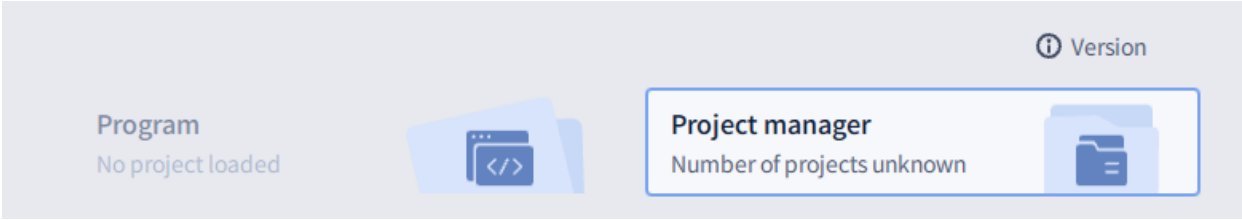
5.1 Home Page

No.	Function	Description
①	Status bar	The status bar displays frequently accessed entries and important information related to system status, including shortcut navigation buttons, user permissions, control authority, log, notification entry button, and the status display of robot. See 6 Status Bar Window.
②	Virtual physical panel	The buttons on the virtual physical panel have the same functions as those on the hardware physical panel, with only layout differences. See 7 Virtual Physical Panel.
③	Program	Includes programming and debugging functions and project management functions. See 8 Programming and Debugging.
④	Monitor	Monitors the status of robot, system parameters, and I/O status. See 9 Monitor.
⑤	Settings	Includes all robot parameter setting modules and function switches. See 10 Settings.



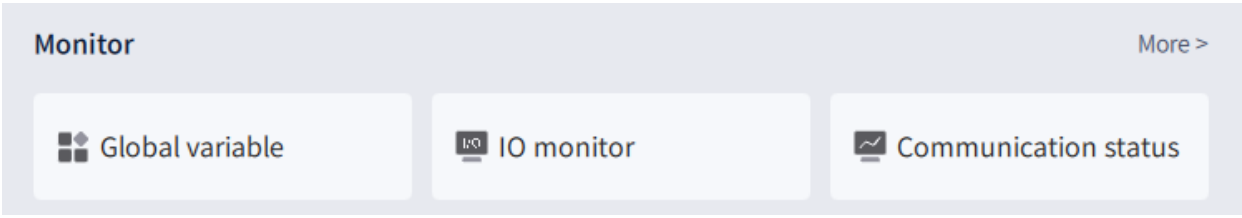
5.2 Programming

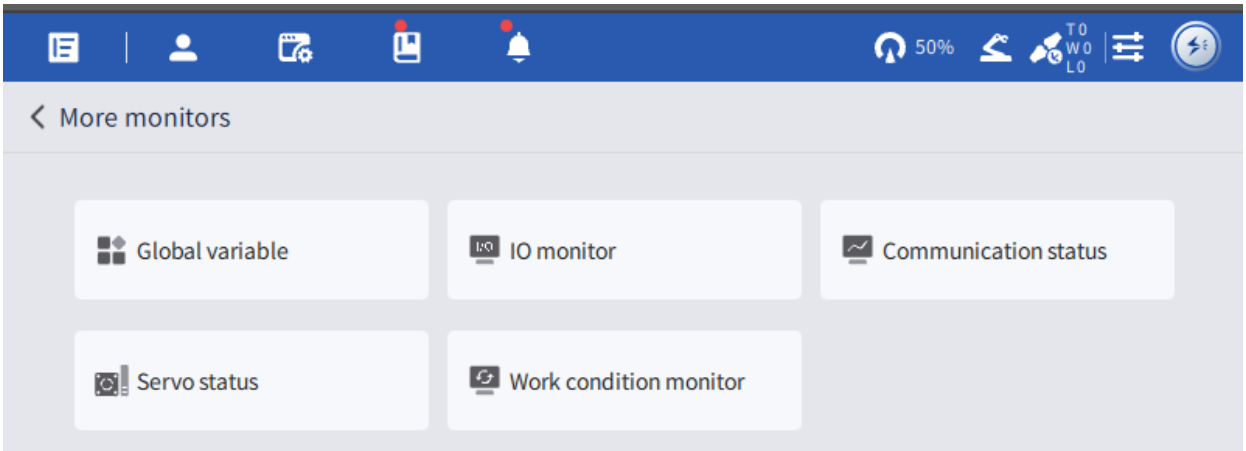
Function	Description
Program	Edit robot program files, which can be debugged in single-step debugging or continuous operation under different operation modes. See 8.1 Programming and 8.3 Debugging.
Project manager	You can add, edit, and delete robot projects, open other projects, and switch between projects. See 8.2 Project Manager.



5.3 Monitor

No.	Description
Global variable	Monitor the status of global variables, such as BRD variables, PR variables, String variables, and P/JP variables. See 8.3.8 Global Variable Monitor.
IO monitor	Monitor the I/O status of robot. See 8.3.9 I/O Monitor.
Communication status	View the connection status of devices and bus communication status. See 9.4 Communication Status.
Servo Status	Monitor the status information of robot servo. See 9.5 Servo Status.
Work condition monitor	Monitor the operating condition information of the robot, such as "Current", "Load", "Overload rate", and "overheat rate". See 9.6 Work Condition Monitor.

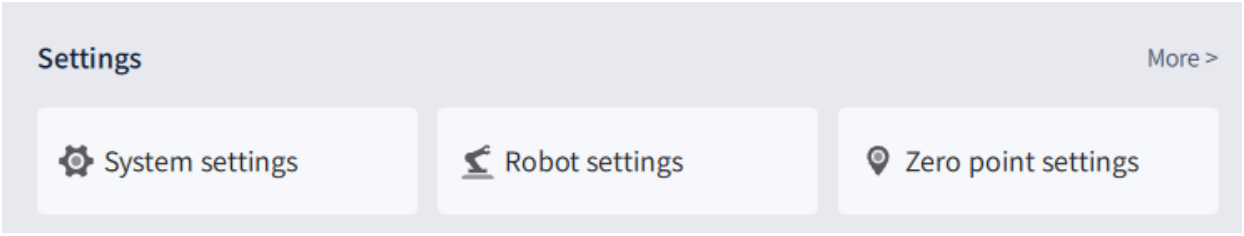




5.4 Settings

Function	Description
Robot settings	Includes "Structural parameters", "Reduction ratio", and "Coupling parameters", etc. See 10.1 Robot Settings.
Zero point settings	Includes "Absolute zero", "Work origin", and "Zero point calibration". See 10.2 Zero Point Settings.

Function	Description
Installation parameters	View and set arm load and installation configuration. See 10.3 Installation Parameters Settings.
Peripheral configuration	Includes setting options for robot peripheral parameters. See 10.4 Peripheral Configuration.
Motion parameters	Includes setting options for robot motion parameters. See 10.5 Motion Parameters Settings.
System settings	Includes setting options for communication, time and date, and other system functions. See 10.6 System Settings.
Workspace	Includes setting options for robot work space. See 10.7 Workspace.
Debug	Includes settings and switch options for debugging. See 8.3 Debugging.
Vision calibration	Vision calibration is the prerequisite for using the vision function of the robot system. Calibration obtains the relative positional relationship between the camera and the robot. See 11.2 Vision Calibration.
Conveyor tracking	The tracking process allows you to track moving objects and plan robot movements with reference to the moving objects. See 11.1 Conveyor Tracking



6 Status Bar Window

The status bar window includes the entries for common operations of the teach pendant and status display.

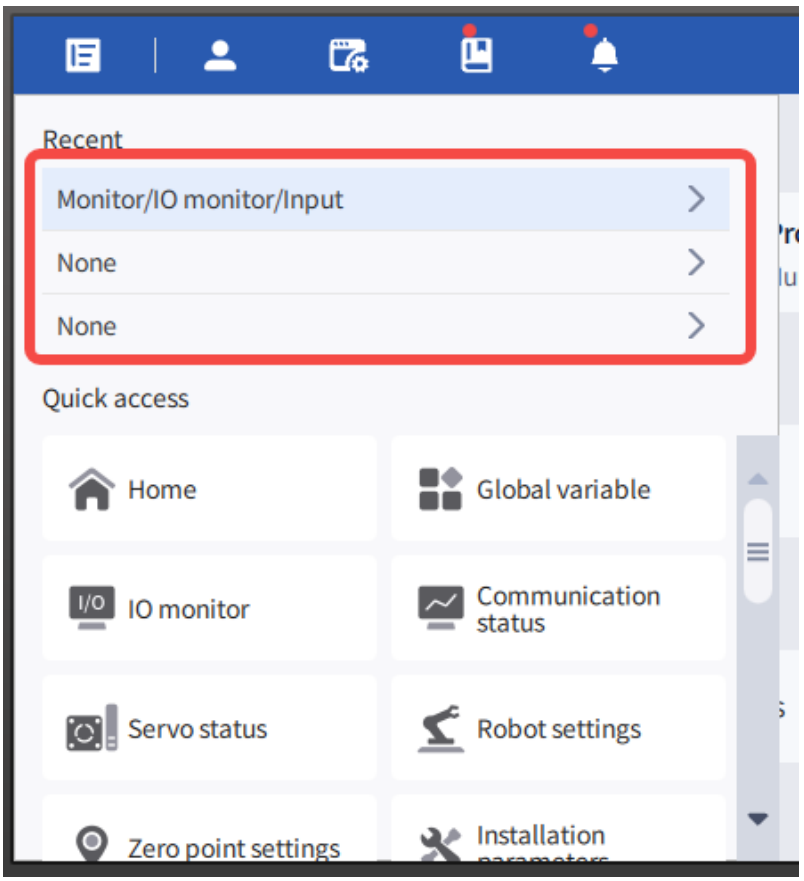


6.1 Shortcut Navigation

The shortcut navigation on the teach pendant InoRobotTP is designed for quick access to specific pages and is divided into two parts: recent pages and preset quick accesses.

6.1.1 Recent

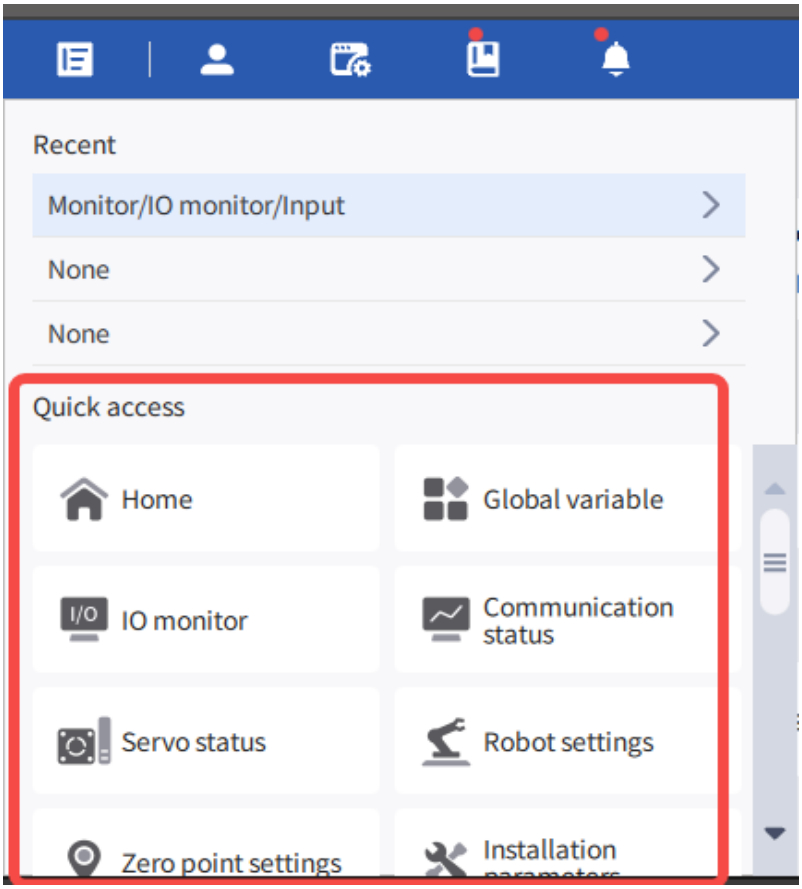
The recent pages list records the last three specific pages opened, arranged in order from top to bottom, as shown in the figure below:



Click the corresponding row of the page to jump to the corresponding page. Under the "Program" module, you can directly navigate to the programming page, while the "Project" module records two subpages: project manager and project details. Both "Monitor" and "Settings" can achieve second-level directory jumps. For example, clicking "Settings" > "Motion parameters" > "Teach parameter settings" will directly jump to the teach pendant parameter settings under the motion parameters module.

6.1.2 Quick Access

Quick access is the primary entry to the corresponding module, as shown in the figure below:

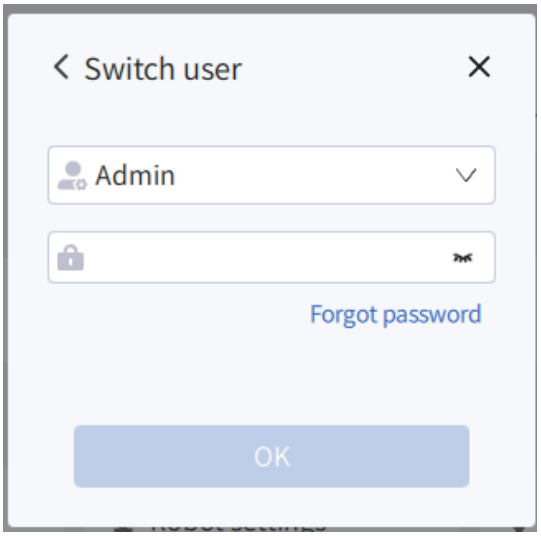


Click the corresponding module button to jump to the corresponding function module.

6.2 Authority

6.2.1 User Login

Click the button on the status bar to open the login interface for user login.



On the user login interface, select the mode based on the current user role and log in:

Mode	Applicable To	Initial Default Password
User mode	Operators on the production line. Allows direct control of robot motion and operation of programs, and control of I/O states and forcing.	No password is required.
Edit mode		

Mode	Applicable To	Initial Default Password
	Teaching programmer. Compared with the user mode, the program editing function is added so that users can perform teaching programming. Authorities such as equipment control and mechanical locking are also added.	The initial password is 000000.
Admin mode	Advanced users. Most system operations are included besides the preceding operation authorities.	The initial password is 000000.
Manufacturer	The manufacturer's maintainers. Maintainers have the highest authority and can perform operations such as upgrading and factory settings restoring.	Reserved by the manufacturer.

Different user modes have different operation permissions:

Operations	Permissions			
	User mode	Edit mode	Admin	Manufacturer
Movement control	✓	✓	✓	✓
Switch of frame, tool number, workobject number, and grip load number	✓	✓	✓	✓
Speed switch	✓	✓	✓	✓
Jogging mode switch	✓	✓	✓	✓
Running projects	✓	✓	✓	✓
Project modification and editing	×	✓	✓	✓
I/O control	✓	✓	✓	✓
Robot settings	×	×	×	✓
Work origin	×	✓	✓	✓
Absolute zero	×	×	✓	✓
Zero point calibration (SCARA only)	×	×	✓	✓
Tool	×	✓	✓	✓
Workobject	×	✓	✓	✓

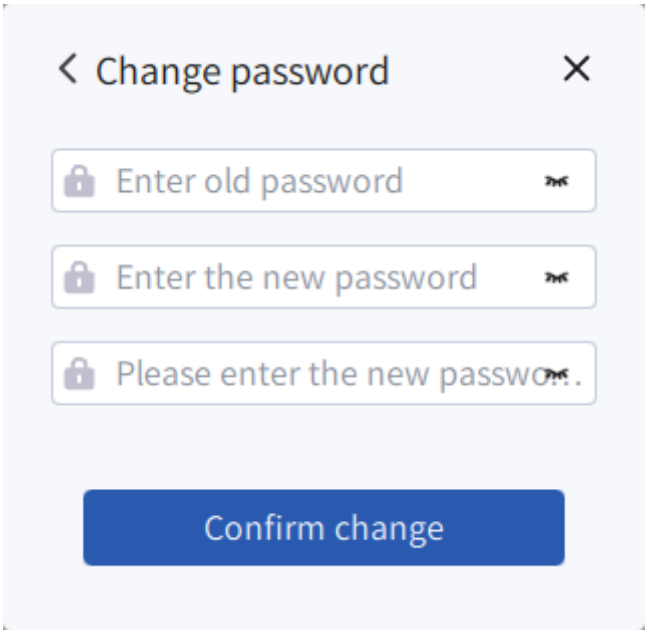
Load	×	✓	✓	✓
Arm load	×	×	✓	✓
Environmental parameters	×	✓	✓	✓
Installation form (6-axis type only)	×	×	×	✓
Teach parameter/Run parameter	×	×	✓	✓
Axis limit	×	×	✓	✓
Tracking error/Arrival error/Current limit /Average load rate limit/Temperature rise protection	×	×	×	✓
Interference zone settings	×	×	✓	✓
Collision detection	×	×	✓	✓
Trajectory recovery settings	×	×	×	✓
Advanced function settings	×	×	✓	✓
Fieldbus switch	×	×	✓	✓
I/O mapping settings	×	×	✓	✓
Project Number Configuration	×	✓	✓	✓
Point file configuration	×	✓	✓	✓
IRLink settings	×	×	✓	✓
Mechanical unit configuration	×	×	✓	✓
Communication settings	Teach pendant communication only	×	✓	✓
Time settings	×	×	✓	✓
Quick stop trigger method	×	×	✓	✓
Emergency stop mode	×	×	✓	✓

Safety door-triggered stop	×	×	✓	✓
COM switch	×	✓	✓	✓
Flying trigger I/O	×	×	✓	✓
Start and Step Into buttons	×	×	✓	✓
Screen calibration	×	×	✓	✓
Brightness and screensaver	✓	✓	✓	✓
Configuration file backup	×	×	✓	✓
Load configuration file	×	×	✓	✓
Memory card backup	×	✓	✓	✓
Load memory card	×	✓	✓	✓
Load point file	×	✓	✓	✓
System upgrade	×	×	×	✓
Restore factory settings	×	×	×	✓
Format memory card	×	×	×	✓
Clear historical alarms	×	×	×	✓
Network debug	✓	✓	✓	✓
Controller debug	×	×	✓	✓
System diagnostics	✓	✓	✓	✓
Servo calibration	×	×	×	✓
Control device	×	✓	✓	✓
Release brake	×	×	✓	✓
Function expansion	×	×	✓	✓
Robot maintenance information	✓	✓	✓	✓

Robot maintenance operation	×	×	×	✓
Controller debug	×	×	✓	✓

6.2.2 Changing the Password

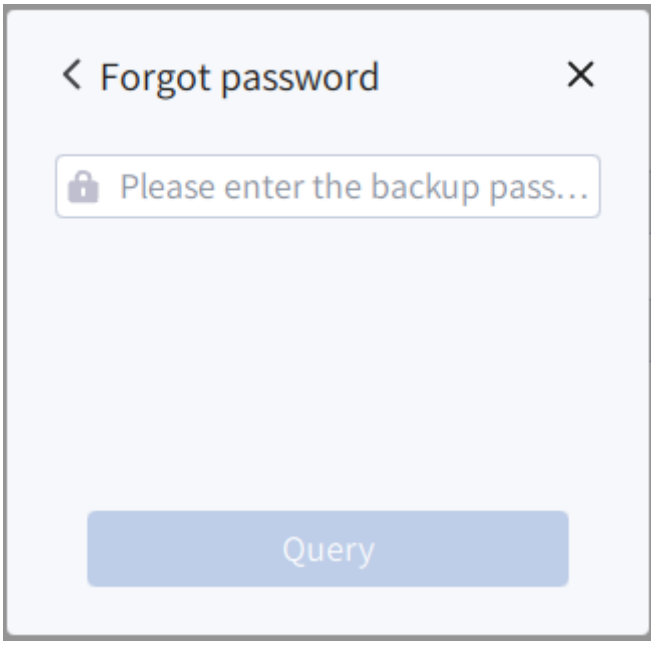
The teach pendant supports changing passwords for editing and administrator permissions. On the login page, select the corresponding permission level and click "Change password". Enter the old password, new password, and confirm password in sequence, then click "Confirm change" to change the password. A corresponding message will appear upon success or failure.



6.2.3 Retrieving the Password

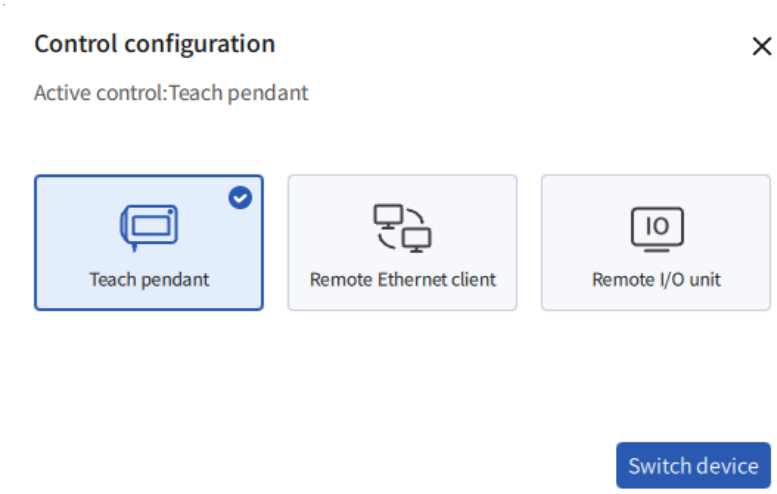
The teach pendant supports retrieving the password under Edit and Admin permissions. If you forget the password for Edit or Admin mode, contact the manufacturer to use the backup password to retrieve the administrator password.

On the login page, click "Forgot password", enter the backup password, then click "Query" to display the old password. A corresponding message will appear upon success or failure.



6.3 Control Authority

You can switch between different control devices by clicking the button on the status bar to open the control configuration interface.



Multiple devices can control the robot, but the robot controller can only be controlled by one device at a time.



- Control authority is a prerequisite for devices to control the robot. The device can control the robot only after obtaining the control authority. Otherwise, the device can only read and monitor the status of the robot.

- In the teach pendant, you can manage permissions; editing and above permissions are required for control authority modification, and the robot must be in a non-motion, non-debugging, and non-auto mode.
- The factory default control authority is granted to the teach pendant upon factory delivery. When other devices (remote Ethernet device, I/O device) need to control the robot, the control authority must be granted to the corresponding device via the teach pendant.



Switching control authority does not require a reboot of the robot controller. Regardless of which device holds the control authority, the emergency stop switch on the teach pendant remains valid.

Scenarios for control authority selection:

- Teach pendant: When using only the teach pendant, select "Teach Pendant" as the control authority.
- Remote Ethernet client: When using APIs, select "Remote Ethernet client" as the control authority. In this case, only API commands can control the robot, and the teach pendant cannot control it.
- Remote I/O unit (effective in both auto and manual modes): When using external devices to fully control the robot, such as HMI, PLC controlling the program start/stop, movement, and point modification of robot via bus (PN/EtherCAT/Modbus/EtherNet/IP, etc.), select the "Remote I/O unit" as the control authority (effective in both auto and manual modes).
- Remote I/O unit (effective only in auto mode): When using external devices to control the robot only in auto mode, such as HMI, PLC controlling the program start/stop of robot via bus (PN/EtherCAT/Modbus /EtherNet/IP, etc.), but needing to use the teach pendant to modify points, select "Remote I/O unit" as the control authority (effective only in auto mode). This maintains the control authority with remote IO, and allows point modification on teach pendant by simply switching to the manual mode.

- Control authority to teach pendant

  When the system control authority is granted to the teach pendant, the teach pendant can operate the controller. Other devices can only read or observe parameters, and cannot modify parameters or operate the controller.

- Control authority to remote Ethernet device

  ▪ When the system control authority is granted to the remote Ethernet device, the remote Ethernet device can operate the controller. Other devices can only read or observe parameters, and cannot modify parameters or operate the controller.

  ▪ Up to 4 remote Ethernet devices can be connected to the robot simultaneously. When the system control authority is switched from another device to the Ethernet device, none of the 4 Ethernet devices have actual control authority and need to request control authority through an instruction.

  ▪ After an Ethernet device has taken the system control authority, it can operate the controller. The other three devices do not have control authority and can only read and monitor parameters. However, they can all forcibly take control away from the current control owner through instructions. After the control authority is granted to the Ethernet device, the default control authority will be on the first Ethernet device every time the system starts up.

- Control authority to remote I/O device

  ▪ The remote I/O unit (effective in both manual and auto modes) takes the control authority.

▪ In this case, the system control authority is granted to the remote I/O device. The remote I/O device can operate the controller regardless of whether it is in manual or automatic mode. Other devices can only read or observe parameters, and cannot modify parameters or operate the controller. Station reservation can be an application of this situation.

▪ The remote I/O unit (only effective in auto mode) takes the control authority.

▪ In this case, the system control authority is granted to the remote I/O device. The remote I/O device can operate the controller when in automatic mode. Other devices can only read or observe parameters, and cannot modify parameters or operate the controller. When in manual mode, the teach pendant takes partial control authority, as shown in the table below.

Function	Operation on teach pendant	**Special requirements**	**Permission requirements**
Enable/Disable the robot	Enable or disable the robot through the button on the right side panel	Line number is not changed.	User mode, Edit mode, Admin, and Manufacturer
Modify the global variables	Go to "Monitor" > "Global variable".	The line number is not changed after the global variable is modified (The hand-held teach pendant cannot set custom global variables, tool, wobj, load parameters, or modify global points.)	Editor, Manager, and Factory
Modify the points during debugging	Modify the points in debugging mode.	The line number is not changed after the points are modified in the debugging mode.	Editor, Manager, and Factory
Modify the I/Os	Go to "Monitor" > "IO monitor".	The line number is not changed after the I/O modification.	Editor, Manager, and Factory
Axis control panel	Function	The following functions do not reset the line number.	User mode, Edit mode, Admin, and Manufacturer
	1: Mechanical unit settings	-	
	2: Axis motion control	-	
	3: Mechanical lock	The robot needs to be disabled.	
	4: Dynamic brake/ Singularity crossing	The robot needs to be disabled.	
	5: Reset independent axis	-	
	6: Change motion mode	-	
	7. Display the current position	-	
	8: Homing	--	-

Function	Operation on teach pendant	Special requirements	Permission requirements
Axis control panel > Coordination function	Turn on/off coordination function	-	User mode, Edit mode, Admin, and Manufacturer
Move to point (MovL, MovJ, JumpL, Jump, MovAbsJ)	Go to "Manual" > "Point" > "GO".	The line number will not be reset (Note: Trajectory recovery not available.)	User mode, Edit mode, Admin, and Manufacturer
Move to point	Go to "Settings" > "Zero point settings" > "Work origin" > "Move to point".	-	Edit mode, Admin, and Manufacturer
Modify the global speed	Go to the upper right corner of the main interface.	The line number is not reset.	User mode, Edit mode, Admin, and Manufacturer

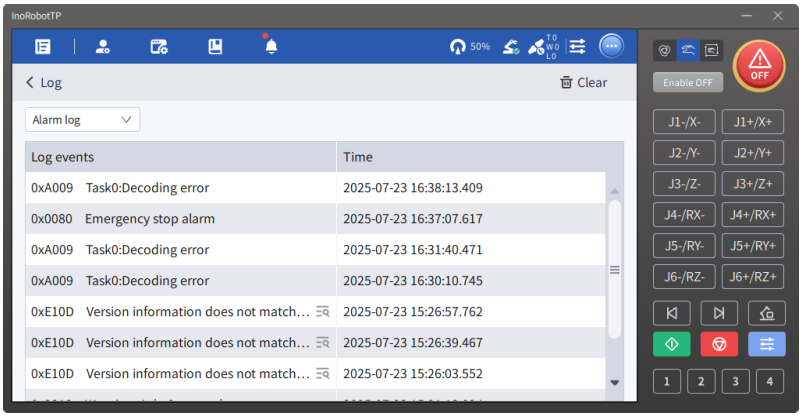
For the differences between the two remote I/O sub-modes, see chapter 4 of the "Industrial Robot Remote I/O Control Function User Guide" Differences Between two Remote I/O Unit Sub-Modes.

CAUTION

- For whether to reset the line numbers of the remote I/O unit, see 10.6.11 Remote Line Number Reset.
- When switching remote I/O control authority, a start speed can be set. This speed will take effect when switching remote I/O and when restarting under remote I/O control.

6.4 Log

Click the "Log" button on the status bar to open the log panel and view the alarm logs and operation logs.



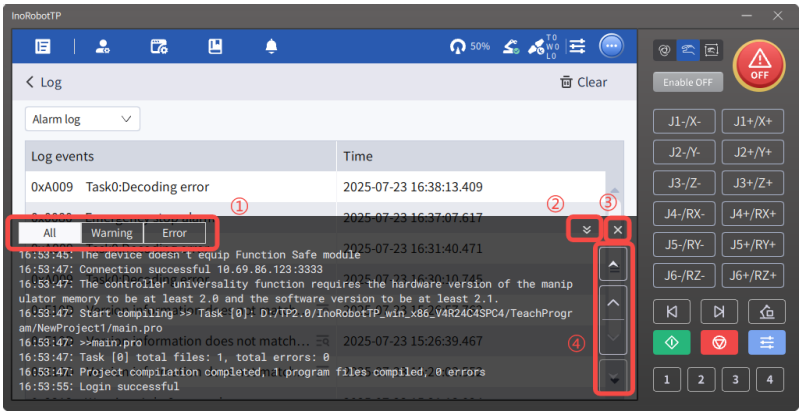
The operation log records key operations of the local use of the teach pendant, while the alarm log records abnormalities in the controller. The operation log and alarm log can provide information support for troubleshooting. See the appendix for methods to handle robot alarms.

CAUTION

- Clicking the Clear button will clear the operation logs or alarm logs, which requires manufacturer authority.
- The operation logs and alarm logs can record up to 1,000 entries each. If more than 1,000 entries, only the most recent 1000 entries will be recorded.
- Resetting the teach pendant will clear the alarm log.

6.5 Notification

Click the button to open or close the notification message bar.



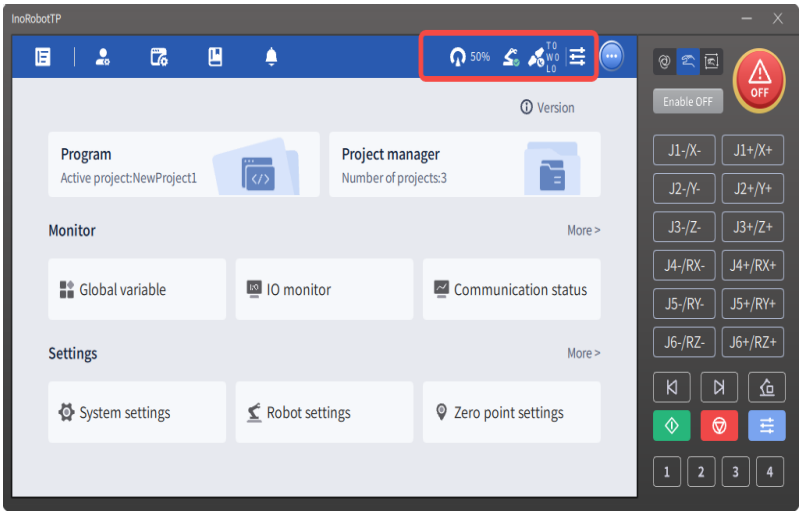
No.	Function
①	Warning or error tag button, which can be used for filtering the content displayed in the message bar.
②	Collapse/Expand area, which can hide or show the message bar.
③	Close the message bar.
④	Page-turning button, which can be used to turn single lines or entire pages in the message bar.

CAUTION

- The historical message records in the message bar will be cleared after the teach pendant is powered on again.
- The message time can be displayed correctly only after the time synchronization between the teach pendant and the controller is completed.

6.6 Control Panel

The control panel includes robot axis motion operations and common parameter configuration.

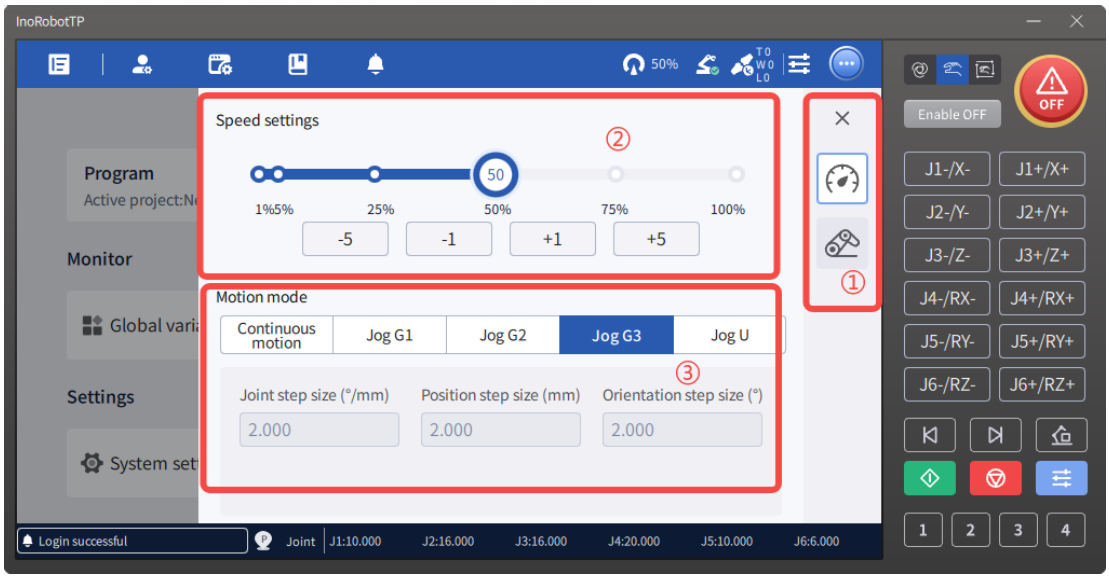


Click the  button or the status display area of the status bar to open the control panel.

Click the status display area  of the status bar to open the speed panel in the control panel.

Click the status display area  or  of the status bar to open the mechanical unit control panel in the control panel.

6.6.1 Speed Panel



No.	Description
①	Used to switch between the speed settings panel and the mechanical unit control panel.
②	The speed settings area, which supports quick setting of robot speed by dragging and clicking, or fine-tuning the speed with the ±5, ±1 below.
③	The motion mode setting area, which supports setting of robot motion, such as jogging and position step size.

Jogging: When you press the axis motion button, the robot will move only up to a specific step size, instead of moving continuously when the button is pressed.

Mode	Description
Continuous motion	Non-jogging, i.e., moving at normal speed.
Jog G1	Jog in joint step size of 0.05°, position step size of 0.05 mm, and orientation step size of 0.05°.
Jog G2	Jog in joint step size of 0.5°, position step size of 0.5 mm, and orientation step size of 0.5°.
Jog G3	Jog in joint step size of 2°, position step size of 2 mm, and orientation step size of 2°.
Jog U	User-defined jogging, can be directly set and saved on the panel. (same function as "Settings" > "Motion parameters" > "Teach parameters settings" > "Jogging")

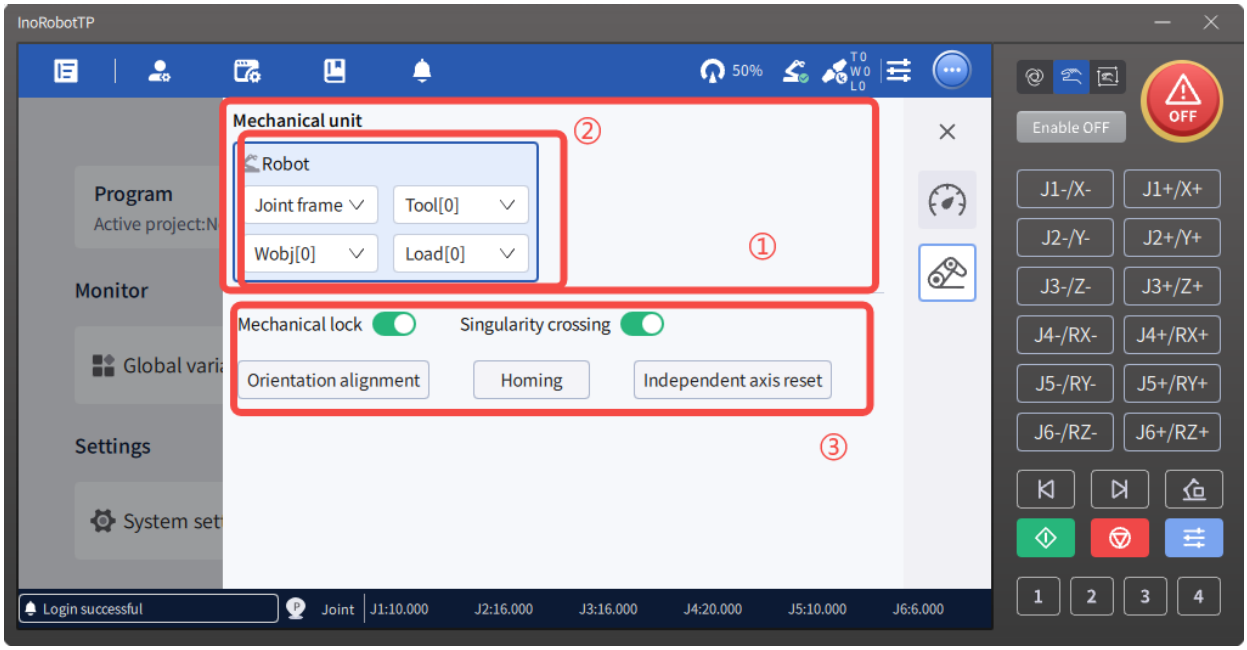


If the robot moves along the tool or workobject frame, pay attention to the current tool and workobject frames.

6.6.2 Mechanical Unit Control Panel

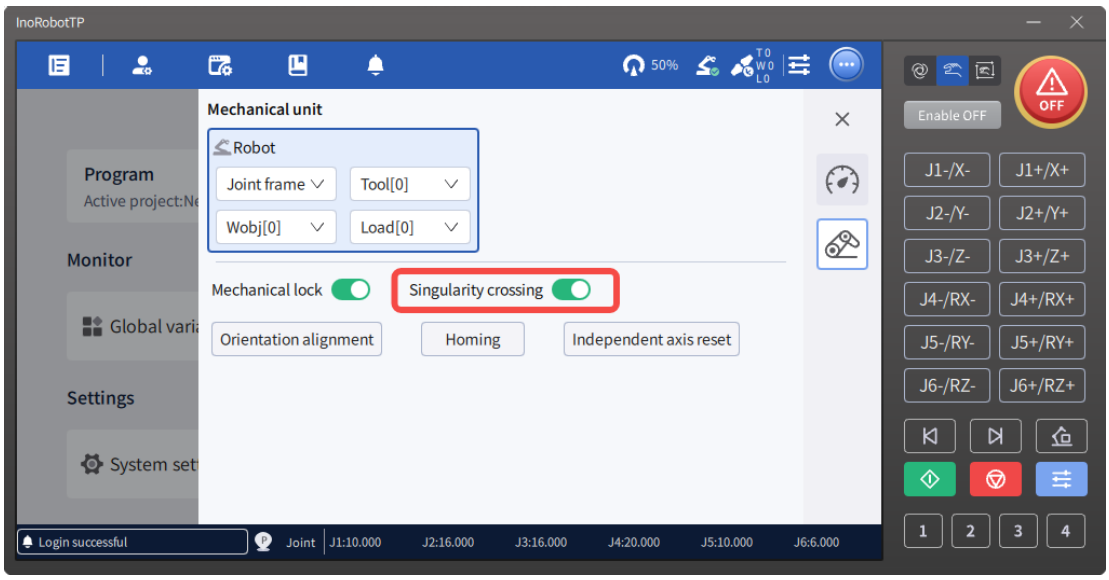
No.	Description
①	Mechanical unit, allows switching the currently active mechanical unit. The external axis panel will only be displayed if external axes are configured. See 10.4.6 Mechanical Unit Configuration.
②	Allows switching the current frame of the robot, typically including five options: Joint frame, world frame, base frame, tool frame, and workobject frame. See 2.2 Frames. Allows quick switching the current tool number, workobject number, and load number. For the configuration of tool, workobject, and load, see 10.3 Installation Parameters Settings.
③	The mechanical unit panel area includes functions such as mechanical lock, homing, dynamic braking, and independent axis reset. • Mechanical lock: When the mechanical lock is enabled, the robot cannot move. However, other robot functions are normal. This helps to verify the logic of the program. • Homing: Returns all joints of the selected mechanical unit to the zero value. When homing is required, click the "Homing" button to start homing and release the button to stop.The homing stops automatically after all joints of the current mechanical unit return to the zero value. • Independent axis reset: resets the independent axis. After the independent axis is reset, the trajectory is cleared. If the independent axis reset is triggered in the stop

No.	Description
	state, the program runs from the yellow cursor line when it is restarted and the preceding trajectory is cleared.



6.6.2.1 Dynamic Brake

For the SCARA robots, the robot axis can be pushed more easily by turning off the dynamic brake switch after the robot is disabled.

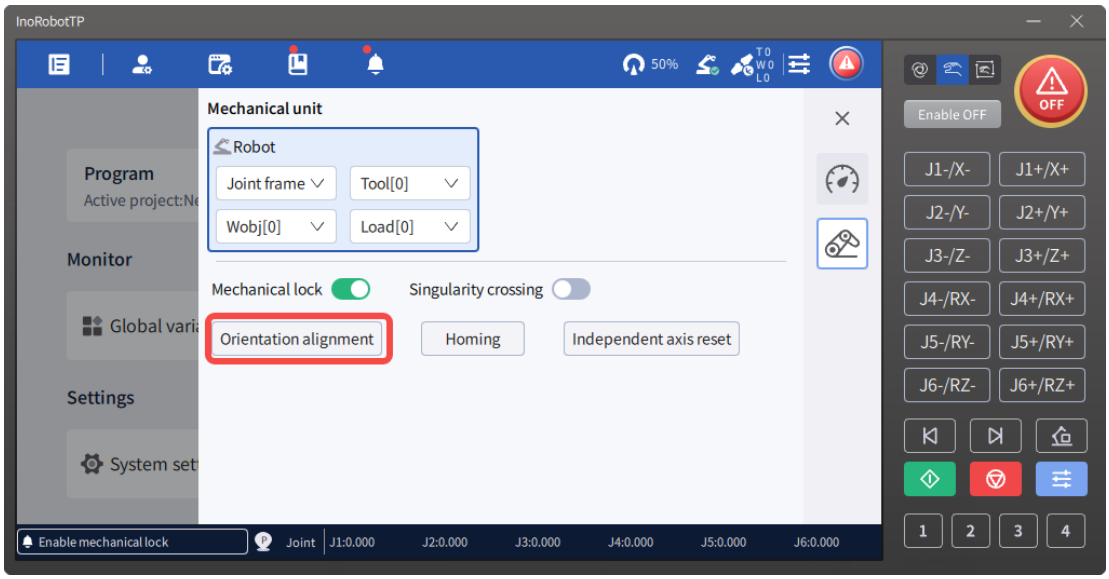


CAUTION

Precautions for using the dynamic braking switch:

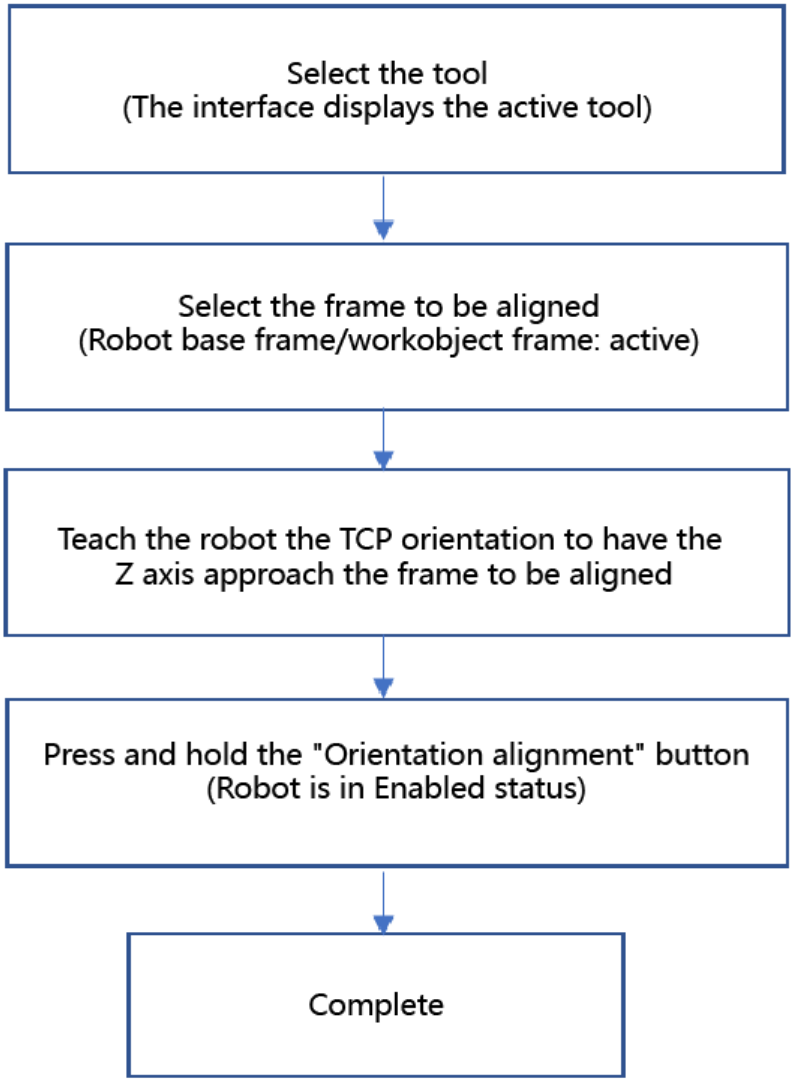
- This function applies to the J1, J2, and J4 axes of the SCARA robots.
- The dynamic brake switch can be turned on or off only when the robot is disabled.
- The dynamic brake switch is always ON when the robot is enabled.
- When the controller is powered on again, the dynamic brake switch is restored to the ON state.

6.6.2.2 Orientation Alignment



Due to the high degree of freedom and flexible movement of 6-axis serial robots, the TCP can face the workbench at any pose from different angles. Joint teaching struggles to achieve right angle alignment to the workobject. The orientation alignment function can calibrate the Z-axis direction to align with any of the axes of the workobject frame (X+, X-, Y+, Y-, Z+, Z-).

The calibration flowchart is as follows:



1. When selecting the current tool and workobject to align, the current tool number and workobject number are activated, and the coordinate settings display interface will also change accordingly.
2. Press and hold the "Orientation alignment" button. The Z-axis of the TCP will automatically align with the nearest axis of the workobject frame.

Limitation: When J1 = 0° (both left and right), using "Orientation alignment" to align with the X-axis of base frame can bring the robot close to a singular area, causing abnormal acceleration or excessive movement.

Grip tool scenario	
World frame	Align the tool's Z axis to the world
Base frame	Align the tool's Z axis to the base
Workobject frame	Align the tool's Z axis to the workobject

External tool scenario	
World frame	Align the flange's Z axis to the world
Base frame	Align the flange's Z axis to the base

Workobject frame	Align the tool's Z axis to the workobject
Flange frame	Align the tool's Z axis to the flange

6.6.2.3 Singularity Crossing

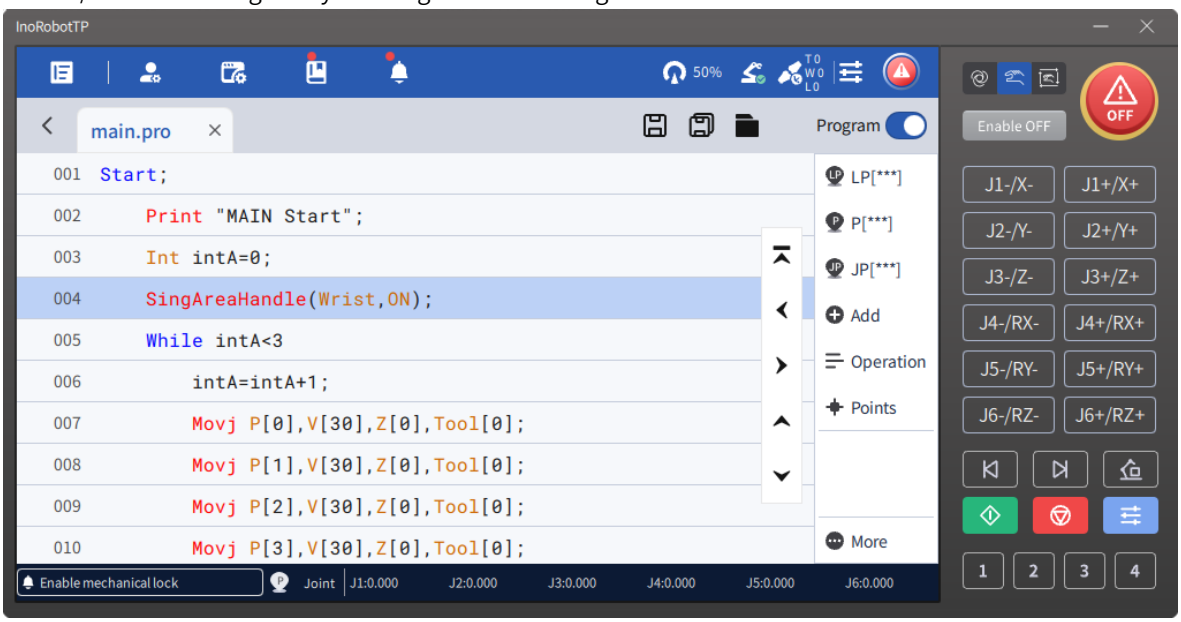
A 6-axis industrial robot has singularities at its shoulder, elbow, and wrist respectively. The shoulder singularity and elbow singularity can be avoided by changing the robot motion trajectory or changing the teaching points. However, it is difficult to avoid wrist singularity that may occur at any time with positive or negative changes in the J5 angle using the CP instruction (motion instructions in Cartesian space, such as: Linear, circular, jumpL, free curve, etc.). The singularity function solves such problems.

CAUTION

This function only supports the 6-axis industrial robot to cross the wrist singular area.

Operating procedure:

1. Enable/disable the singularity crossing function through instruction:



In the above figure, "SingAreaHandle (Wrist, ON)" is the control instruction of the wrist singular traversing function. The instruction contains two parameters, "Wrist" is the default parameter and cannot be modified, the other parameter is "ON" or "OFF". ON indicates that the wrist singularity crossing function is enabled, and OFF indicates that the wrist singularity crossing function is disabled.

2. Enable/disable the singularity crossing function for jog motion:

Note

In the above figure, the red box shows the singularity crossing function switch.

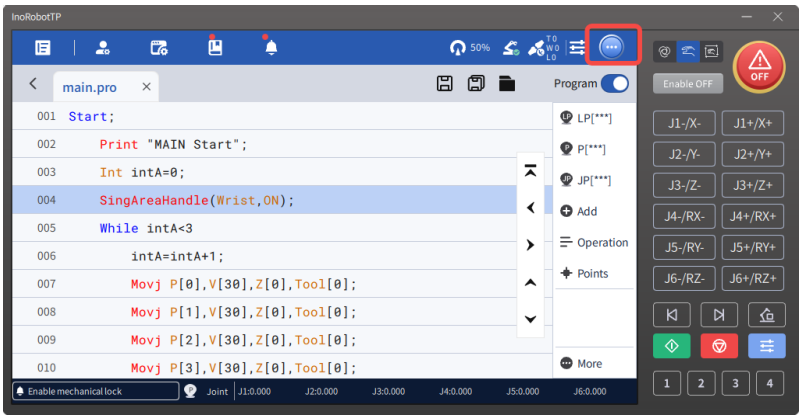
Note:

1. After the singularity crossing function is enabled, it takes effect for the subsequent motion instructions, until it is disabled by a new instruction or the parameter is restored to default value (the default value is "Wrist,OFF"). The default value is restored in the following conditions:
   - The program has a file or point modification, which requires the controller to compile the project.
   - The program running pointer is return to the start line.
   - The program running pointer is set to another function.
   - The controller is power on again.
2. When any of the above conditions occur, the parameter is restored to default value "Wrist,OFF".
3. The transition instruction does not take effect between the motion instruction enabled with this function and the motion instruction that is not enabled with this function.
4. After this function is enabled, a small portion of the trajectory cannot reach the orientation/joint angle of the target position set by the user.
5. The trajectory of the wrist singularity crossing movement realized by instruction is different from that realized by jog motion.
6. After this function is enabled, the orientation of TCP during operation is different from the orientation of TCP during user teaching.
7. The wrist singularity crossing movement realized by instruction is independent of that realized by the teaching.
8. Function compatibility description

Function	Function	Compatibility	Action if incompatible
Wrist singularity crossing in instruction	Motion I/O	Yes	-
	Pause/Start	Yes	-
	TCP	Yes	-
	ECP	No	Alarm occurs when the singular area is reached
	External axis	Only no-model external axes are supported	Alarm occurs when the singular area is reached
	Model-based external axes	Axis singularity crossing is not supported for model-enabled external axes.	Alarm occurs when the singular area is reached
	Collision detected	Yes	-
	Vibration suppression	No	Alarm occurs when the singular area is reached

Function	Function	Compatibility	Action if incompatible
	Trajectory recovery	Yes	-
	Move to point	No	Alarm occurs when the singular area is reached
	Point offset	Yes, supports solution selection based on the same arm parameters	-
	Dynamic tracking	No	Alarm occurs when the singular area is reached
Wrist singular crossing during jogging	Position teaching TCP	Yes	-
	Jog	No	Alarm occurs when the singular area is reached
	Coordinated external axis	No	Alarm occurs when the singular area is reached
	Position teaching ECP	No	Alarm occurs when the singular area is reached

6.7 Status Display Light



The status indicators on the right side of the status bar will display the current status of the robot in real time. During use, you can determine whether the robot is abnormal based on the status indicators.

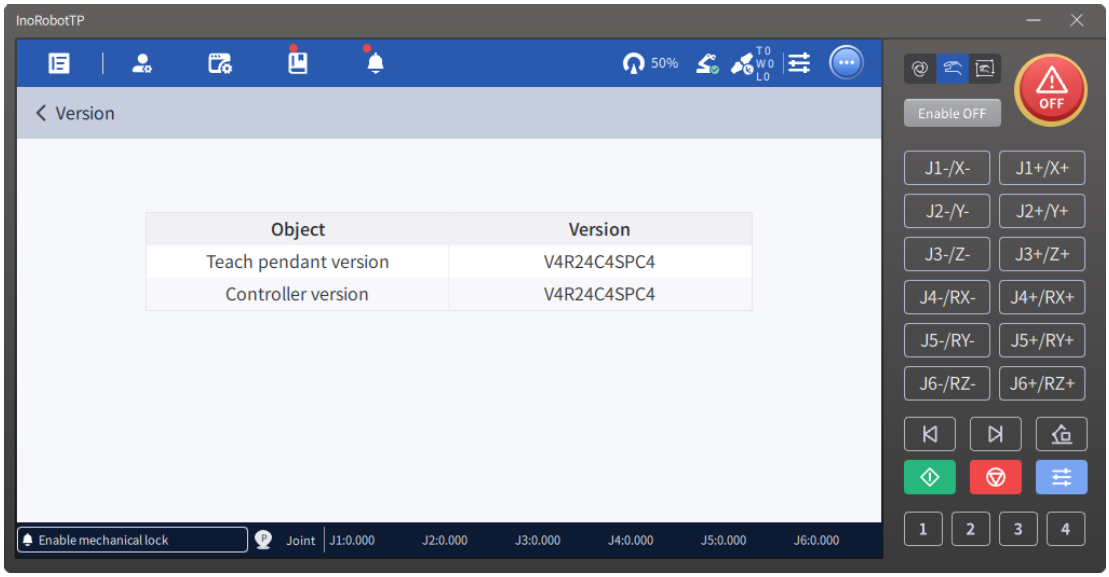
Meaning of the 6 status indicators:

Status indicator	Meaning	Action
	Servo enabled: At this moment, the emergency stop button is released and the servo is enabled.	-
	Emergency stop state: The emergency stop button is pressed and the robot cannot move.	-

Status indicator	Meaning	Action
	Standby state: The emergency stop button is released and servo is not enabled.	-
	Error state: An abnormality occurs and needs to be handled immediately.	Refer to the status bar message and the "Robot Alarms and Handling Method" section to take appropriate action, then click the button to clear the alarm.
	Warning state: An abnormality occurs and the system prompts users.	Refer to the status bar message and the "Robot Alarms and Handling Method" section to take appropriate action, then click the button to clear the warning.
	Offline state: The network is disconnected and communication with the controller fails.	Go to "System settings" > "Connection", enter the IP address to reconnect.

6.8 Version

Click the "Version" button on the main interface to open the version information interface and view the software version.

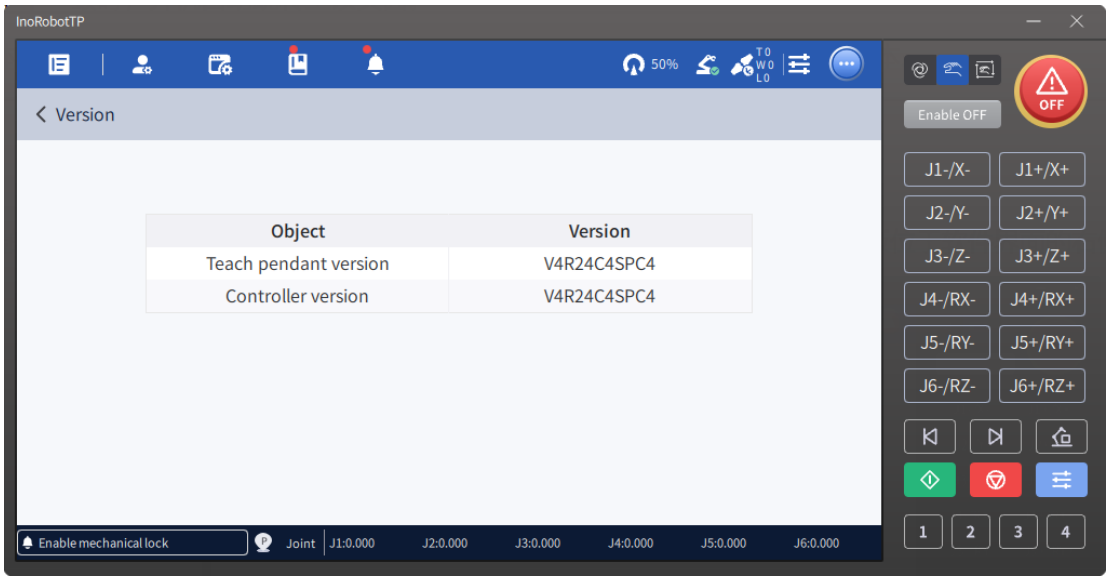


CAUTION

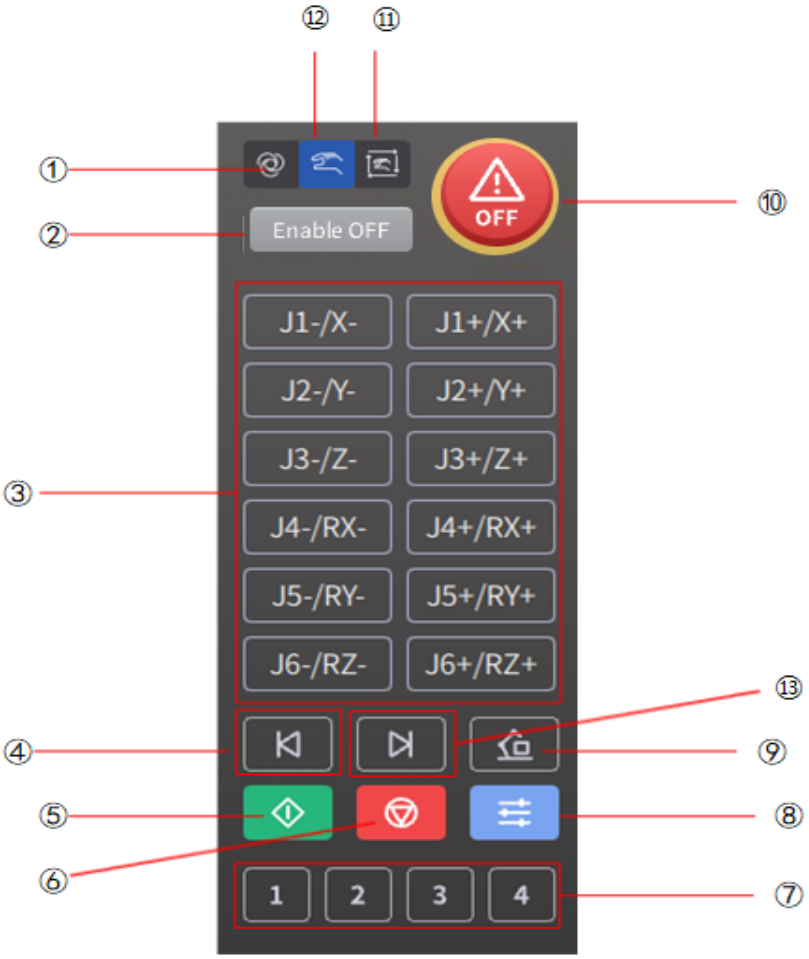
- When the teach pendant and controller versions do not match, the system will automatically redirect to this page upon startup.
- For the hand-held teach pendant, when the versions do not match, a synchronization button will appear on the interface, allowing the teach pendant to be upgraded to the same version as the controller.

7 Virtual Physical Panel

The virtual physical panel is a function of the PC-based teach pendant, simulating the physical buttons of the physical teach pendant. This interface is not available on the hand-held teach pendant. The operation panel is located on the right side of the software interface:



Function descriptions are as shown in the following figure:



No.	Description
①	Auto

No.	Description
②	Enable ON/OFF
③	Axes motion control/Pose motion control
④	Single-step forward/backward
⑤	Run
⑥	Stop
⑦	User-defined buttons
⑧	Open control panel
⑨	Switch mechanical unit
⑩	Emergency stop ON/OFF
⑪	Manual high speed mode
⑫	Manual low speed mode
⑬	Reserved function disabled

Note

The backward function is temporarily not implemented.

7.1 Operation Mode

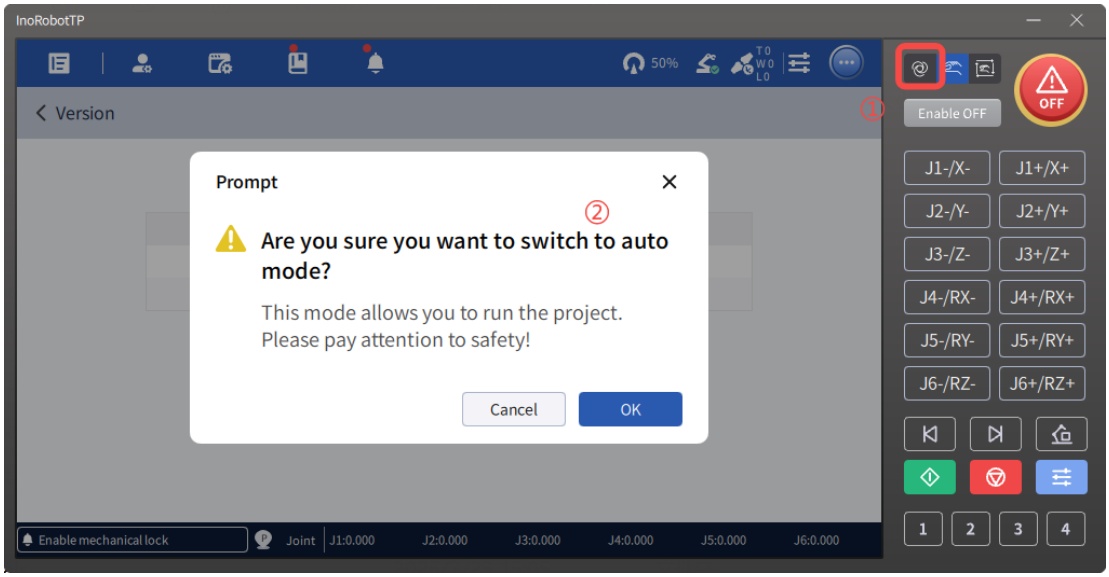
Three operation modes are available: Auto mode, manual high speed mode, and manual low speed mode.

The corresponding operation buttons are shown in the figure below, where switching to auto mode and manual high speed mode requires a confirmation in a pop-up dialog.

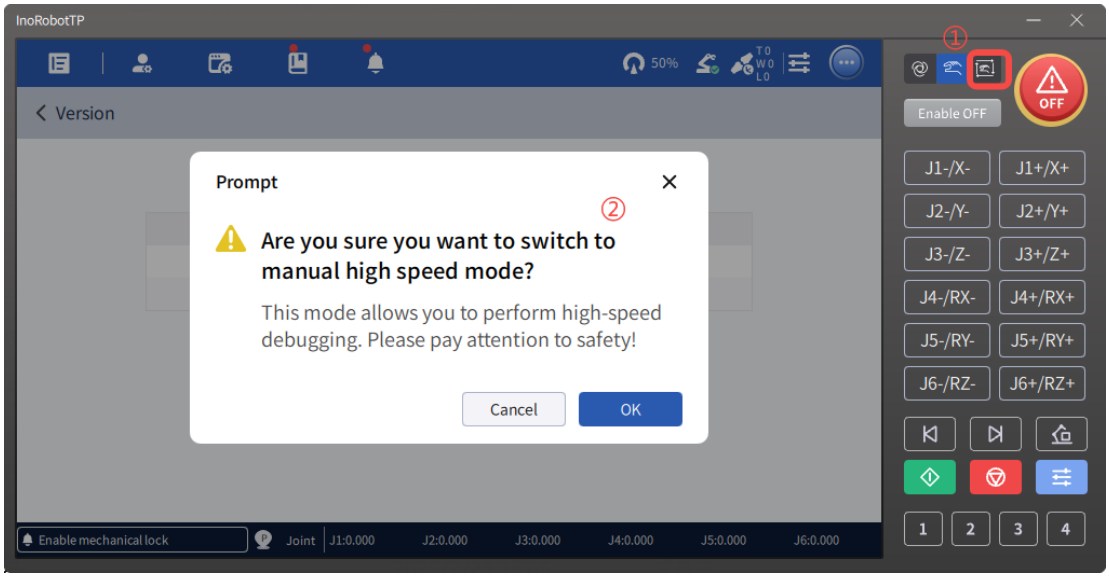
For the hand-held teach pendant, the operation mode can be switched using the key switch.

For detailed description of the operation modes, see 1.4 Operation Mode Declaration.

- Switch to auto mode



- Switch to manual high speed mode



- Switch to manual low speed mode

  Click the corresponding button directly to switch without confirmation.

7.2 Shortcuts for PC-based Teach Pendant

For the PC-based teach pendant, the programming interface supports shortcuts:

Shortcut command	Description
CTRL + A	Select all, and bring up the multi-selection bar. The operation through this shortcut selects all items when not all items on the current page are selected, and deselects all items when all items are selected.
CTRL + Q	Bring up the multi-selection bar.
CTRL + C	Copy
CTRL + V	Paste

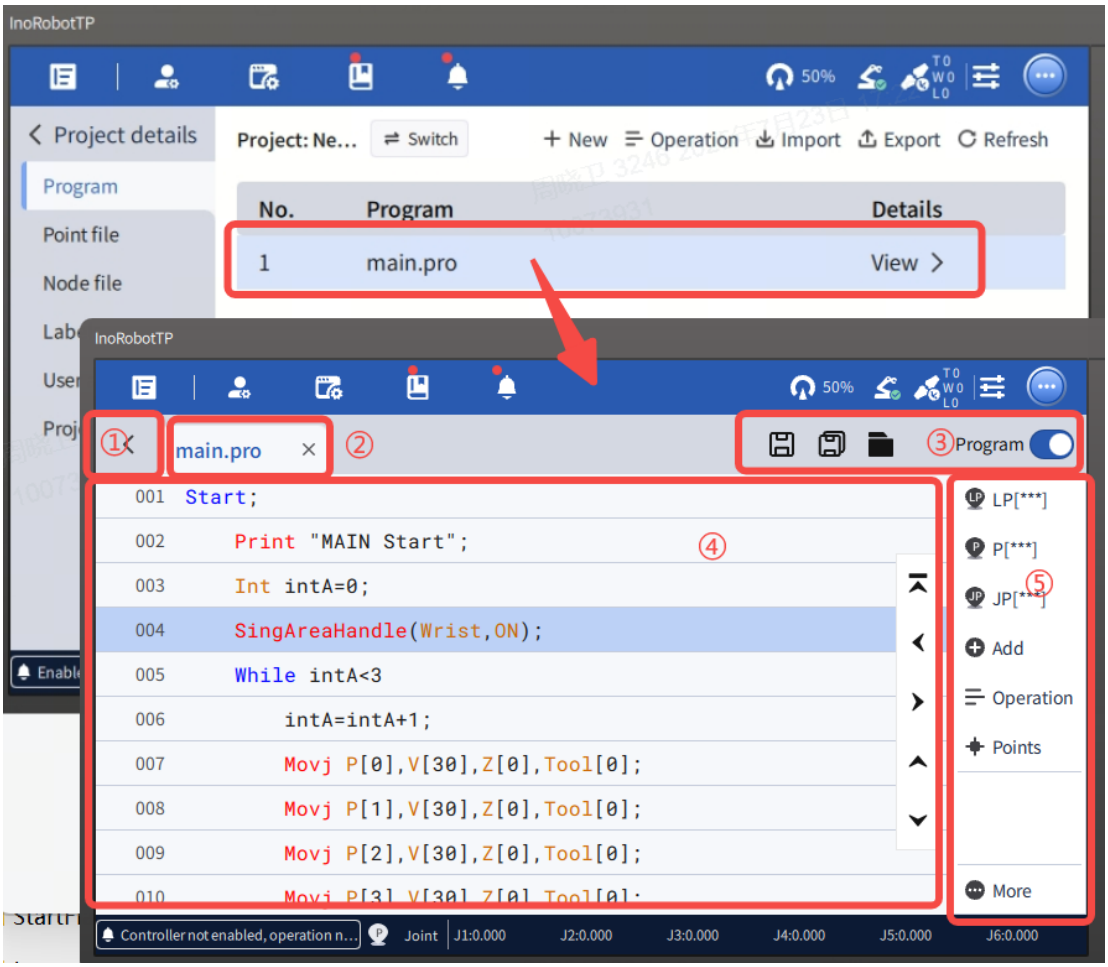
Shortcut command	Description
CTRL + D	Comment line
CTRL + F	Open the search function.
CTRL + G	Open the "Jump to line" dialog.
CTRL + S	Save file.

8 Programming and Debugging

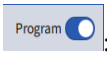
8.1 Programming

8.1.1 Programming Interface

Click "Program" on the homepage. If the current mode is "Program", the programming page will open, which provides functions for editing programs and navigating to other pages of the project.



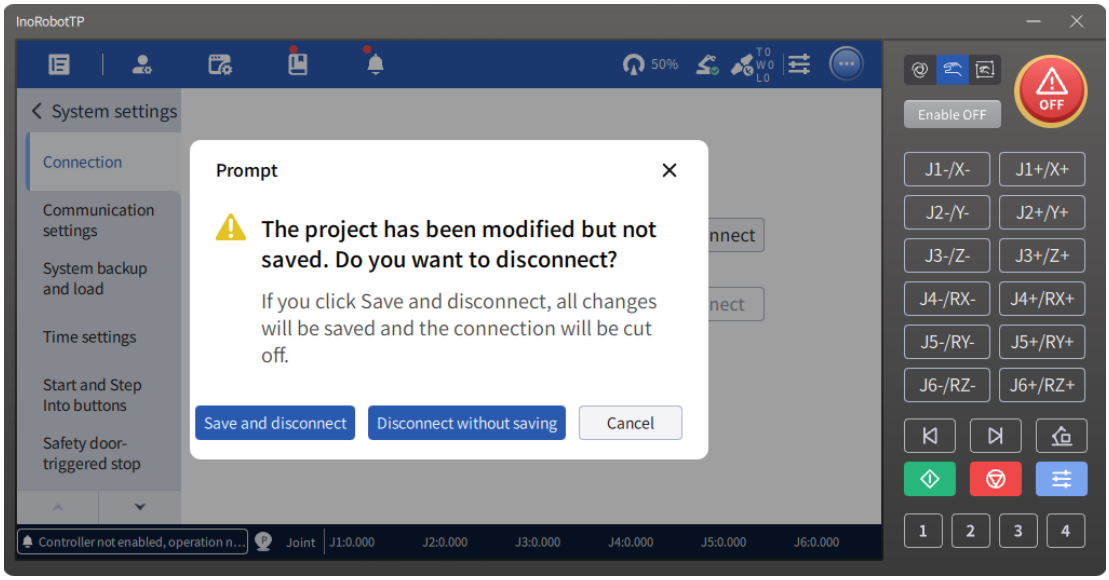
Programming page introduction

No.	Description
①	Return to the previous level page
②	Tabs of open program files
③	Toolbar, with the following function buttons:  : Save a single program file  : Save the entire project  : Jump to the project details page  : Switch programming and debugging modes

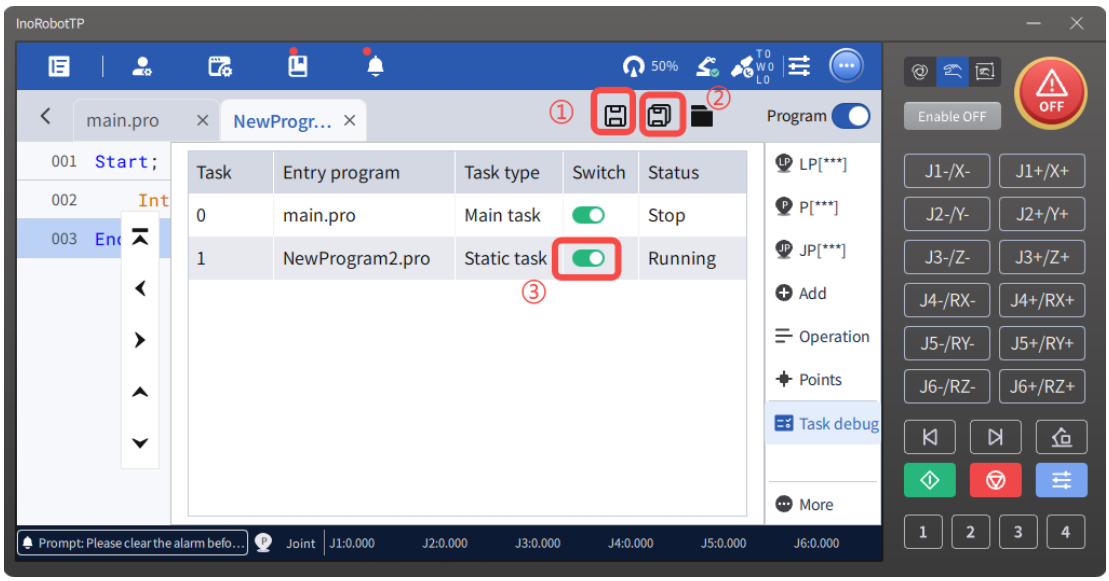
No.	Description
④	Program instruction text
⑤	Program editing toolbar

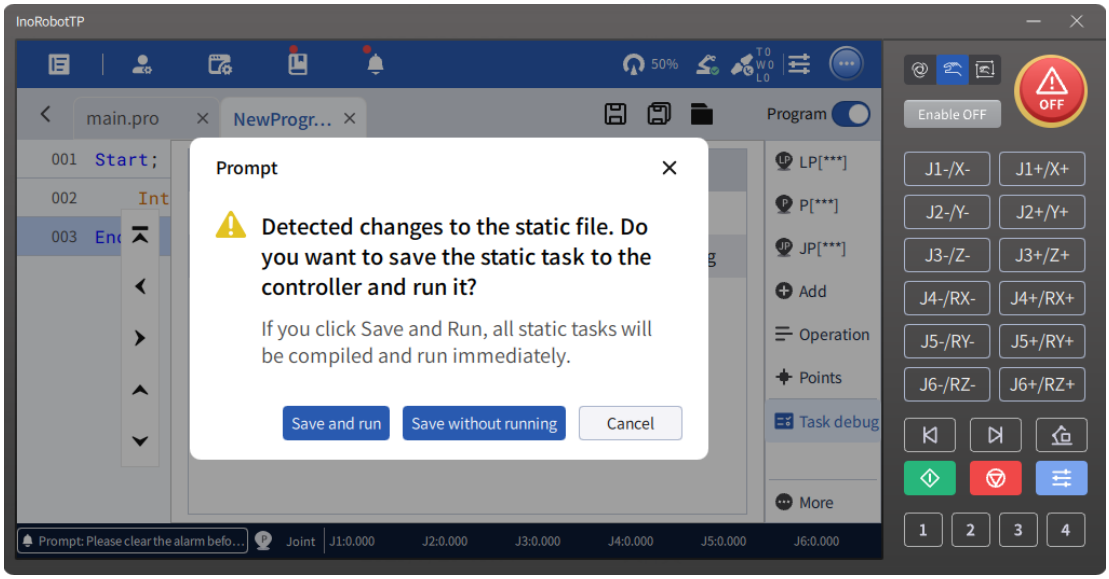
8.1.1.1 Save

- If changes are not saved after modifying the program, disconnecting controller from the "System settings" will result in a dialog box with three options: "Save and disconnect", "Disconnect without saving", and "Cancel".



Name	Description
Save and disconnect	Save the program and disconnect the connection.
Disconnect without saving	Disconnect the connection without saving the modification.
Cancel	Cancel the operation.





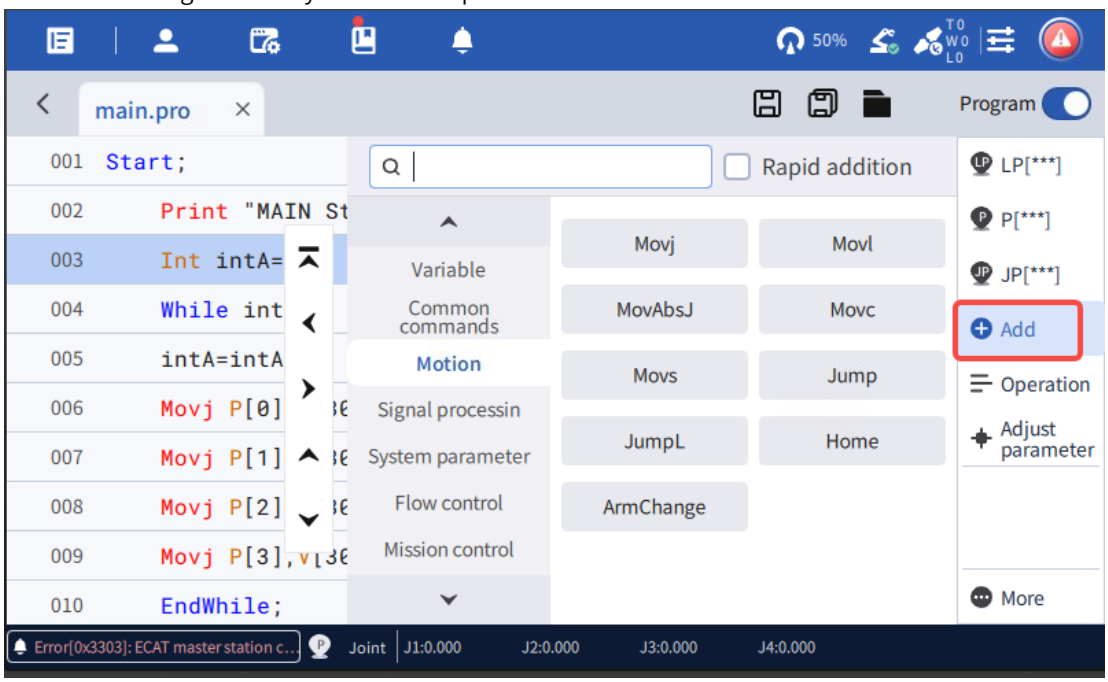
- After modifying the static task, clicking the three buttons (Save button, Save All button, and static task enable button) shown in the above figure will pop up a dialog box, prompting the user whether to save and run the modified static task content immediately, and providing three operation options: "Save and run", "Save without running", and "Cancel".

Name	Description
Save and run	Compile all files and run the static task immediately.
Save without running	Save the file without running the static task, and compile all except the static task.
Cancel	Cancel the operation.

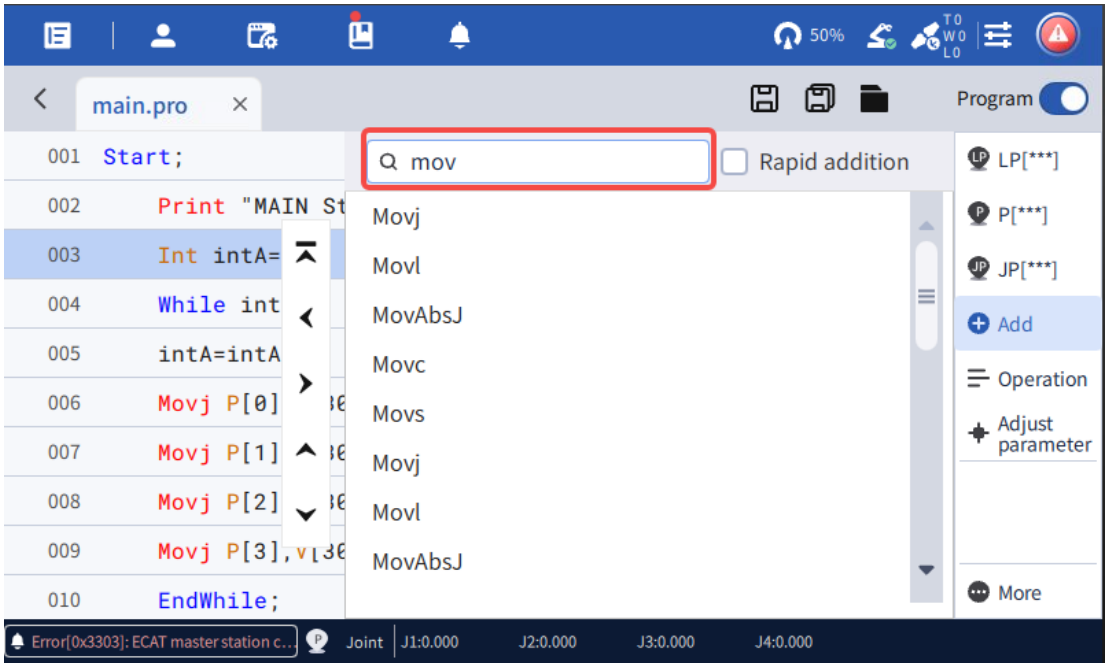
8.1.2 Program Operation

- Add instruction

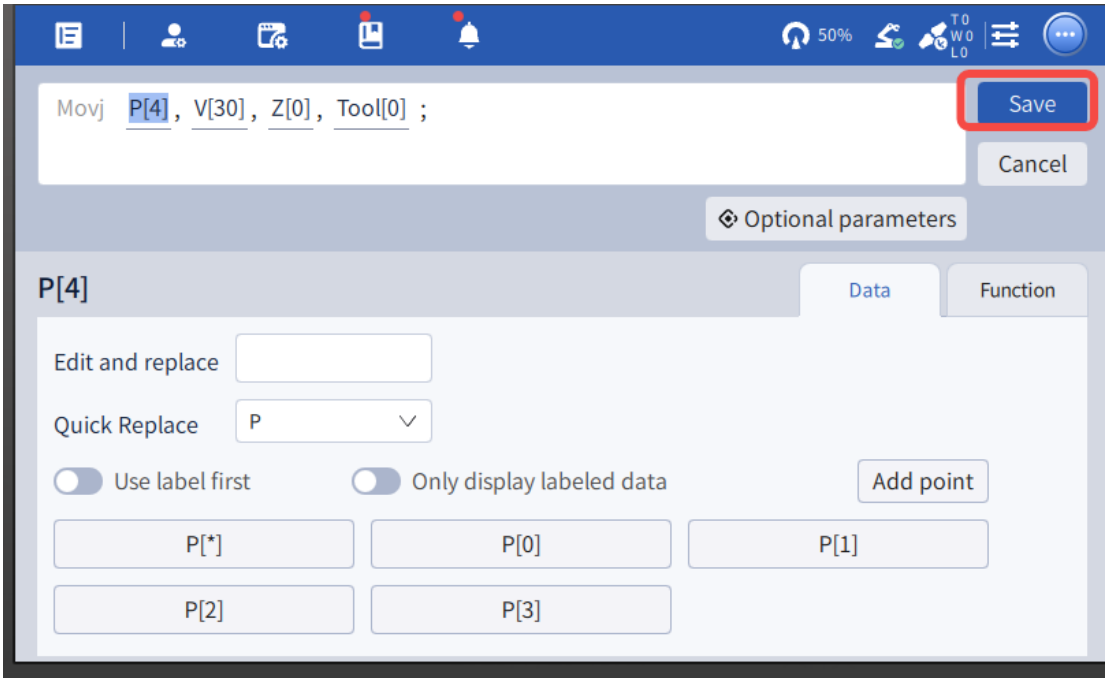
1. Click "Add" in the right auxiliary toolbar to expand the instruction list.



You can also enter text in the search bar to filter instructions for quick access.



2. Select the target instruction for editing and click "Save" to add the instruction to the program text. All regular instructions, except for special program content like Include and global variable declarations, should be added between the Start and End keywords.



- Edit instruction
  - In the program text list, select the instruction you want to edit, double-click the line where the instruction is located to open the instruction editing page, or click "Operation" in the auxiliary toolbar and then click "Edit line" in the operation list to open the instruction editing page.
  - After completing the edit, click "Save" to apply the changes to the program text. Click "Cancel" to cancel the current edit operation.
- More instruction operations

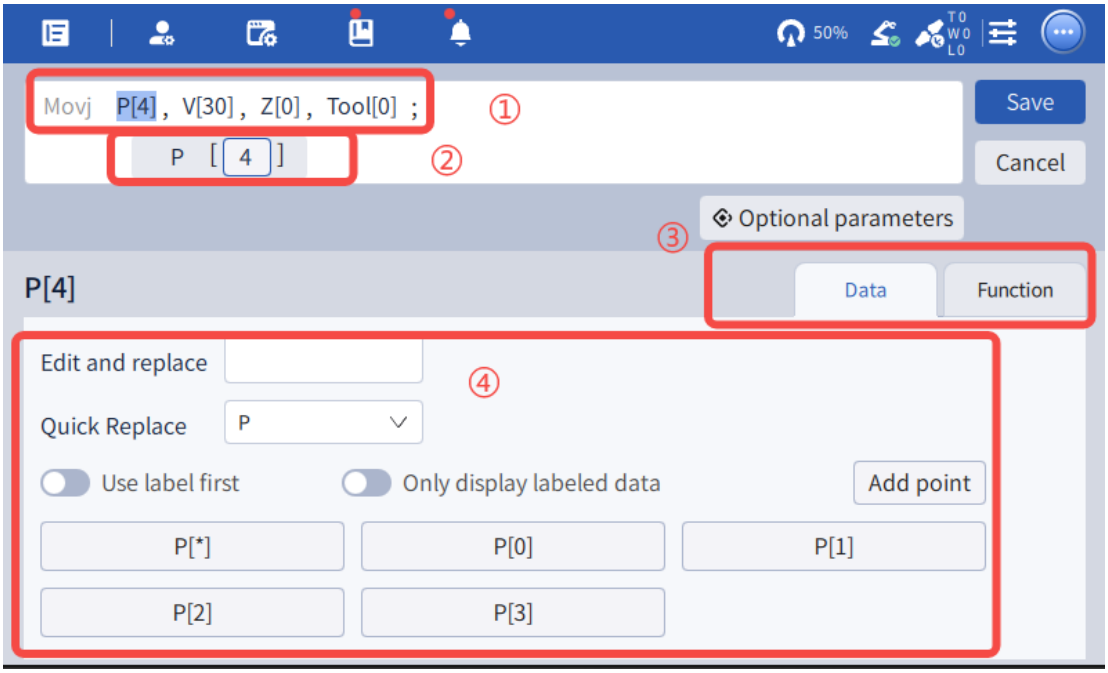
  Click "Operation" in the auxiliary toolbar to expand the list of more instruction-related operations.

  Instruction operation button description

Button	Description
Copy	Copy the selected instruction.
Paste	Paste the copied or cut instruction, inserting the instruction below the currently selected line.
Delete	Delete the selected instruction from the program text.
Cut	Cut the selected instruction.
Multi-select	Enable multi-selection mode, allowing you to select and operate multiple instructions simultaneously.
Full keyboard	Enable full keyboard mode. In this mode, double-clicking an instruction or clicking the "Edit Line" will no longer open the instruction editing page. Instead, you can directly input and modify the instruction text via the keyboard
Comment	Comment the selected instruction. Commented instructions do not take effect during program operation.
Uncomment	If the selected instruction is already commented, this will uncomment that line.
Edit line	When full keyboard mode is disabled, clicking this button will open the instruction editing page. When full keyboard mode is enabled, clicking this button will allow direct editing of the selected instruction.
Format	Align all instructions in the current tab to the left according to the programming standards

8.1.3 Instruction Edit

Add any instruction or double-click the code line to enter the instruction editing interface. The layout of each instruction interface is unified, as shown in the figure below:



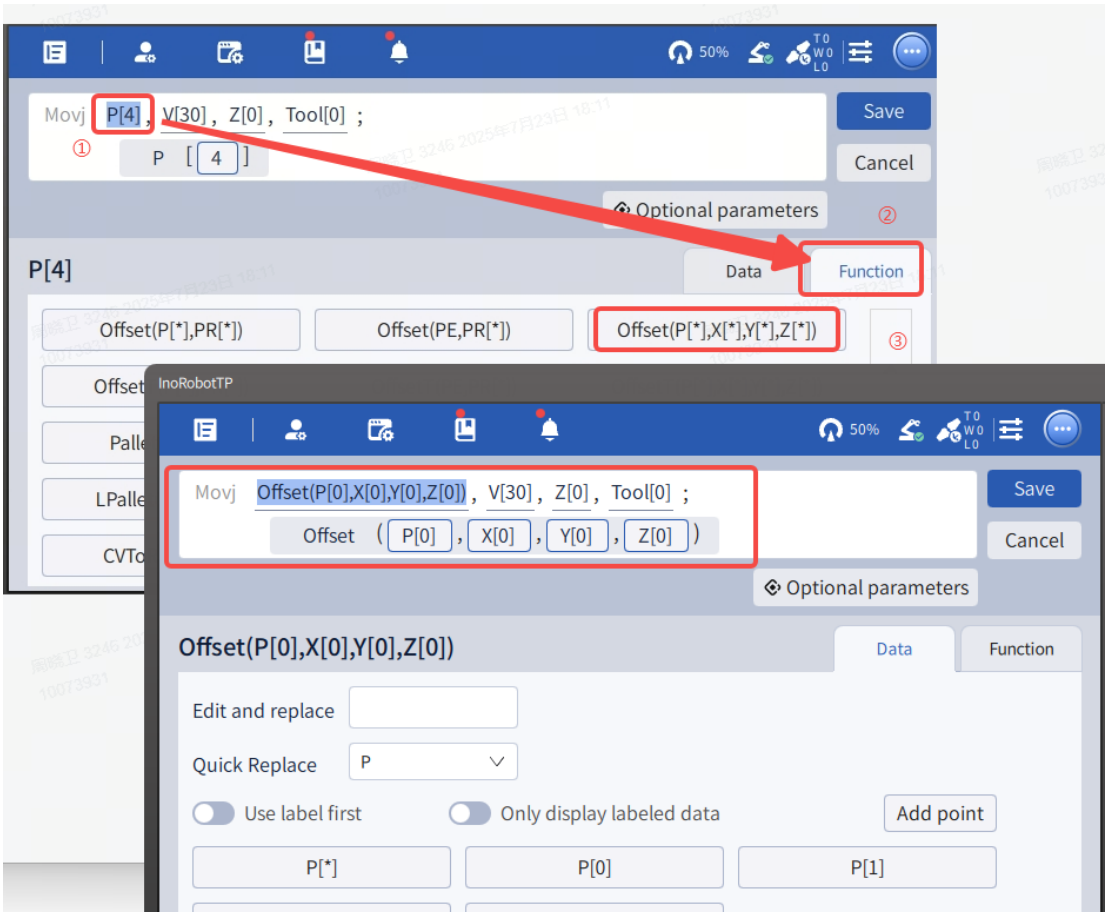
Main areas in the instruction interface:

No.	Name	Description
①	Content area	Displays the complete content of the current instruction being edited. Underlined parameters can be directly selected for operations.
②	Parameter selection area	Expands various levels of parameters. Select to modify.
③	Type selection area	Select to replace the parameter with data or function.
④	Parameter replacement area	Replace the selected parameter with other selected content.

- Modify instruction parameters

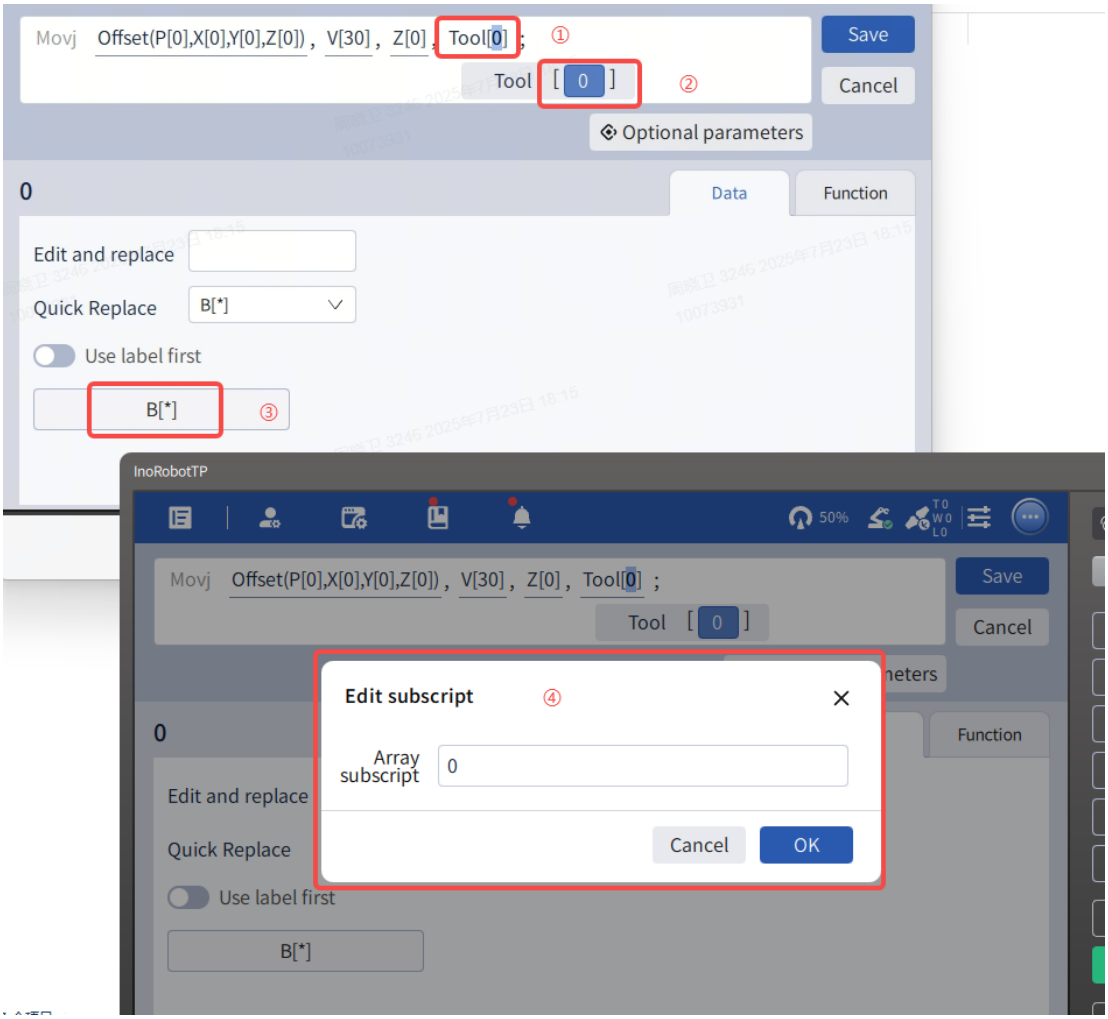
  Example 1: Replace the 'P[0]' in Movj P[0],V[30],Z[0],Tool[0],Wobj[0] with Offset(P[0],X[0],Y[0],Z[0]).

  Steps: Select the parameter and click P[0]; Select the "Function" tag; In the parameter replacement area, find the corresponding function and click to replace directly.



  Example 2: Based on Example 1, replace the '0' in 'Tool[0]' with 'R[4]' in Movj Offset(P[0],X[0],Y[0],Z[0]),V[30],Z[0],Tool[0],Wobj[0].

  Steps: Select the primary parameter and click Tool[0]; Click "0" to select the secondary parameter "0"; Select the "Data" tag (default); In the parameter replacement area, find the value to be replaced or directly edit to replace.



- Multi-level nesting

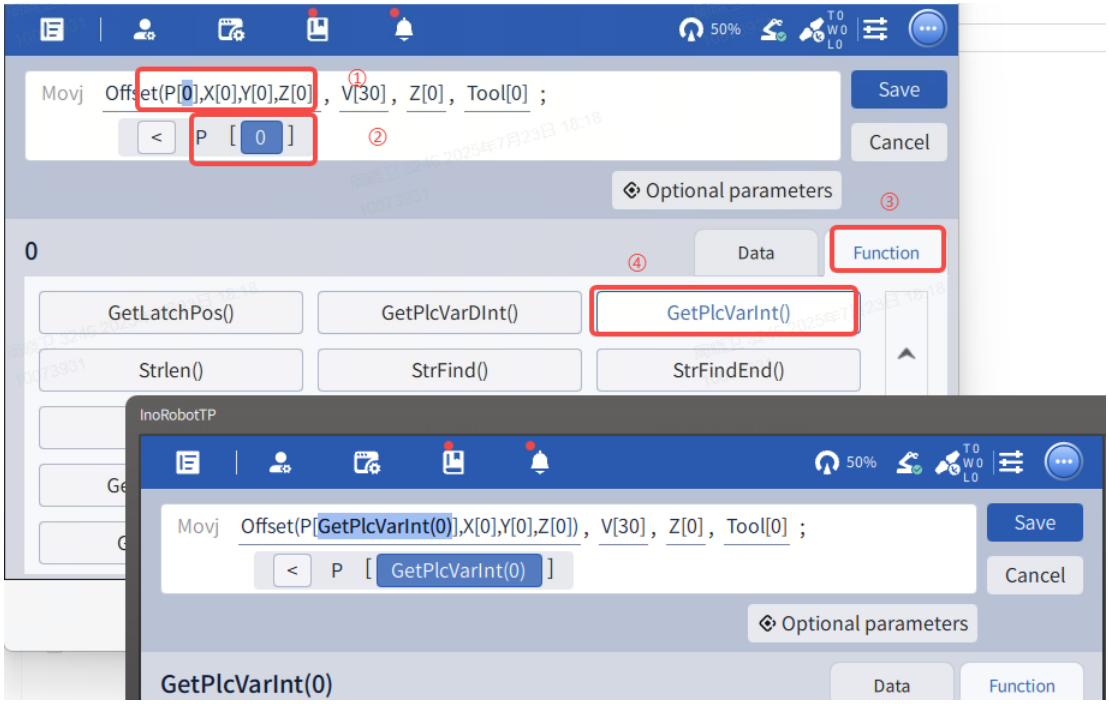
  Instruction parameters support multi-level nesting, meaning they support the replacement of the same type of data or functions. For example, integer 0 can be replaced with R[0] or an integer variable, or it can be replaced with a function that returns an integer.

  Example 3: After replacing "P[0]" in Movj P[0],V[30],Z[0],Tool[0],Wobj[0] with Offset(P[0],X[0],Y[0],Z[0]), you can further replace the "0" in "P[0]" of Offset(P[0],X[0],Y[0],Z[0]) with GetPlcVarInt(0).

  The final modification will be: Movj Offset(P[GetPlcVarInt(0)],X[0],Y[0],Z[0]),V[30],Z[0],Tool[0],Wobj[0].

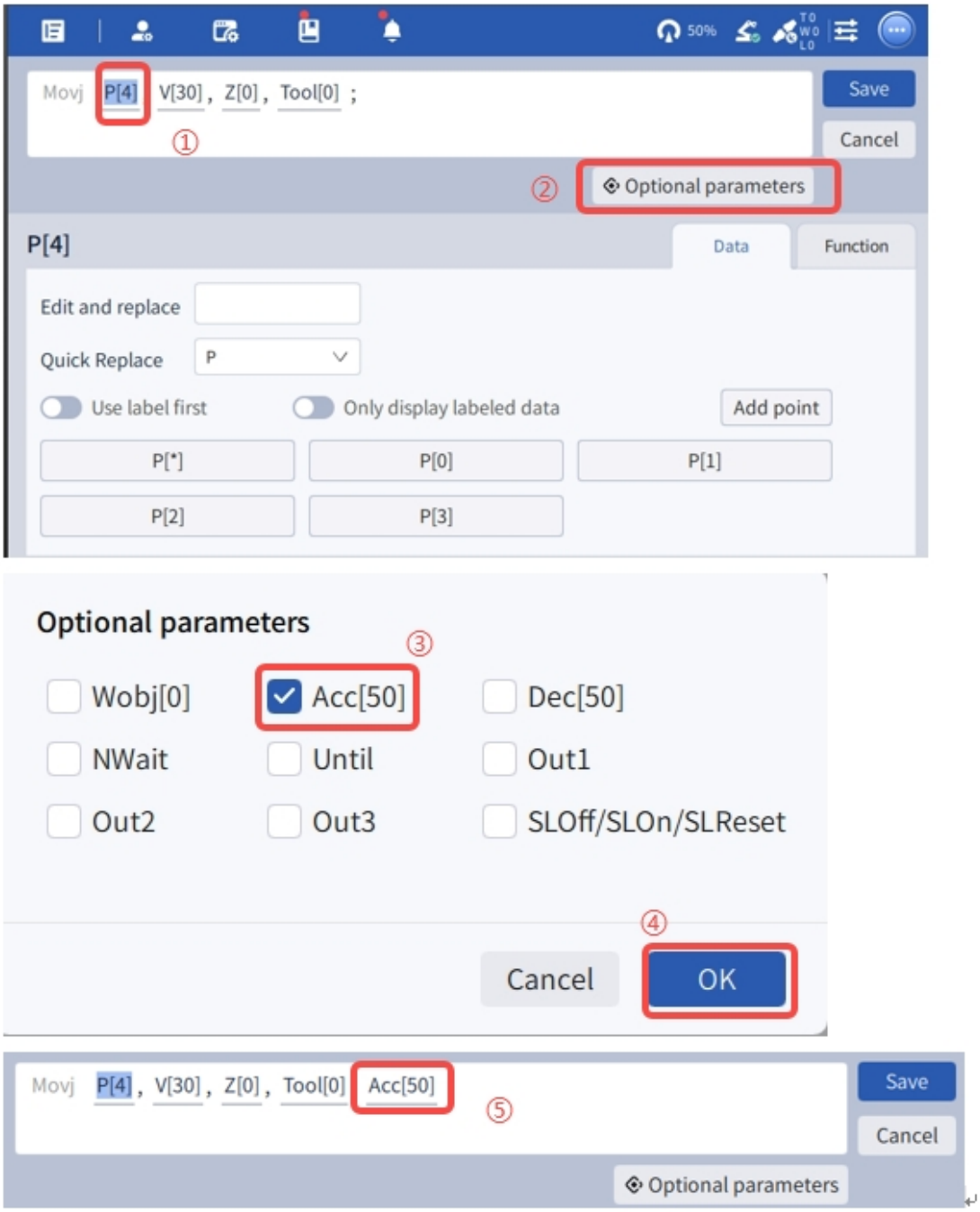
  This example is shown in the following figure, and other instructions are similar:

  Continue with the steps from Example 1.



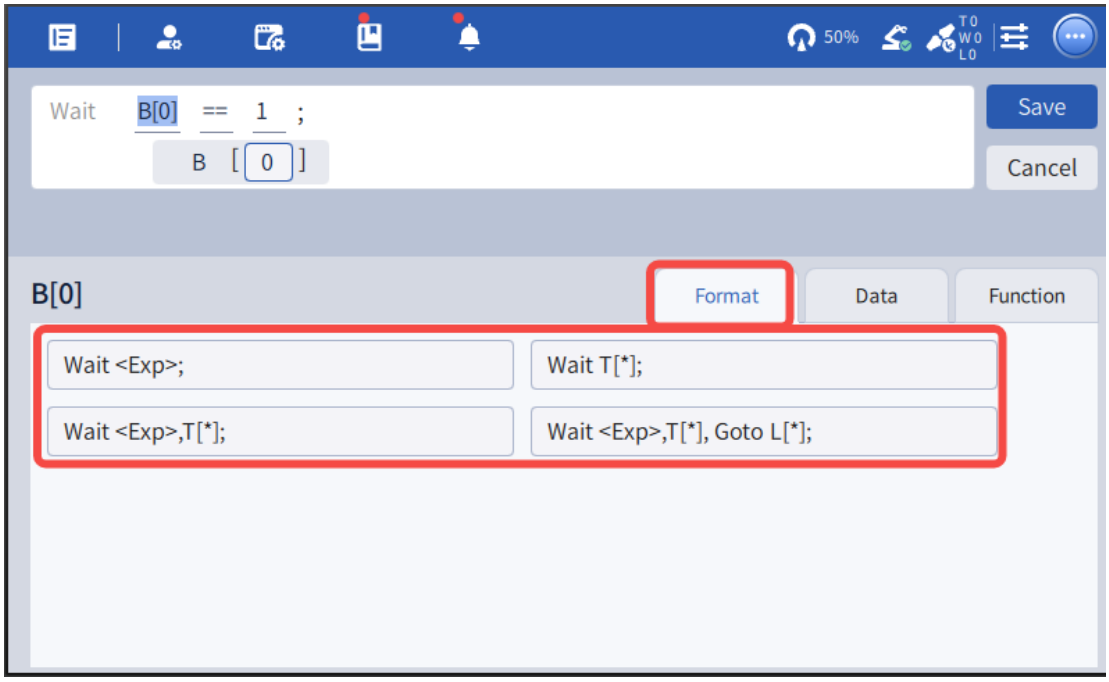
- Edit optional parameters

  If the current instruction has optional parameters, an "Optional parameters" button will be displayed. Click to pop up a list of optional parameters, for example, adding the optional parameter "Acc" to Movj:



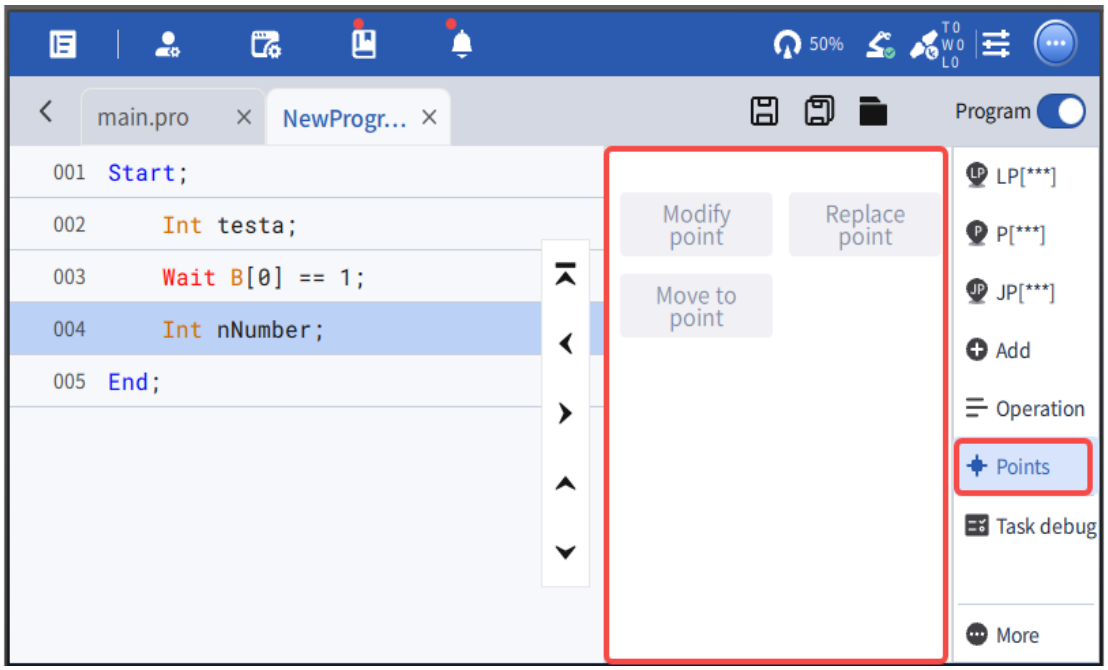
- Multi-format instructions

  If the current instruction has multiple formats, a "Format" tab will be displayed. Click to list the various formats and select any format to enter the corresponding instruction. For example, with "Wait" instruction, click the "Format" tab, and select the corresponding format to modify the parameter.



8.1.4 Point Operation

Click "Points" in the auxiliary toolbar to open the point operation panel. This panel contains "Modify point", "Replace point", and "Move to point" function buttons, which allow for quick modification and debugging of points in the program.

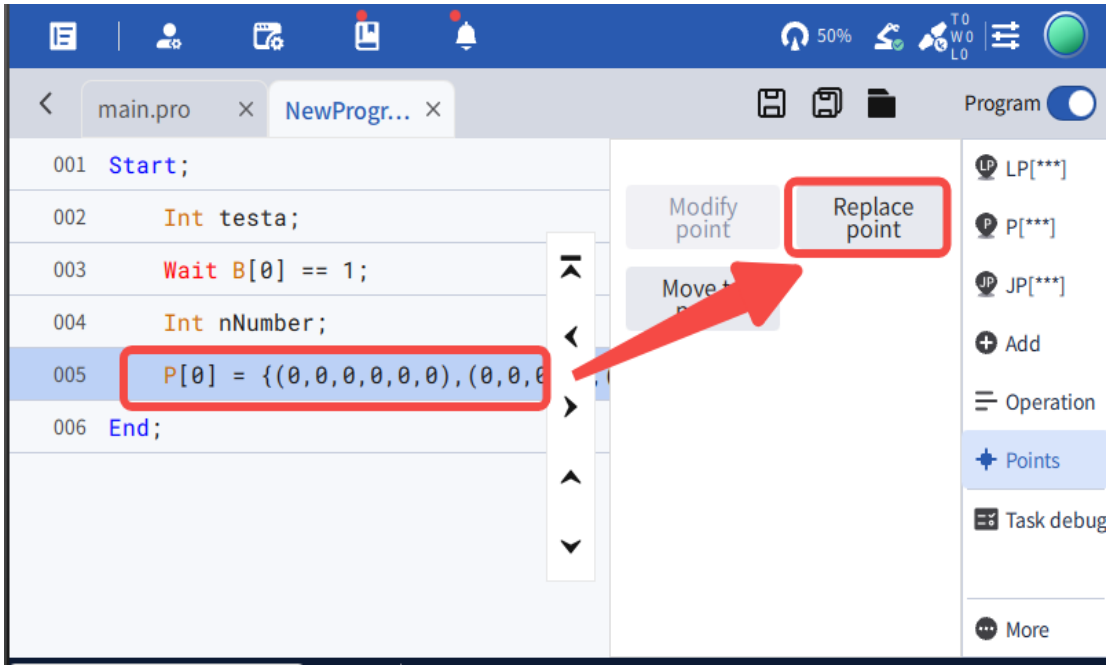


- Modify point

  The "Modify point" button is used for quickly replacing point data in motion instructions with the current position data. It is only enabled when the current selected line in the program is a motion instruction.

- Replace point

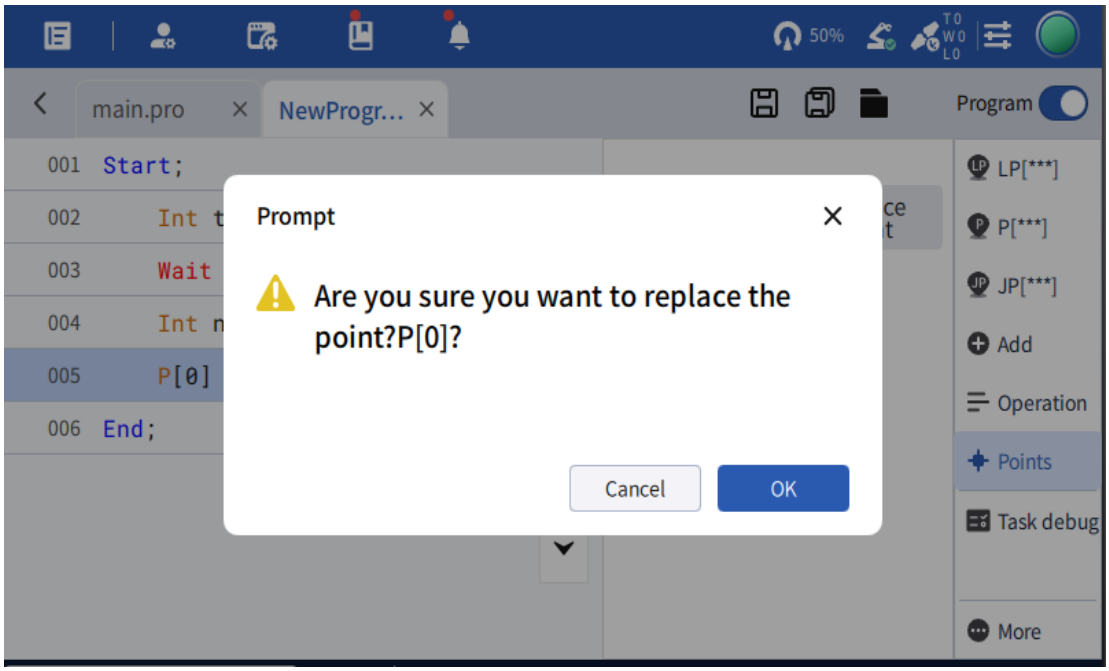
  ▪ The "Replace point" button is used for quickly replacing point data in point assignment instructions, replacing the point data on the right side of the "=" sign with the current position data. It is only enabled when the current selected line in the program is a point assignment instruction.



▪ When the "Replace point" button is enabled, click the button to bring up a confirmation dialog for point replacement.

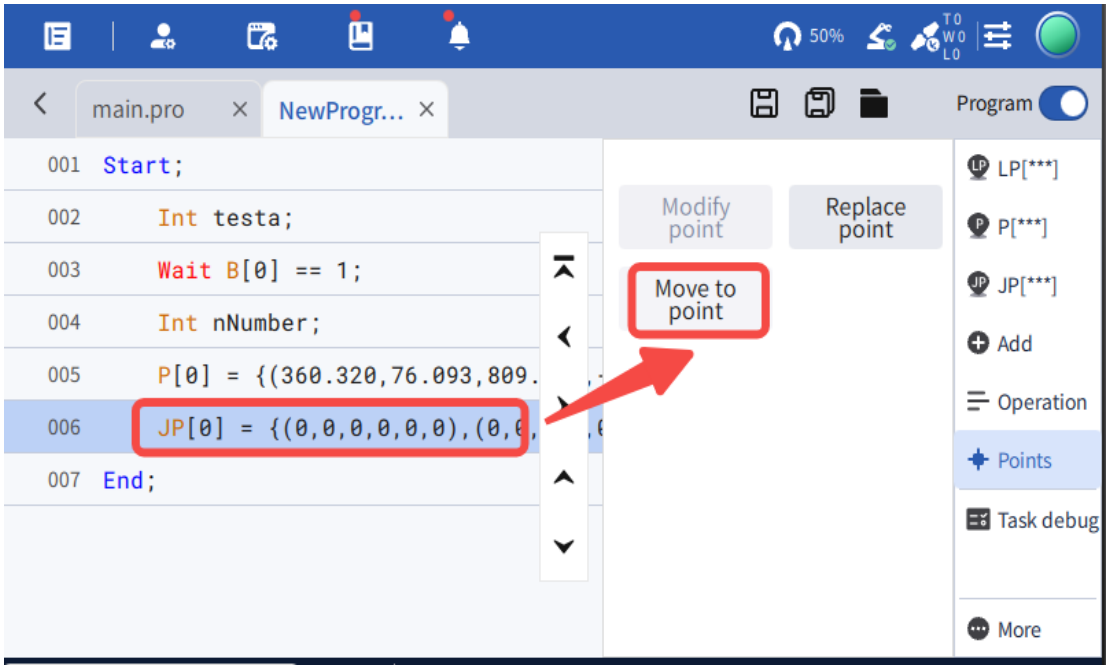
▪ Click "OK" to quickly replace the point data in the point assignment instruction of the currently selected program line with the current position data. As shown in the figure, the "P[0]" point data will be replaced with the current position data after "OK" is clicked.

▪ Clicking "Cancel" will cancel the replacement operation.



- Move to point

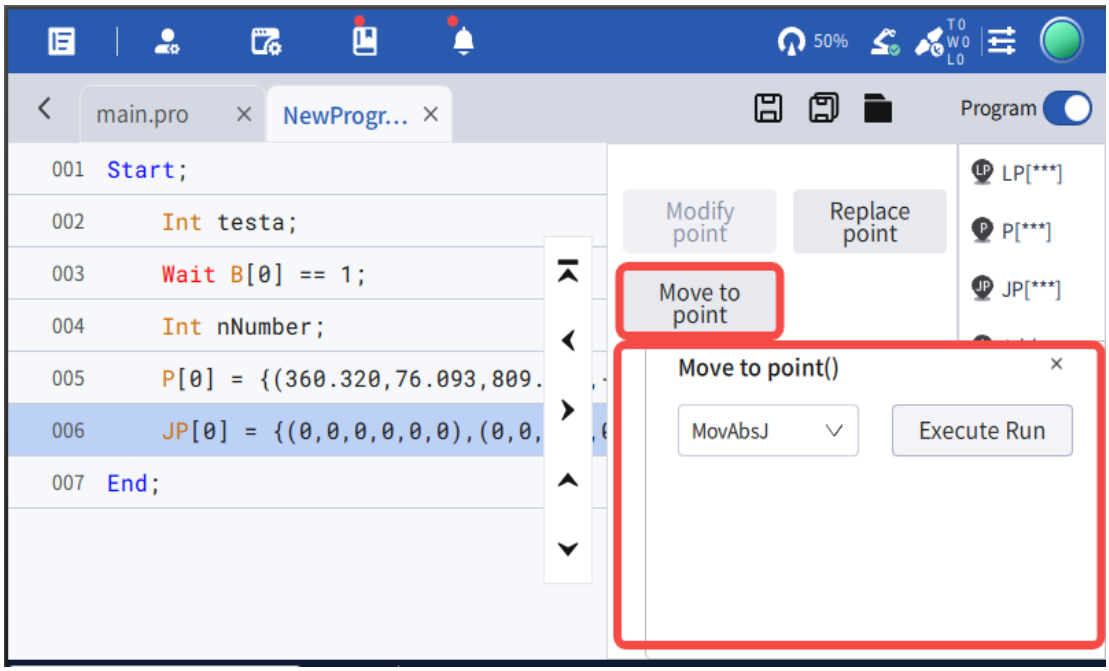
▪ The "Move to point" button is only enabled when the current selected line in the program is a point assignment instruction.



▪ When the button is enabled, click the button to bring up a "Move to point()" dialog.

▪ The drop-down list in the dialog provides different motion types depending on the robot model. For a 6-axis robot, the motion types include Movj and Movl. For a 4-axis robot, the motion type includes MovAbsj.

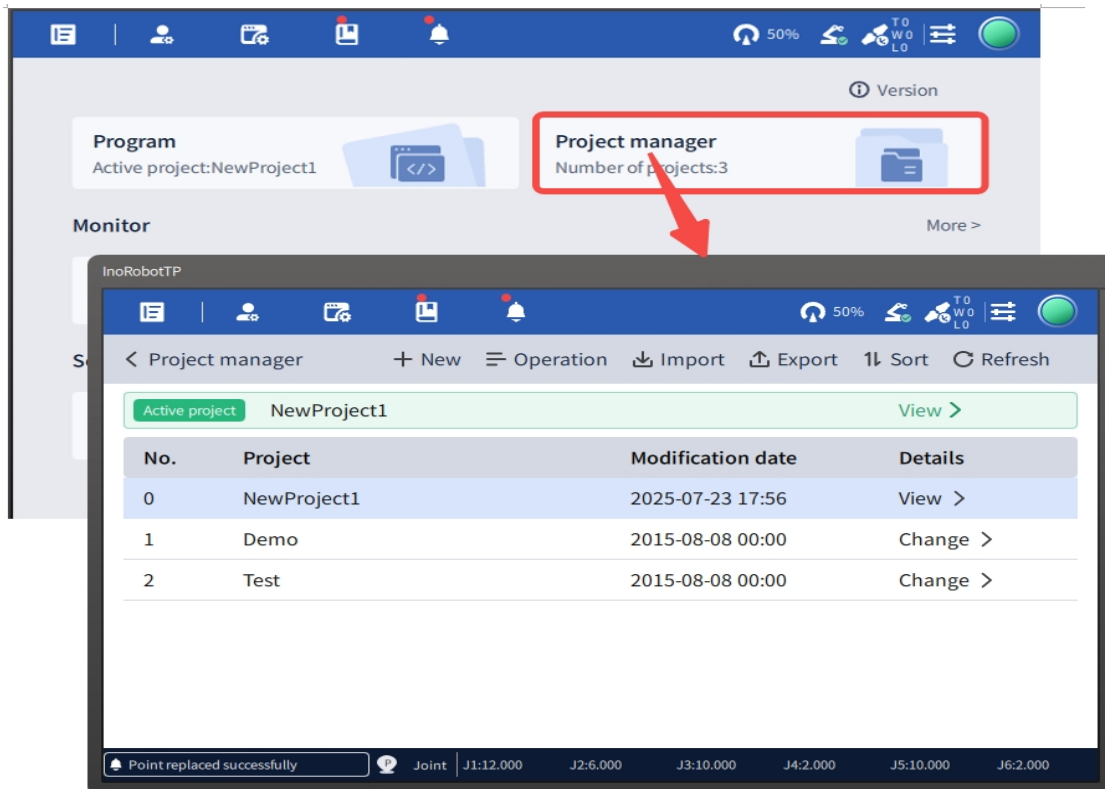
▪ After selecting the motion type, continuously clicking "Execute Run" will move the robot continuously to the selected point, and releasing the button will stop the robot motion.



8.2 Project Manager

8.2.1 Project List

Click the "Project manager" button on the homepage to enter the project list page, which displays project information stored in the controller and provides function buttons for project operations.



- Active project

  ▪ This area displays the currently active project in the controller. If there is no active project in the controller, this area will not be displayed.

  ▪ Click "View", or double-click the entire area to enter the "Project details" page.



- All projects

  ▪ This area displays all projects stored in the controller along with their modification dates. The "View" button is displayed for the active project, while the "Change" button is displayed for other projects.

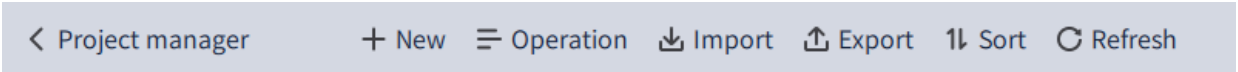
  ▪ Click "View" in the row of the active project, or double-click the row to enter the "Project details" page.

  ▪ Click "Change" in other rows, or double-click the corresponding row to switch projects and enter the "Project details" page.

No.	Project	Modification date	Details
0	NewProject1	2025-07-23 17:56	View >
1	Demo	2015-08-08 00:00	Change >
2	Test	2015-08-08 00:00	Change >

- Toolbar

  The toolbar contains various operation buttons for projects, as well as a return button to return to the previous level page.



  Project operation function buttons

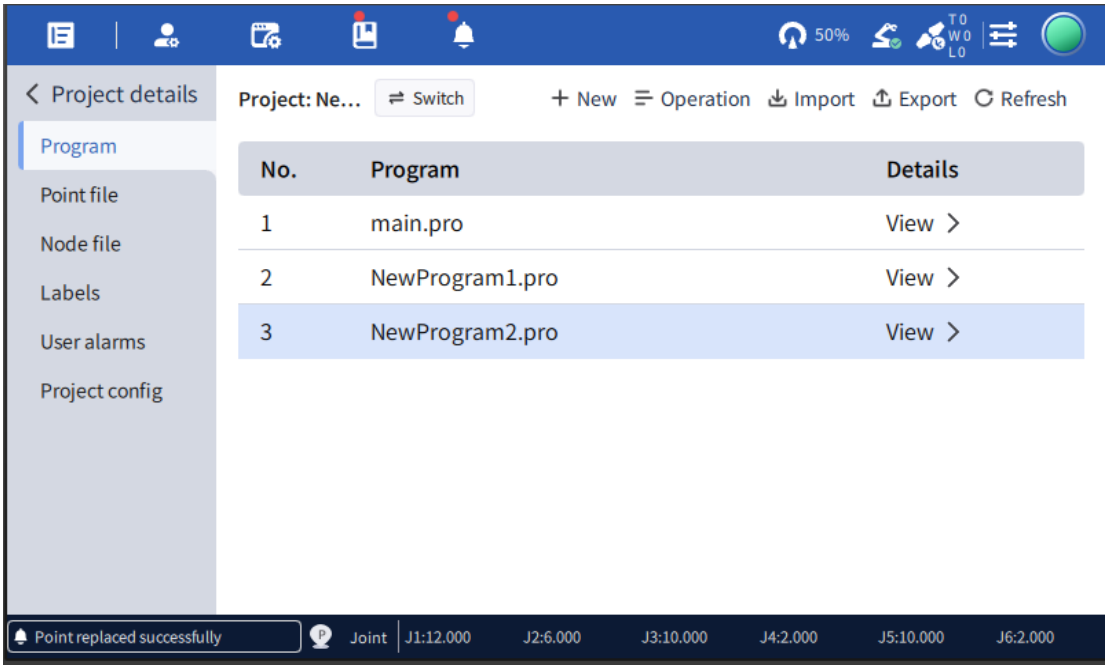
Primary button	Secondary button	Description
+ New	-	Create a project.
Operation	Copy	Copy the selected project.
	Paste	Paste the copied project.
	Rename	Rename the selected project.
	Delete	Delete the selected project.
Import	-	Import a project from local to the controller. When importing, select the project configuration file with the extension .prj under the project folder. The import will synchronize the entire project folder to the controller.
Export	-	Export a project from the controller to local.
Sort	Sort by time	Sort the project list in descending order by time.
	Alphabetical	Sort the project list in ascending order by project name.
Refresh	-	Get the latest project directory from the controller, refresh the project list display, and also trigger the content refresh of the currently activated project.



- Project names must start with a letter, contain 1-16 characters (letters, digits, or underscores).
- The currently active project cannot be deleted or renamed.
- Direct manipulation of project files via FTP is not permitted.

8.2.2 Project Details

This page primarily displays the components of a project and provides functional buttons for operations on various project files.



Project components description

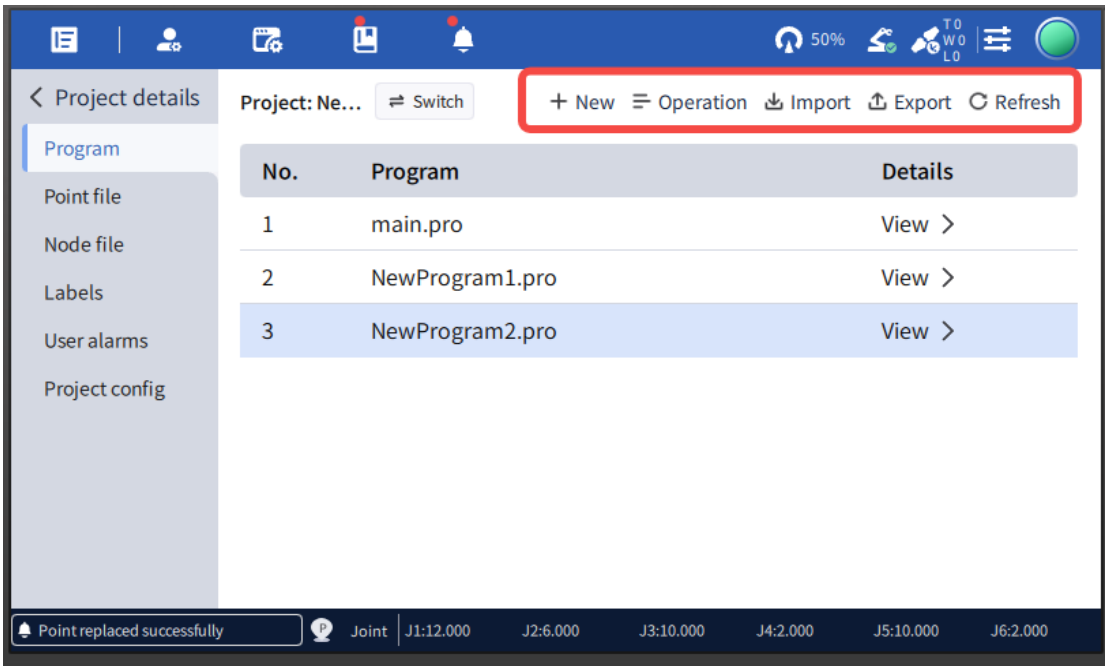
Component	Description
Program	The content includes robot instructions and local points, where the scope of local points is limited to the program file they are in. The main.pro file is the default program file and cannot be deleted or renamed. Other new program files can be categorized into general programs and entry programs. The maximum number of program files is 16 by default, which can be extended to 256 through settings. General program: The start and end keywords are Func…EndFunc, typically used for writing some common business methods to be called by various entry programs. Entry program: The start and end keywords are Start…End, used for binding to various tasks to implement different operation logics.
Point file	The content includes global position point data, with a scope covering the entire project. P.pts is the default point file and cannot be deleted or renamed. The maximum number of point files is 128.
Joint point file	The content includes global joint point data, with a scope covering the entire project. JP.pts is the default joint point file and cannot be deleted or renamed. The current maximum number of joint point files is 1.
Labels	The content includes the following: • IN labels • OUT labels • AD labels • DA labels • B labels • R labels

Component	Description
	• D labels The IN labels and OUT labels belong to I/O labels, while the AD labels, DA labels, B labels, R labels, and D labels belong to global variables labels.
User alarms	Custom alarm description content, used with the Alarm instruction.
Project config	Configure to bind the entry program with the task ID to achieve the runtime logic of the projects. Task types include main task, dynamic task, static task, and Xqt task. The total number of all tasks is limited to 16.

8.2.3 Project File Operations

On the "Project details" page, you can perform operations on project files through the toolbar, such as creating a new file, copying and pasting files, renaming files, deleting files, importing files, exporting files, and refreshing the file list.

Currently, only program files, position point files, and joint files allow file operations. Other project files are default files and cannot be operated.



Project file operations button description

Primary button	Secondary button	Description
+ New	-	Create a project file.
Operation	Copy	Copy the selected project file.
	Paste	Paste the copied project file.

Primary button	Secondary button	Description
	Rename	Rename the selected project file.
	Delete	Delete the selected project file.
Import	-	Import a project file from local to the controller.
Export	-	Export a project file from the controller to local.
Refresh	-	Get the latest project file directory from the controller and refresh the project file list display.

CAUTION

- Project file names must start with a letter, contain 1-26 characters (letters, digits, or underscores).
- Project files from incompatible earlier versions or with invalid file names cannot be imported.

8.2.4 Projects Editing Operations

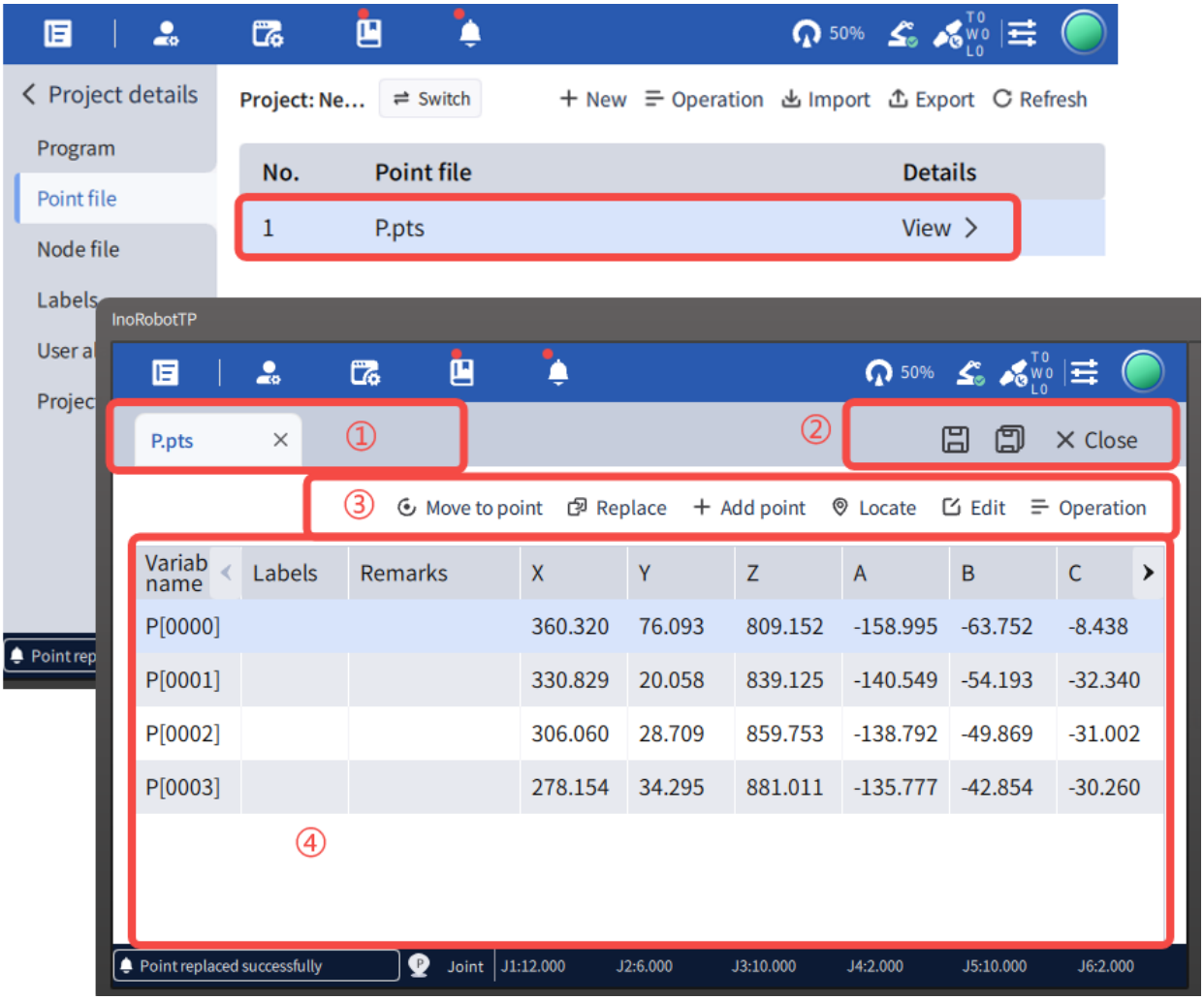
8.2.4.1 Editing the Program

On the "Project details" > "Program" page, click "View" on the selected line in the file list, or double-click the selected line in the file list to jump to the programming page. For more details, see Programming Page.

8.2.4.2 Editing the Point

For point editing, the procedures for position points, joint points, and local points are identical. The following uses the editing of Position Points as an example for description.

On the "Project details" > "Point file" page, Click "View" on the selected line in the file list, or double-click the selected line in the file list to jump to the position point data page.

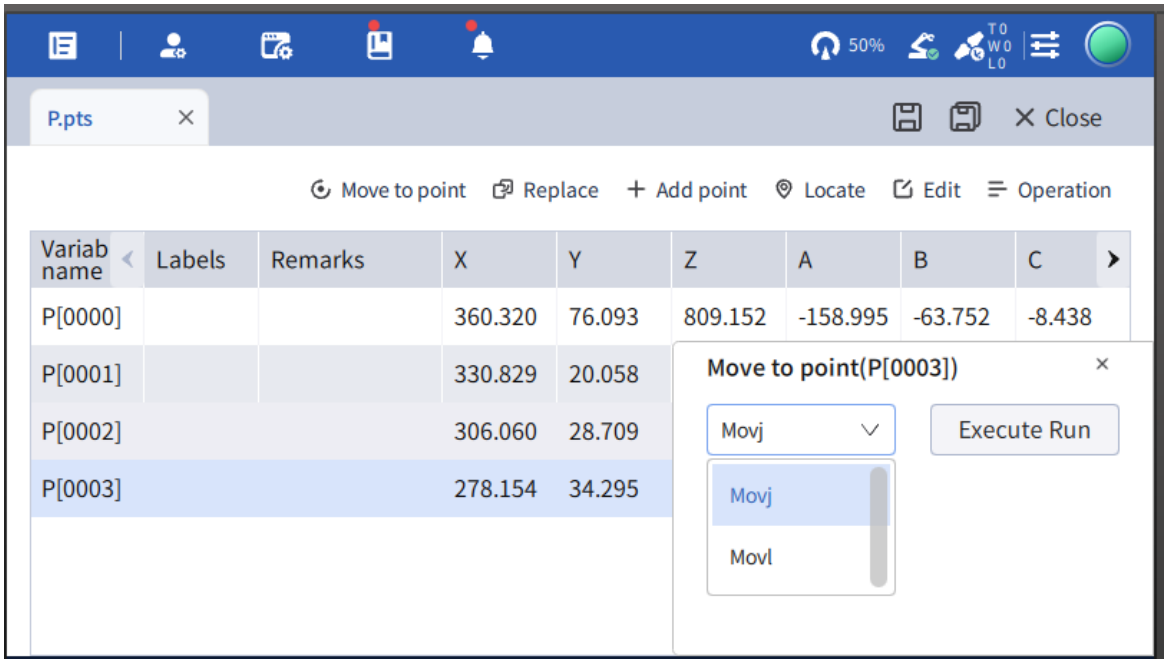


Programming page introduction

No.	Description
①	Tabs of open position point files.
②	The page operation buttons, from left to right, are "Save single point file", "Save all opened point files", and "Close".
③	Toolbar, including all buttons for operating on point data.
④	Point data table.

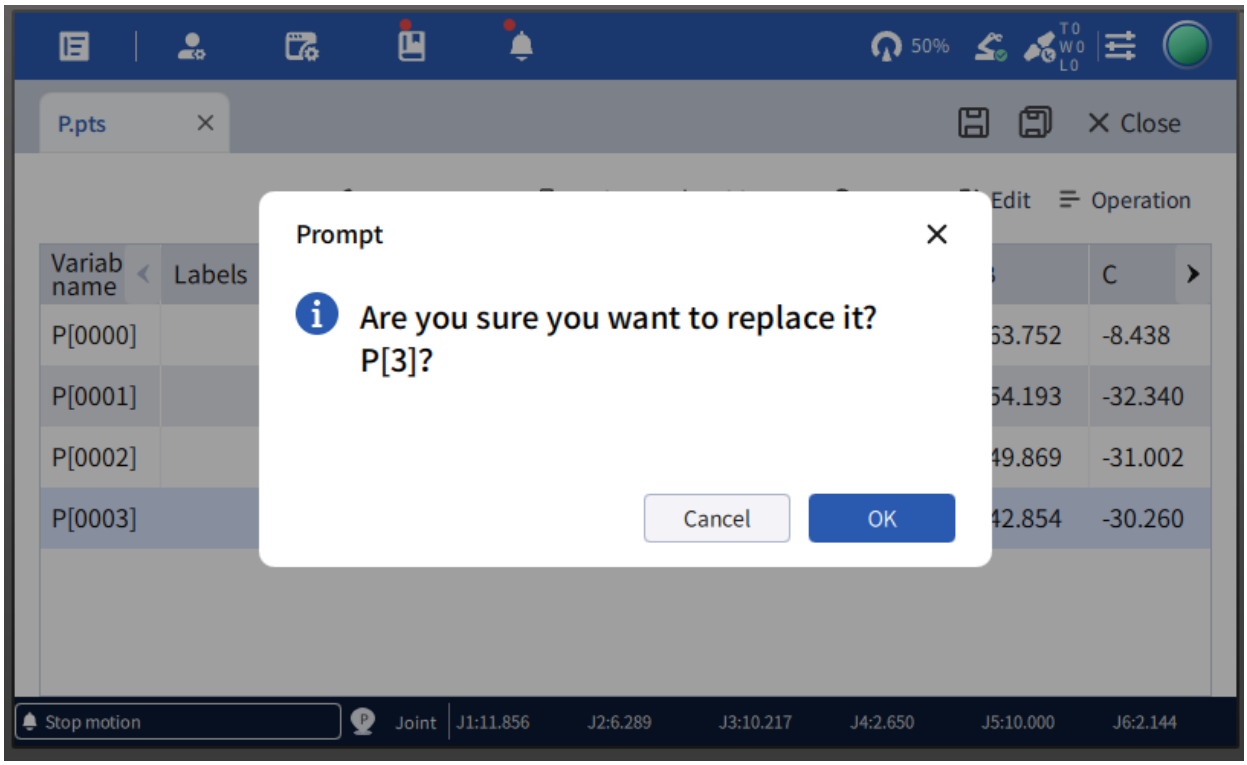
- Move to point

  1. Click "Move to point" in the toolbar to open the "Move to point" dialog.
  2. The drop-down list in the dialog provides different motion types depending on the robot model. For a 6-axis robot, the motion types include Movj and Movl. For a 4-axis robot, the motion type includes MovAbsj.
  3. Continuously clicking "Execute Run" will move the robot continuously to the selected point, and releasing the button will stop the robot motion.



- Replace

  1. Click "Replace" in the toolbar to bring up the point data replacement confirmation dialog.
  2. Click "OK" to replace the position data of the selected point with the current position data of the robot.
  3. Clicking "Cancel" will cancel the replacement operation.



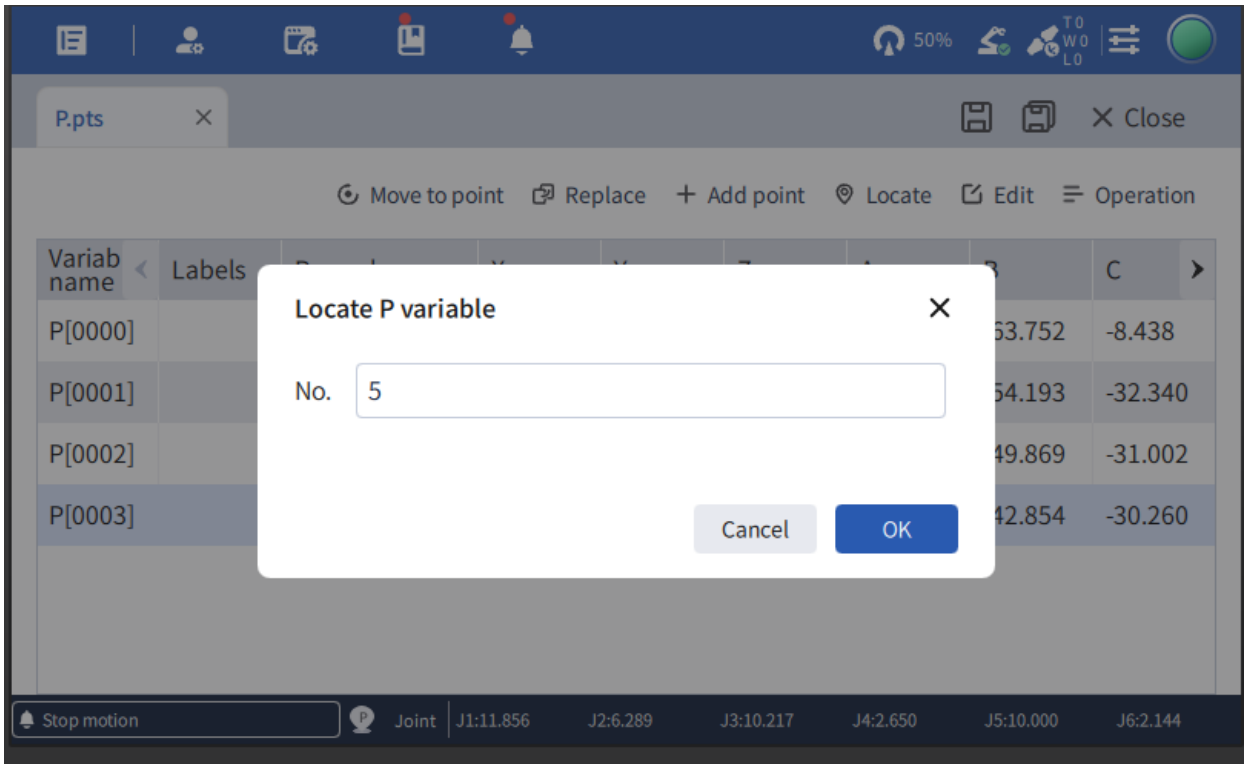
- Add point

  Click "Add point" in the toolbar to automatically generate a point with the current position information and add it to the current point file. The point number will be automatically inserted based on the existing points in the current point file, and the new point will be automatically updated in the point data table.

If the current position is a singularity or other unavailable position data, adding the point will fail. In this case, perform axis teaching motion first to move the robot to a non-singularity position before adding the point.

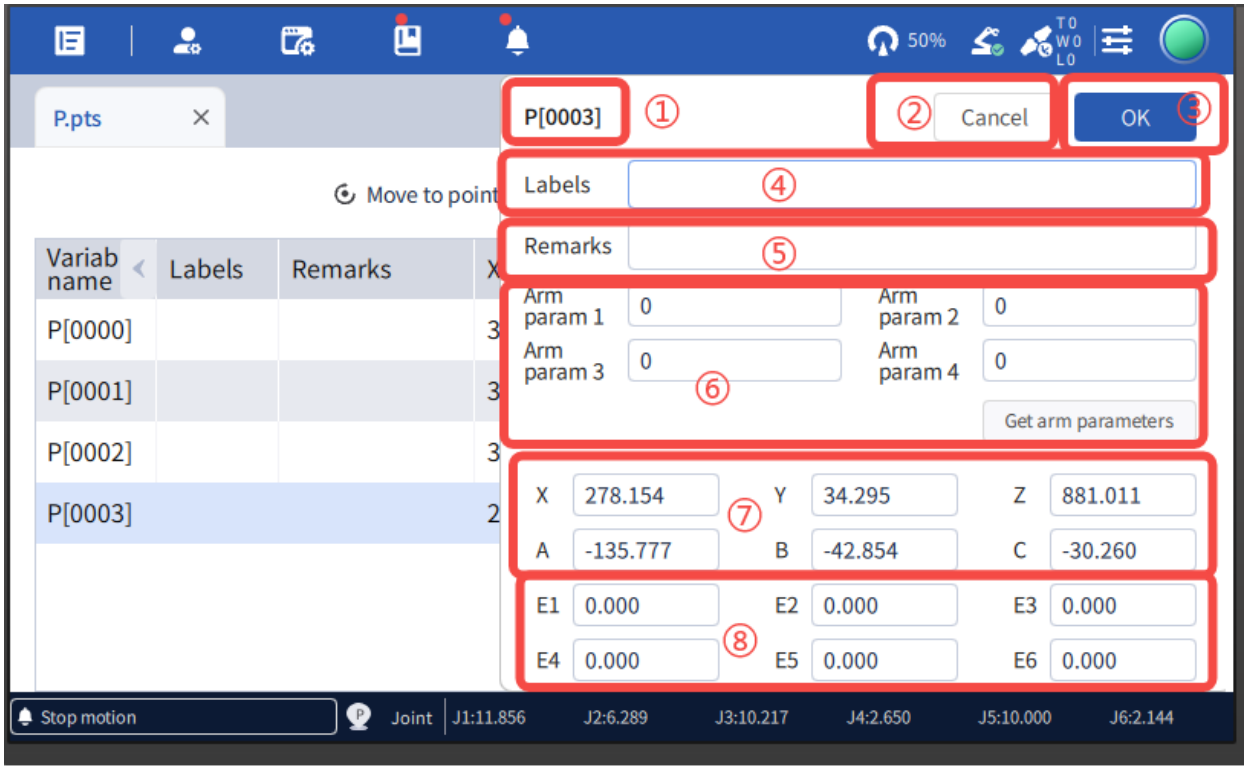
- Positioning

  1. Click "Locate" in the toolbar to open the positioning input dialog.
  2. Click "OK" to jump to the line of the specified point. If the specified point number does not exist in the table, it will prompt the user that the point does not exist.
  3. Click "Cancel" to cancel the positioning operation.



- Edit

  Select any line in the point data table and click "Edit" in the toolbar, or double-click the line of any point to open the point data editing dialog.

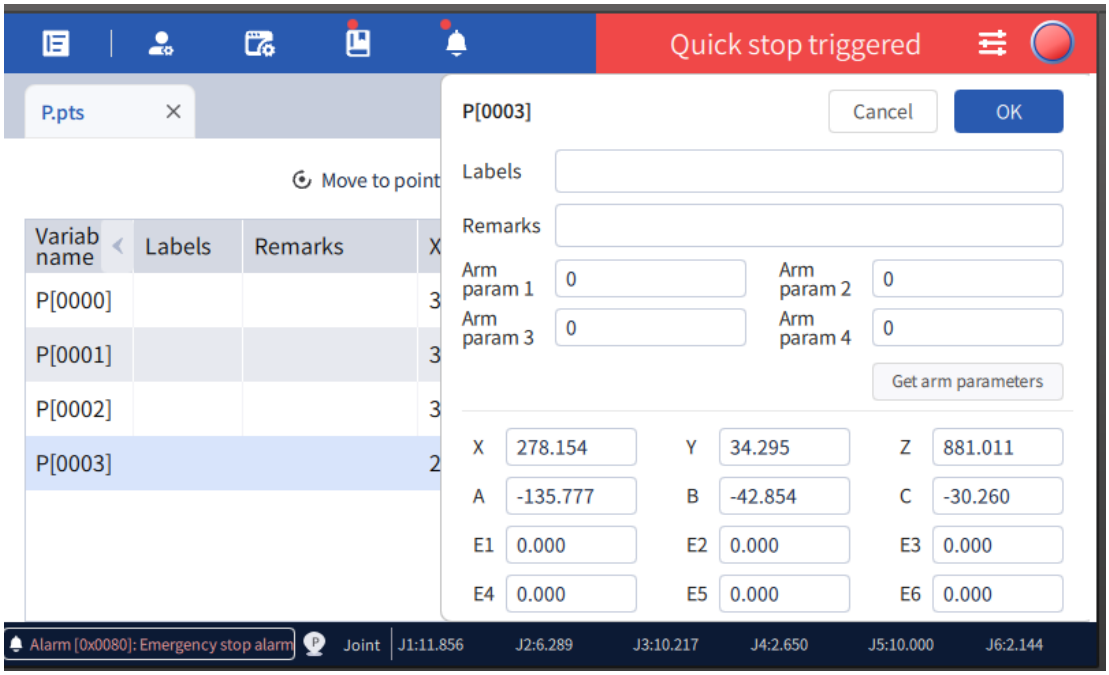


Point data editing dialog introduction

No.	Description
①	Dialog title, showing the name of the point being edited
②	"Cancel" button. Click to cancel the current edit and close the dialog.
③	"OK" button. Click to apply the current edit and close the dialog.
④	The "Labels" input box, where you can enter the point label name. The label must start with a letter, contain 1-20 characters (letters, digits, or underscores).
⑤	The "Remarks" input box, where you can enter remarks about the point. Remarks can be up to 100 characters long, with no restrictions on character type.
⑥	The "Arm Parameter" area, where displays arm parameter data. Click "Get arm parameters" to replace the arm parameter data with the data corresponding to the current robot pose.
⑦	The robot position data area.
⑧	The external axis position data area.

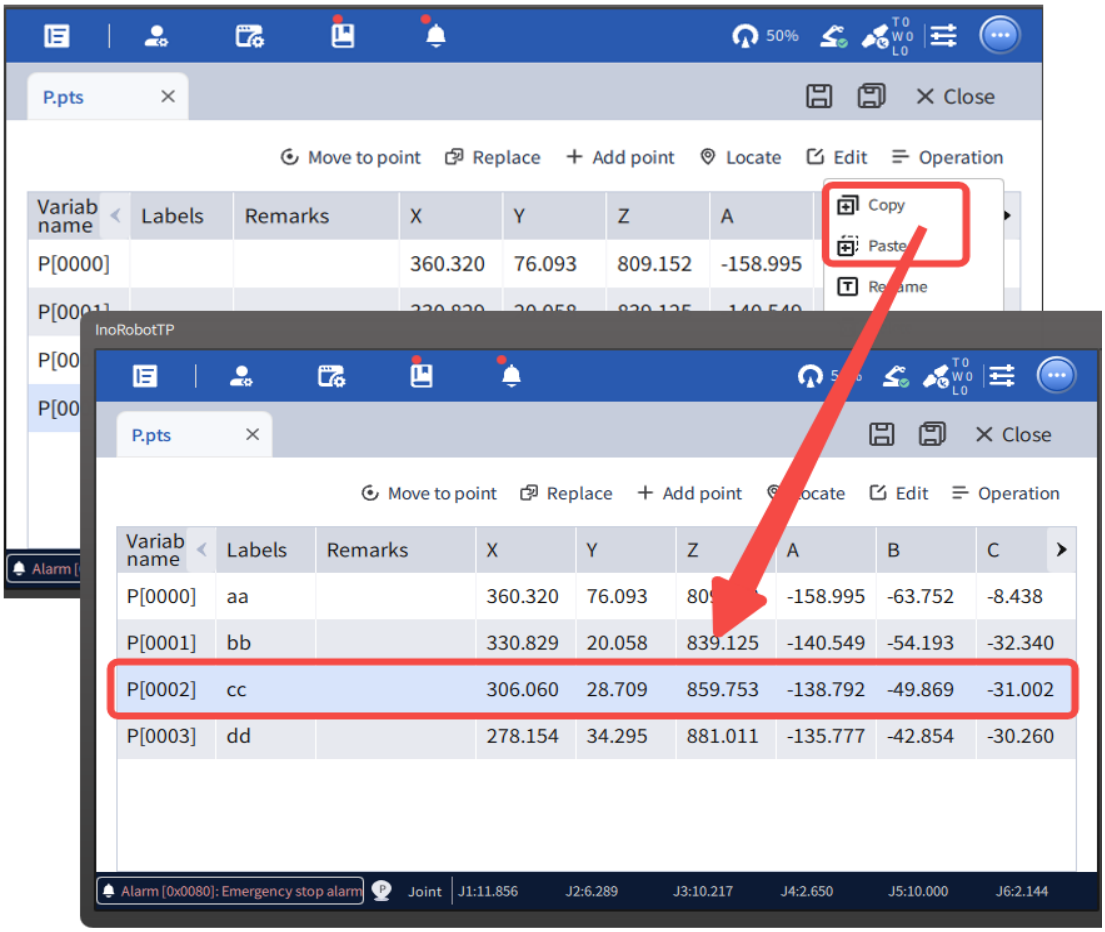
Note:

Point information modification is supported in auto mode/debug mode/remote mode. The point modification in these modes is restricted, with a single modification range of [-5, 5]. The interface style in these modes is as follows:



- Copy or paste

  Select any line in the point data table. Click "Operations" in the toolbar and select "Copy", then click "Operations" > "Paste" to insert a new point with the same position data as the selected point in the form of interpolation.

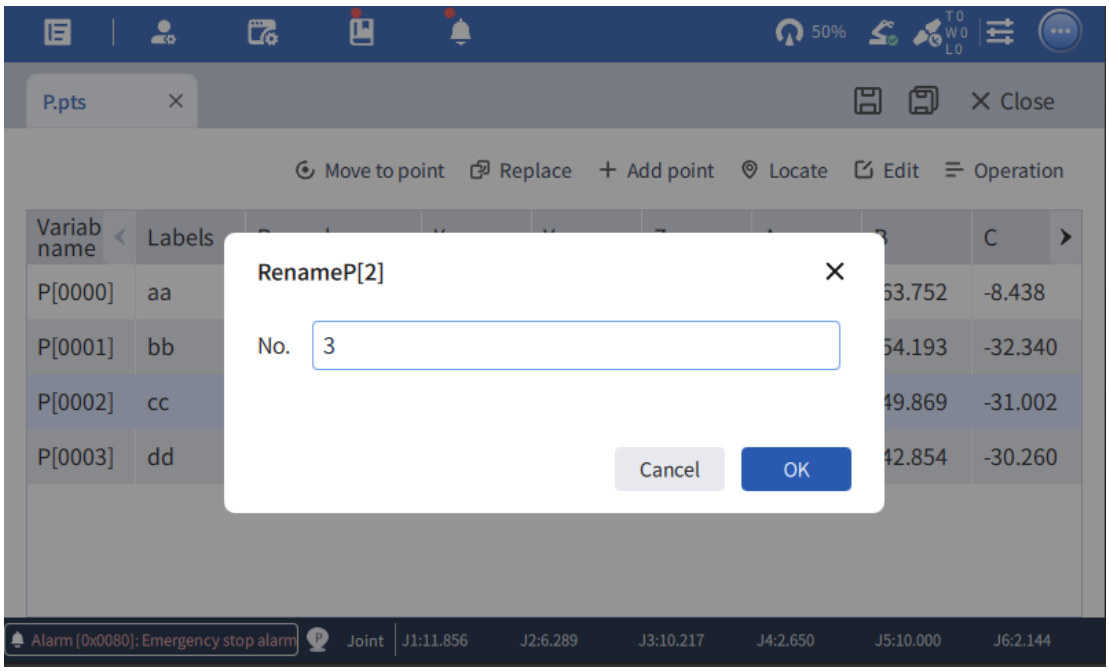


- Rename

  1. Select any line in the point data table and click "Operations" > "Rename" to open the rename input dialog.

2. Enter the new number and click "OK" to change the selected point number to the specified number. If the target number already exists or is out of range, the renaming will fail.

3. Click "Cancel" to cancel the renaming operation.

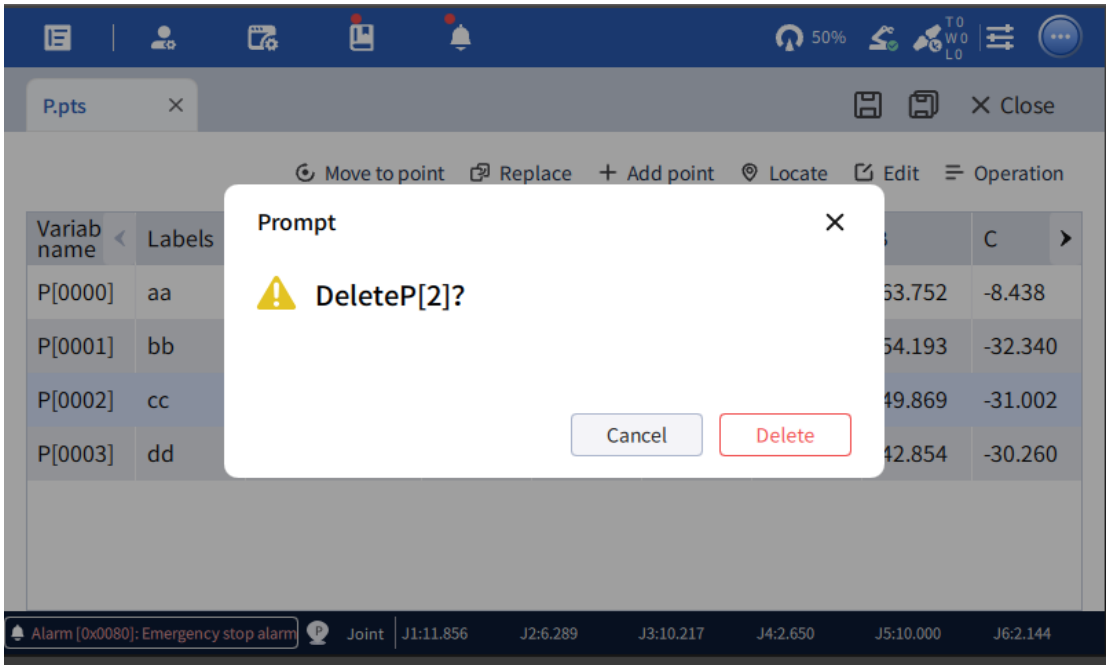


- Delete

1. Select any line in the point data table and click "Operations" > "Delete" to open the confirmation dialog.

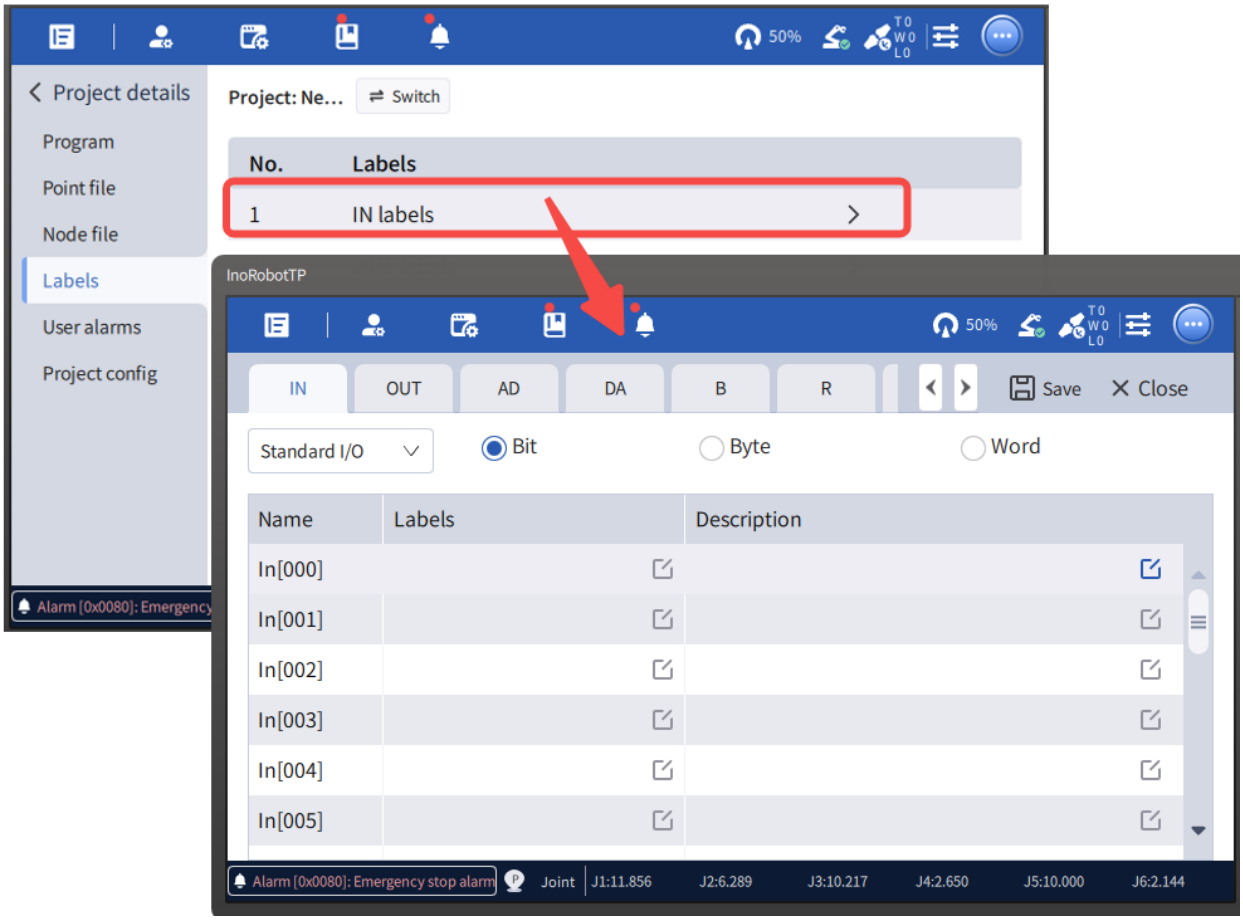
2. Click "Delete" to delete the selected point.

3. Click "Cancel" to cancel the delete operation.



8.2.4.3 Editing the Labels

On the "Project details" > "Labels" page, click the selected line in the file list to jump to the label data page.



1. Label Type

- I/O labels

  "IN" labels and "OUT" labels belong to I/O labels. The types include Tag I/O, Fieldbus I/O, and Memory I/O. Each type can be further categorized into Bit type, Byte type, and Word type.

- Global variables labels

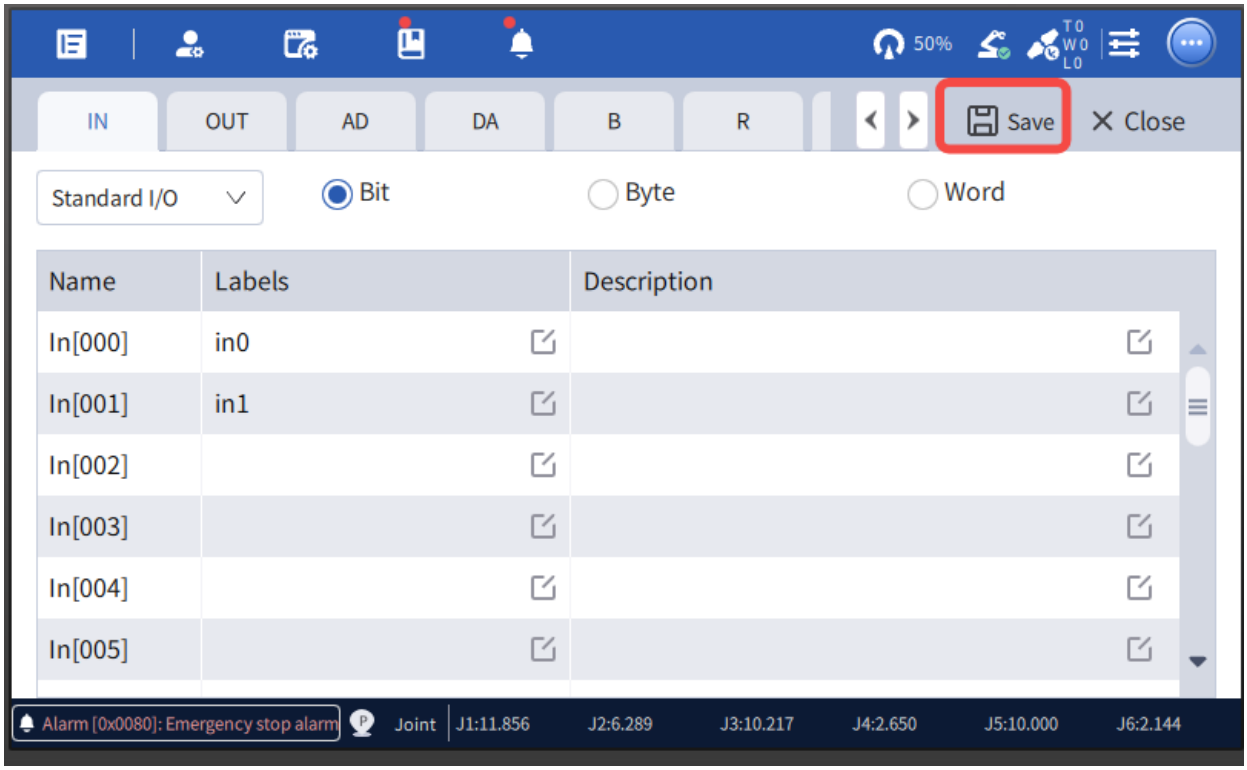
  "AD" labels, "DA" labels, "B" labels, "R" labels, and "D" labels belong to global variables labels.

- Remarks

  Typically used to add descriptions for points. Remarks can be up to 100 characters long, with no restrictions on character type.

2. Edit operations

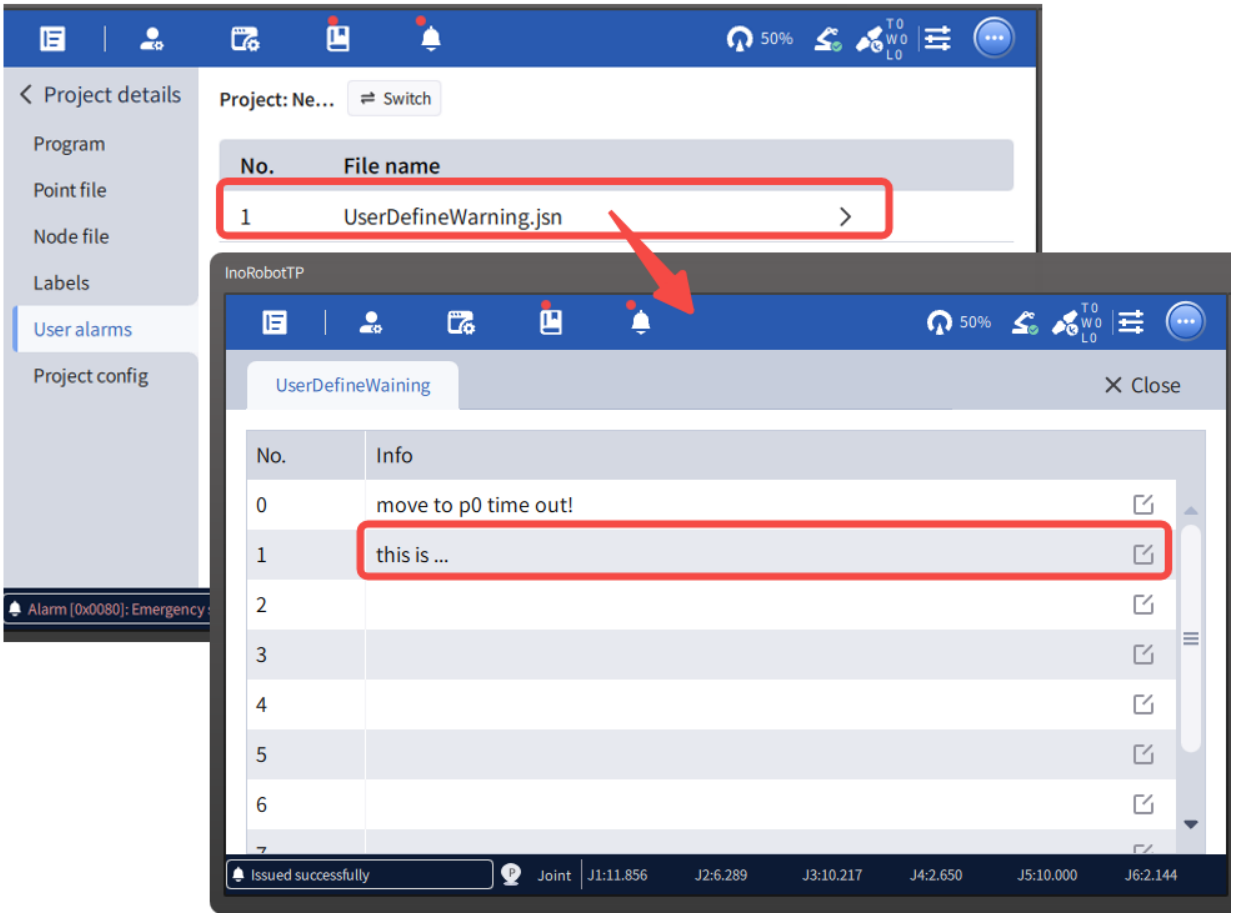
In the label data table, click the cell of the item to open the content input box and click "OK" to apply. Then click "Save" to synchronize the label data to the controller.



8.2.4.4 Editing the User Alarm

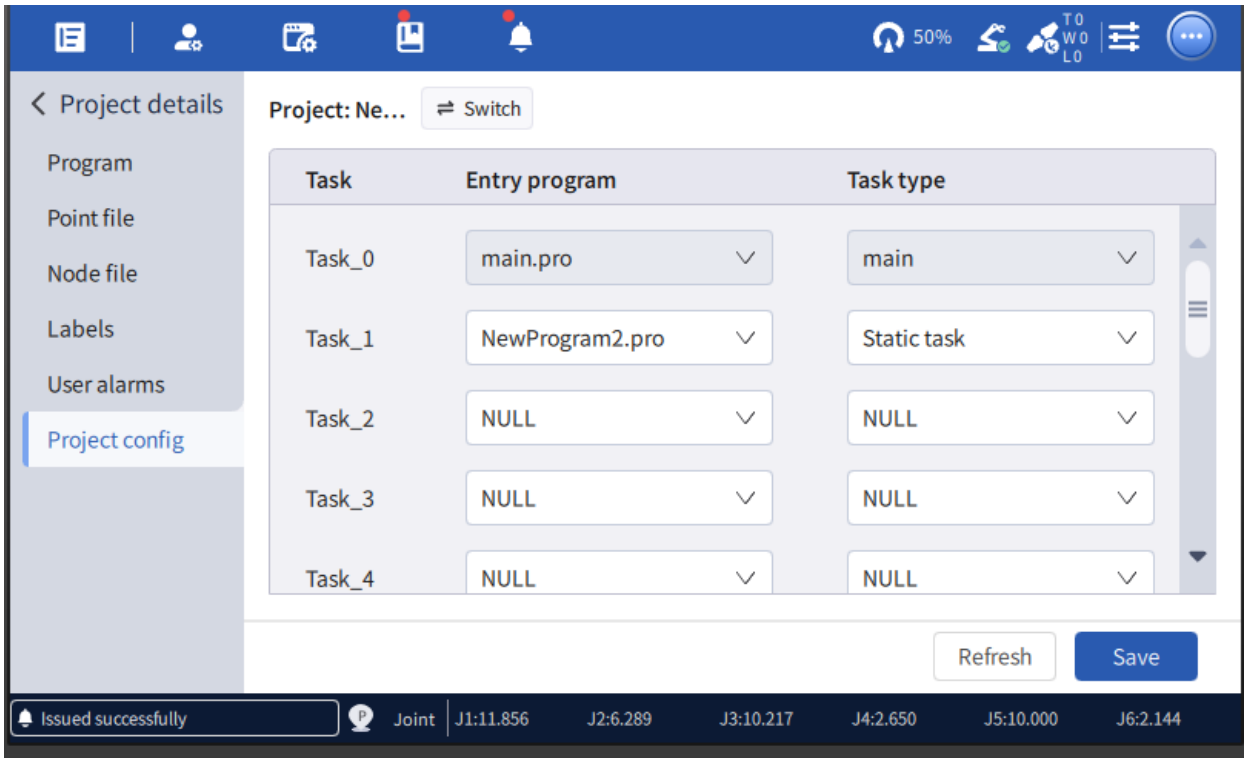
On the "Project details" > "User alarm" page, click the line where "UserDefineWarning.jsn" is located in the file list to jump to the "User alarm" editing page.

In the user alarm data table, click the cell of the item to open the content input box and click "OK" to apply. The user alarm data will be automatically synchronized to the controller.



8.2.4.5 Project Configuration

Click "Project details" > "Project Config" to open the project configuration settings page.



1. Content

Task types include main task, dynamic task, static task, and xqt task. The total number of all tasks is limited to 16. The task management configuration page only supports the configuration of dynamic and static tasks. The specific distribution of tasks is as follows:

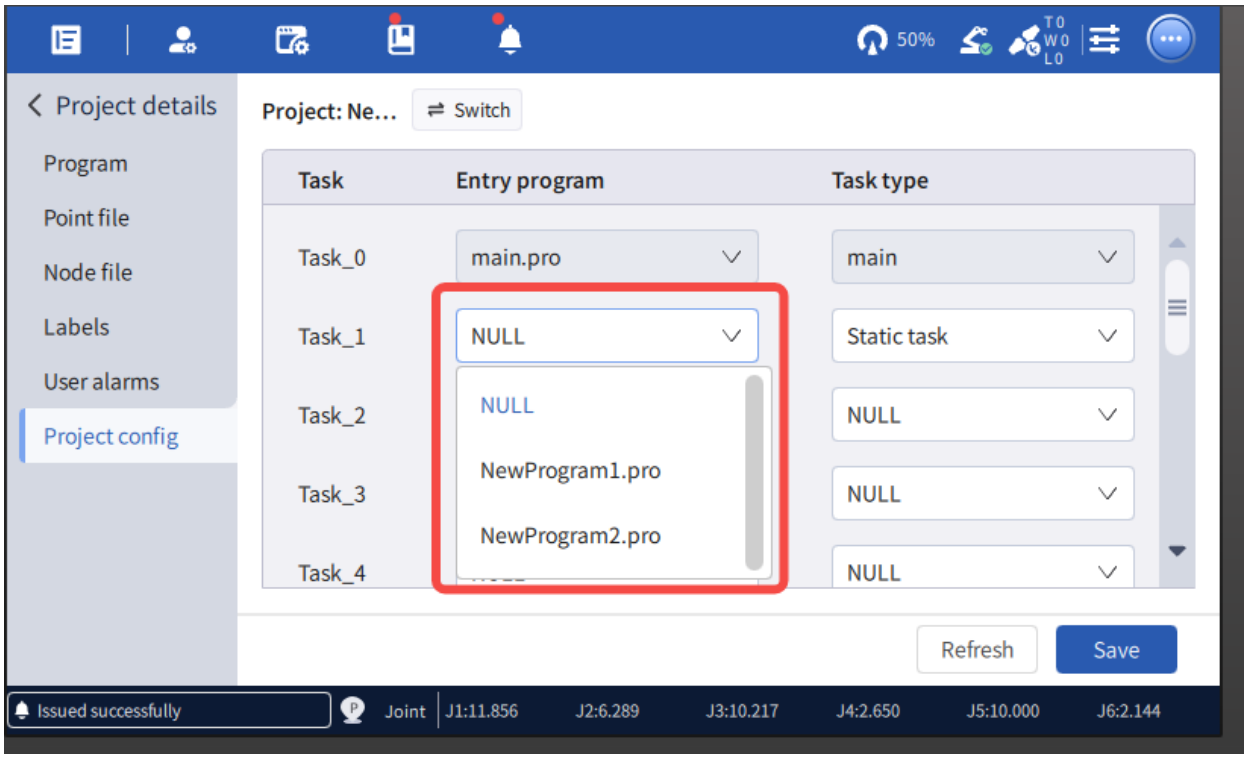
Task framework introduction

Task type	Quantity	Description
Main task	1	The program file main.pro is binded by default; This configuration cannot be modified.
Multitasking (dynamic task or static task)	14	The task management configuration page only supports the configuration of multitasking. ▪ Dynamic task: A task that synchronizes with the program running and stop. The dynamic task starts running synchronously when the main task starts running , and it stops synchronously when the main task stops; ▪ Static task: A task running in the background. As long as the task configuration is synchronized to the controller, the static task will automatically run without the need to start the program operation;
Xqt task	1	A task controlled by instructions. The Xqt instruction controls when the task starts running, and the Halt instruction controls when the task pauses. It is a relatively flexible task.

2. Configuration operations

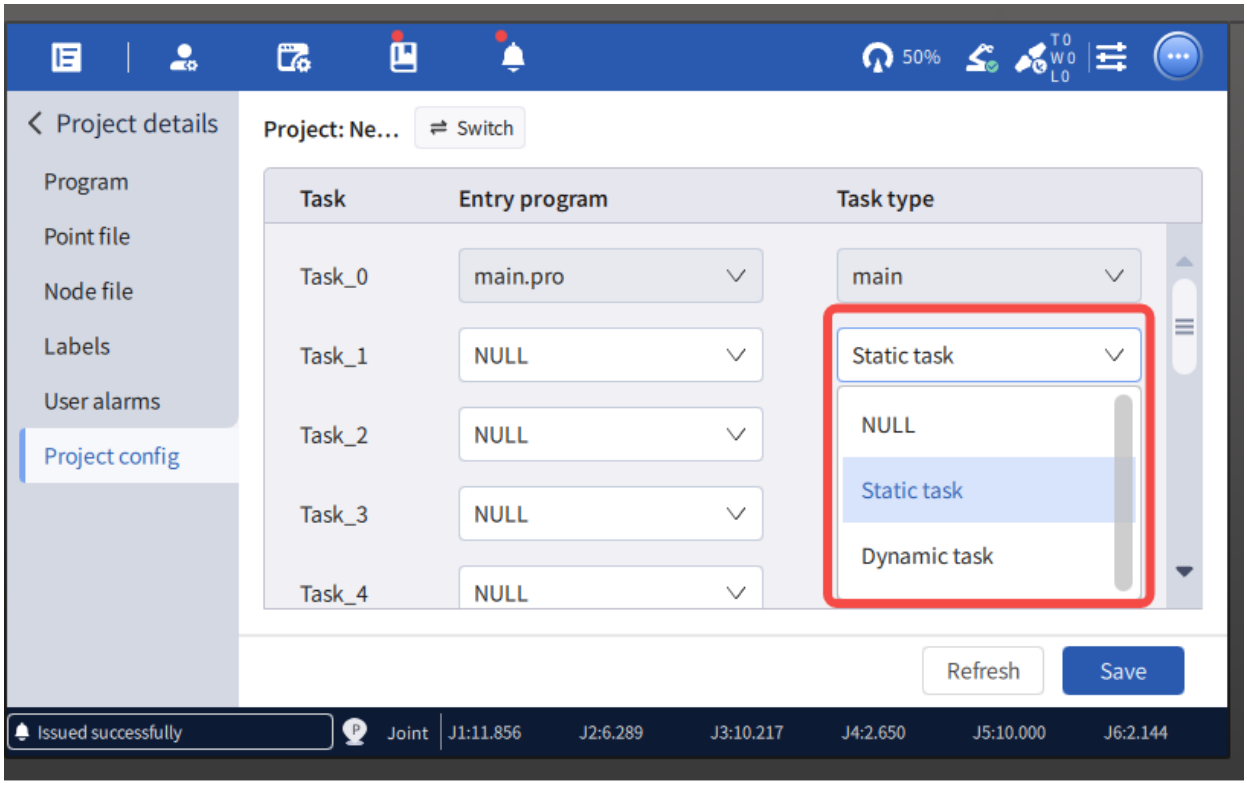
◦ Select the program file.

Click the "Program" drop-down list and select the program file you want to configure. For flexible use, all program files will be listed in the drop-down list options, regardless of entry programs or general programs. "NULL" indicates no selection and no corresponding task is configured.



◦ Select the task type.

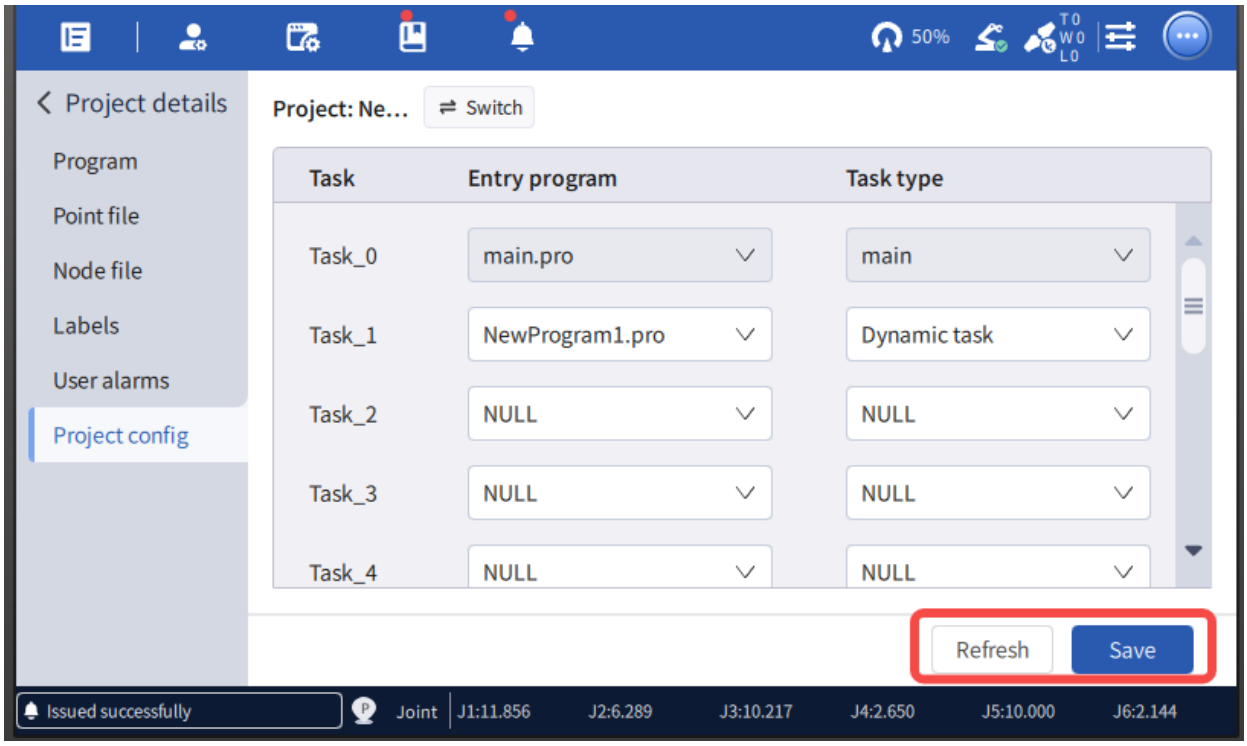
Click the "Task type" drop-down list and select the type you want to configure. In the drop-down list options, "dynamic task" and "static task" are available. "NULL" indicates no selection and no corresponding task is configured.



◦ Function button

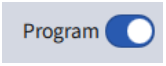
Click "refresh" to reparse the configuration file and update the latest task configuration to the interface display.

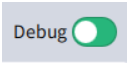
Click "Save" to apply the modifications of the current task configuration and synchronize the configuration information to the controller.



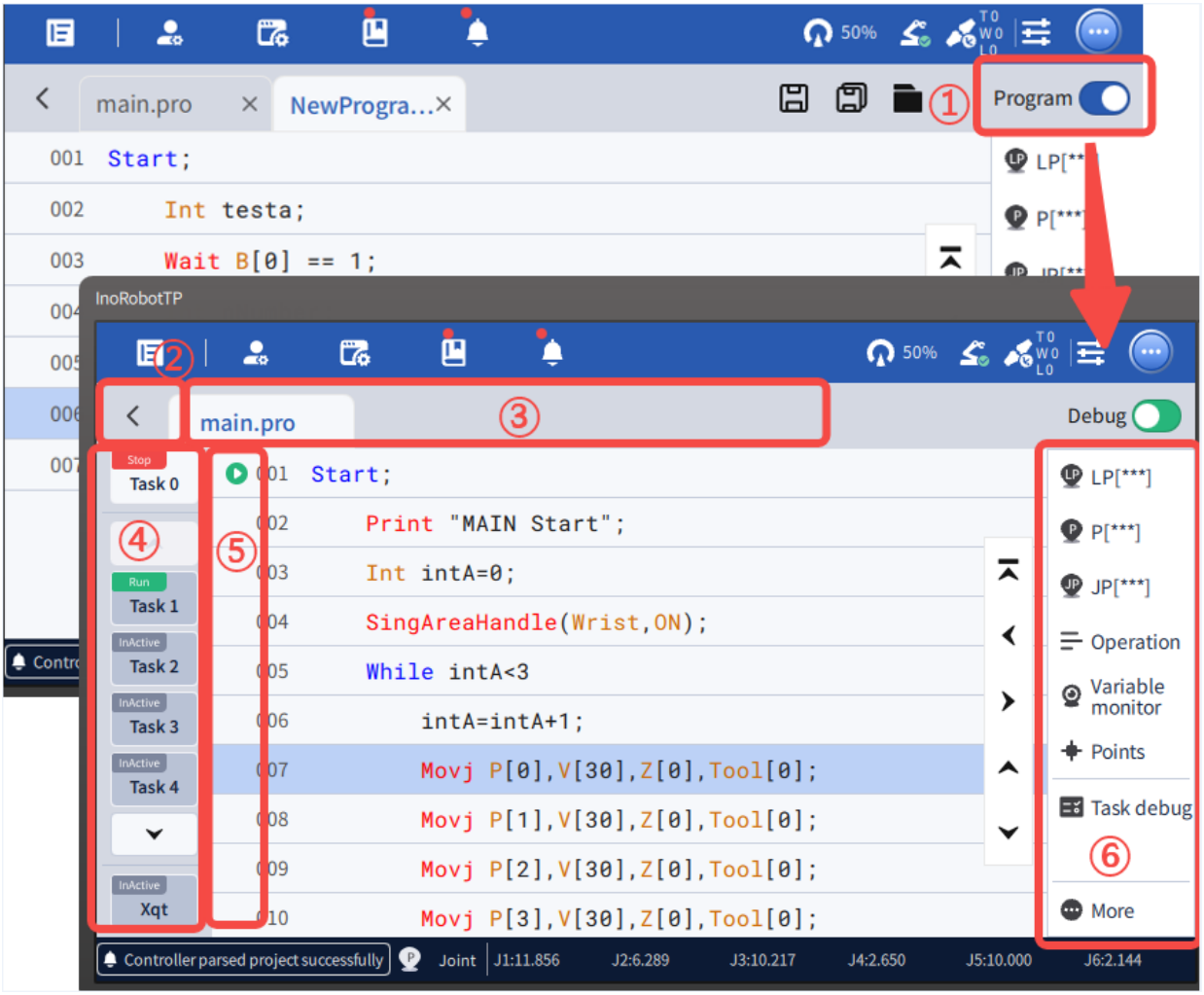
8.3 Debugging

8.3.1 Debugging Page

Click "Program" on the homepage to enter the programming page. In the "Manual low speed mode", switch 

to 

to enter the debugging mode. The debugging mode page mainly displays task information, running status, and some auxiliary debugging functions.

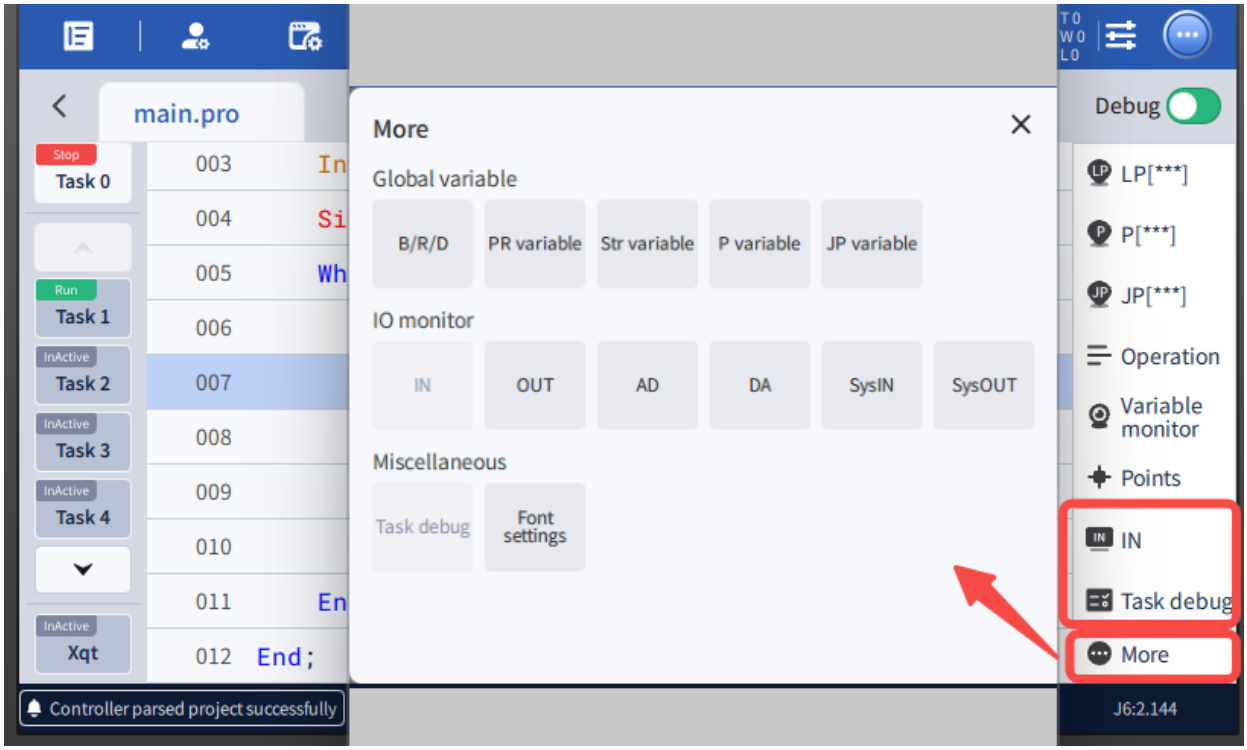


Debugging mode page introduction

No.	Description
①	"Program" and "Debug" mode switch
②	Return to the previous level page
③	Tabs of all open program files
④	Task running status display
⑤	Run cursor display area
⑥	Auxiliary toolbar

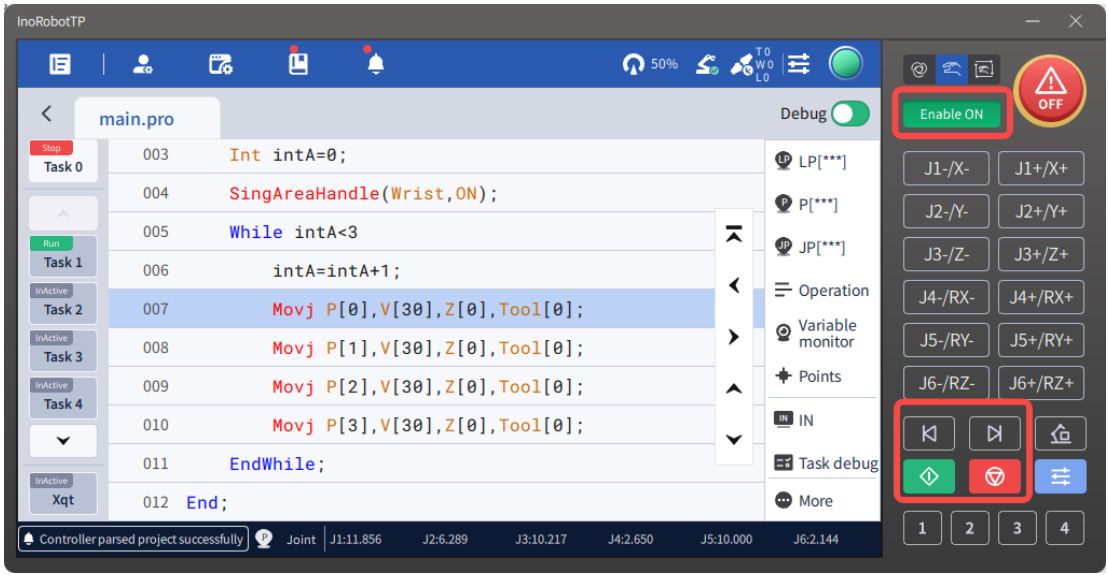
- Extended function buttons of auxiliary toolbar

  Click "More" to pop up the extended function button panel. Click any button on the panel to open the corresponding function panel, and the function button will be placed in the bottom area of auxiliary toolbar, where can hold up to 3 recently used extended function buttons.



8.3.2 Debugging Running

The prerequisite for normal debugging operation is that there are no exceptions during compiling the project and no alarm in the control cabinet. This section mainly introduces the debugging mode under the "Manual low speed mode". Apart from the robot movement speed and some operation restrictions, this mode is not much different from the "Manual high speed mode."



- Running steps

1. After entering the "Debug" mode, click 

to enable the robot. When the button status changes to 

, it indicates that the robot has been successfully enabled;

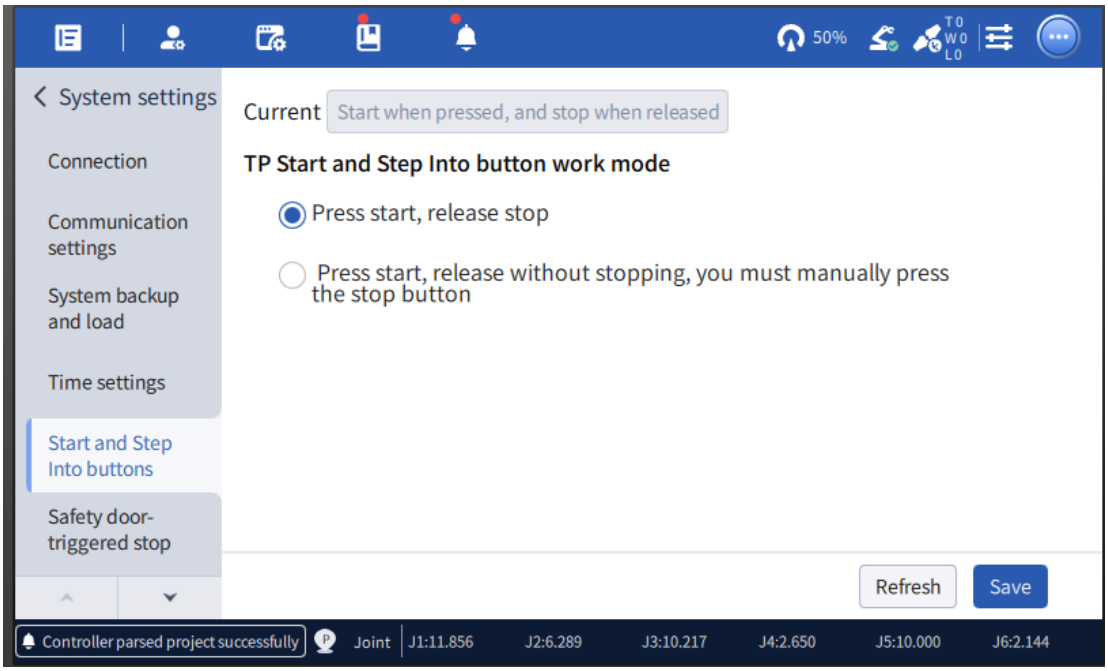
2. After enabling, you can perform the debugging operation using the following function buttons:

Debugging running button introduction

Button	Description
	Step back button. Moves to the line preceding the current execution point. (not implemented yet).
	Step run button. Executes one line of instructions.
	Starts the program running. Depending on the settings in "Start and Step Into buttons", there are different operation modes.
	Stops the program running.

- Start and Step Into buttons

  Click "System settings" > "Start and Step Into buttons" to enter the "TP Start and Step Into button work mode" settings page.



- Mode explanation

  1. "Press Start, release stop"
     Hold the "Start" button to start the program, and release the button to stop immediately.

  2. "Press Start, release without stopping, you must manually press the stop button"

  Click the "start" button to start the program, and click the "Stop" button to stop.

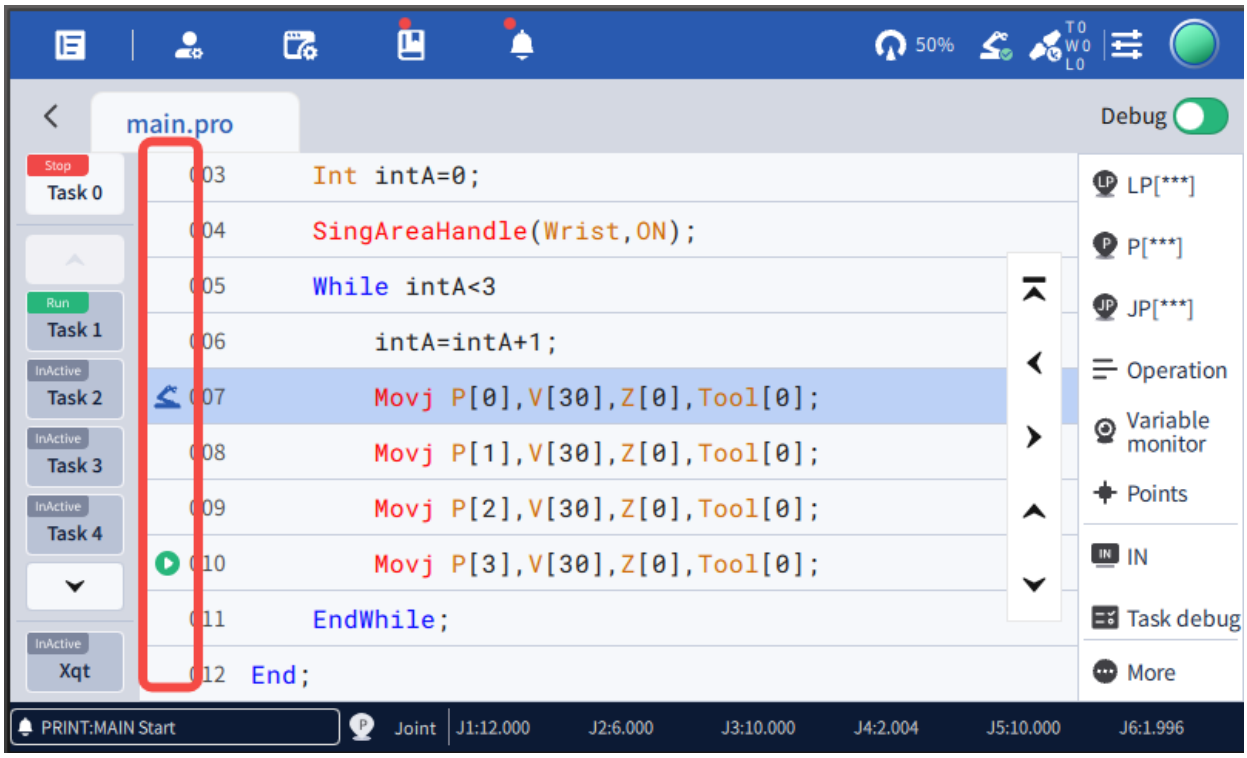
- Function button

  ▪ Click "Refresh" to read the latest "TP Start and Step Into button work mode" settings from the controller and refresh the display.

  ▪ Click "Save" to apply the current settings and synchronize the settings to the controller.

8.3.3 Run Cursor

The run cursor area is located to the left of the program text list. There are two types of run cursors: "pre-compilation line cursor" and "motion line cursor".

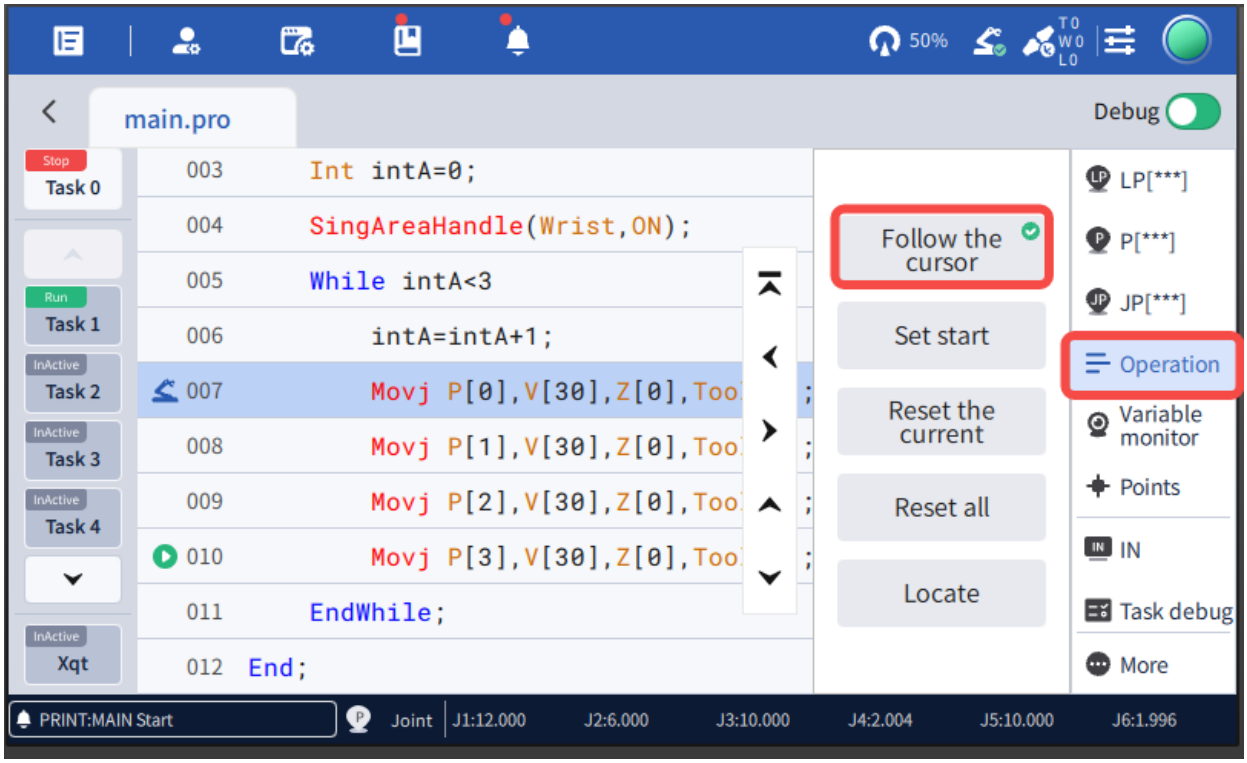


Run cursor introduction

Cursor	Description
	"Pre-compilation line cursor" indicates the pre-compilation line of the robot, representing the pre-compilation position. Due to the pre-processing characteristics, it always leads the execution line during runtime. Before starting, you can set a specific line as the start line to make the robot start from that line on the next run.
	"Motion line cursor", indicates the line number of the currently executing motion instruction, representing the current position of the robot.

Cursor switch

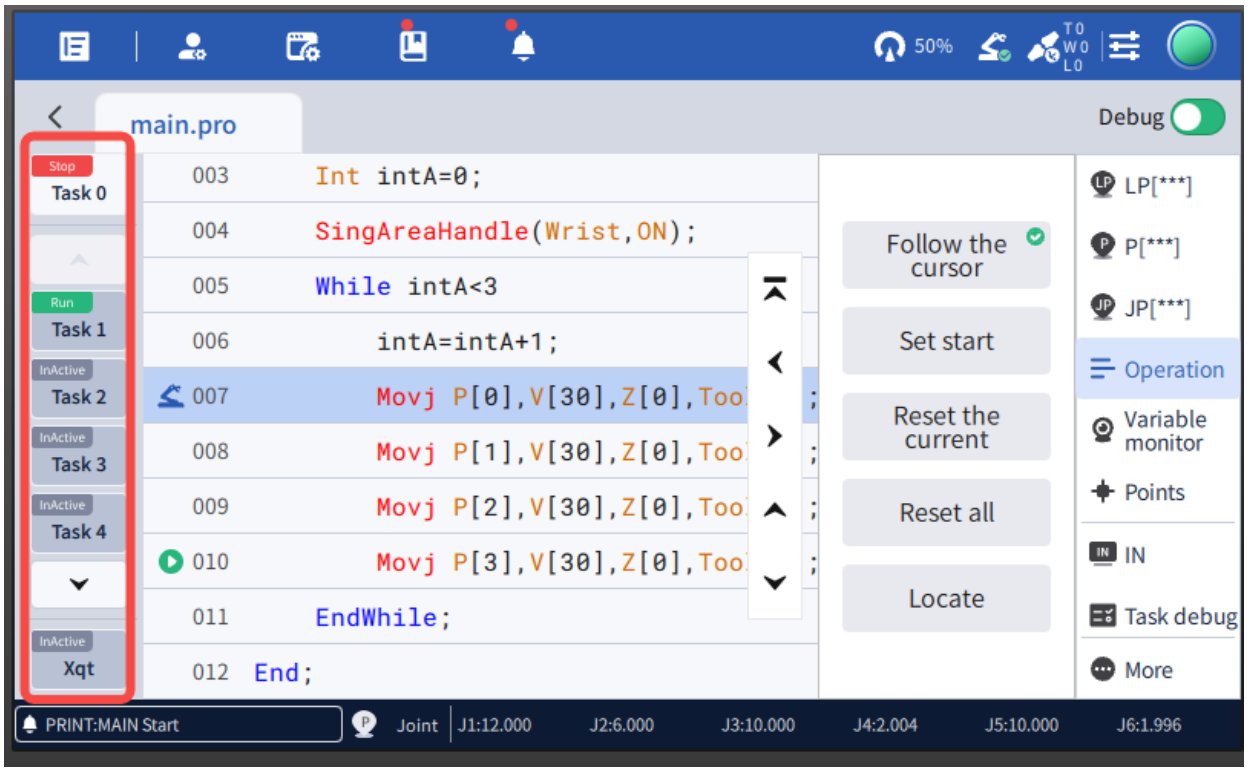
Click "Operation" > "Follow the cursor" to control the display of the run cursor during program running.



8.3.4 Task Status

The task status area is located on the left side of the programming and debugging page. This area only displays under "Debug" mode, manual high speed mode and auto mode, showing configuration information and the operation status of each task.

Click the button in the task status area, and the program file tabs will automatically refresh to the entry program files bound to the corresponding task. As shown in the following figure, when "Task0" is selected, since "main.pro" is bound to the main task "Task0" and "newfile3.pro" is included in "main.pro", the content of the program file tabs are refreshed to "main.pro" and "newfile3.pro".



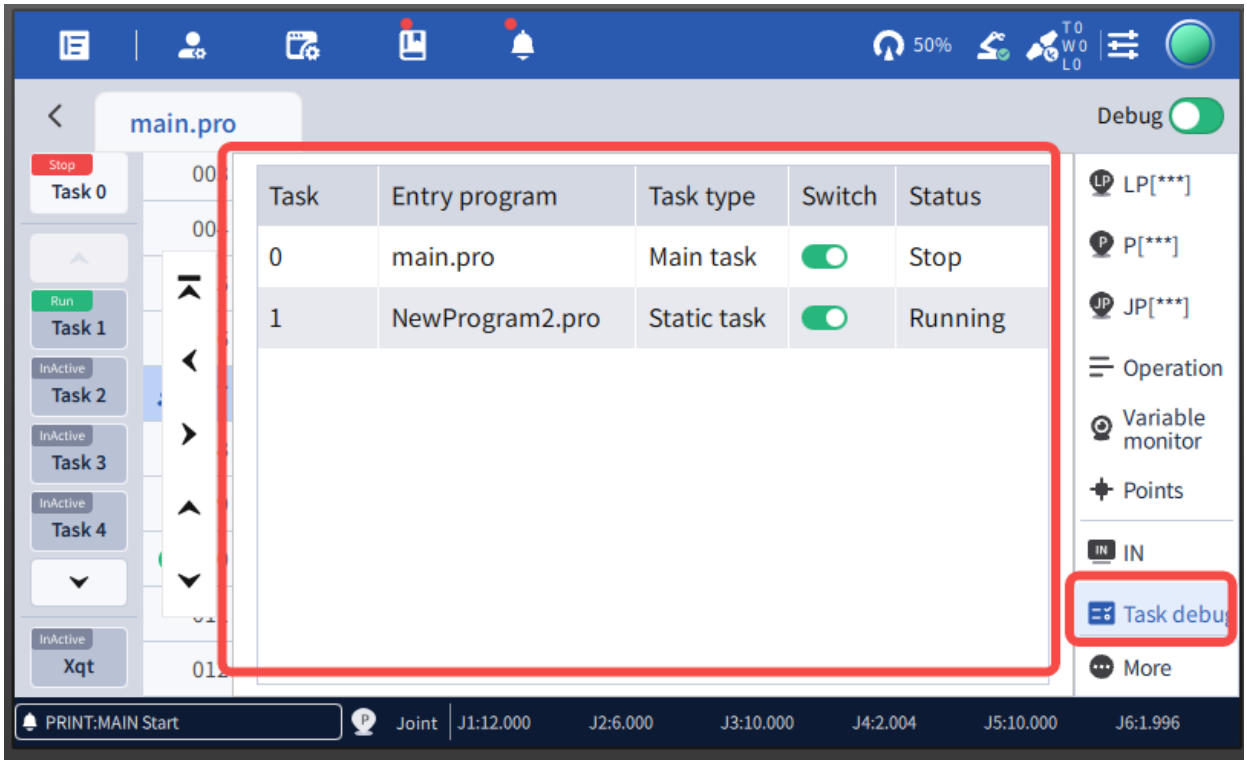
Task status introduction

Task status	Description
Run	"Run" status
Stop	"Stop" status
Finish	"Finish" Status
InActive	"InActive" Status (Including idle status)

8.3.5 Task Debugging

Click "More" > "Task Debug" in the auxiliary toolbar to open the task debugging panel, where you can perform operations on all configured task items and control the active status of task items.

If a task is in the active status, it will be included in the program execution, and the task status will be display as Run, Stop, or Finish. If a task is in the inactive status, it will not be included in the program execution, and the task status will be displayed as InActive. You can set the activation status of task items according to the actual debugging scenario.



Task debugging table introduction

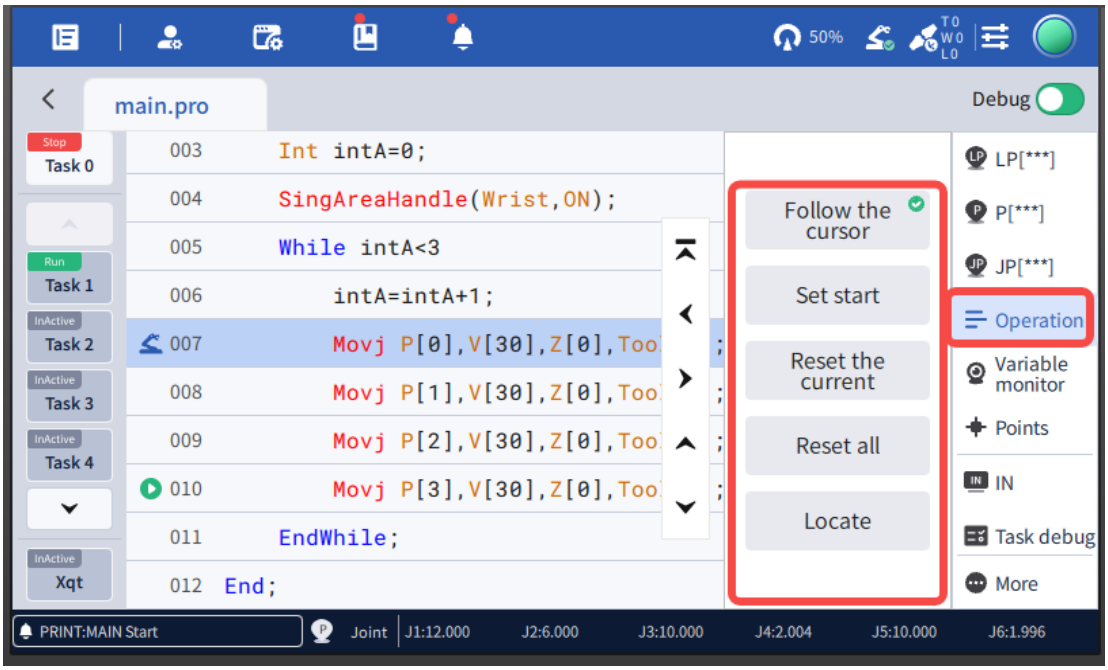
Name	Description
Task	The task ID.
Entry program	The entry program name configured for the task in task management settings.

Name	Description
Task type	Task types include main task, dynamic task, and static task.
Switch	The task activation switch. Click to toggle the activation status of the task.  : Active  : Inactive
Status	The current task status.

8.3.6 Debugging Operations

Click "Operation" in the auxiliary toolbar to open the operation button panel, which primarily includes three types of function buttons:

1. Run cursor display toggle button: "Follow the cursor".
2. Start line related buttons: "Set start", "Reset the current", and "Reset all".
3. Quick Jump to program text line: "Locate".

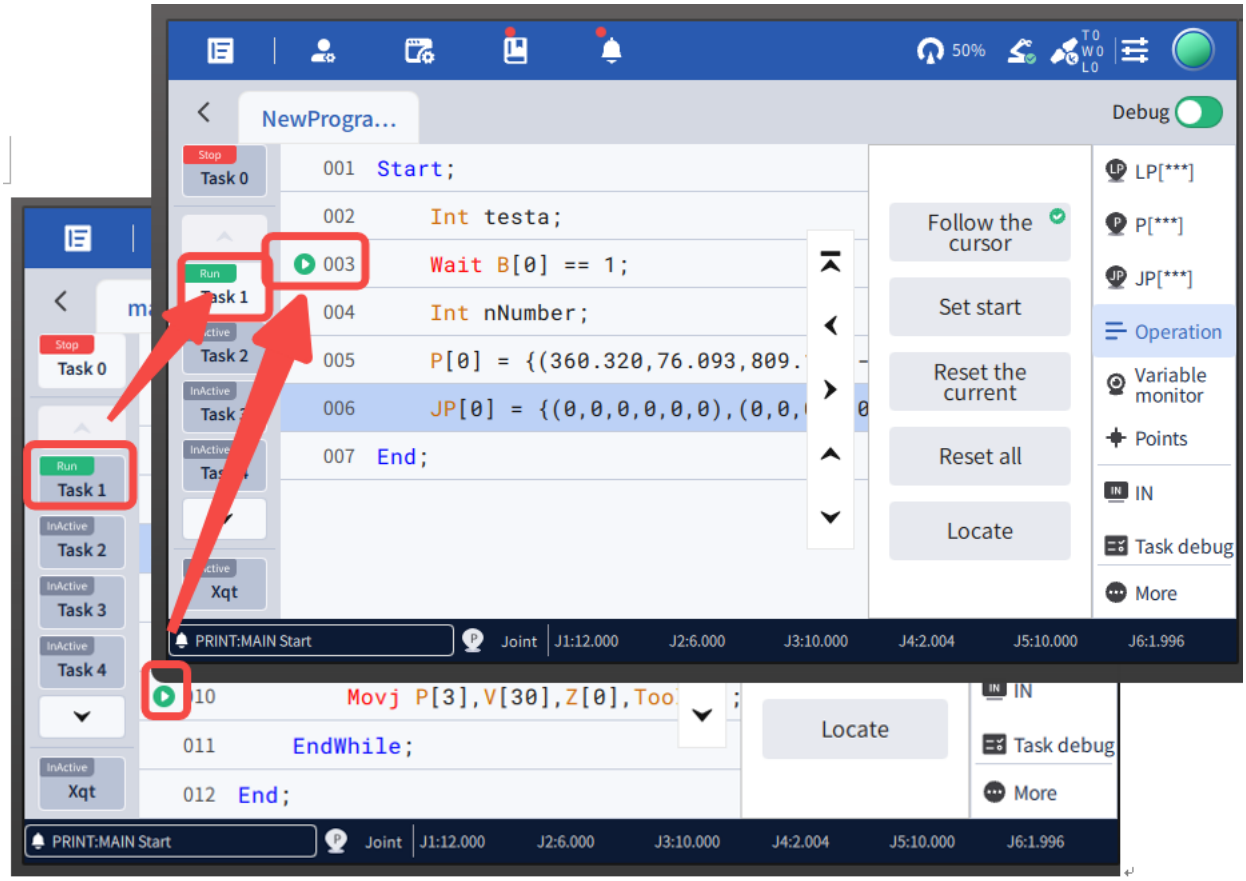


- "Follow the cursor"

  Used to set whether the cursor  and  are displayed.

- Start line related buttons

  "Set Start", "Reset the current", and "Reset all" can control the line where the "Compilation line cursor" is located and the status of the corresponding task. If the task is already in a Finish status, the status will be changed to a Stop status. The following diagram shows the status changes after selecting Task2 and executing "Reset the current".



Start line related operation buttons introduction

Button	Description
Set start	Sets the start line of the current task to the currently selected line. The program will start execution from this line on the next run.
Reset the current	Resets the start line of the current task to the line where the Start keyword is located. The program will start execution from the beginning on the next run.
Reset all	Resets the start line of all tasks to the line where the Start keyword is located. The program will start execution from the beginning on the next run.

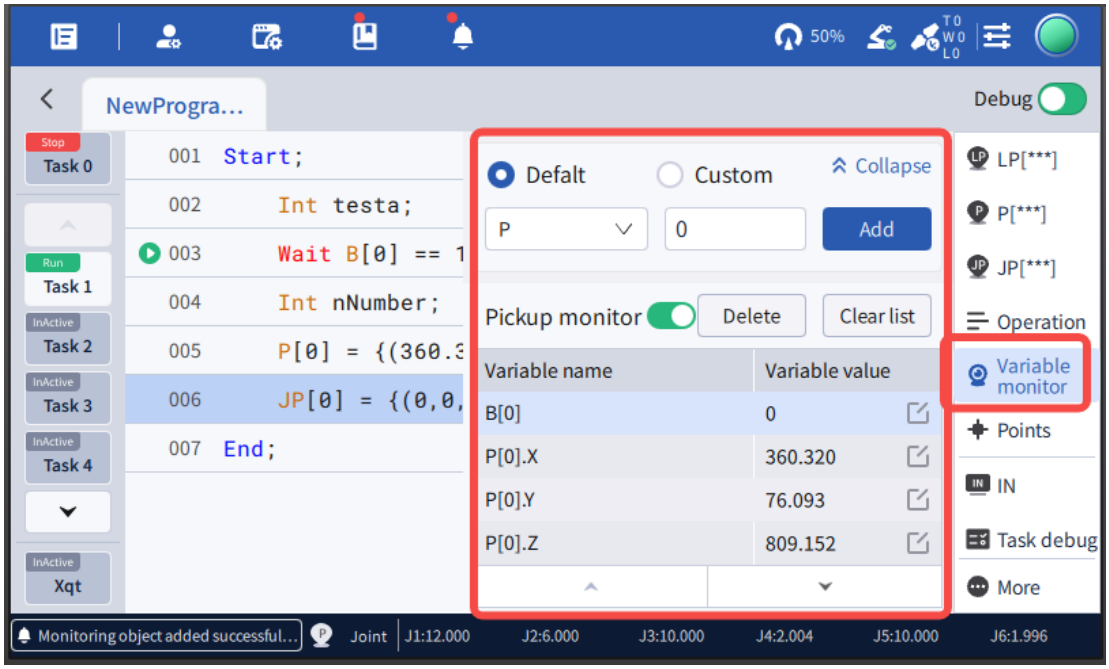
- Locate

  Click "Operation" > "Locate" to open the target line number input window. After entering the target line number, click "OK" to directly jump to the target line, facilitating quick browsing of the program text.

8.3.7 Variable Monitor

Click "Variable monitor" in the auxiliary toolbar to open the variable monitoring panel. In this panel, you can add monitoring for different types of variables, which covers the values of variables in the current task scope and the function scope where the current "compilation line cursor" is located.

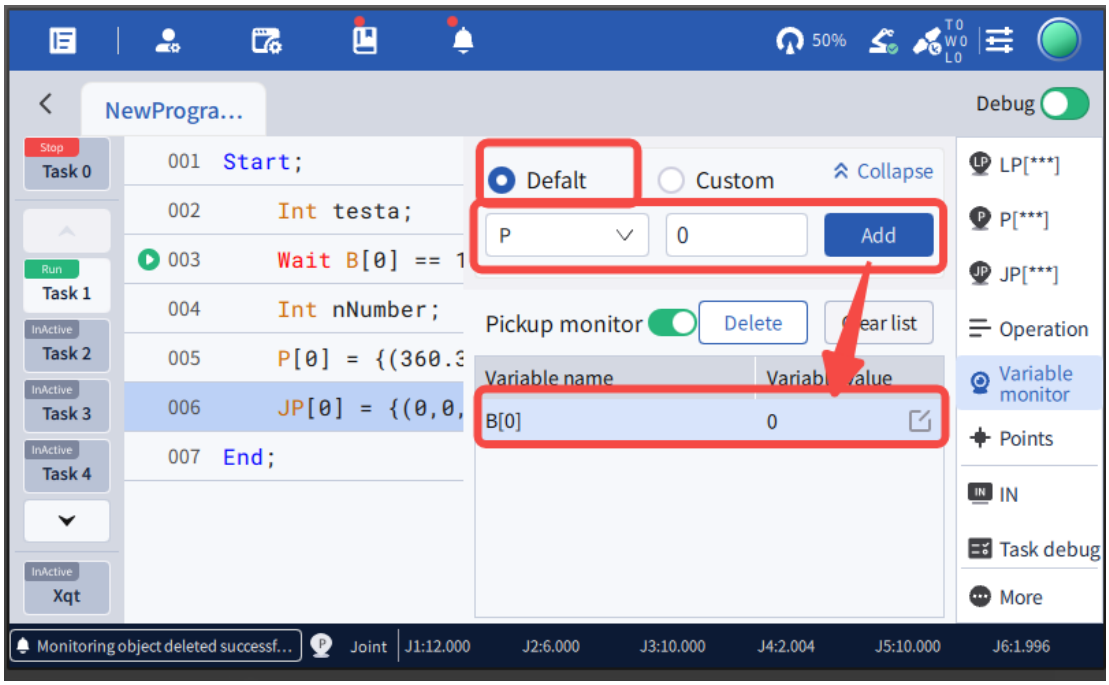
Functionally, it is mainly divided into "Default" for fixed variable monitoring, "Custom" for custom type monitoring, and "Pickup monitor" for pick monitoring. Flexibly select the monitoring method depending on the actual debugging scenario.



- Fixed variable monitoring

  Click "Default" to select the fixed variable monitoring mode. Fixed variable types include "B", "R", "D", "LB", "LR", "LD", "P", "LP", "PR", "LPR", "Str", "IN", "OUT", "InB", "InW", "OutB", "OutW", "Tool", "Wobj", and "Load." You can select the variable type from the drop-down box, enter the variable number in the input box, and click "Add" to add the corresponding variable to the monitoring table. For example, if the selected type is "R" and the entered number is "3", the monitoring object will be R[3].

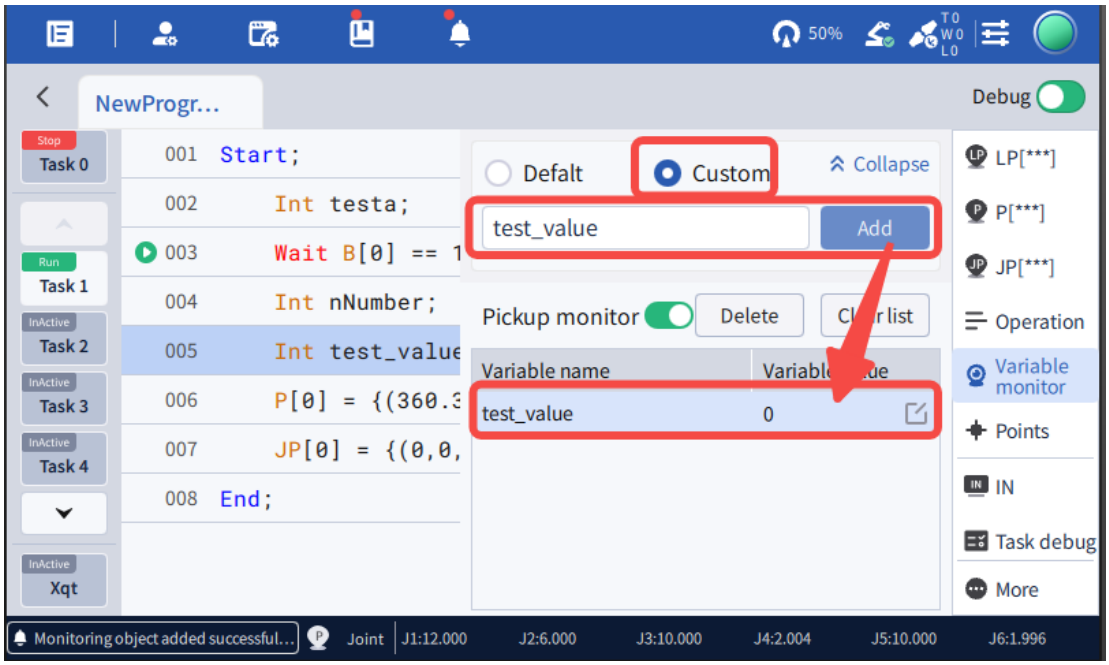
  For the above variables, only non-system variables can have their values modified in the monitoring variable table. The system variable value cannot be modified.



- Custom type monitoring

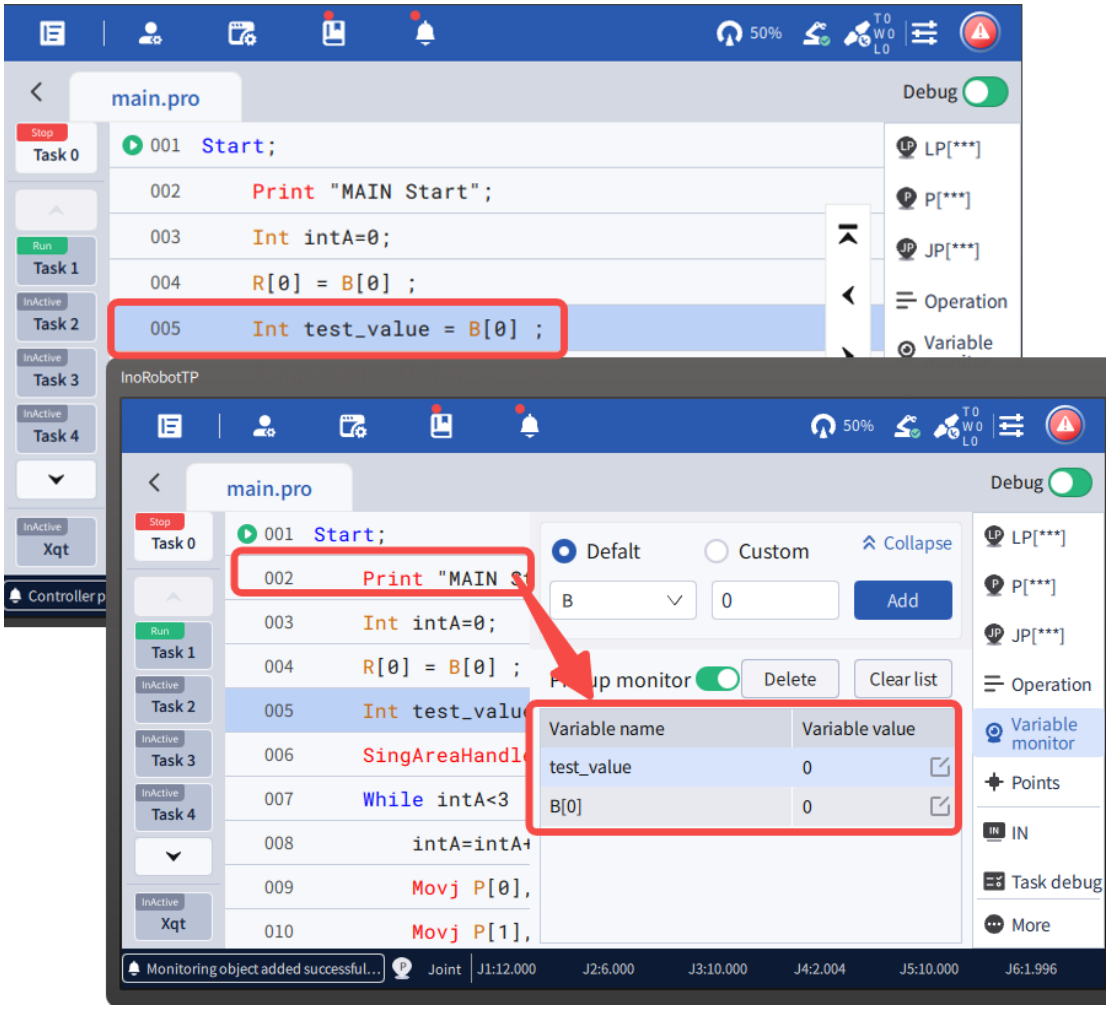
  Click "Custom" to select the custom type monitoring mode. Custom types include "Bool", "Int", "Float", "Double", "Byte", and others. You can enter the name of a custom type variable in the input box and click "Add" to add the corresponding variable to the monitoring table. For example, if an Int type variable "nNumber" is added in the program text, enter the name in the input box to add the monitoring.for the corresponding variable. If the added variable does not exist, it will be displayed as "Not identified" in the monitoring variable table.

For the aforementioned types of custom global or local variables, their values can be modified in the monitoring variable table.

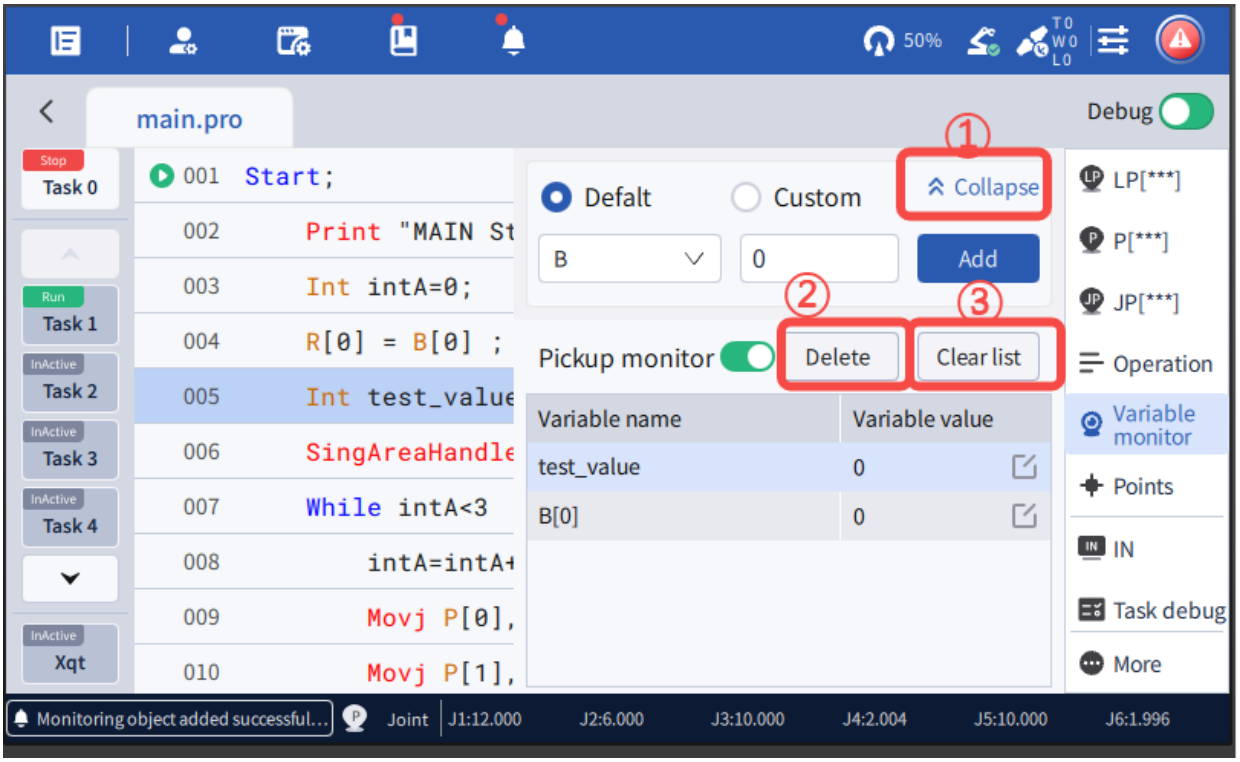


- Pick monitoring

  Click the "Pickup monitor" switch to enable or disable the pick monitoring mode. When enabled, the data in the monitoring variable table will be updated to the variables included in the currently selected line of the program text. For example, if the content of the currently selected line is "Int nNumber", the monitoring variable table will refresh the monitoring item for the "nNumber" variable.



- Other operations



Other operation buttons introduction

No.	Description
①	Collapse or expand the "Default/Custom" area.

No.	Description
②	Delete the selected line in the variable monitoring table.
③	Clear all content in the variable monitoring table.

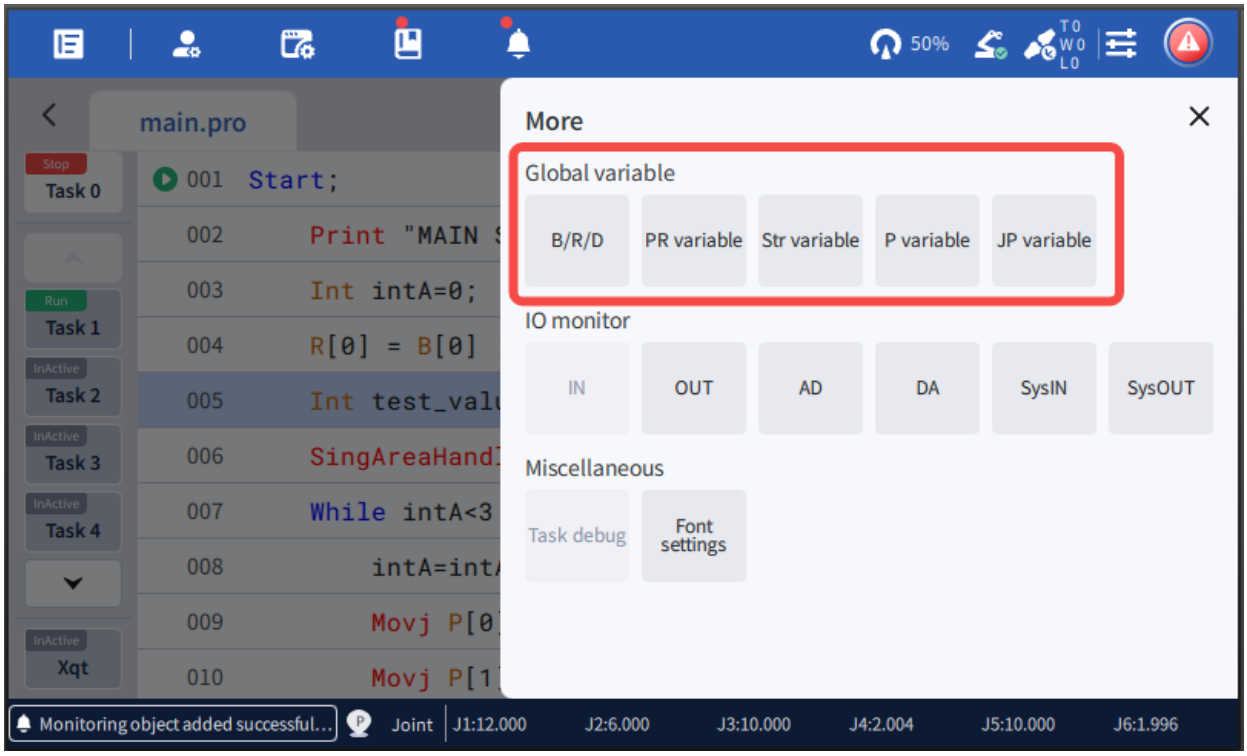
CAUTION

- The maximum number of variables that can be monitored at the same time is 10.
- When using the fixed variable monitoring mode and custom type monitoring mode, it is recommended to disable the pick monitoring mode to prevent manually added variables from being refreshed when the selected line in the program text changes.
- For variables of custom structure types, pick monitoring is not available.
- The values of system variables, such as I/O type variables, Tool, Wobj, Load, etc., cannot be modified in the monitoring panel.
- For "Pick Monitoring", during non-runtime, the monitoring object can be changed only after the program text line is selected; during runtime, the monitoring object cannot be changed.
- If the current scope changes, such as switching to auto mode, switching tasks or programs, the data in the variable monitoring table may be cleared.

8.3.8 Global Variable Monitor

Click "More" in the auxiliary toolbar to open the More panel, which includes a "Global variable" sub-section, containing monitoring functions for the global variables of "B/R/D", "PR", "Str variable", "P variable", and "JP variable".

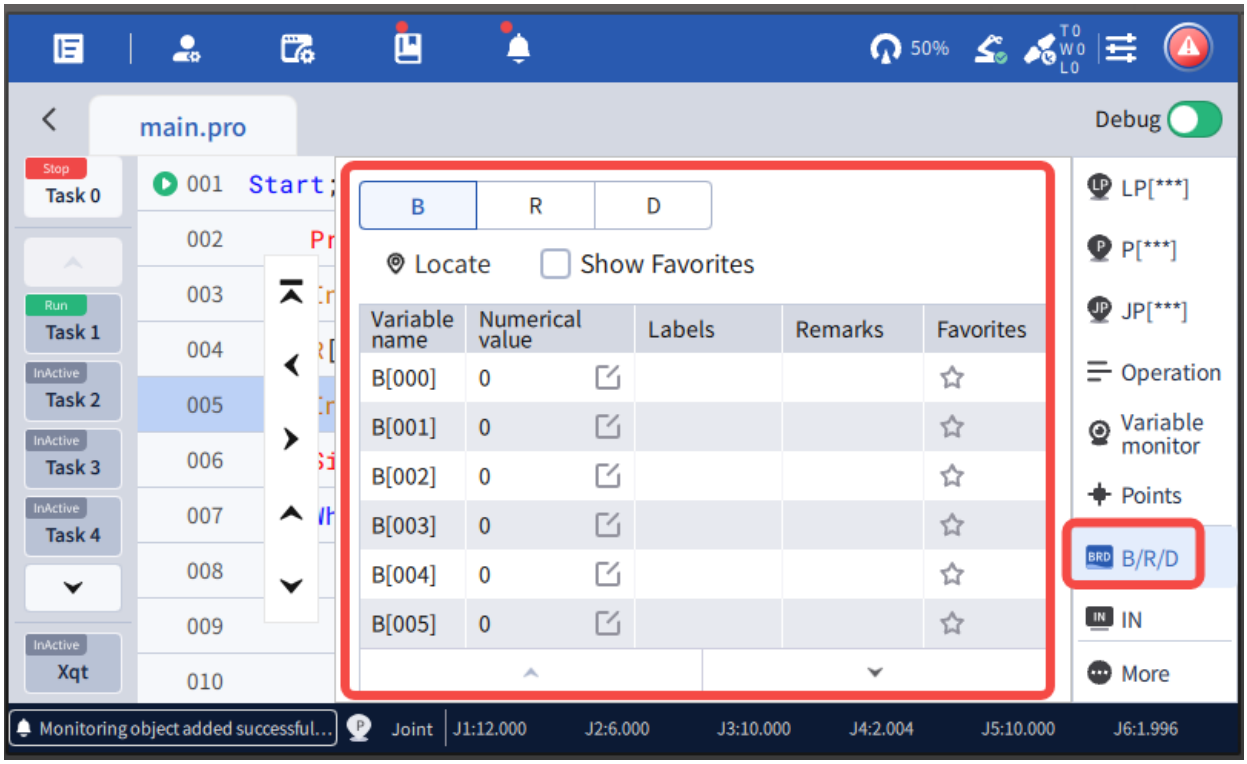
In the monitoring panel for the above global variables, to modify the variable values, you need to switch to the "Program" mode.



- B/R/D variables

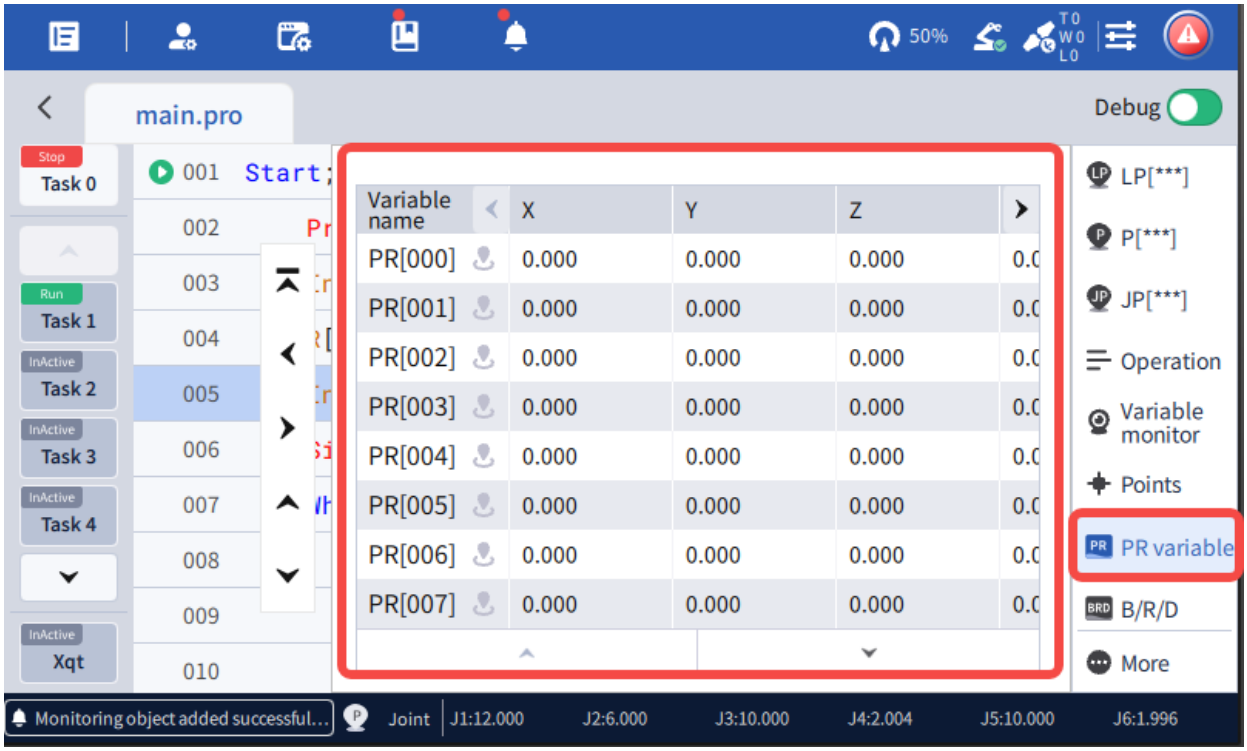
  This monitoring panel displays data monitoring for "B", "R", and "D" global variables, with a maximum of 256 variables each. Use the page turning button to browse.

  In "Program" mode, you can modify the variable values and mark frequently used variables as favorites. Check "Show Favorites" to refresh the data in the monitoring variable table to show only the marked variables.



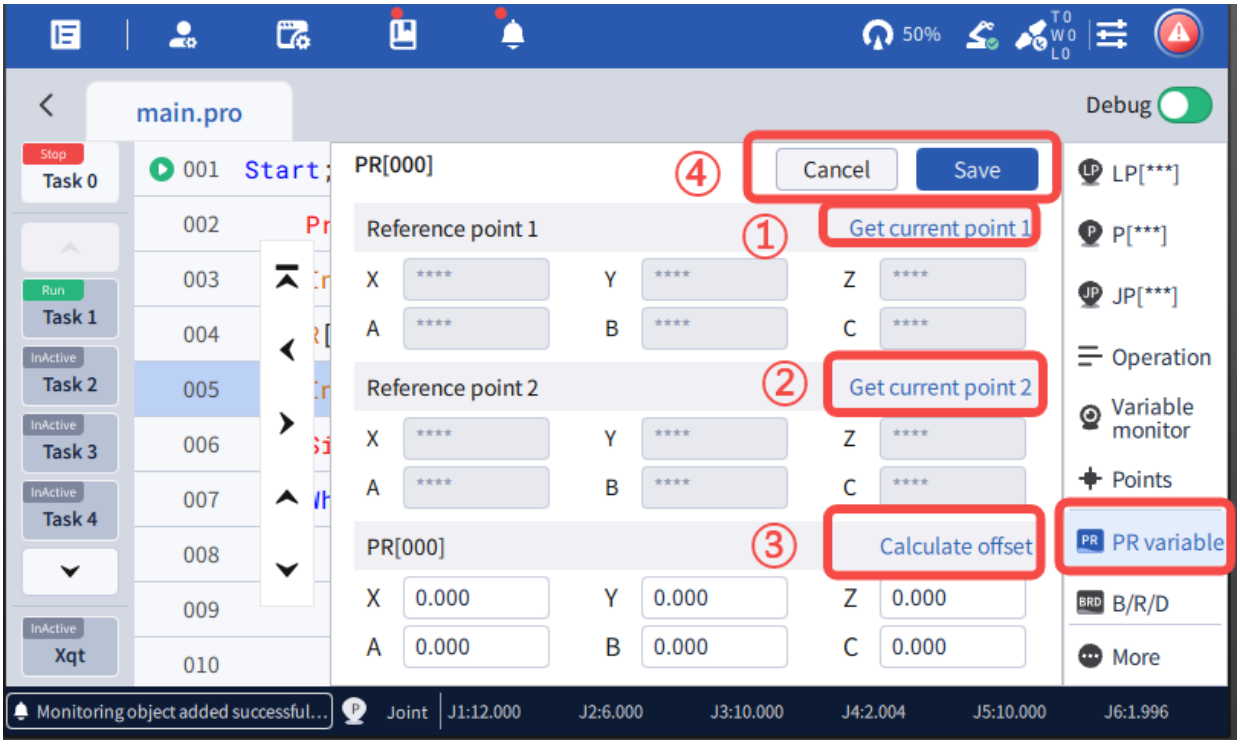
- PR variable

  The maximum number of "PR" variables is 256, and their data includes X/Y/Z/A/B/C. You can browse through the data using the up/down and left/right page turning buttons.



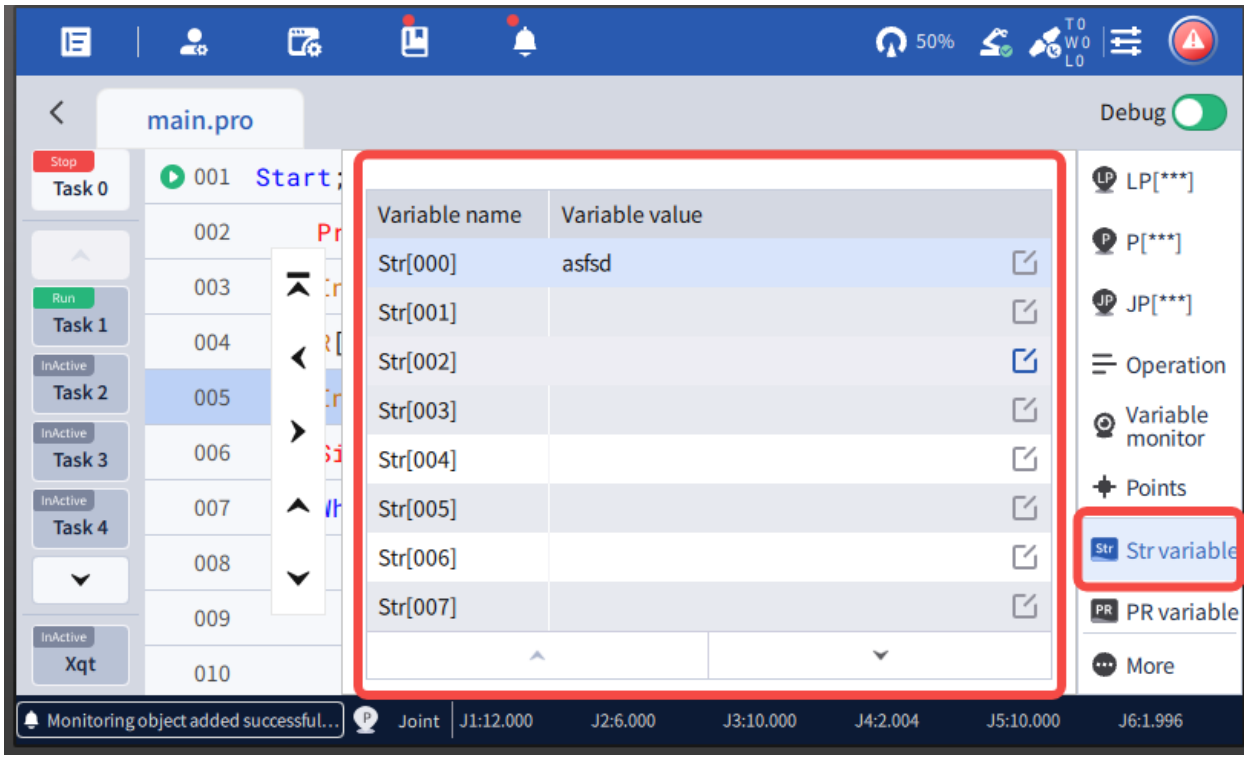
In "Program" mode, click to modify the variable value, with the following steps:

1. Click "Get current point 1" to get the robot position data for "Reference point 1".
2. Click "Get current point 2" to get the robot position data for "Reference point 2".
3. Click "Calculate offset" to get the difference between the robot position data of "Reference point 1" and "Reference point 2", which is the value of the PR variable.
4. Click "Save" to apply the modified PR variable value, or click "Cancel" to cancel the current modification operation.



- Str variable

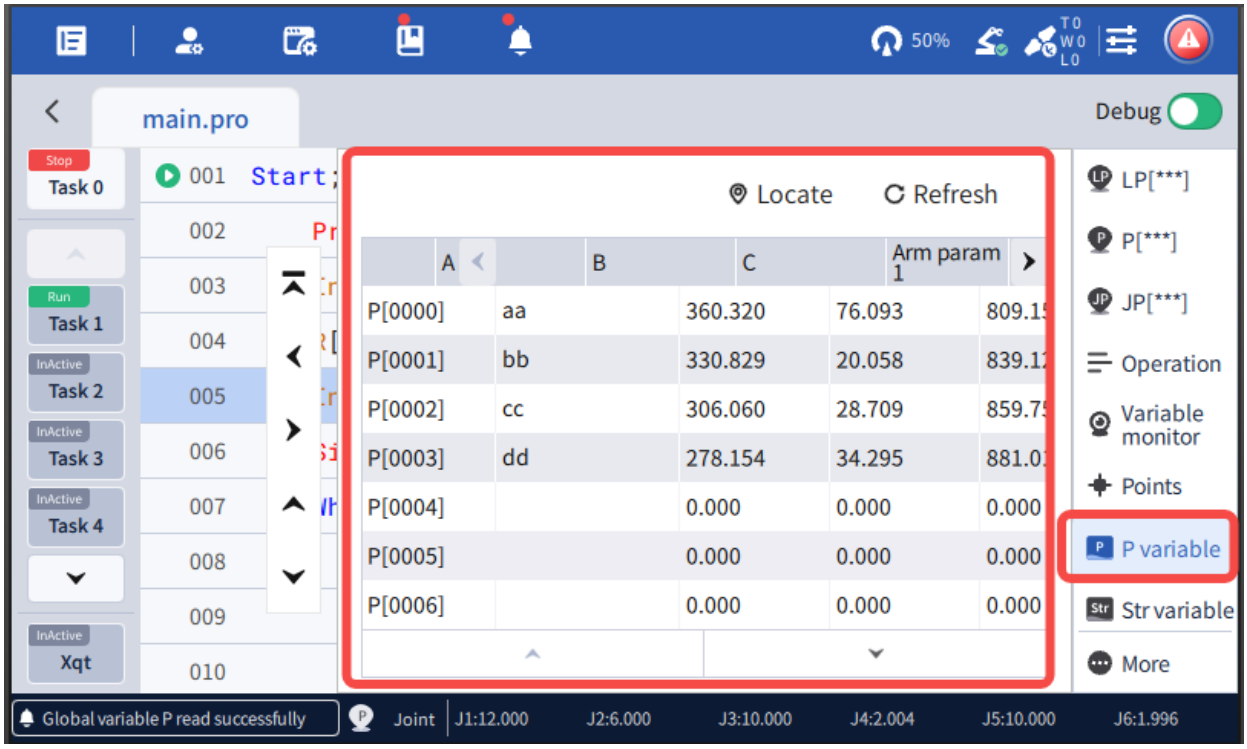
The maximum number of "Str" variables is 256. You can browse through the data using the page turning buttons. In "Program" mode, click the corresponding cell to modify the variable value.



- P variable

  The "P" variables are essentially global position points, with a maximum number limit of 10,000. The global position point data displayed on this monitoring panel corresponds to the data of the currently loaded point file in the controller. The displayed data is affected by the LoadPoints instruction. When the LoadPoints instruction has not been used, the default display is the data of the point file P.pts. After using the LoadPoints instruction, for example, executing the instruction "LoadPoints "test.pts"", the display will then show the data of test.pts.

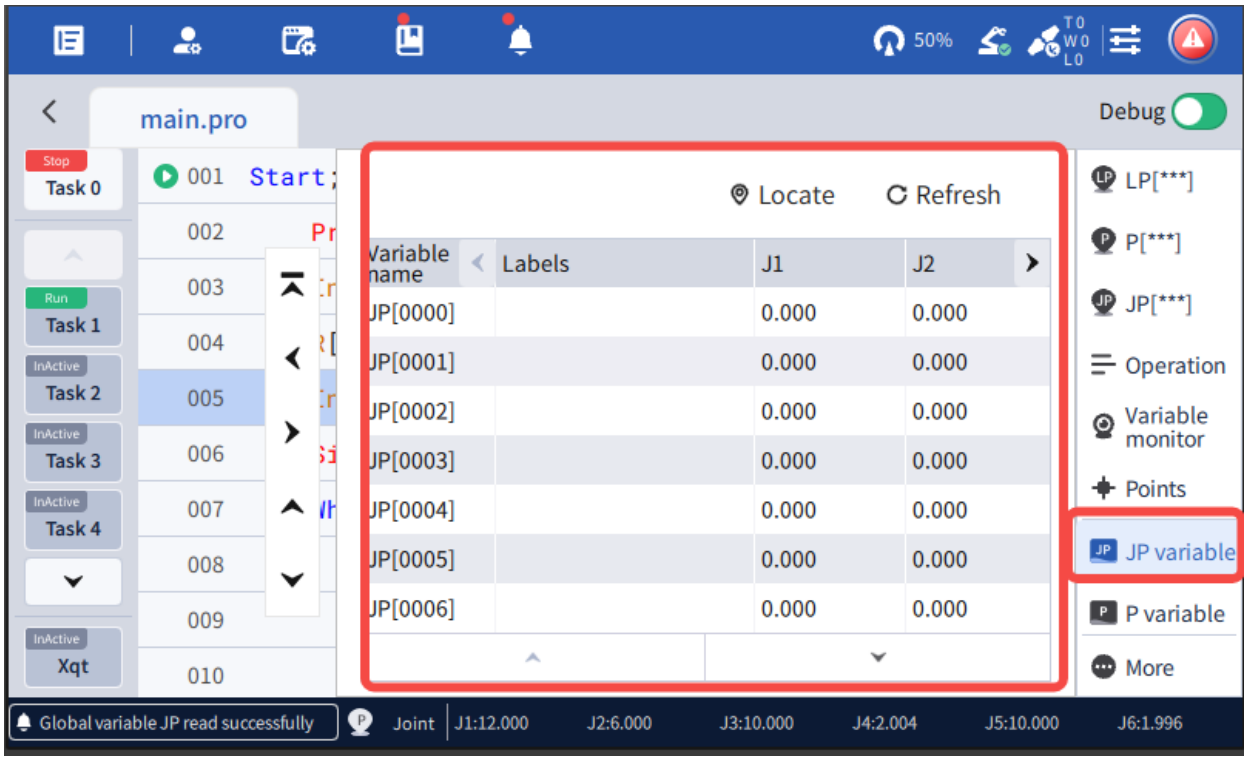
  You can browse through the data using the up/down and left/right page turning buttons. This type of variable cannot be modified.



- JP variable

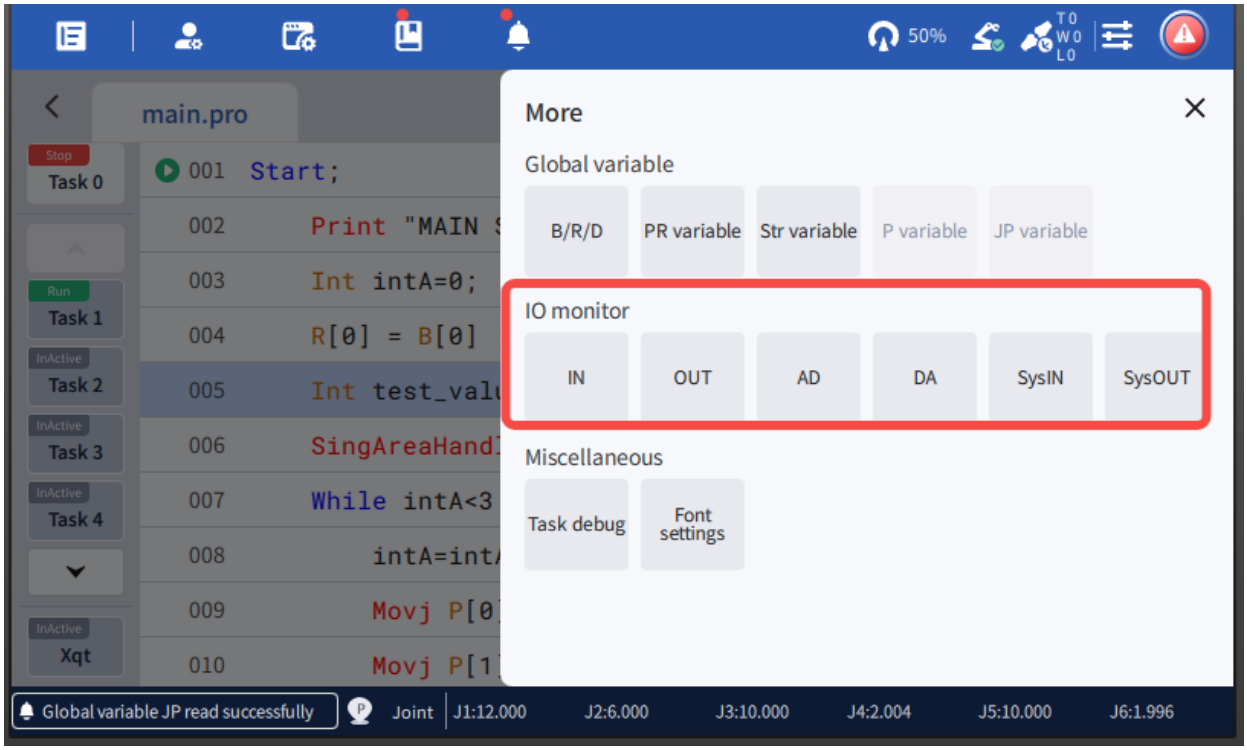
  The "JP" variables are essentially global joint points, with a maximum number limit of 10,000. This monitoring panel displays the data from the joint point file JP.pts.

  You can browse through the data using the up/down and left/right page turning buttons. This type of variable cannot be modified.



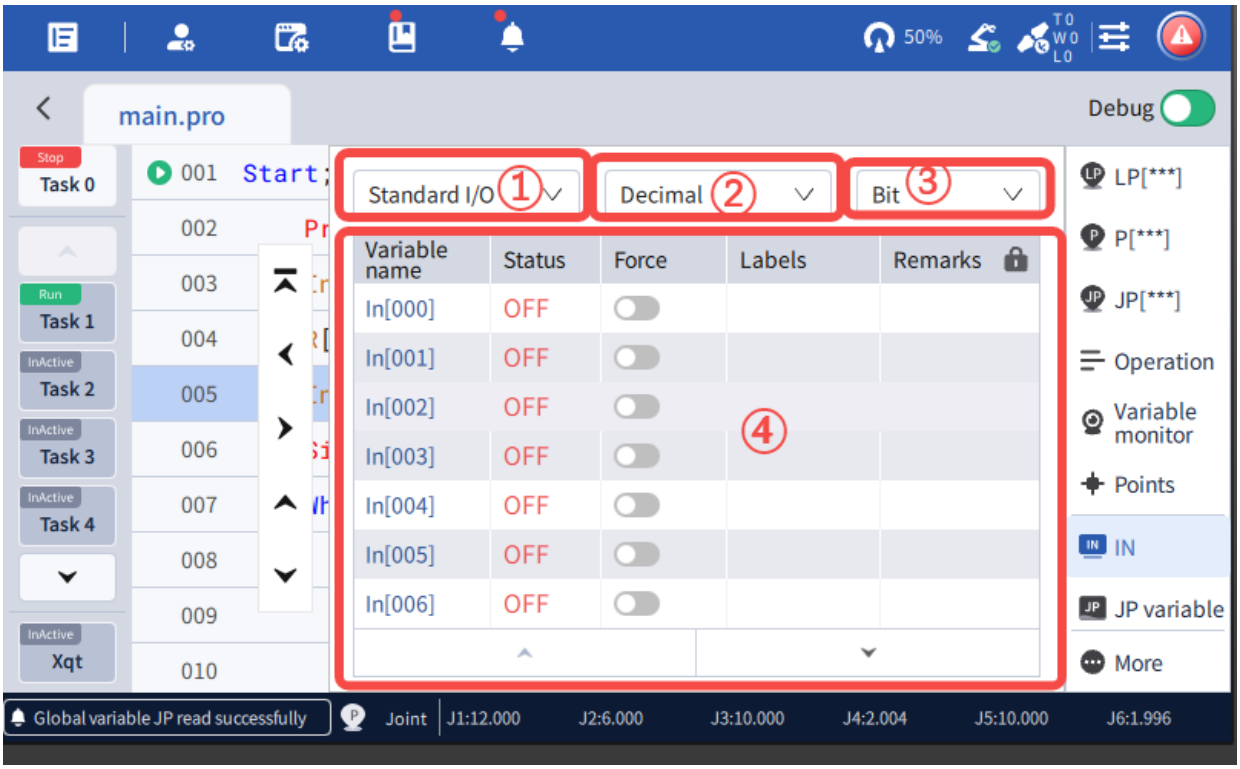
8.3.9 I/O Monitor

Click "More" in the auxiliary toolbar to open the More panel, which includes a "IO monitor" sub-section, containing "IN", "OUT", "AD", "DA", "SysIn" and "SysOut" types of I/O monitoring functions.



- IN/OUT

  The "IN" and "OUT" monitoring panels are used to display input and output I/O data and provide the function to modify the I/O status. Other data such as "Label" and "Remarks" cannot be modified.



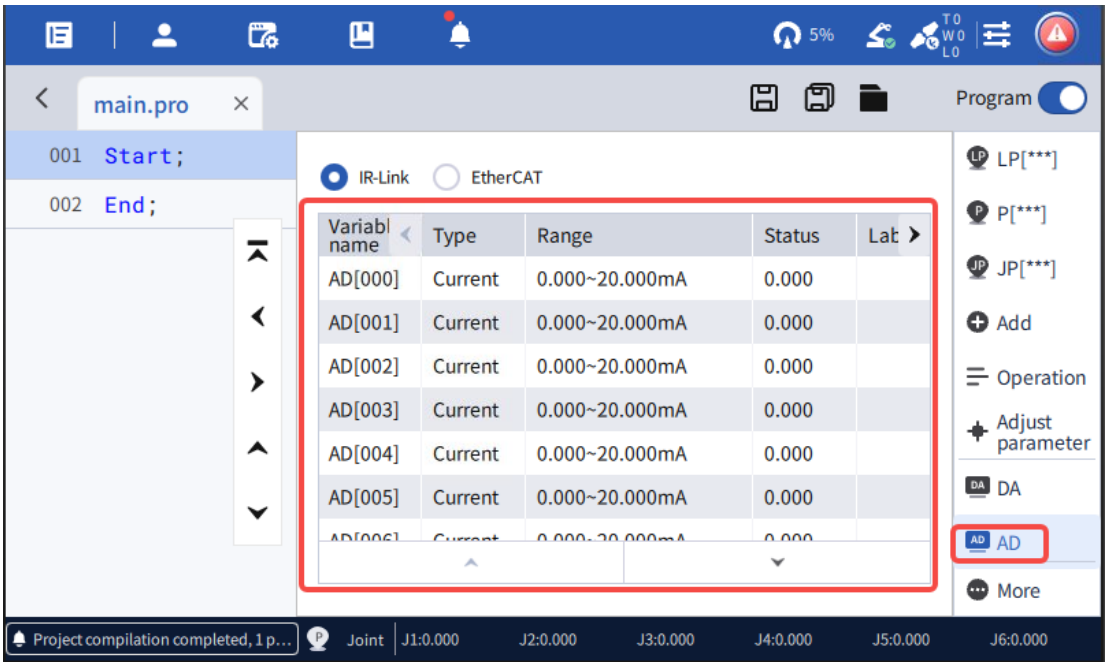
IN/OUT monitoring panel introduction

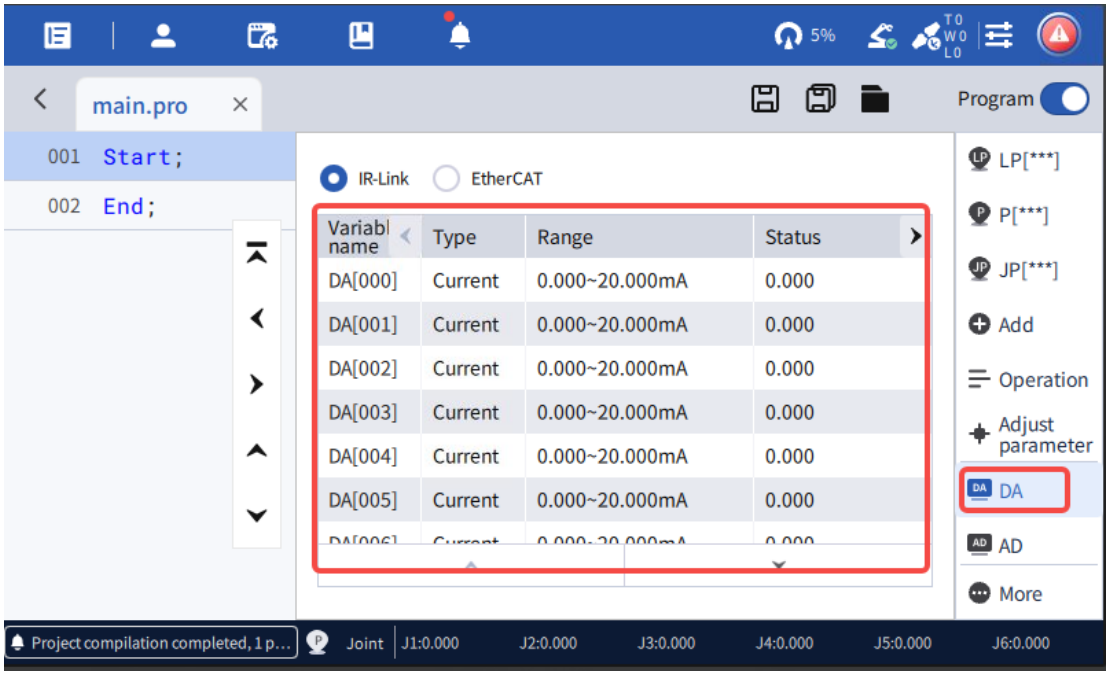
No.	Description
①	I/O Type, mainly classified as follows: • Common I/O • Standard I/O • Fieldbus I/O

No.	Description
	• Memory I/O
②	Data Type, determines the data base of the corresponding I/O, classified as follows: • Binary • Decimal • Hexadecimal
③	Data type, classified as follows: • Bit • Byte • Word
④	I/O data table, displays specific data and provides the function to modify I/O status. I/O status modification 1. Click the button in the table to switch the button to , unlocking the modification permission; 2. Click the toggle button or in the corresponding line of the I/O table to modify the I/O status.

- AD/DA

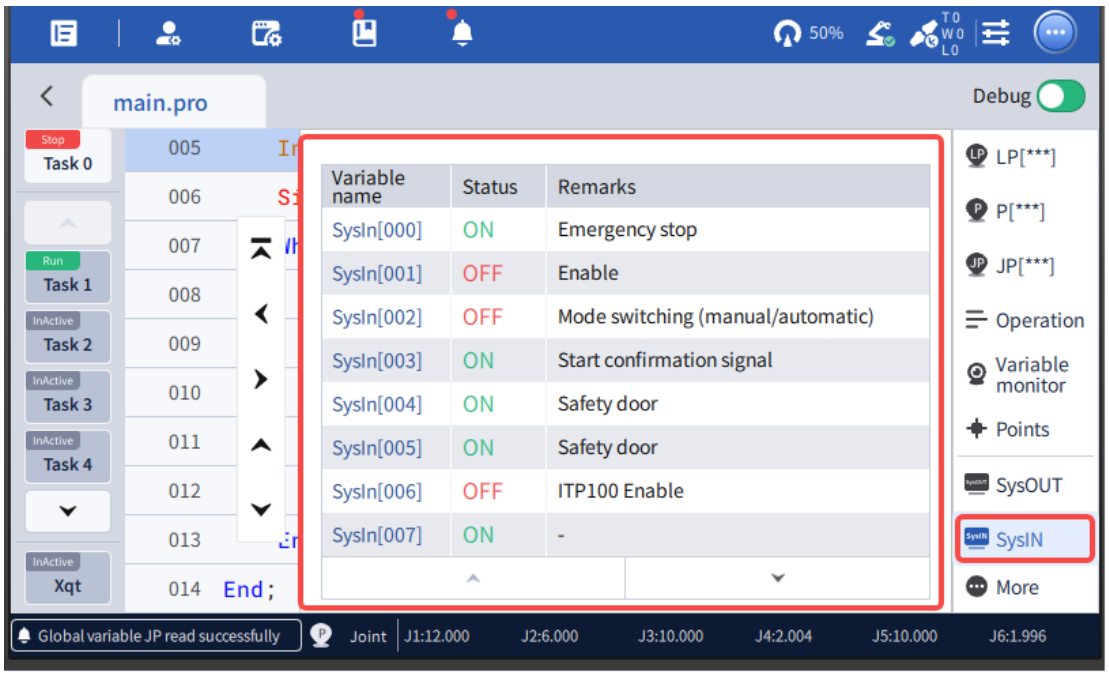
  Analog signal data. The monitoring panel only displays the data and does not allow any data modification.

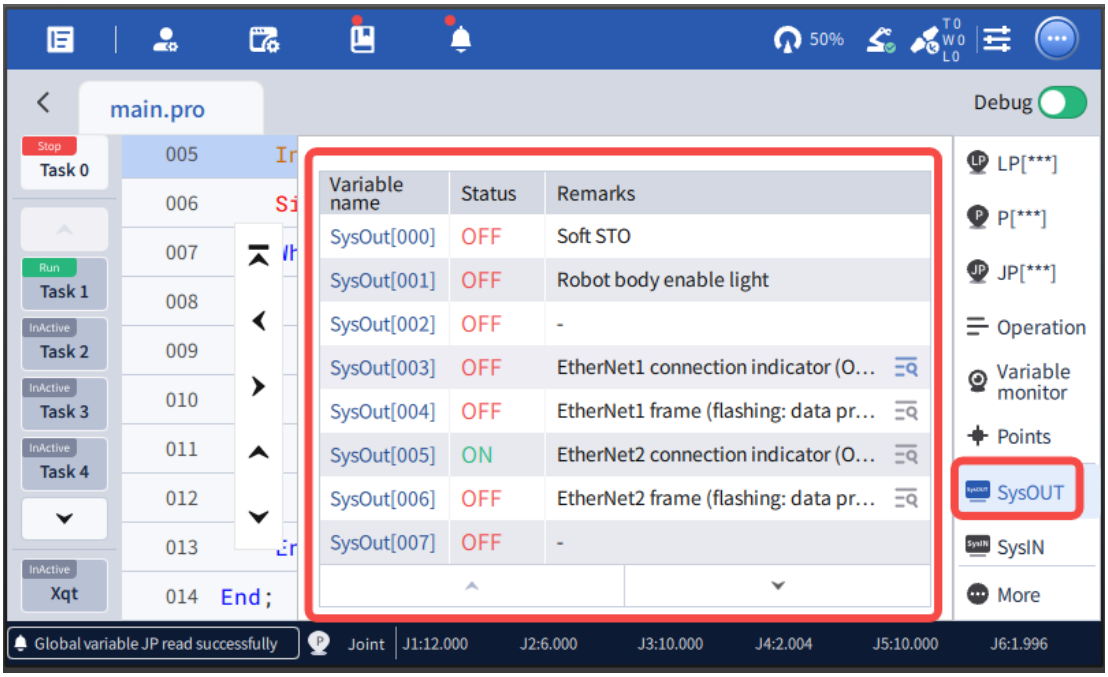




- SysIn/SysOut

  System I/O data. The monitoring panel only displays the system I/O data status and does not allow any status modification.

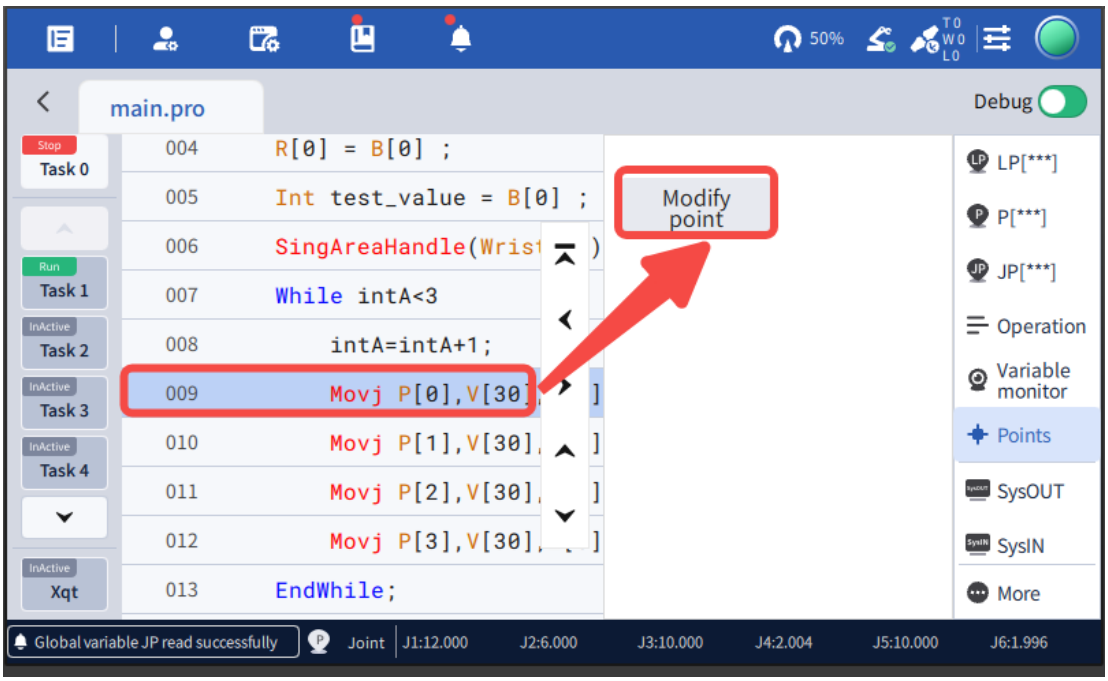




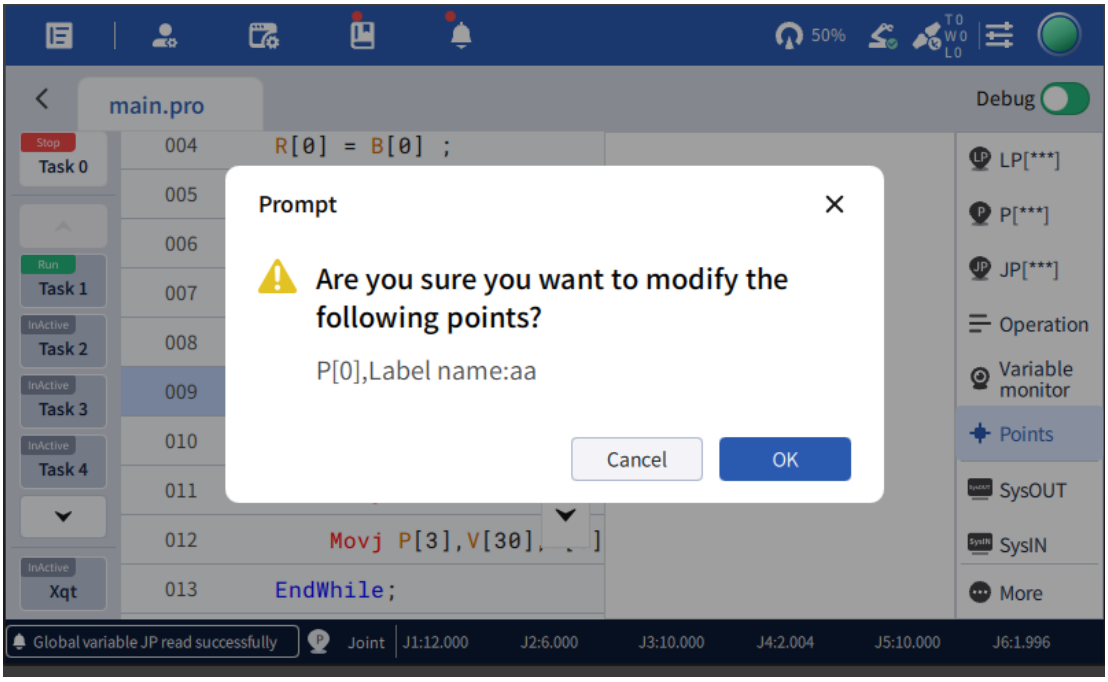
8.3.10 Modify Point

Click "Point" in the auxiliary to open the point operation panel. The "Modify point" button will be enabled and clickable when the currently selected line of the program is a motion instruction. If not, the button will be grayed out and unclickable.

- The "Modify point" button is available in both "Program" and "Debug" modes, for quick replacement of point data.



- When the "Modify point" button is enabled, click the button to open a point modification confirmation dialog.
- Click "OK" to quickly replace the point data in the motion instruction of the currently selected program line with the current position data. As shown in the figure, the "P[0]" point data will be replaced with the current position data after "OK" is clicked.
- Click "cancel" to cancel the current modification operation.



8.4 Multitasking

8.4.1 Task Type and Specification Description

Specification	Main task	Static task	Dynamic task	Xqt task
Task type	Main.pro, which is always active and is used to perform robot motion. It is controlled by Start and Stop instructions.	The static tasks are started immediately upon power-on of the robot and run until the stop conditions are met.	The dynamic tasks are not started immediately upon power-on of the robot and are controlled by Start and Stop instructions like the main task.	The xqt task is controlled separately by the instructions Xqt, Halt, and Resume.
Recompilation	1) Restart the controller. 2) Re-save project configuration information. 3) Switch from Program mode to Debug mode. 4) Save all.	1) Restart the controller. 2) Re-save project configuration information.	1) Restart the controller. 2) Re-save project configuration information. 3) Switch from Program mode to Debug mode. 4) Save all.	1) Restart the controller. 2) Re-save project configuration information. 3) Switch from Program mode to Debug mode. 4) Save all.
Activation of task	Re-save the project configuration information to activate automatically.	1) Re-save the project configuration information to activate automatically. 2) Activate and deactivate static tasks via the task debugging panel.	1) Re-save the project configuration information to activate automatically. 2) Activate and deactivate dynamic	1) Activated via the xqt instruction and deactivated via the quit instruction. 2) Deactivated in the following

Specification	Main task	Static task	Dynamic task	Xqt task
			tasks via the task debugging panel.	cases: ① When re-decoding the project. ② When any task returns to the start line. ③ When switching to other control authority.
	Summary: There is no coupling between the activation and inactivation of each task.			
Start/Stop	Started via the Start button on the main interface.	1) Automatically started after activation. 2) If a static task is configured before restart, it runs automatically after restart. 3) Teach pendant: Stopped by the Deactivate button on the task management interface.	Started when the main task starts.	1) Activated and started via xqt instruction. 2) After stopping via halt instruction, started again via resume instruction.
	1) Stopped by the Stop button on the main interface. 2) Stopped upon alarm.	1) Stopped by the Stop button in the task management interface. 2) Stopped when an error occurs on the corresponding static task channel. 3) PC platform: Stopped by the Stop button on the task management interface. 4) Teach pendant: Stopped by the Stop button on the task management interface. Note: Reactivating a static task will start it again.	1) Stopped when the main task stops. 2) PC platform: Stopped by the Stop button on the task management interface when the main task is deactivated and the dynamic task is started.	1) Stopped when the main task stops. 2) Stopped via the halt instruction after xqt task is activated.
	Summary: 1. The task must be active to be subject to start/stop control. 2. Static tasks are not affected by the state of main task.			

Specification	Main task	Static task	Dynamic task	Xqt task
Conditions for resuming operation after an alarm	Clear the alarm and restart.	Clear the alarm and re-activate the static task or synchronize the project.	Clear the alarm and restart.	Clear the alarm and restart.
Statement-by-statement debugging	Supported	Not supported	Supported	Not supported
	Summary: 1. When you click the "Step into" button, the main task and dynamic task each run forward by one line of statement. 2. If you click the "Step into" button when the current line of the main task is not completed, the main task continues to run the current line, and the dynamic task runs forward by one line of statement.			
Return to the start line	Supported. Supports returning a single task or all tasks to the start line.	Supported. Supports returning a single task to the start line. Operations are only allowed on that task.	Supported. Supports returning a single task or all tasks to the start line.	Not supported
	Summary: Returning to the start line is allowed only when the task is in the stop or ready state.			

8.4.2 Use of Multitasking

In a controller, a "task" refers to a collection of program modules (files) designed to implement a specific function. This task set consists of an entry module and other interdependent modules. There are 16 tasks in total: Task 0 is the main task, Tasks 1–14 are dynamic or static tasks, and Task 15 is the xqt task.

The main task is responsible for motion, and the PLC task is responsible for logic. The main task changes motion in real time based on the data processed by the PLC Task.



1. The following should not exist in multitasking:
   - Motion instructions: Movj, Movl, Movc, Movs, MovAbsJ, Jump, JumpL, Home, IndCMove, Curve.
   - Motion parameter instructions: For details, see "Variable and Instruction Scope" section in the "Industrial Robot Instruction Guide".
2. If the above motion instructions are introduced during programming, they will be skipped.
3. From an execution efficiency perspective, task 0 (main task) has the highest efficiency, while tasks task 1 to task 14 (multitasking) have relatively lower efficiency. This is reflected in the fact that task 0 has faster calculations or I/O processing than other tasks.
4. The PLC loop execution cycle is approximately 10 ms.

Case 1:

Selective motion based on communication data

Scenario:

The controller simultaneously executes two tasks:

1. Continuously communicates with external devices, and sets the flag to a corresponding value based on whether the received data is 201;
2. Continuously execute the motion of Movj P[1] and Movj P[0] selectively based on the flag value.

Design:

Main task: Continuously evaluate a global numeric variable value (e.g., B[4] below) within the loop body, and execute the corresponding motion based on the value.

PLC task: Continuously communicates with the external devices and sets B[4] to the corresponding value based on the read result.

Main task: Main.pro

```
START;
  Movj P[0],V[30],Z[0],Tool[0];
  L[0]:
  If  B[4] == 2
    Movj P[1],V[30],Z[0],Tool[0];
  EndIf;
  If  B[4] == 4
    Movj P[2],V[30],Z[0],Tool[0];
  EndIf;
  Goto L[0];
END;
```

PLC task: Communication.pro

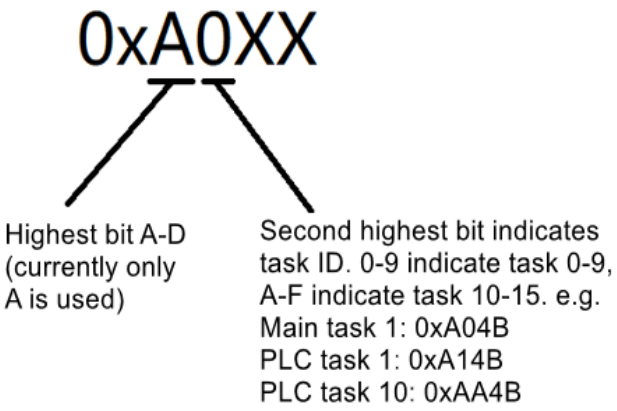
```
START;
  String recv= "000000";
  While LB[0] <> 1
    Open Socket("10.44.97.53",2000,3000, Single,LB[0]);
  EndWhile;
  L[1]:                    ##PLC task characteristics, loops continuously, this line can also be removed
  Send Port[3000],"hello",String;
  L[0]:
  Get Port[3000],T[0],Goto L[0];
  recv = GetPortbuf(0,100,3000);
  If  StrToR(recv) == 201
    B[4] =4;
  Else
```

```
    B[4] =2;
  EndIf;
  Goto L[1];          ##PLC task characteristics, loops continuously, this line can also be removed
END;
```

> **Note**
>
> For the aforementioned PLC task
>
> - If set as a static task, the task starts immediately after power-up or re-saving the project configuration, and is unaffected by start/stop instructions.
> - If set as a dynamic task, the task starts and stops along with the main task.
> - If the task of communicating with external devices is set as an xqt task, add the following at the beginning of the task 0 program: Xqt 3,"Communicatin.pro".

8.4.3 Multitasking Alarm

In the alarm list in Appendix I, only main task alarms are listed. For multitasking alarms, the following rules apply:



Example:

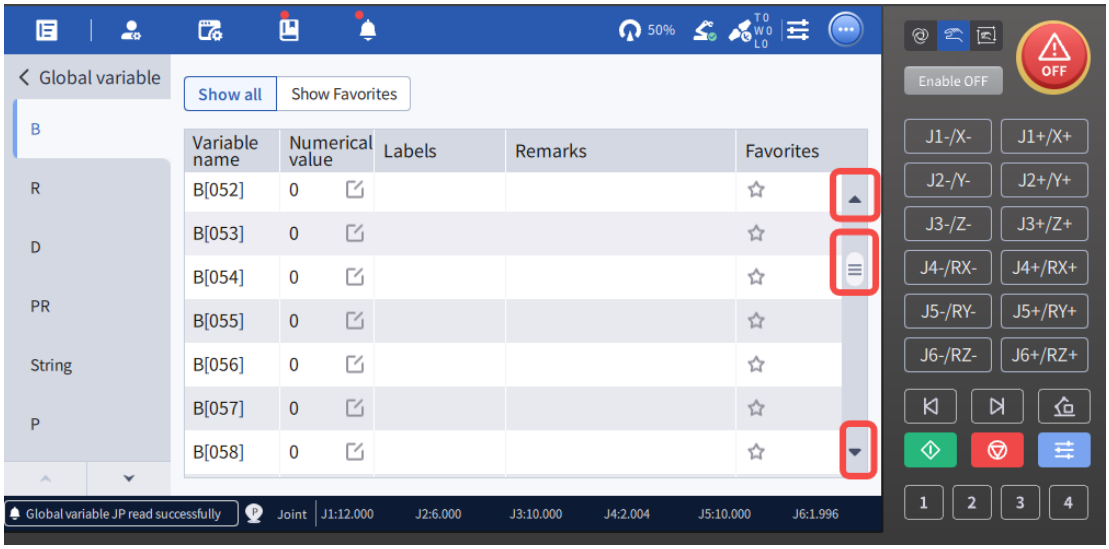
For robot system alarm 0xA130, no corresponding alarm code is found in the appendix, thus it is likely a multitasking alarm. Check the alarm table "0x0030: Decode error during operation". Since the second highest bit is 1, 0xA130 is determined to be an alarm for Task 1, and the alarm message is "Decode error during operation".

9 Monitor

9.1 General Operation Introduction

Several common basic operations on the Mon page are as follows:

- Turn page: Turn pages up and down by clicking the up and down buttons on the scroll bar at the right end of the figure below.
- Scroll: Scroll up and down by pressing and dragging the scroll bar at the right end of the figure below.

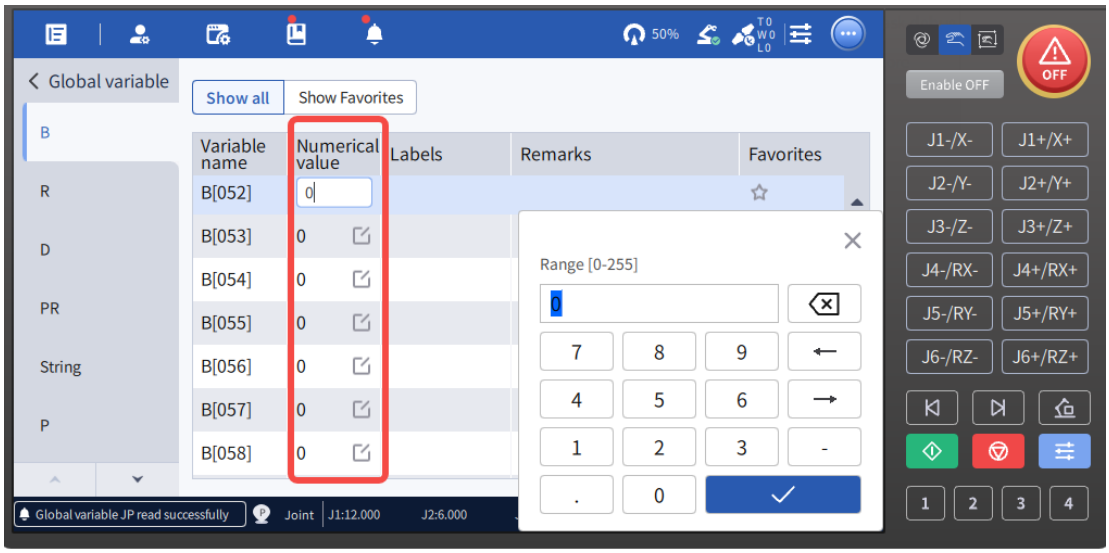


9.2 Global Variable Monitor

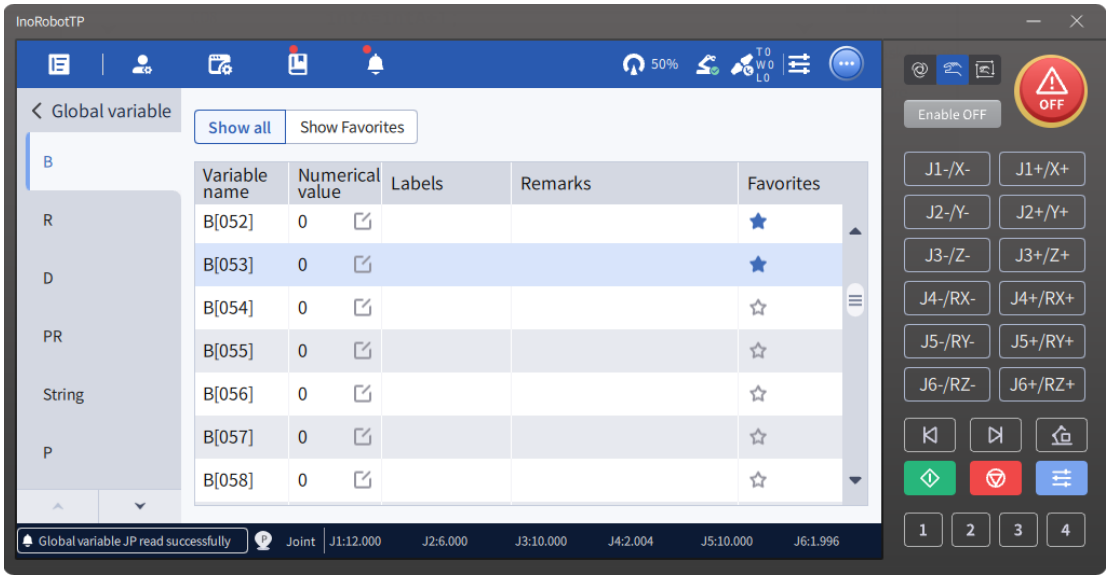
There are 8 pages for global variables: B variable, R variable, D variable, PR variable, String variable, P variable, JP variable and Search.

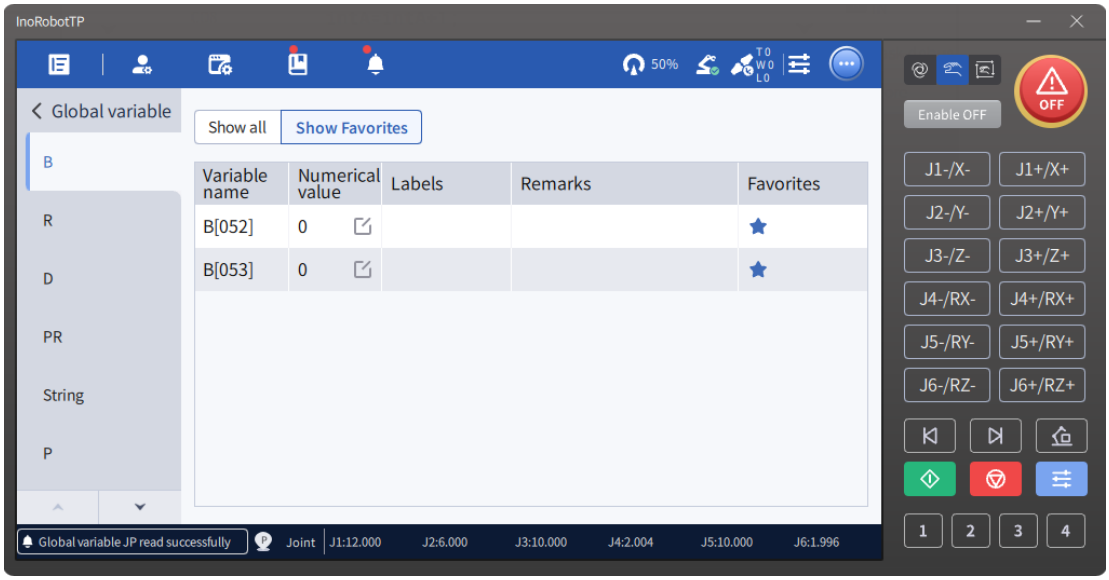
9.2.1 B/R/D Variable

Modify: Click the  edit button to display the following window, where you can modify the variable value.



Favorites: Click the button in the Favorites column to favorite/unfavorite the variable in the corresponding line. You can filter the favorited variables by checking "Show Favorites".



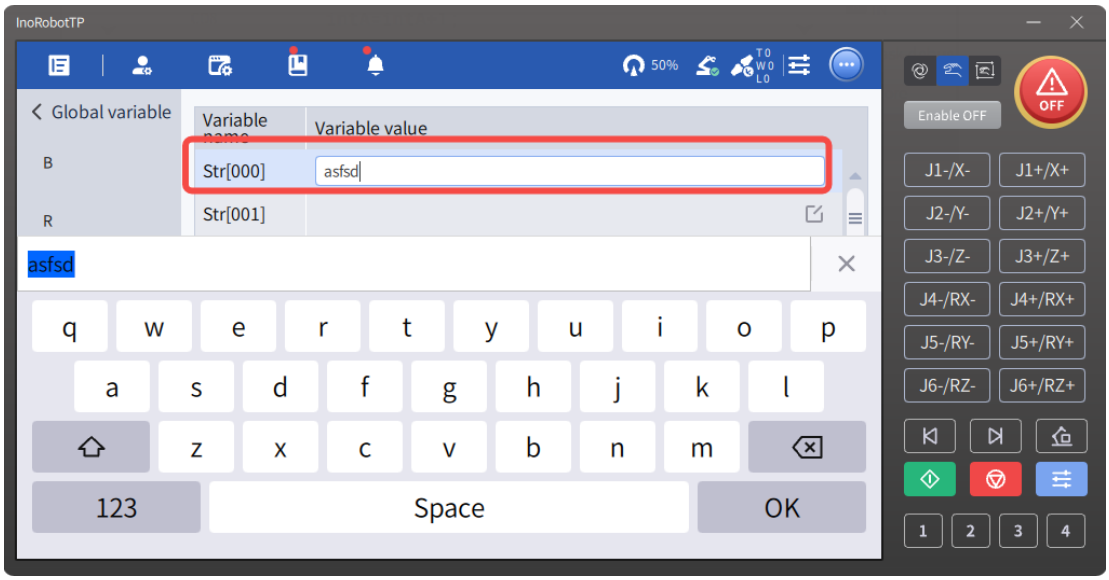


9.2.2 PR Offset Variable

Click any PR variable to modify. You can directly enter a value or calculate it from two points.

9.2.3 String Variable

Click the edit button in the corresponding string line to change the string value.

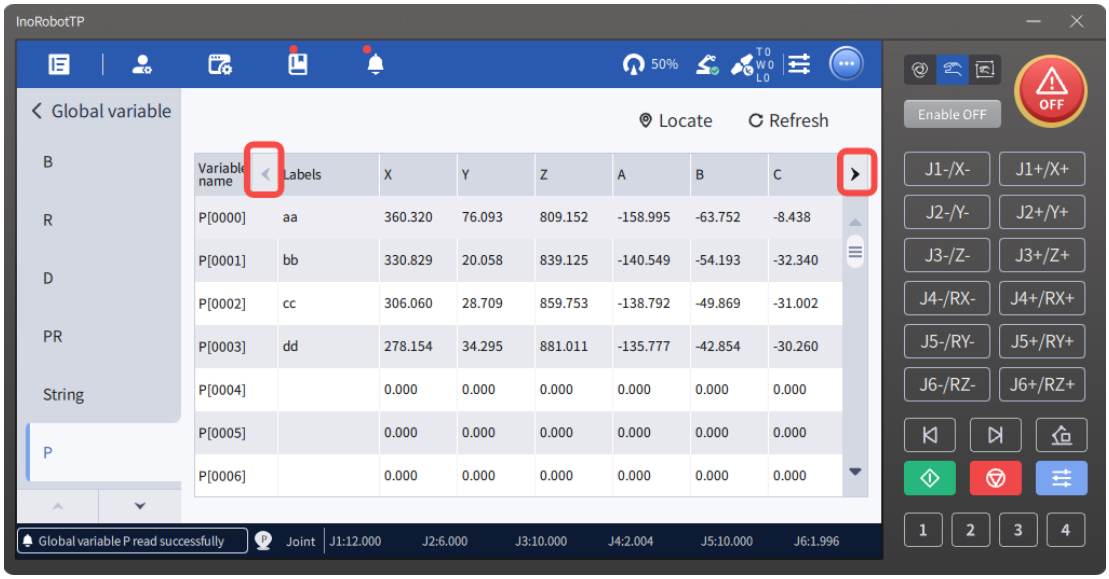


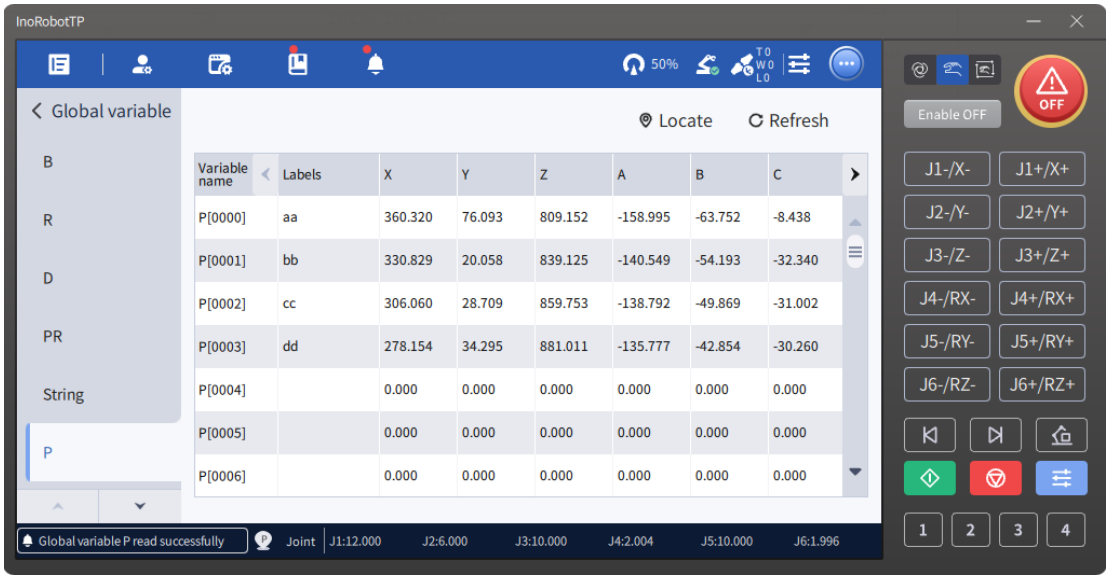
9.2.4 P/JP Variable

Global P/JP position variables in monitoring reflect their current real-time values.

CAUTION

1. Unlike the position variables on the programming page, which are the initial points defined in the global point file, the P/JP values on the monitoring page show the current values. Modifying the points with the instructions "P=" or "JP=" will be reflected here.
2. The monitoring P/JP always displays all points from 0 to 9999. For unused P/JP points, the position variables still exist with empty values.
3. The refresh specification for position variables is:
   - Clicking refresh or switching to this page will trigger the refresh of position variables.
   - Position variables are not refreshed in real-time and must be actively refreshed through the above operations.
4. Position variables cannot be modified in monitoring. To modify the initial values defined in the file, go to the programming page; to modify memory values without changing the initial values defined in the file, use the quick monitoring panel on the debugging page.





The left and right arrows at both ends of the variable name are used to scroll through the interface. Scrolling to the right from the initial interface will show the arm parameters and external axis parameters of the current variable.

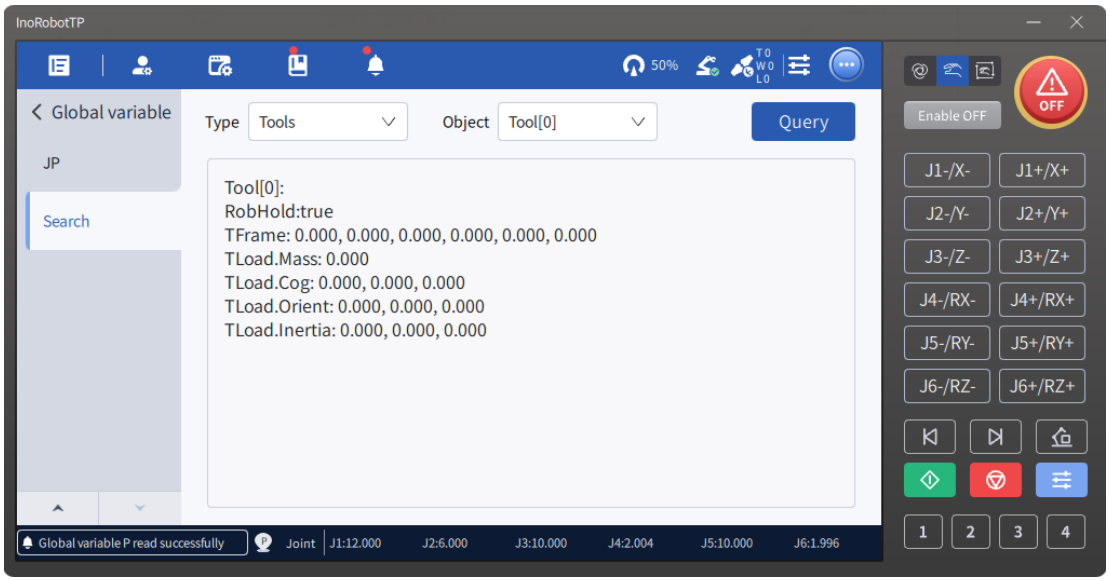
The "Locate" button on the right is used to quickly navigate to the specified point position.

9.2.5 Global Variables Search

For tool frame, workobject frame and load, memory values can be queried. After using instructions to modify the values, you can query and see the results here.

To perform the query operation, select the type and object, then click "Query".

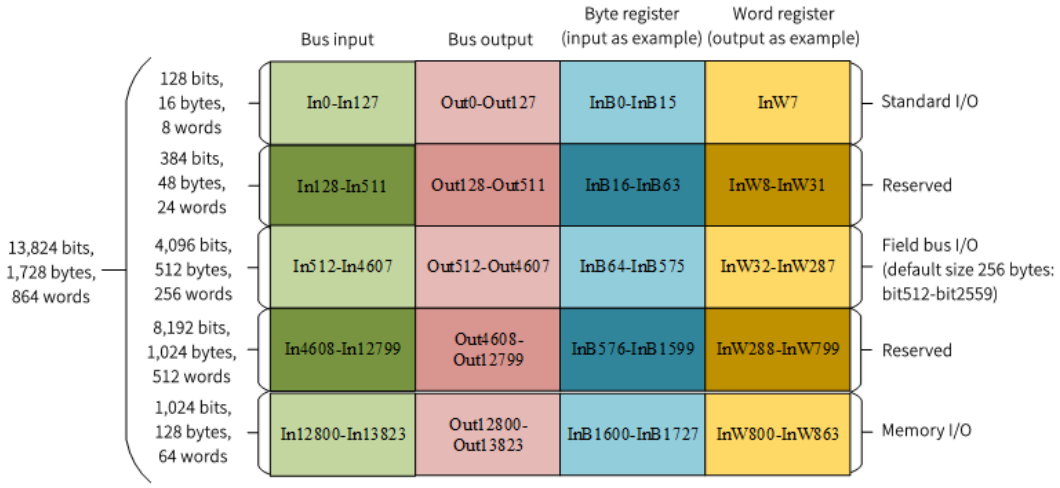
> **CAUTION**
>
> The page will not refresh when switching.



9.3 I/O Monitor

9.3.1 Concept of Robot Bus Addresses

The following describes the concept of the robot bus addresses. The bus addresses of the robot include standard I/Os, fieldbus I/Os, and memory I/Os, as shown below.



- Standard I/O: Equivalent to digital I/O, i.e., I/O where the switching state is directly associated with the physical level high or low.
- Fieldbus I/O: Currently, the fieldbus I/O of the robot refers to the I/O used by the robot to interact with the master when the robot is acting as a fieldbus slave.
- Memory I/O: Equivalent to the robot's internal Bool-type variables, used for internal arithmetic.

9.3.2 Use of I/O Monitor

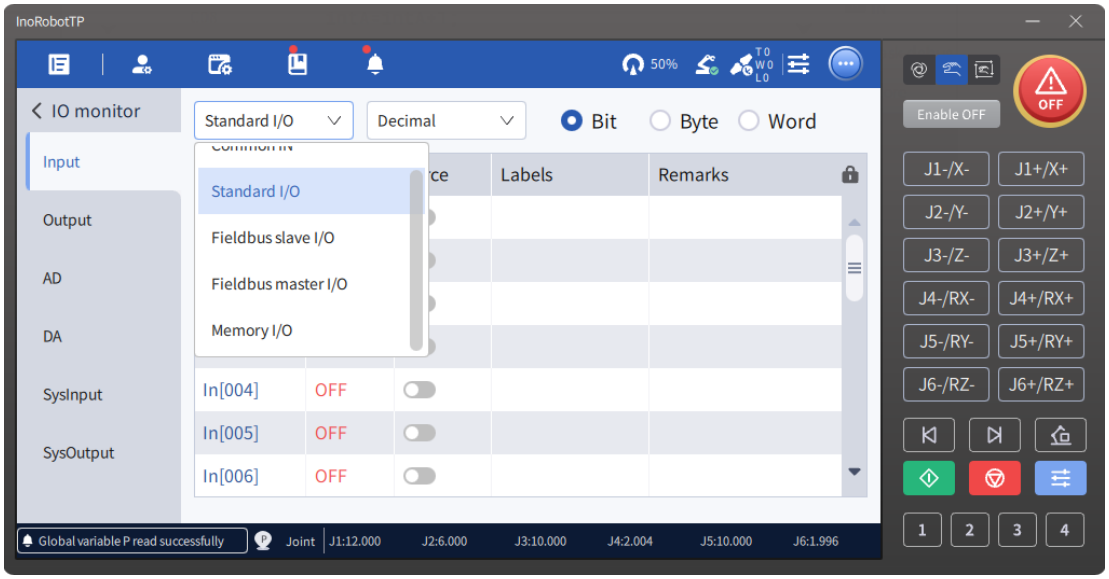
The IO monitor interface includes six sections: IN, OUT, AD, DA, SysInput, and SysOutput.

> **CAUTION**
>
> Before using AD and DA monitoring, ensure that the IR-Link configuration is correct.

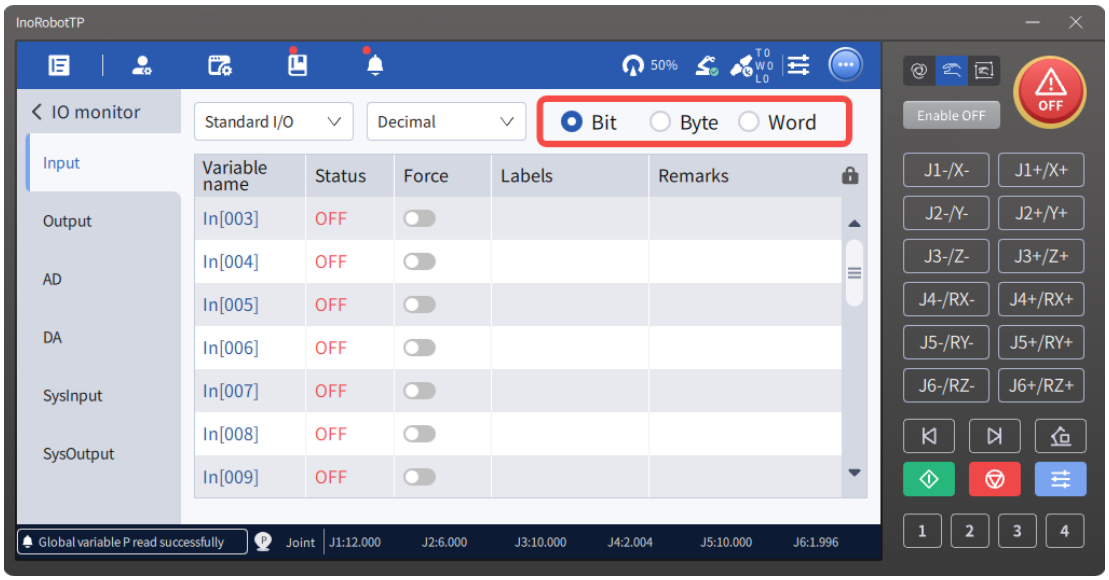
9.3.2.1 IN

1. The input includes common input, standard input, fieldbus input, and memory input, which can be selected through the drop-down menu, as shown below.
   Common input: Indicates inputs with specified label and remark. If the current active project contains inputs with specified label, these inputs are displayed as common inputs.

   For the definitions for standard I/O, slave fieldbus I/O, master fieldbus I/O, and memory I/O, see 9.3.1 Concept of Robot Bus Addresses.

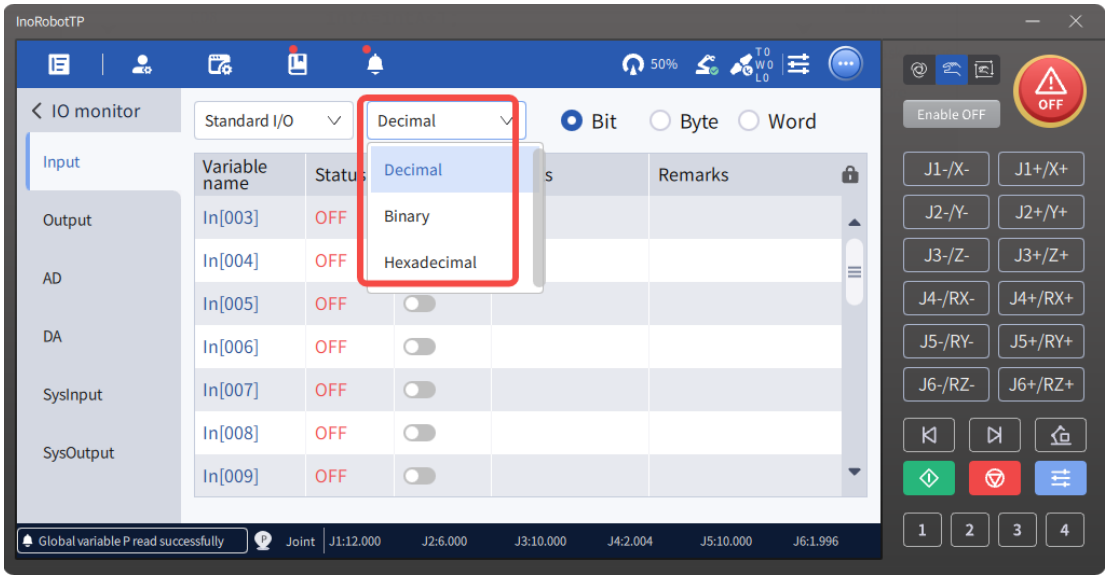


2. Each I/O is further divided into three display modes: Bit, Byte, and Word.
   The value of 8 bits corresponds to the value of one Byte, and the value of 16 bits corresponds to the value of one Word. (For example: The I/O value with bit indexes 0-7 corresponds to the value of InB[0]; the I/O value with bit indexes 0-15 corresponds to the value of InW[0].)

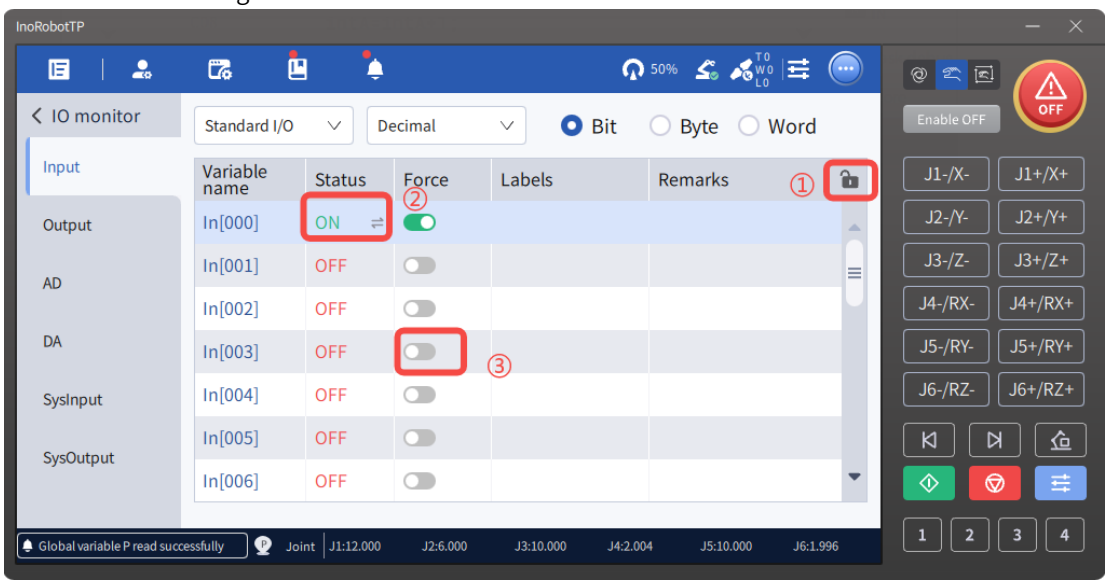


3. When you choose to display an input by bit, the status may be ON or OFF depending on the return value, 1 for ON, 0 for OFF, ON in green, and OFF in red.

4. Inputs displayed by byte and word can further be displayed in decimal, binary, or hexadecimal. The default display format is "Decimal".



5. When you choose to display an input by bit, the "Force" column is displayed. In the figure below, areas 1, 2 and 3 respectively indicate the lock button, variable status bar, and force switch button. Clicking the lock button can switch the status between "Locked" and "Unlocked". When the lock button is in the unlocked status, you can click the "Force" toggle button to switch to force. At this time, you can double-click the "Status" column to change the status of the value.



6. Column description:

Status: Displays the current status. Specifically, for standard I/O inputs, the signal value can be toggled by a single click to its opposite state.

Force: The status of the input signal is determined by the external source by default. However, IN can be changed to "Forced" status using the "Force" switch. Then the signal can be forced to ON or OFF.

Labels: The "Label" string in the project IO label corresponding to the I/O variable name;

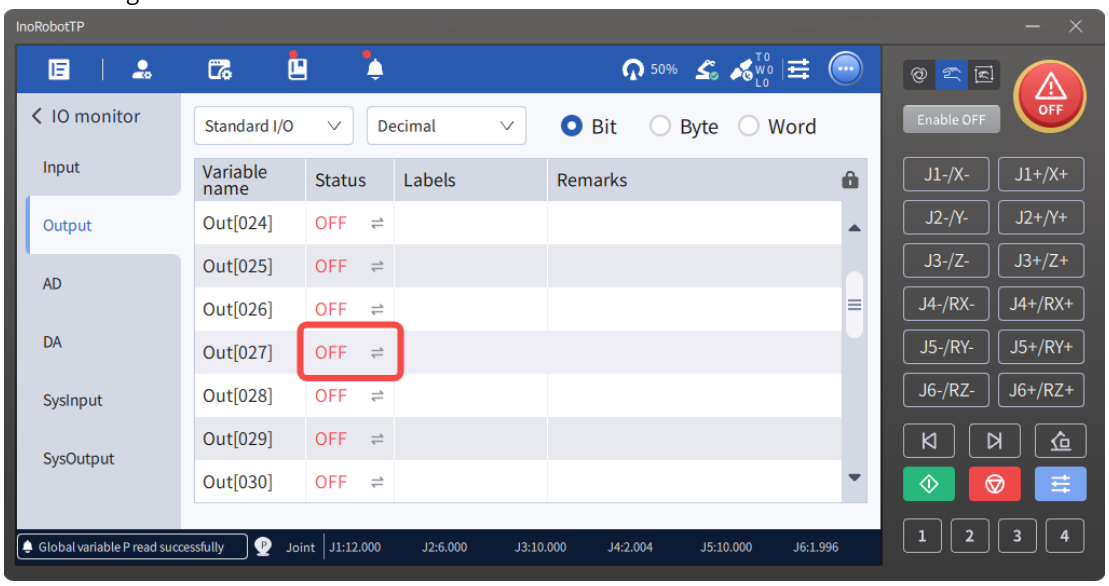
Remarks: The "Remarks" string in the project I/O label corresponding to the I/O variable name.

> **Note**
>
> All IN variables can be viewed on the debugging page. "Variable Monitor" can be monitored in the list (for details, see the "Variable Monitor" section).
>
> Enter debug mode, click "Variable Monitor", check the "Pick" option; or select "Custom", enter the variable name, click "Add" and then the variable is automatically displayed in the list of "Variable Monitor" objects.

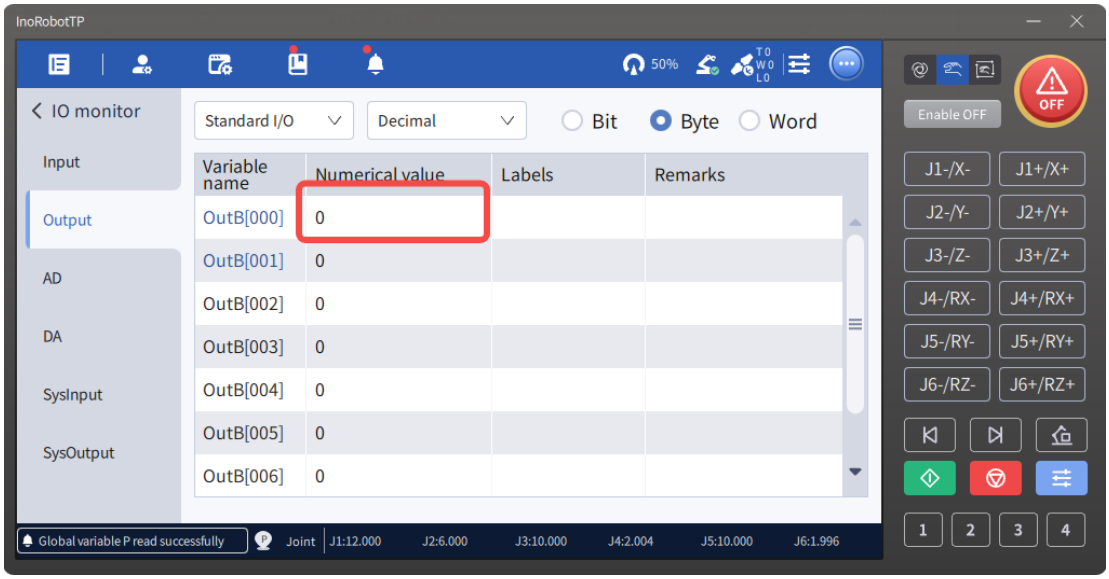
9.3.2.2 OUT

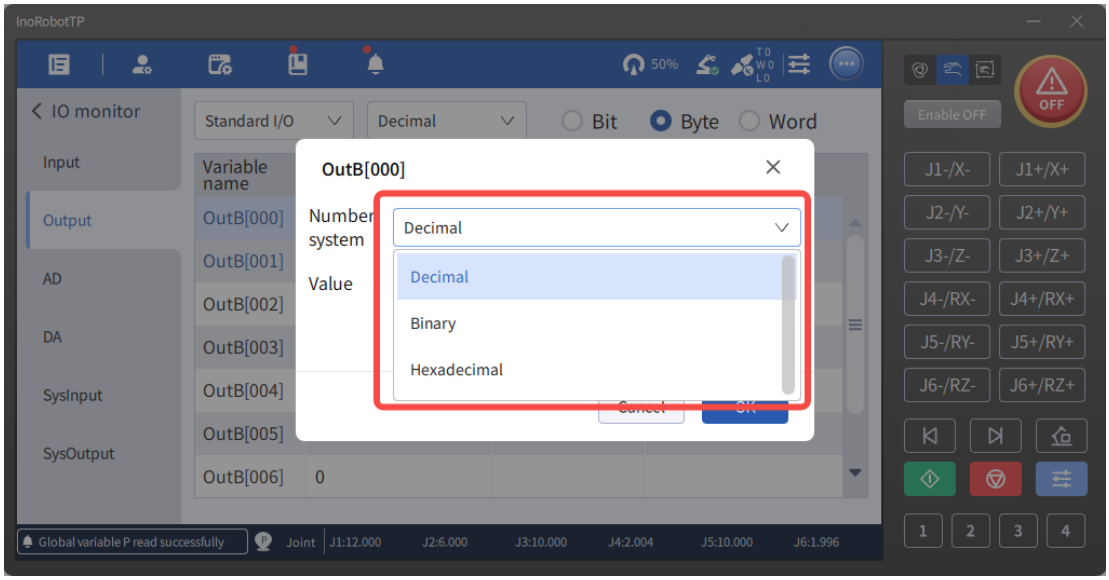
The operation on the outputs is generally similar to that on the inputs.

1. Similar to the input, the value of 8 bits corresponds to the value of one Byte, and the value of 16 bits corresponds to the value of one Word.
2. For Out Bit, when the I/O is displayed in orange, it indicates no control authority, and the ON/OFF status cannot be changed by double-clicking. When the I/O is displayed in blue, the status can be switched by double-clicking.



3. For writable status of Out Byte and Out Word, it differs slightly from Out Bit. For example: a. For OutB[000], it consists of Out[000] to Out[007]. Therefore, if any of Out[000] to Out[007] are mapped, the value of OutB[000] cannot be modified via the page. b. Based on the above example a, for OutW[000], it consists of OutB[000] and OutB[001]. Since OutB[000] is non-modifiable, when changing the value of OutW[000] triggers a modification of OutB[000], it will result in an error and the modification will not take effect.





Note

You can monitor the OUT variables in the monitor in the debug mode (for details, see the description of the Monitor function in section 8.3.7 Variable Monitor).

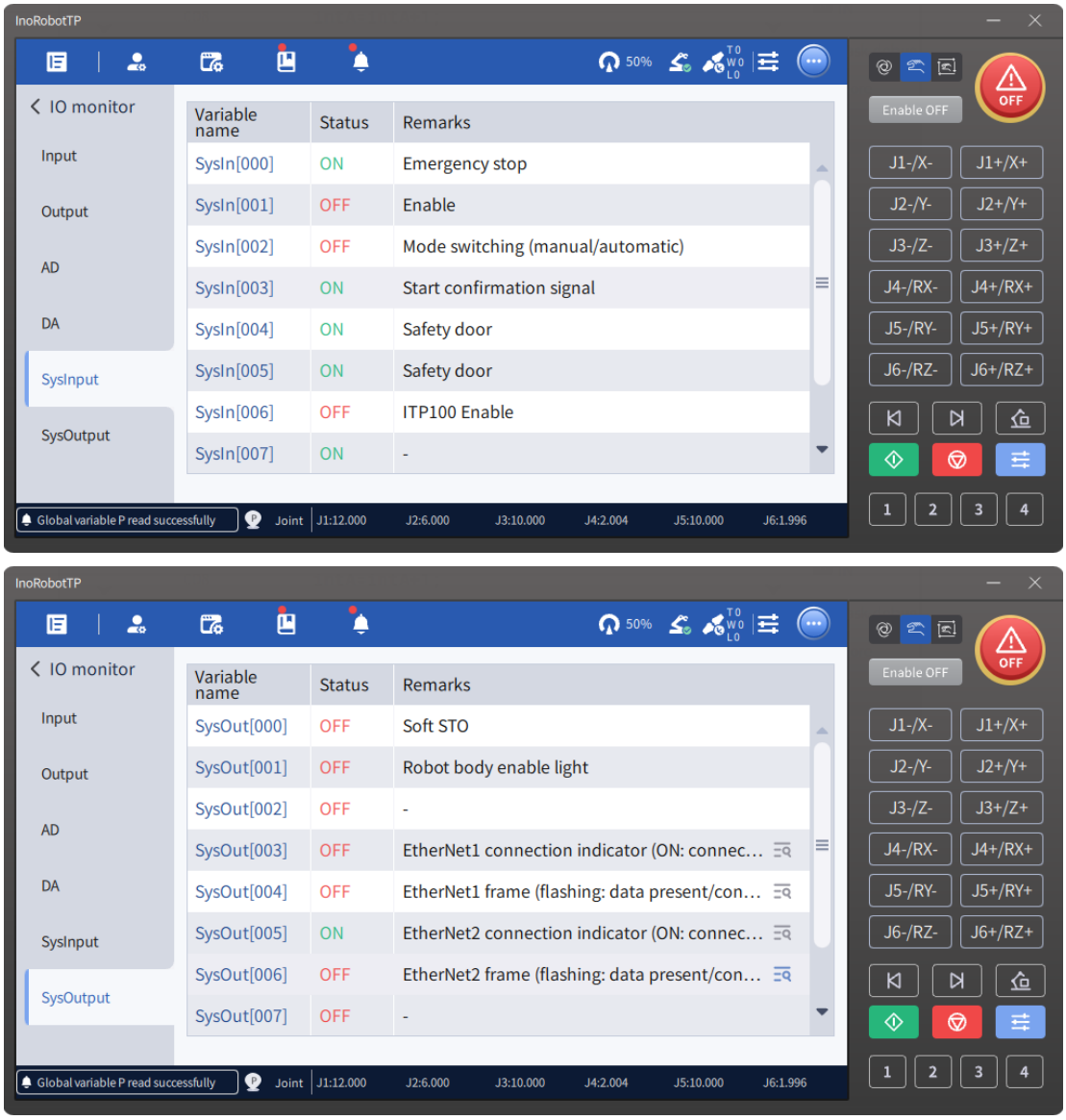
Enter debug mode, click "Variable Monitor", check the "Pick" option; or select "Custom", enter the variable name, click "Add" and then the variable is automatically displayed in the list of "Variable Monitor" objects.

9.3.2.3 AD/DA

- Output type: It indicates that an analog signal is current or voltage.
- Range: Analog signal range. Every analog port has several selection ranges according to IR-Link or EtherCAT product models.
- Status: An analog parameter value. When it is a voltage signal, the unit is V; When it is a current signal, it is measured in mA. Click the status to directly modify the status value.
- DA switch: It determines whether a DA status value is valid. You can change the status by clicking the switch.
- Label: Displays the label set in the project.
- Remark: Displays the remarks set in the project.

> **CAUTION**
>
> Labels and remarks cannot be modified here, please modify them in the project.

9.3.2.4 System I/O



For the IRCB10 controller, System I/Os are In[0] to In[2] that are linked to emergency stop, enable function and mode switching respectively and displayed on the IN/OUT interface.

For the IRCB300, IRCB100 and IRCB500 controllers, System I/Os have a separate SysIO interface with 16 inputs and 16 outputs as follows:

System I/Os of IRCB300/IRCB100 controller			
Input	Function	Output	Function
SysIn[0]	Emergency stop	SysOut[0]	System running indication
SysIn[1]	Enable	SysOut[1]	System error indicator
SysIn[2]	Switch mode	SysOut[2]	System enabled indication

	(Manual/Auto)		
SysIn[3]	-	SysOut[3]	EtherNet1 connection indication On: Connected Off: Disconnected
SysIn[4]	Safety Door-Triggered Stop Mode	SysOut[4]	EtherNet1 frame transmission indication Flashing: Data is being transmitted Solid ON: Connected, but no data is being transmitted
SysIn[5]	Safety Door-Triggered Stop Mode	SysOut[5]	EtherNet2 connection indication On: Connected Off: Disconnected
SysIn[6]	ITP100 enabled	SysOut[6]	EtherNet2 frame transmission indication Flashing: Data is being transmitted Solid ON: Connected, but no data is being transmitted
SysIn[7]	-	SysOut[7]	-
SysIn[8]	Dual circuit enable	SysOut[8]	Manipulator enabled indicator
SysIn[9]	-	SysOut[9]	-
SysIn[10]	-	SysOut[10]	-
SysIn[11]	-	SysOut[11]	-
SysIn[12]	-	SysOut[12]	-
SysIn[13]	-	SysOut[13]	-
SysIn[14]	-	SysOut[14]	-
SysIn[15]	-	SysOut[15]	-

System I/Os of IRCB500 controller			
Input	Function	Output	Function
SysIn[0]	Emergency stop	SysOut[0]	Soft STO
SysIn[1]	Enable	SysOut[1]	Manipulator enabled indicator
SysIn[2]	Switch mode (Manual/Auto)	SysOut[2]	-
SysIn[3]	Start confirmation signal	SysOut[3]	EtherNet1 connection indication On: Connected Off: Disconnected
SysIn[4]	Safety Door-Triggered Stop Mode	SysOut[4]	EtherNet1 frame transmission indication Flashing: Data is being transmitted Solid ON: Connected, but no data is being transmitted
SysIn[5]	Safety Door-Triggered Stop Mode	SysOut[5]	EtherNet2 connection indication On: Connected Off: Disconnected
SysIn[6]	ITP100 enabled	SysOut[6]	EtherNet2 frame transmission indication Flashing: Data is being transmitted Solid ON: Connected, but no data is being transmitted
SysIn[7]	-	SysOut[7]	-
SysIn[8]	-	SysOut[8]	-
SysIn[9]	-	SysOut[9]	-
SysIn[10]	-	SysOut[10]	-
SysIn[11]	-	SysOut[11]	-

SysIn[12]	-	SysOut[12]	-
SysIn[13]	-	SysOut[13]	-
SysIn[14]	-	SysOut[14]	-
SysIn[15]	-	SysOut[15]	-

9.3.2.5 Meaning of Colors in I/O Monitor

In the I/O monitor, the variable names are differentiated by colors: blue, orange and black, respectively.

- Blue: Indicates standard I/Os connected to the actual device or bus I/Os assigned with an address.
- Orange: Indicates outputs which have been occupied and for which the control permissions is not RC_ ACTIVE. The status of such outputs cannot be changed through monitoring interface or instructions.
- Black: Indicates I/Os that meet the following conditions:
  1. Standard I/Os not connected to the actual device or bus I/Os not assigned with an address.
  2. Outputs which have not been occupied and for which the control permissions is RC_ ACTIVE.

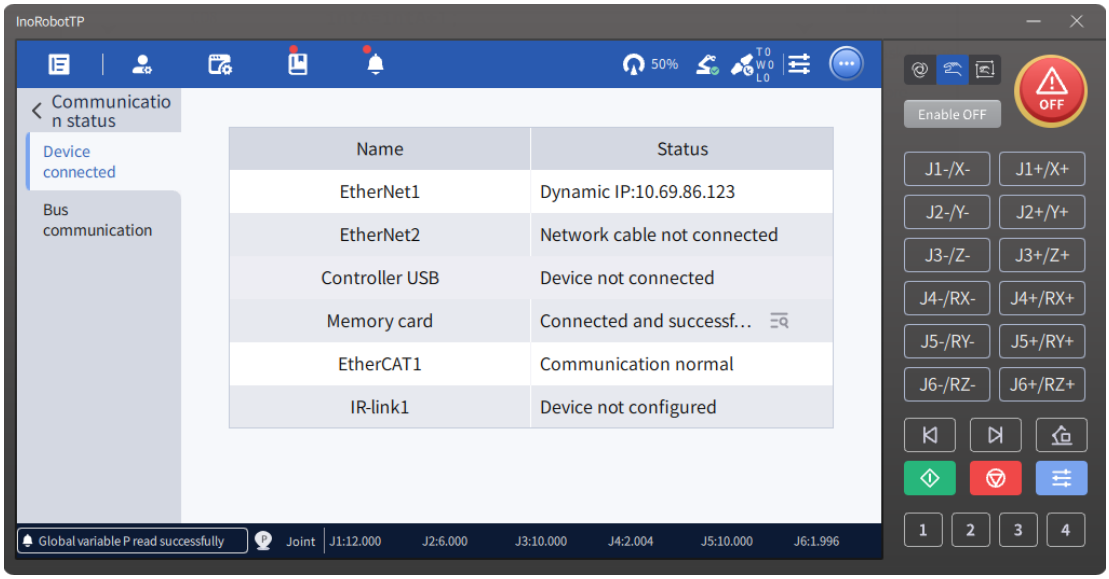
Note

1. The orange display has a higher priority than blue and black. When an I/O is displayed in orange, if you want to know whether the I/O has blue or black attributes, you can infer based on the color of the I/Os before and after it.
2. Control permission of output signal

Control Permission	Note
RC_STATIC	Indicates that it is occupied by the RC system. That is, Out is bound to a system function. In this case, the output signal is related to the function only and the signal status cannot be manually changed.
RC_ACTIVE	Indicates that it is under normal RC control. In this case, the signal is normally controlled. For example, you can change the signal in "IO Monitor" or using the Set instruction.
PLC_ACTIVE	Indicates that it is under PLC control status.

9.4 Communication Status

9.4.1 Equipment Connection



You can monitor the status of the system hardware, as shown below.

Name	Status type
EtherNet1	Network cable not connected
	Dynamic IP: XX.XX.XX.XX or Static IP: XX.XX.XX.XX
	Disabled
	Undefined
	Information acquisition failed
EtherNet2	Network cable not connected
	Static IP: 192.168.23.25
	Disabled
	Undefined
	Information acquisition failed
Controller USB	Device not connected
	Connected and successfully mounted
	Connected but failed to mount
	Undefined
	Information acquisition failed
SD card	Device not connected
	Connected and successfully mounted
	Connected but failed to mount

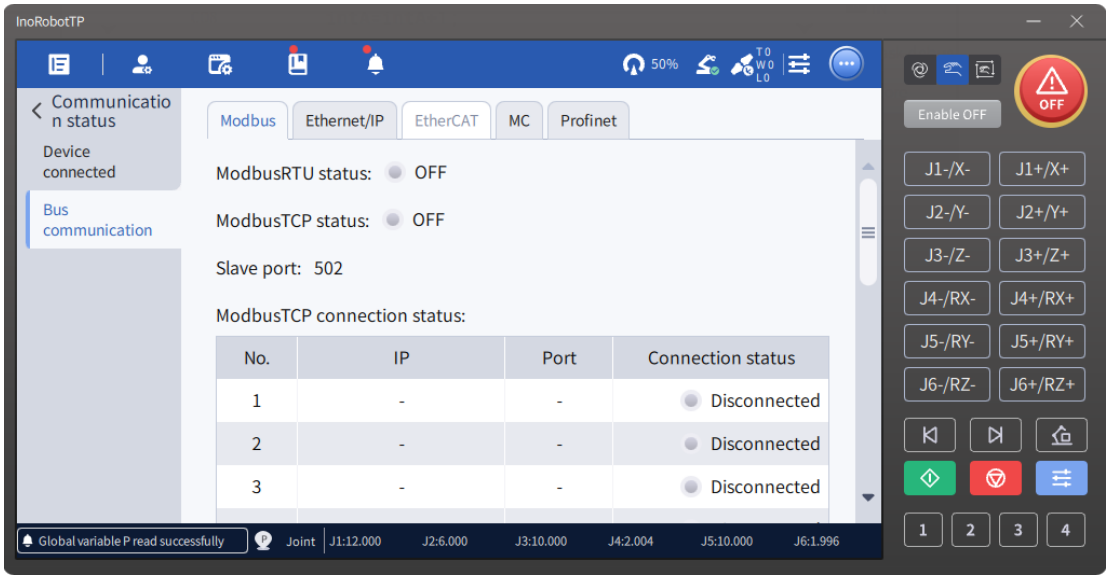
Name	Status type
	Undefined
	Information acquisition failed
EtherCAT1	Communication OK
	Slave disconnected
	Network cable not connected
	Non-EtherCAT device connected
	Disabled
	Undefined
	Information acquisition failed
IR-Link1	Communication OK
	Slave disconnected
	Network cable not connected
	Non-IR-Link device connected
	Disabled
	Undefined
	Information acquisition failed

*Controller USB: The USB on the controller is the controller USB; for the controller USB, the USB drive must be in FAT32, EXT2, or EXT3 format to be successfully loaded.

9.4.2 Bus Monitoring

On the "Monitor" > "Communication status" > "Bus communication" page, Modbus TCP, EtherNet/IP, EtherCAT, and MC buses can be displayed.

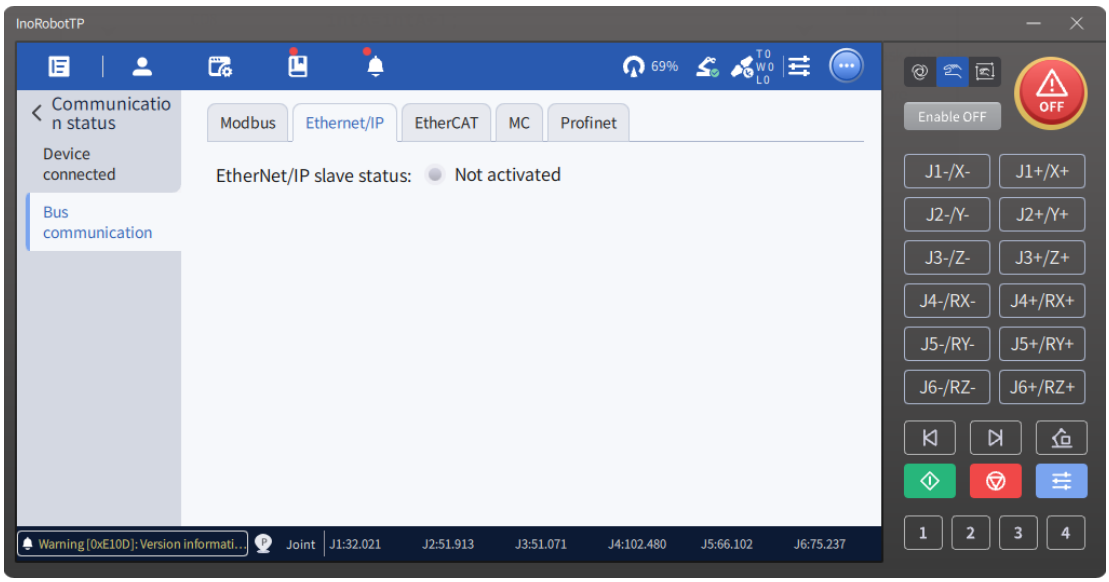
9.4.2.1 Modbus



This page displays the Modbus connection status. Once the page is activated, it refreshes the active status and connection status in real time:

1. The top of the page shows whether Modbus-RTU is active, followed by whether Modbus TCP is active and the port of the slave connection (default is 502).
2. Modbus TCP can connect up to 16 masters, displaying the IP address and port of the master.
3. The alarm specifications for Modbus TCP are as follows: If the connection is disconnected by the master, no alarm will be triggered. If the network cable is unplugged, an alarm "Eth1 physical network link disconnected" or "Eth2 physical network link disconnected" will be triggered.

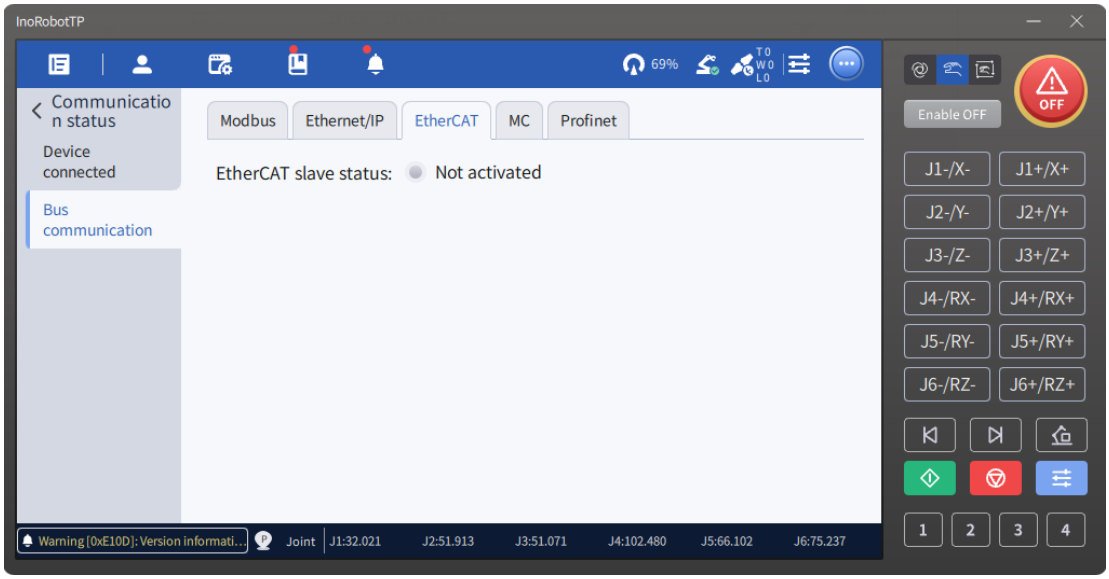
9.4.2.2 EtherNet/IP



This page displays the EtherNet/IP connection status. Once the page is activated, it refreshes the active status and connection status in real time.

It shows whether the EtherNet/IP slave is activated, the port number of the slave, and the connection status of EtherNet/IP. It can connect up to one EtherNet/IP master, displaying the IP address and port of the master in connected status.

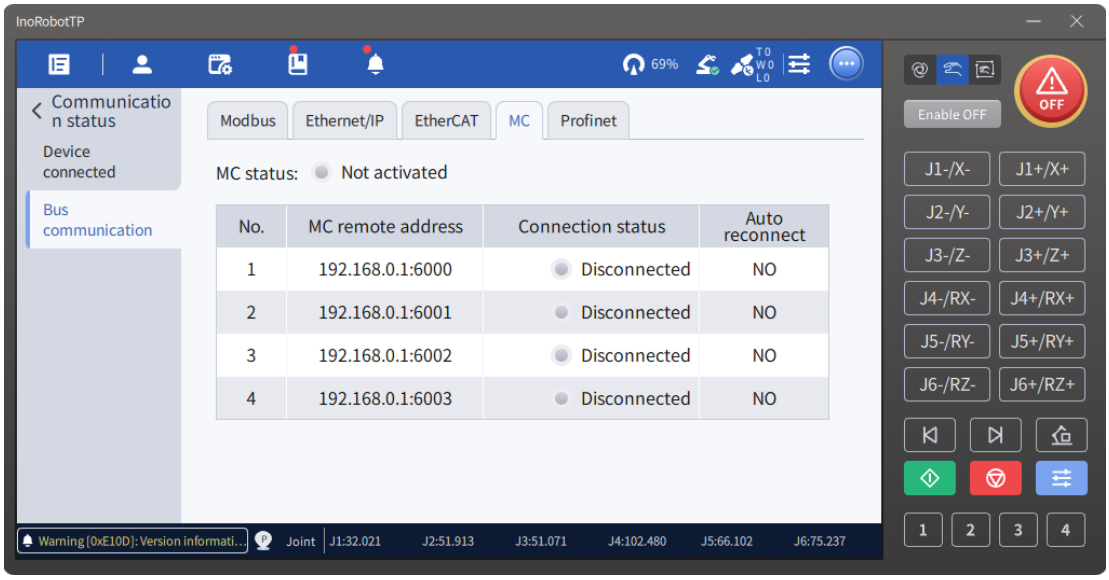
9.4.2.3 EtherCAT



This page displays the EtherCAT connection status. Once the page is activated, it refreshes the active status and connection status in real time:

- Displays whether EtherCAT is active.
- Displays whether EtherCAT is connected.

9.4.2.4 MC

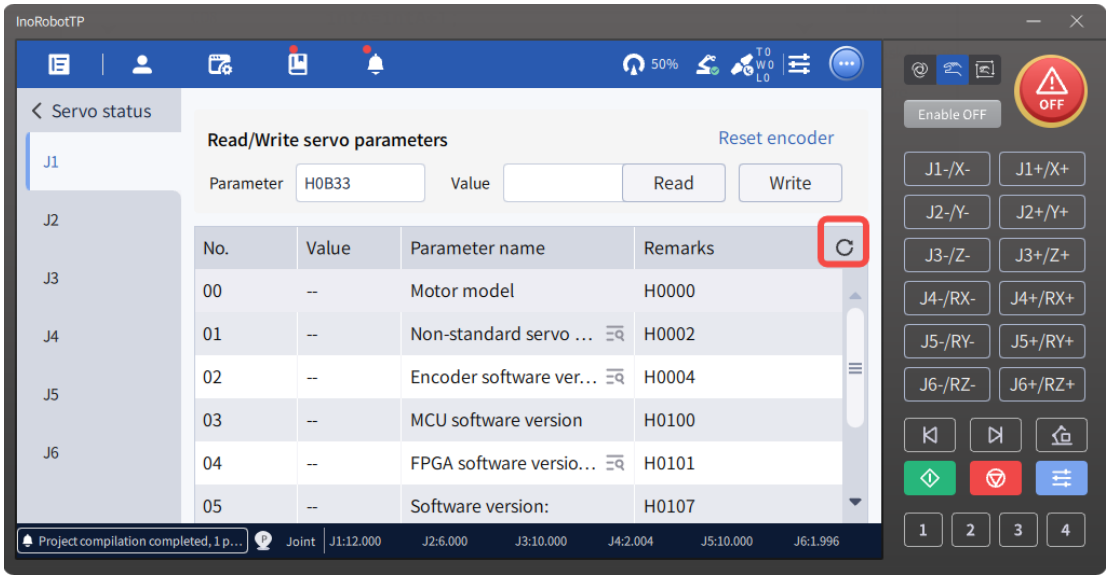


This page displays the master connection status when the robot acts as an MC slave:

When the master is not connected, four default master configurations are displayed by default. When the master is connected, a green dot is displayed. The MC function supports four master connections.

9.5 Servo Status

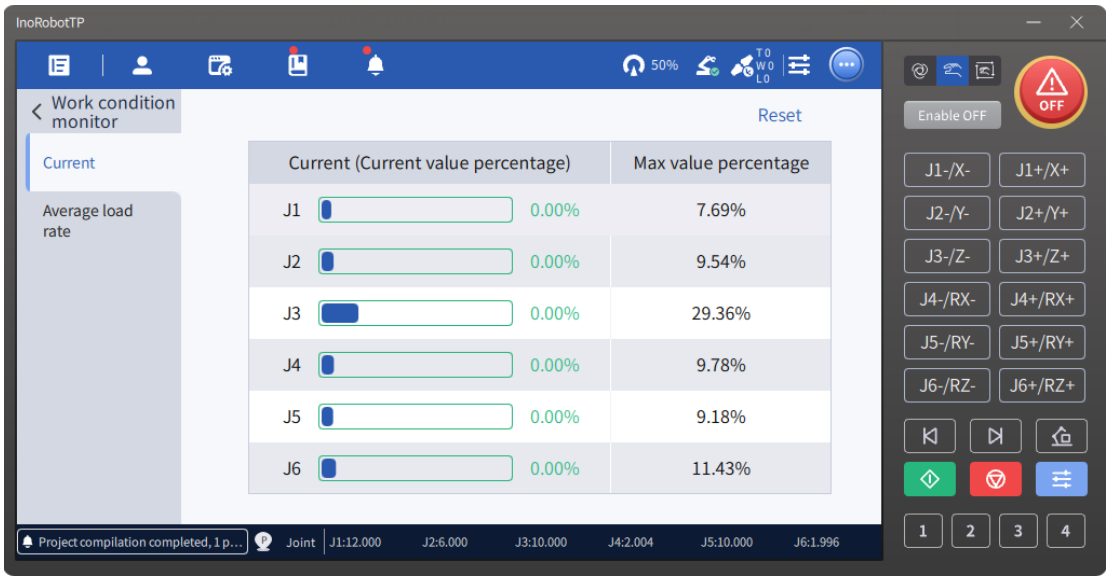
In the servo status panel, click the refresh button in the top right corner to refresh the servo parameters (data is not updated at the time you enter the servo status panel by clicking; you need to click the refresh button to update the data). The panel also provides read and write functions for servo parameters at the top.



About servo parameter read and write: The currently provided function code for servo parameter read and write is H0B33. It enables writing values to select the desired servo fault record entry for querying.

9.6 Work Condition Monitor

Through the work condition monitor interface, you can monitor the current, average load, overload rate, and overheat rate of each joint of the robot.



Current and average load belong to current protection, overheat rate and overload rate belong to temperature rise protection. For details, see 12.6 Current Protection and Temperature Rise Protection.

10 Settings

10.1 Robot Settings

The robot settings include structural parameters, reduction ratio, coupling parameters, etc., and need to be configured in the manufacturer mode.



CAUTION

Robot settings are of great significance. Please contact the manufacturer if you need to change them.

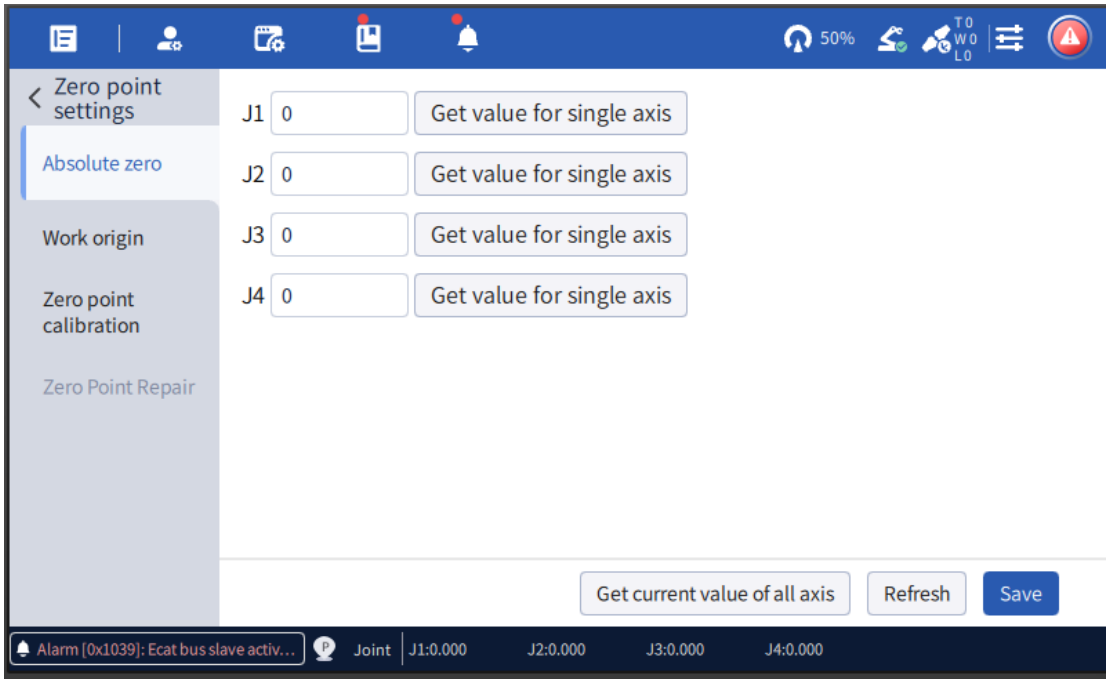
10.2 Zero Point Settings

Zero point settings include "Absolute zero", "Work origin", and "Zero point calibration" (zero point calibration is only for SCARA robots).

10.2.1 Setting the Absolute Zero Point

The following figure shows the "Absolute zero" setting interface. Settings are finished in the following two steps:

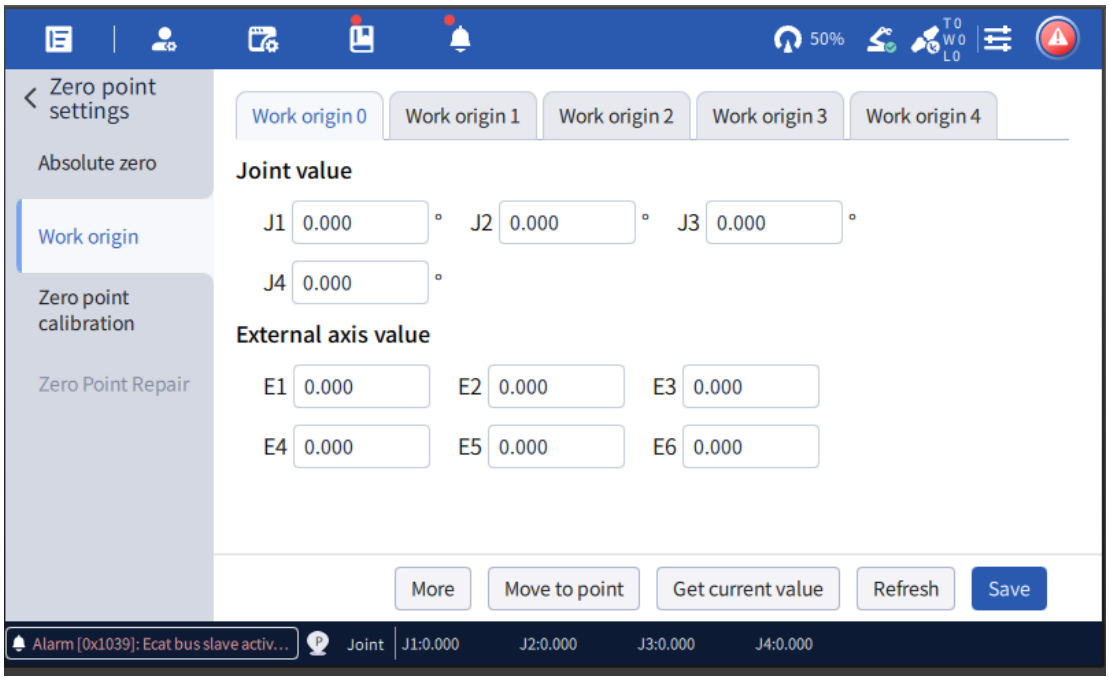
1. Adjust a robot joint to zero position using the teach pendant. Click the "Get value for single axis" button, and the encoder values are displayed in the editing box of the panel.
2. Press the emergency stop button and click the "Save" button.



The J1-J6 encoder numeral range supported by the teaching software is -2147483648 to +2147483647. If the encoder readings are too large at the zero point of the robot, it is recommended to clear the number of encoder turns and re-perform operations according to the preceding steps. For the operation to clear the number of encoder turns, see related servo and encoder guides.

10.2.2 Setting the Work Origin

Different from the zero point, the work origin is a user-defined position variable that can be used in the program. You can set up to five work origins and save them into variables Home[0] to Home[4]. You can manually enter the coordinates of the work origin. Alternatively, you can click and hold the "Move to point" button to move the robot to the work origin, and release the button to stop the motion. Click "Get current value" to automatically get the zero point coordinates, then click "Save" to save the origin, as shown in the figure below.



10.2.2.1 Triggering Signal Output when Approaching Work Origin

Function Overview: When the robot approaches a certain work origin, an signal is outputted.

Usage: Click the "More" button to configure the output signal trigger settings. The parameters are described below.

1. Work mode: There are three work modes, including:
   ① Disable auto-recognition and don't signal: This function is disabled.

   ② Enable automatic recognition J1-J6, and send a signal when approaching the origin: It only detects whether the manipulator axes fall within the error range of the origin. If yes, the corresponding Out signal is set to ON.

   ③ Enable automatic recognition J1-J6, E1-E6, and send a signal when approaching the origin: When both the manipulator axes and external axes fall within the error range of the origin, the corresponding Out signal is set to ON.

2. Associated Out: Specify the number of the Out signal. The range is -1, or Out[0]-Out[127], or Out[512]-Out[4607].

3. Offset range of axes and external axes: Set the offset range for each axis. The range is ±[0.01-10].



- This function can only be used in Edit, Manager and Manufacturer modes.
- When an axis is set as an independent axis, the motion of the axis is controlled only by independent axis instructions (IndCMove, IndReset, IndSpeed). Motion instructions using the Home point function will not take effect on the axis.
- If an Out port number is set in this function, and the work mode is set to mode ② or mode ③, an alarm will be triggered when another function attempts to set this port number. Clear the alarm and set a new Out port number.
- If the set Out port number is used by other functions, the alarm will also be triggered. Clear the alarm and set an unused Out port number.
- If the Home instruction is used in the project file and the parameters related to the Home instruction are modified after running is suspended, the modification will not trigger a recompilation. If the modified line is before the running line or after the start line, the start line number and running line number are not affected. If the modified line is between the running line and the start line, the start line number and running line number are not affected, but the robot still moves according to the original planned trajectory during the actual execution of the program. This means that the modified Home instruction-related parameters will not take effect until the next execution of the instruction.

10.2.3 Zero Point Calibration

10.2.3.1 Four-Axis Zero Point Calibration

This function is applicable only to SCARA robots.

In practice, the SCARA robots may lose the zero point due to collision with hard objects, improperly parameter settings, and etc., affecting their absolute accuracy. It is also possible that the points that have been taught cannot be used. The zero point calibration function is developed to solve the problem of zero point loss.

CAUTION

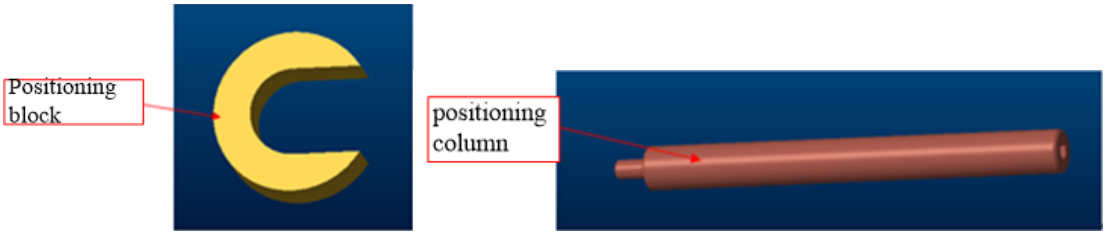
All axes are zeroed by means of automated collision stops. The stops for the J1 and J2 axes are hardware limit stops, while the J3 and J4 axes require additional calibration jig. In addition, due to the structure of the robot, the home operation for the J3 and J4 axes must be done at the same time.

10.2.3.1.1 Preparation

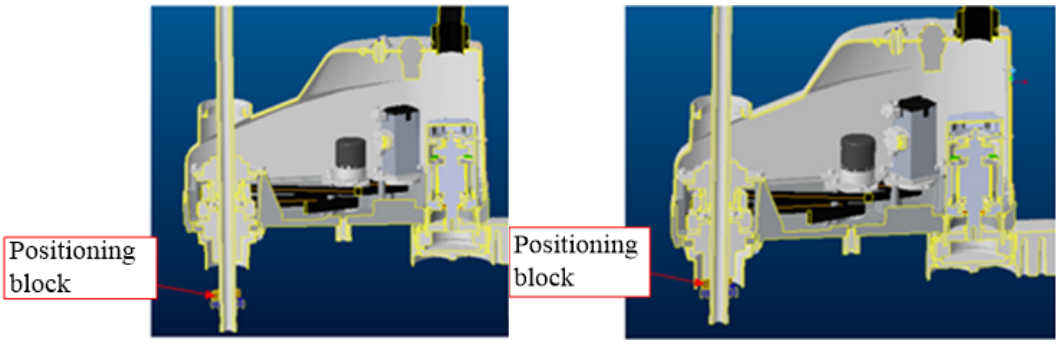
1. Reference position: The homing of all axes depends on the reference position. The reference positions of J1 and J2 axes are the positive and negative hardware limit stops, and the reference positions of J3 and J4 axes are limit rings. Before homing, ensure that the positive and negative hardware limit stops on J1 and J2, and the limit ring on J3 have not been changed from the factory settings.
2. Before zeroing the J3 and J4 axes, install the homing calibration jig first.
3. Remove the fixture to avoid entanglement of the air tubes etc., which otherwise may lead to mistaken assumption that the reference positions are reached.
4. Remove any objects between the current position and the positive limit to ensure that there is no interference.

Installation of the homing calibration jig for J3 and J4:

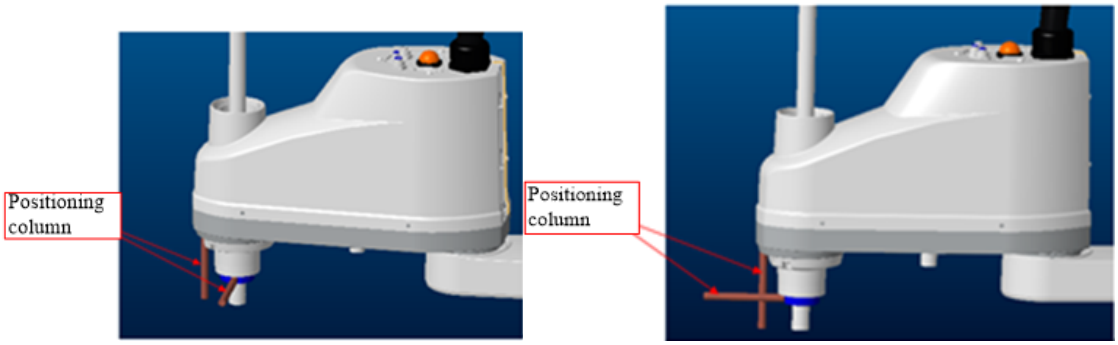
Two types of jigs, positioning block and positioning column are required, as shown below.



Release the brake of the J3 axis, run the lead screw to a proper position where the positioning block can be easily stuck on the lead screw, as shown below. Then move the J3 axis slowly in the forward direction by hand. When the positioning block hits the spline nut or the spline nut housing, the zero point of the J3 axis is reached, as shown on the right in the following figure.

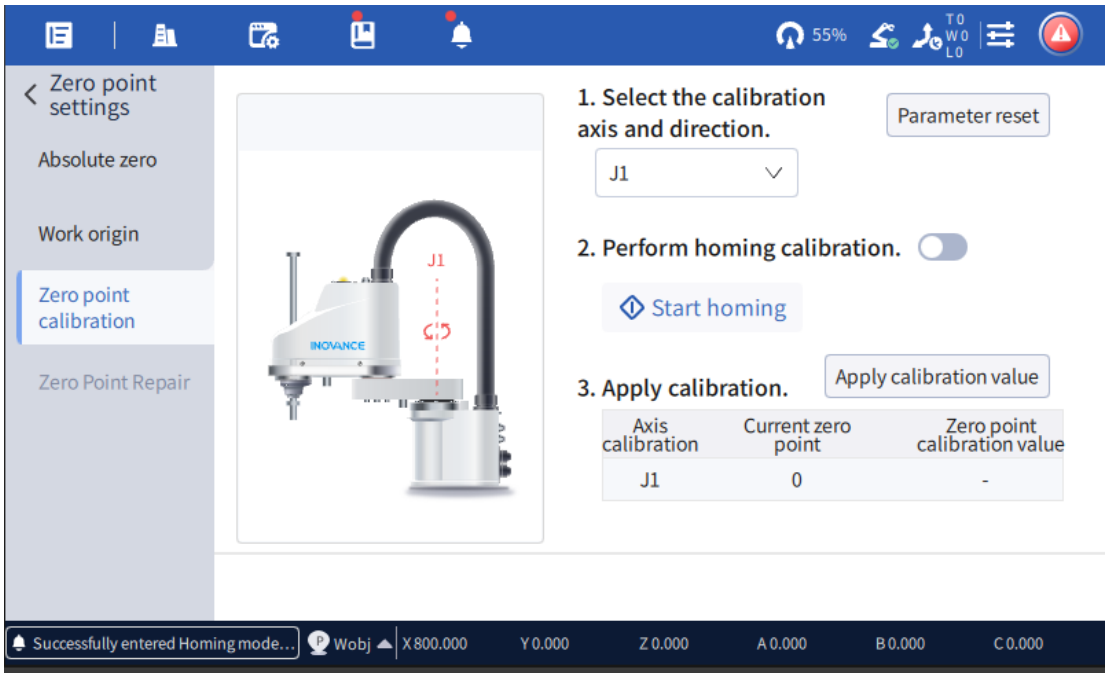


Fix the positioning columns on the forearm and the limit rings, as shown on the left in the following figure. (Ensure that the two columns do not collide with each other to leave space for homing calibration of J3 and J4.)



10.2.3.1.2 Homing Steps

1. Log in to InoRobotLab as administrator or manufacturer.
2. Open the homing page.
   Settings > Zero point settings > Zero point calibration



3. Select an axis.
   Choose the axis you want to calibrate from the "Select the calibration axis and direction" drop-down list.

> **CAUTION**
>
> The zeroing motion direction of all axes is positive.

4. Enter the homing mode.
   Turn on the "Perform homing calibration" switch.

   (a) If the software prompts lack of parameters, reset parameters under the manufacturer's guidance.

   In normal circumstances, for new manufactured robot, the system does not lack parameters and can enter the homing mode normally. However, in the following two cases:

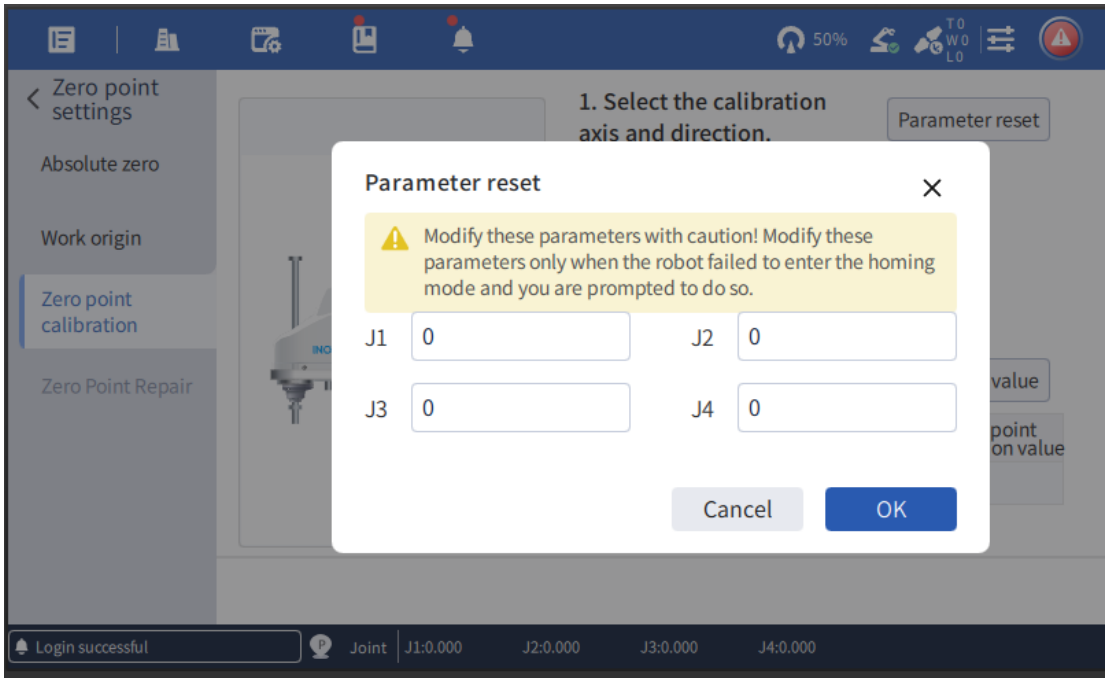
   - For robot systems that have been manufactured before S03.21R
   - For robot systems that have been manufactured after S03.21R and that have lost homing calibration parameters due to flashing

In the above two situations, it is impossible to enter the homing mode. The following message is displayed: "Missing parameters, please reset parameters under the manufacturer's guidance."



▪ The homing calibration function is not available for the robot systems that have been manufactured before S03.21R. (The manufacturer only keeps the parameters of the new robot systems.)

▪ If the robot systems have been manufactured after S03.21R, contact the manufacturer to reset the parameters. (Ask for the parameters from the manufacturer, enter the parameters for the corresponding axis in the "Parameter reset" dialog and click "OK" and save the configuration. Then you can continue with the zero point calibration function.)



▪ If you cannot determine whether the robot system is manufactured before or after S03.21R, contact the manufacturer to check if the parameters are kept. If the manufacturer has kept the parameters, get the parameters and do as described above.

(b) When the system is switched to homing mode and the multi-turn value of the encoder exceeds 2,000, a warning pops up and emergency stop is triggered. In this case, you need to restart the controller and perform the homing operation again.

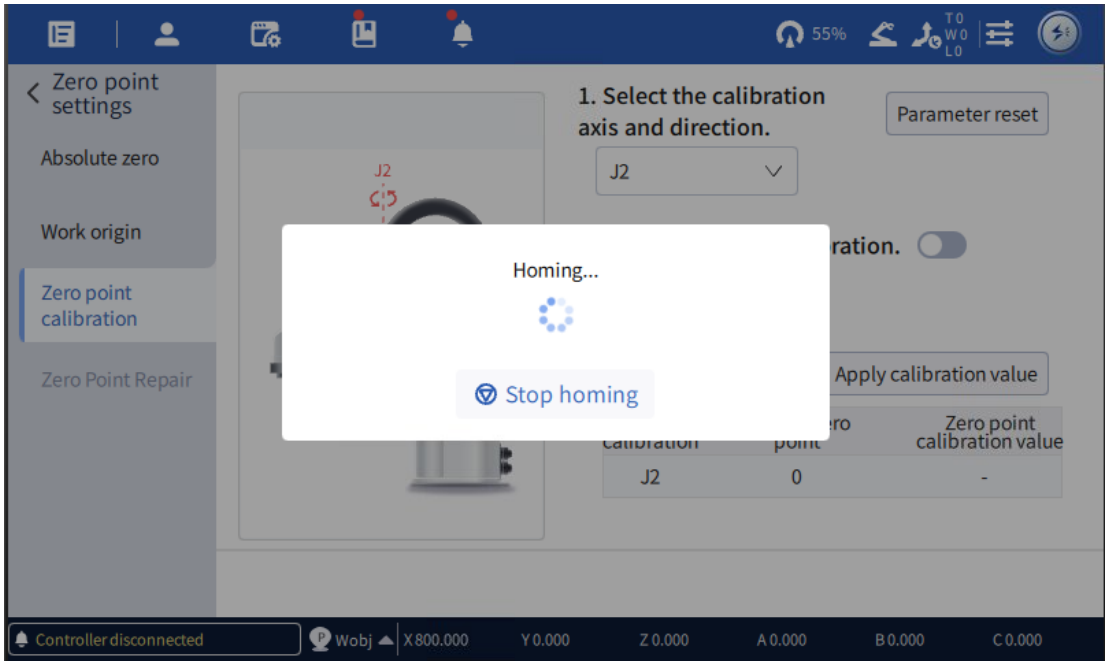


(c) When switched to homing mode, the robot servo will be automatically enabled.

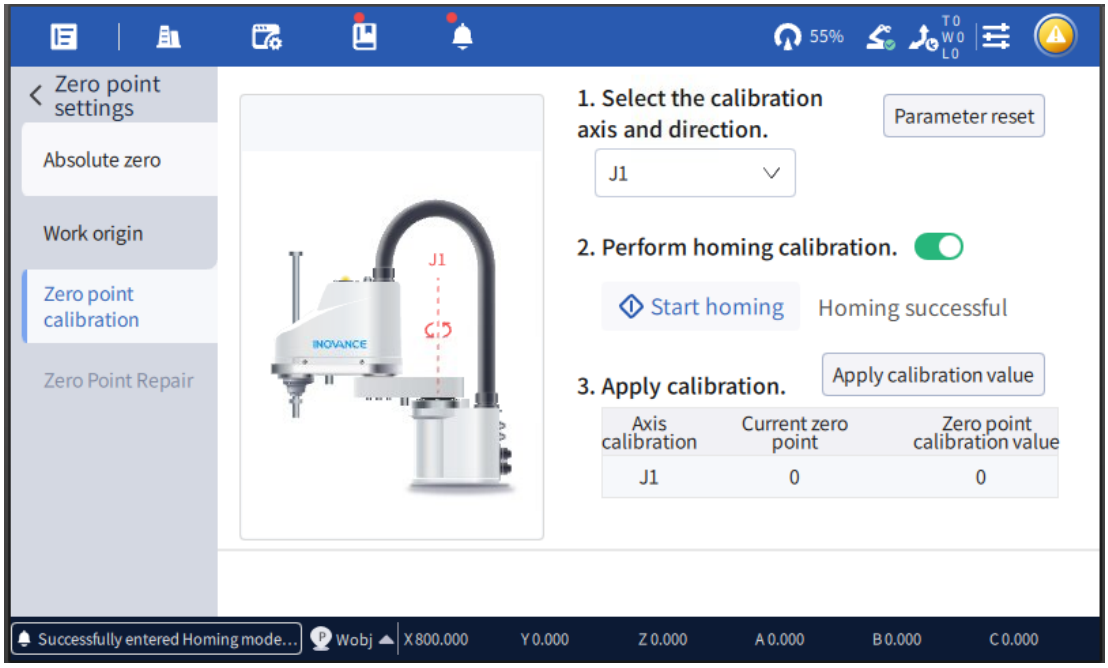
5. Homing

For example, select J2+ axis and start homing.

> **CAUTION**
>
> To ensure accuracy, the homing calibration is slow and may take several minutes. Please wait patiently for the status feedback. (If you want save time, you can manually teach the robot to be around 10° away from the hardware limit before starting homing calibration.)



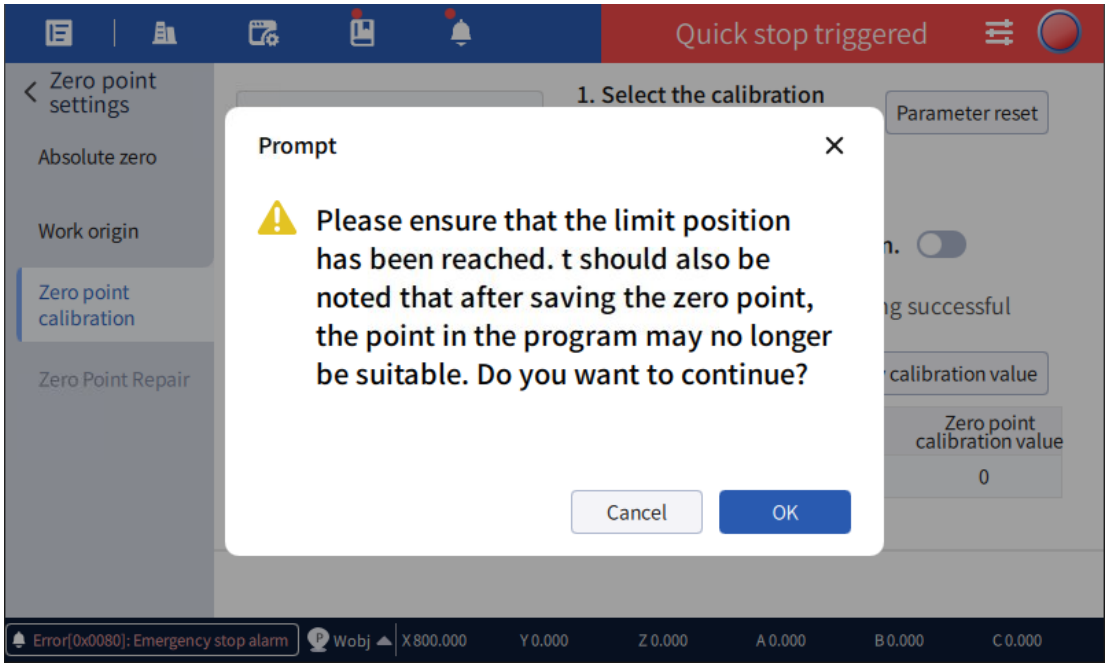
When the calibration is complete, a message "Homing successful" is displayed and the alignment value is updated. See the figure below.



6. Update the zero point.

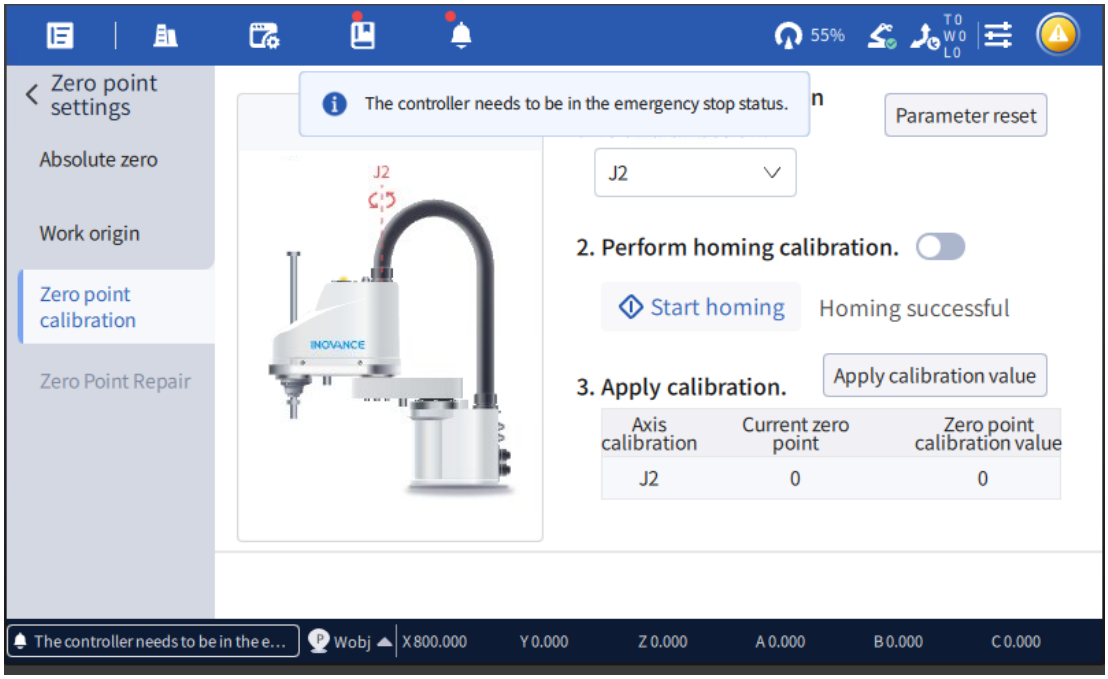
   Put the robot in emergency stop mode and then click "Apply".

   In the pop-up dialog, click "Yes". The calibration value will then be applied to replace the current zero point.





If you click "Apply" without being in emergency stop mode, a pop-up prompt will appear. See the figure below.



7. Check the zero point.

   After updating the system zero point, check the result.

10.2.3.1.3 Notes

1. To zero the J3 and J4 axes, install the homing calibration jig first.
2. Before homing, ensure that the positive and negative hardware limit stops on J1 and J2, and the limit ring on J3 have not been changed from the factory settings. The homing calibration is accurate only if they are the same with factory defaults.
3. Remove the fixture to avoid entanglement of the air tubes etc., which otherwise may lead to mistaken assumption that the reference positions are reached.
4. The zeroing motion direction of all axes is positive. Remove any objects between the zero point and the positive limit to ensure that there is no interference.
5. Automatic homing calibration applies to a single axis. If you want zero multiple axes, zero them one by one.
6. If the software prompts "Missing parameters", reset parameters under the manufacturer's guidance.
7. If the multi-turn value of the encoder exceeds 2000, a warning pops up and emergency stop is triggered. In this case, you need to restart the controller and perform the homing operation again.
8. After updating the system zero point, check the result.

10.3 Installation Parameters Settings

You can configure the arm load parameters and the installation form of the robot in the installation parameters page.

10.3.1 Setting the Tools

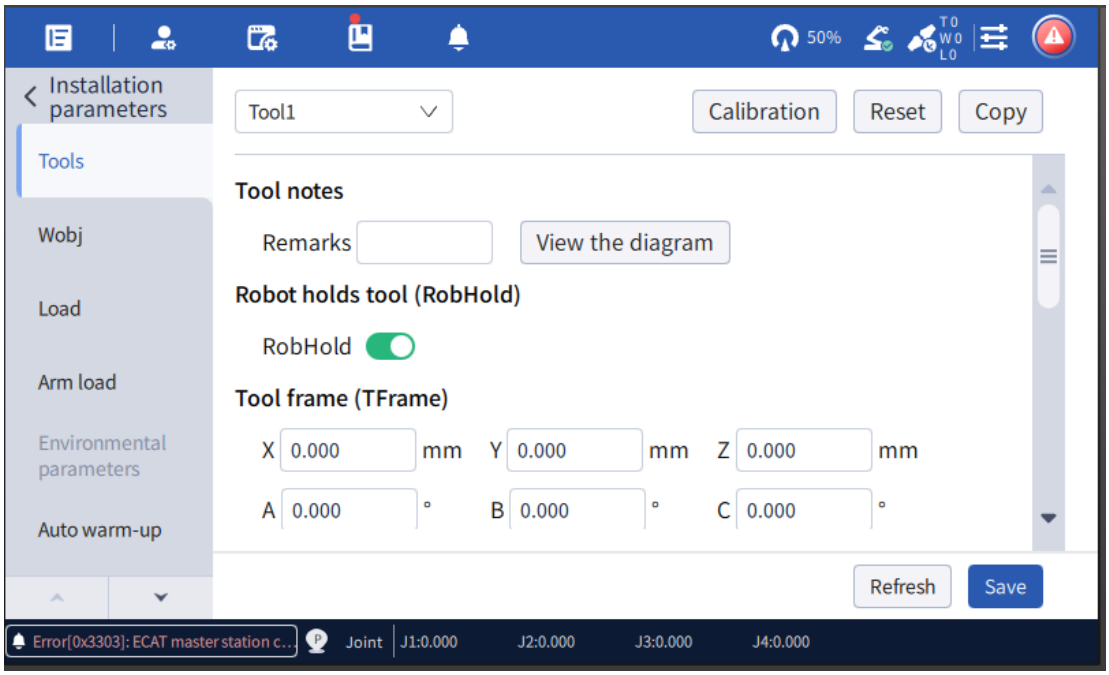
Steps

Select "Settings" > "Installation parameters" > "Tools", as shown below. You can set the tool parameters, including tool frame and tool load parameters. Also, you can calibrate the tool frame with the "Calibration" button.

- The tool parameters include RobHold, TFrame, and tool load parameters.
- The RobHold parameter determines whether the tool is gripped by the robot.
- The TFrame parameters include the value of position parameters X, Y, and Z in mm, and the value of orientation parameters A, B, and C in degrees (°).
- The tool load parameters include mass, center of gravity (CoG), orientation, and inertia.
- The mass is the weight of the load in kg.
- The center of gravity is the X, Y, and Z coordinates of the mass center relative to the object frame of the load to be tuned, in mm.
- The orientation is the A, B, C coordinates of the mass center relative to the object frame of the load to be tuned, in degrees (°).
- The inertia is the moment of inertia of the load around the X, Y, and Z axes of its CoG frame, in $kg \cdot m^2$.

CAUTION

Enter the tool load parameters correctly as they affect the accuracy and stability of the robot motion.



- The number range of the tool frame is 0 to 15. Tool0 is used when no tool is mounted (end flange) and is the default tool number (default parameters cannot be changed). Al other 15 frames except Tool0 frame can be calibrated based on the actual tool mounted.
- The tool frame can be divided into TCP (Tool Center Point) and ECP (External Control Point). The following describes the tool calibration method according to the different tool types.

Calibration of the grip tool frame in TCP mode

- After tools such as grippers, nozzles, or welding gun are installed at the end of the robot, it is necessary to calibrate the tool frame before use to determine the relative relationship between the working position

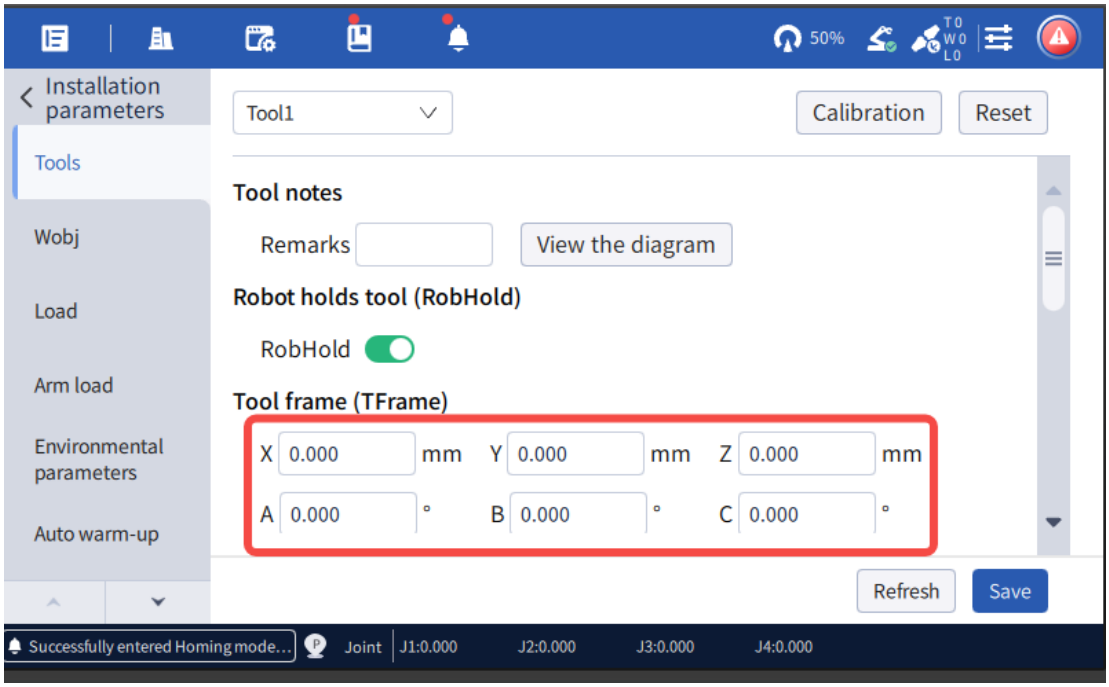
and orientation of the tool and the robot base frame. This allows you to program and control the position and orientation of the end tool.

- The calibration methods for the grip tool include direct method, three-point TCP method, and three-point TCP+ZX method. The following provides a detailed description of each method.

Method	Description	Applicable scenario
Direct method	Directly enter the frame parameters.	Frame parameters are known.
3-point TCP method	Obtain the tool position by three points.	Position values of the tool frame need to be manually calibrated.
3-point TCP+ZX method	Obtain the tool position by three points and then the tool orientation by three more points.	Position and orientation of the tool frame need to be manually calibrated.

Direct method

If you know the values of the tool frame, you can select direct method, enter the values and save them.



3-point method

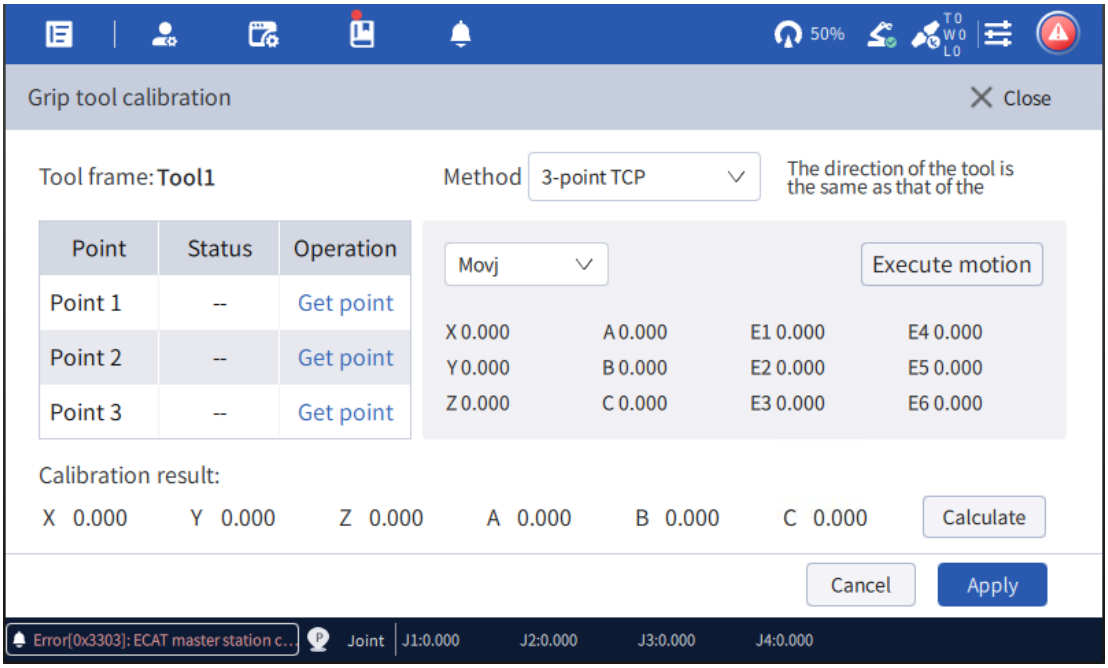
This method is applicable to scenarios where it is only needed to get the TCP position, without the tool orientation.

After installing the tool at the end of the robot, perform the following steps.

1. Select the tool to be calibrated, and click the "Calibration" button to enter the calibration page.
2. Control robot motion so that the TCP is aligned with the reference point in direction ①, select point 1 and then click "Get point".
3. Control robot motion so that the TCP is aligned with the reference point in direction ②, select point 2 and then click "Get point".
4. Control robot motion so that the TCP is aligned with the reference point in direction ③, select point 3 and then click "Get point".

5. Click "Calculate" to obtain the calibration result.

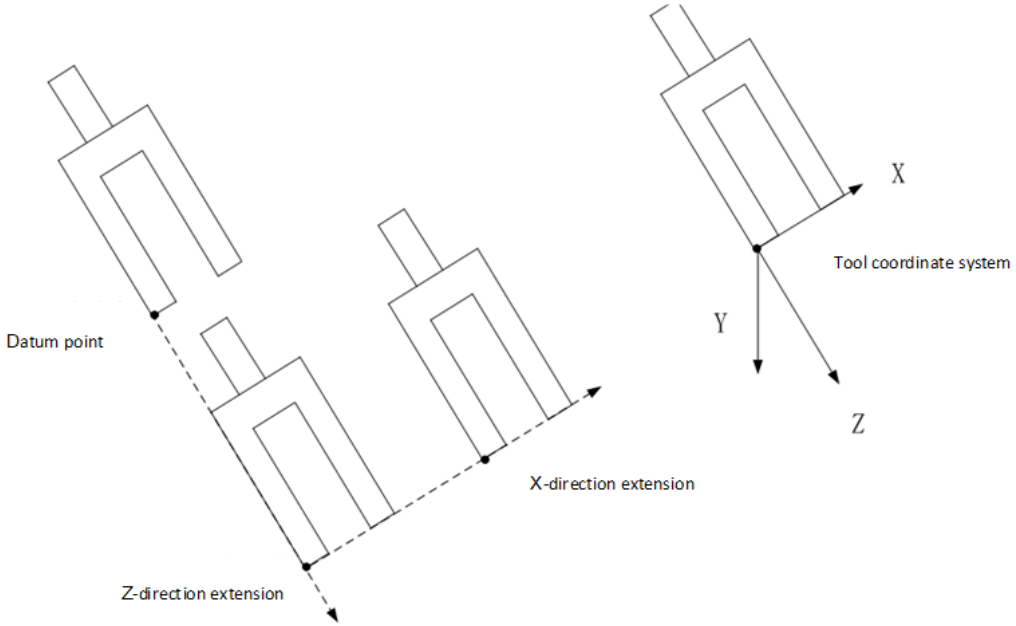
6. Click "Apply" to record the calibration result and complete the calibration.



3-point TCP+ZX method

This method is applicable to scenarios where both the TCP position and the TCP orientation need to be obtained.

Three more points are taken to calibrate the orientation of the tool frame on the basis of 3-point TCP method. The Z extension point and the reference point compose the Z direction of the tool frame. The X and Z extension points compose the X direction of the tool frame. The Y direction is obtained from the Z and X directions by the right-hand rule. See the figure below.

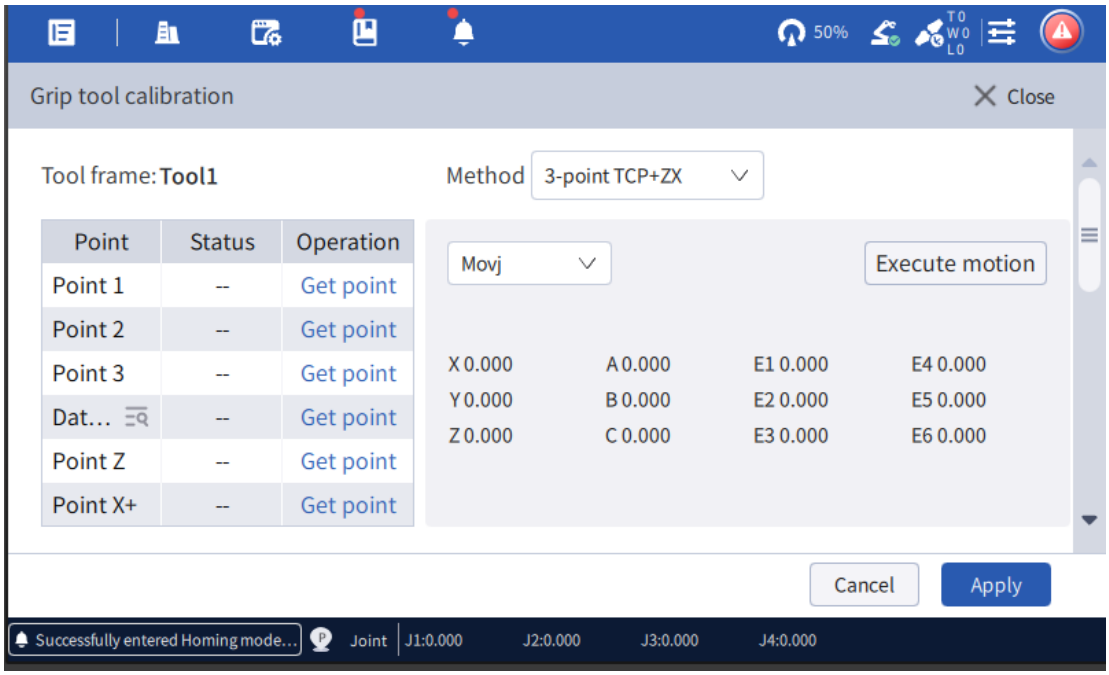


The steps are as follows.

1. Select the tool to be calibrated, and click the "Calibration" button to enter the calibration page.

2. Control robot motion so that the TCP is aligned with the reference point in direction ①, select point 1 and then click "Get point".

3. Control robot motion so that the TCP is aligned with the reference point in direction ②, select point 2 and then click "Get point".
4. Control robot motion so that the TCP is aligned with the reference point in direction ③, select point 3 and then click "Get point".
5. Control robot motion, select the TCP at any moment as the datum point and click "Get point".
6. Control robot motion so that the tool extends by a distance in Z direction, select the Z extension point and click "Get point".
7. Control robot motion so that the tool extends by a distance in X direction, select the X extension point and click "Get point".
8. Click "Calculate" to obtain the calibration result.
9. Click "Apply" to record the calibration result and complete the calibration.



Precautions for calibration of grip tool

- TCP: Tool center point, which is used as a reference point for measuring the arrival position of the robot. The tool endpoint is generally taken as the TCP and its direction can be freely defined.
- The orientations of the three points taken shall vary as much as possible. An orientation difference of at least 20 degrees is recommended.
- After the calibration is complete, the error parameter will be displayed. It is generally accepted that the maximum error should be less than the absolute accuracy of the manipulator by + 0.1 mm. If the error is too large, it is recommended to calibrate again using new points.
- When the tool end of SCARA and Delta robots is coaxial with the robot's end axis (i.e., only Z direction values are available), it is not possible to find the Z-direction position parameter of this tool frame by the three-point TCP method.

Calibration of the external fixed tool frame in **ECP** mode

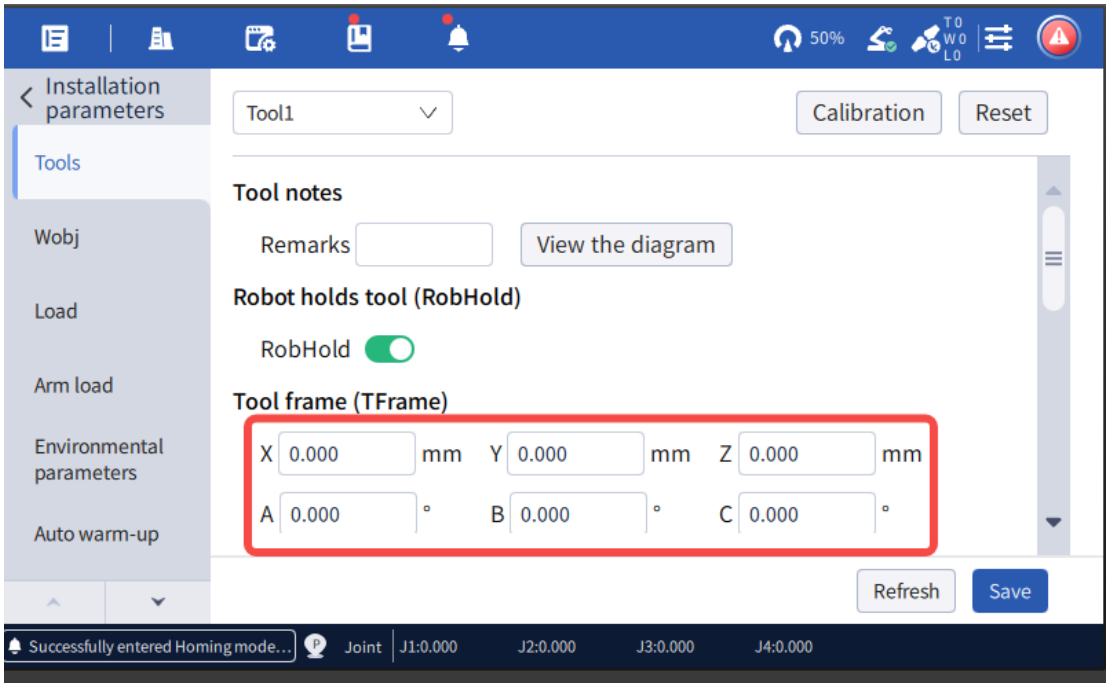
The tool is fixed in the world frame. When the robot grips a work object for operation, it is necessary to calibrate the frame of an external tool in order to determine the working position and orientation of that tool in the world frame. In this way, you can precisely control the work object to reach the end of the tool.

For calibration of the external fixed tool, set the grip property of the tool (RobHold) to "False". The calibration method for the external fixed tool is similar to that for the grip tool, including direct method, known tool 1-point TCP, known tool 1-point TCP+ZX, unknown tool 3-point TCP, and unknown tool 3-point TCP+ZX. The reference frame of the external fixed tool is the world frame. The following describes the three calibration methods.

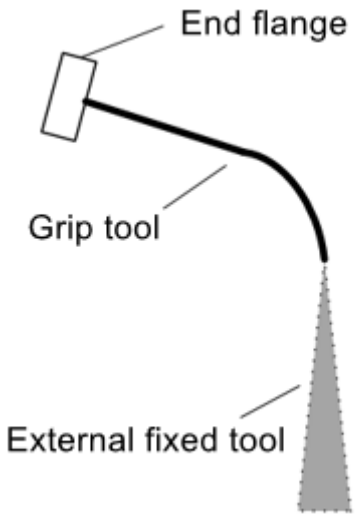
Method	Description	Applicable scenario
Direct method	Directly enter the frame parameters.	Frame parameters are known.
Known tool 1-point TCP	The currently active grip tool has been calibrated. In this case, calibrate the position of the external fixed tool by one point.	Position values of the tool frame need to be manually calibrated.
Known tool 1-point TCP+ZX	The currently active grip tool has been calibrated. In this case, calibrate the position of the external fixed tool by one point, and the orientation by two more points.	Position and orientation values of the tool frame need to be manually calibrated.
Unknown tool 3-point TCP	The currently active grip tool is unknown. In this case, calibrate the position of the external fixed tool by three points.	Position values of the tool frame need to be manually calibrated.
Unknown tool 3-point TCP+ZX	The currently active grip tool is unknown. In this case, calibrate the position of the external fixed tool by three points, and the orientation by the datum point and two more points.	Position and orientation values of the tool frame need to be manually calibrated.

Direct method

If you know the values of the external tool frame, you can select direct method, enter the values and save them.



Known tool 1-point TCP



This method is applicable to scenarios where it is only needed to obtain the position of the fixed tool, without the orientation, when the frame of the grip tool is known.

Fix the external tool relative to the world frame, install the grip tool at the end of the robot and calibrate the tool, and then perform the following steps.

1. Select the tool to be calibrated (must not be the same with the grip tool number), and click the "Calibration" button to enter the calibration page.
2. As shown in the preceding figure, control the robot motion to align the TCP of the grip tool with the ECP (External Control Point) of the external fixed tool. After the alignment, select point 1 and click "Get point" button.
3. Click "Calculate" to obtain the calibration result.
4. Click "Apply" to record the tool calibration result and complete the calibration.

Known tool 1-point TCP+ZX

This method is applicable to scenarios where it is needed to obtain both the position and orientation of the fixed tool, when the frame of the grip tool is known.

Fix the external tool relative to the world frame, install the grip tool at the end of the robot and calibrate the tool, and then perform the following steps.

1. Select the tool to be calibrated (must not be the same with the grip tool number), and click the "Calibration" button to enter the calibration page.
2. Control the robot motion to align the TCP of the grip tool with the ECP (External Control Point) of the external fixed tool. Select point 1 and click "Get point".
3. Select the calibration point in the Z+ direction of the external fixed tool, control the robot to move for a distance, select point Z+, and click "Get point".
4. Select the calibration point in the X+ direction of the external fixed tool, control the robot to move for a distance, select point X+, and click "Get point".
5. Click "Calculate" to obtain the calibration result.
6. Click "Apply" to record the calibration result and complete the calibration.

Unknown tool 3-point TCP

This method is applicable to scenarios where it is only needed to obtain the position of the fixed tool, without the orientation, when the frame of the grip tool is unknown.

The external tool is fixed relative to the world frame, and the parameters of the grip tool installed at the end flange of the robot are unknown. The operation process of this calibration method is basically the same as the "3-point" calibration of the grip tool. In the "unknown tool 3-point TCP" calibration, the ECP of the external fixed tool is used as the reference point and aligned with the TCP of the grip tool.

Unknown tool 3-point TCP+ZX

This method is applicable to scenarios where it is needed to obtain both the position and orientation of the fixed tool, when the frame of the grip tool is unknown.

The external tool is fixed relative to the world frame, and the parameters of the grip tool installed at the end flange of the robot are unknown. Perform the following steps.

1. Select the tool to be calibrated (must not be the same with the grip tool number), and click the "Calibration" button to enter the calibration page.
2. Modify the point 1, point 2, and point 3 in the way as described in relation to the "unknown tool 3-point TCP method".
3. Get the datum point for calculation the position of external fixed tool, control the robot motion align the TCP of the grip tool with the ECP of the external fixed tool. Select datum point and click "Get point".
4. Select the calibration point in the Z+ direction of the external fixed tool, control the robot to move for a distance, select point Z+, and click "Get point".
5. Select the calibration point in the X+ direction of the external fixed tool, control the robot to move for a distance, select point X+, and click "Get point".
6. Click "Calculate" to obtain the calibration result.
7. Click "Apply" to record the calibration result and complete the calibration.

Precautions for calibration of external fixed tool:

- ECP: ECP is the center point of the external fixed tool, and the reference frame of the external fixed tool is the world frame.

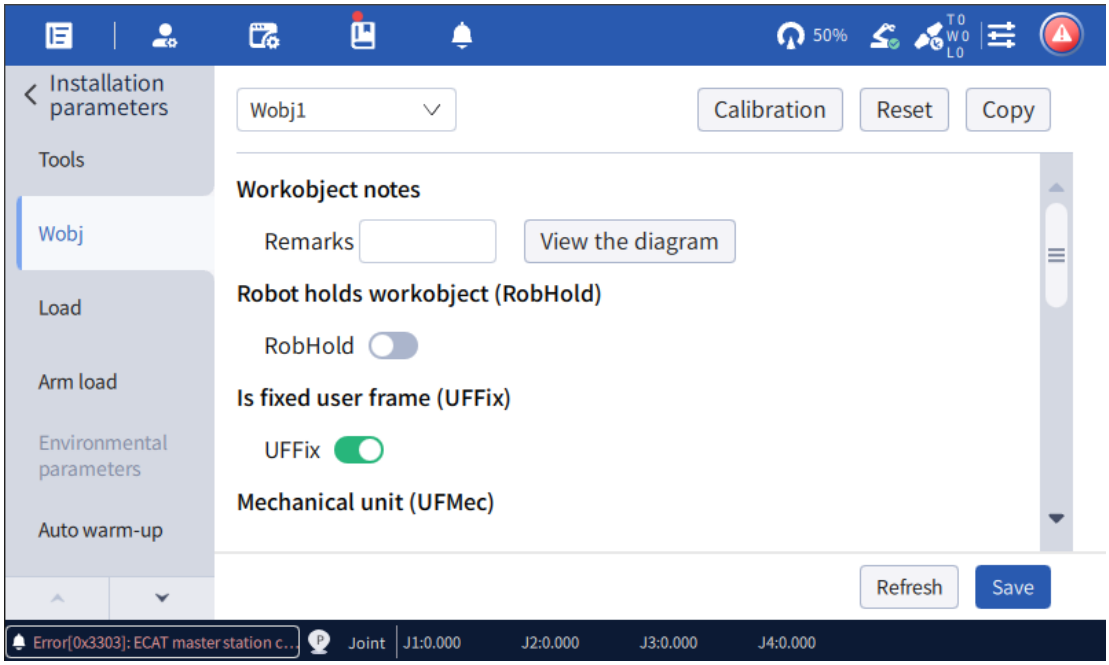
- The orientations of the three points taken shall vary as much as possible. An orientation difference of at least 20 degrees is recommended.
- After the calibration is complete, the error parameter will be displayed. It is generally accepted that the maximum error should be less than the absolute accuracy of the manipulator by + 0.1 mm. If the error is too large, it is recommended to calibrate again using new points.
- Except for the direct method, other calibration methods need to calibrate the external fixed tool using the grip tool.
- The "Tool load" parameter set for the external fixed tool is also the load parameter of the active grip workobject.

10.3.2 Setting the Workobject

Steps

Select "Settings" > "Installation parameters" > "Wobj", as shown below, where you can set and calibrate the workobject frame.

- The workobject parameters include RobHold, UFFix, UFMec, UFrame, and OFrame.
- The RobHold parameter sets whether the workobject is gripped by the robot.
- The UFFix parameter sets whether the user frame is fixed relative to the world frame (when not fixed, it can move with certain unit).
- The UFMec parameter sets the mechanical unit associated with the frame.
- The UFrame parameters include the value of position parameters X, Y, and Z in mm, and the value of orientation parameters A, B, and C in degrees (°).
- The OFrame parameters include the value of position parameters X, Y, and Z in mm, and the value of orientation parameters A, B, and C in degrees (°).



- The number range of the workobject frame is 0 to 15. Wobj0 is the default value (default parameters cannot be changed) and coincides with the world frame. All other 15 frames except Wobj0 frame can be calibrated according to requirements.

Calibration of the non-grip workobject frame in TCP mode

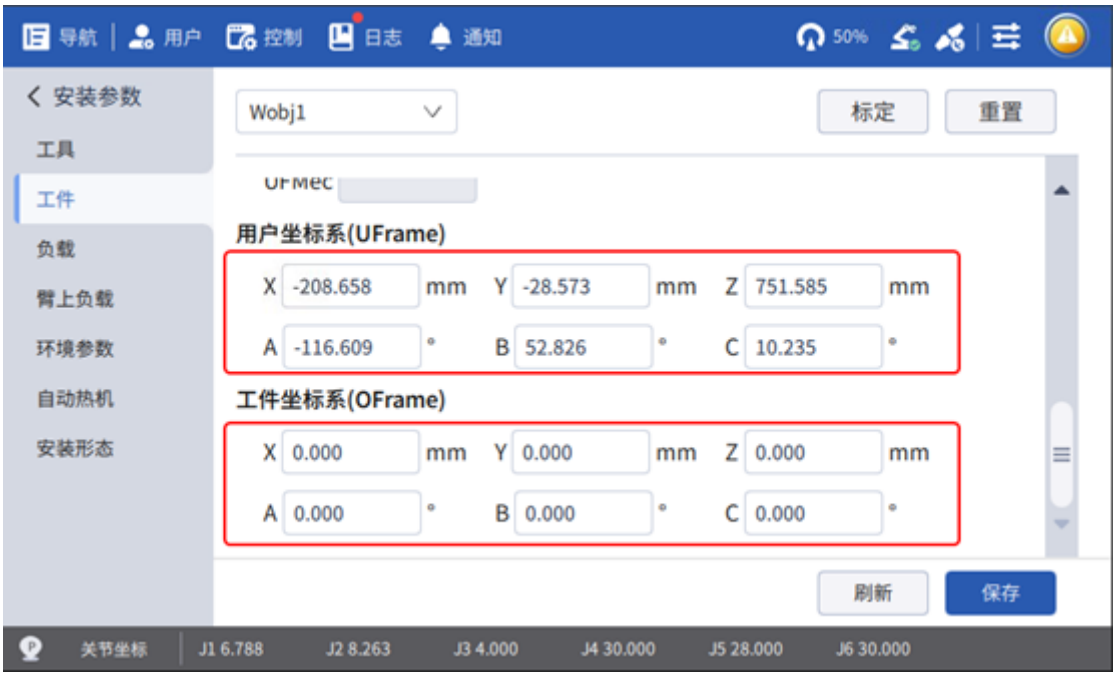
- The workobject frame is a user-defined frame.

- The workobject frame can be set arbitrarily and is generally set on specific objects, such as a workbench or a conveyor. Before using the workobject frame, calibration is required.
- When the non-grip workobject is calibrated, the active tool should be grip tool that has been calibrated. You also need to change the grip attribute of the workobject (RobHold) to "False" and save the change.
- Each frame includes the user frame (UFrame) and the workobject frame (OFrame). The user frame can be calibrated by direct method, 3-point method, and rotation method. The workobject frame can be calibrated by direct method and 3-point method.

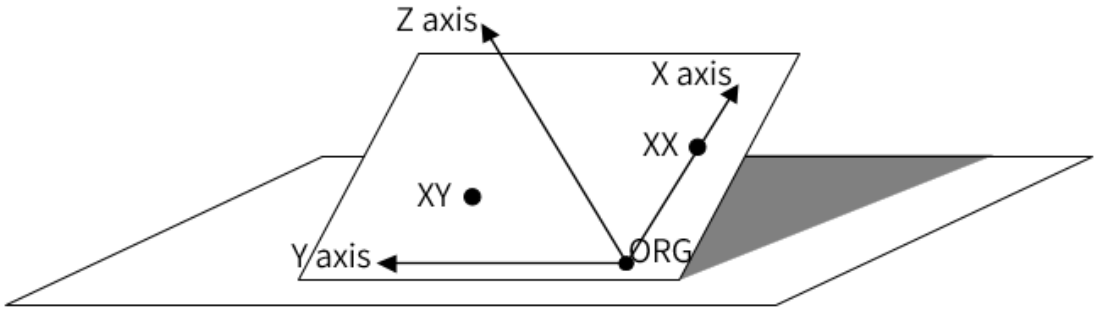
Method	Description	Applicable scenario
Direct method	Directly enter the frame parameters.	Frame parameters are known.
UFrame 3-point method	Calibrate the user frame using three points.	Values of the user frame need to be manually calibrated.
UFrame rotation method	Make marks on the turnplate. Rotate the turnplate and get points for teaching.	A turnplate is provided and the user frame is located at the center of the turnplate.
OFrame 3-point method	Calibrate the workobject frame using three points.	Values of the workobject frame need to be manually calibrated.

Direct method

If you know the values of the user frame or workobject frame, you can select direct method, enter the values and save them.



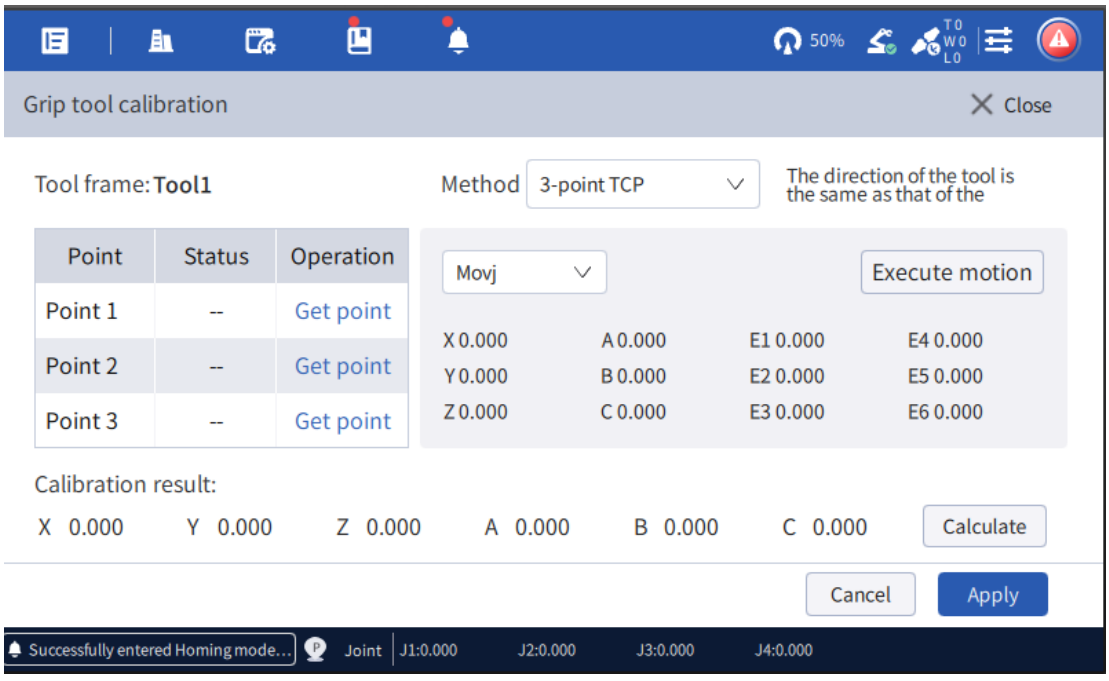
UFrame/OFrame 3-point method



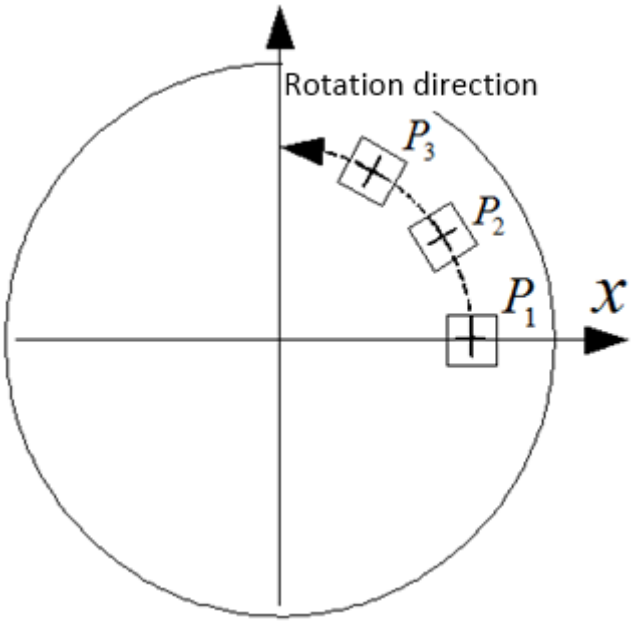
User coordinate defined points
ORG: Origin
XX: Point on X-axis
XY: Point on X-Y plane

Follow the steps below.

1. Set RobHold to "False", click the "Calibration" button to enter the calibration page, and select "Three-point method".
2. Get the origin ORG of the frame, select the user point O/workobject point O, and click "Get point".
3. Take a point XX in the positive direction of the X-axis of the user frame, select user point X+/ workobject point X+, and click "Get point".
4. Take a point XY in the Y+ direction of the XY plane of the frame, select user point Y+/workobject point Y+, and click "Get point".
5. Click "Calculate" to obtain the calibration result.
6. Click "Apply" to record the calibration result and complete the calibration.

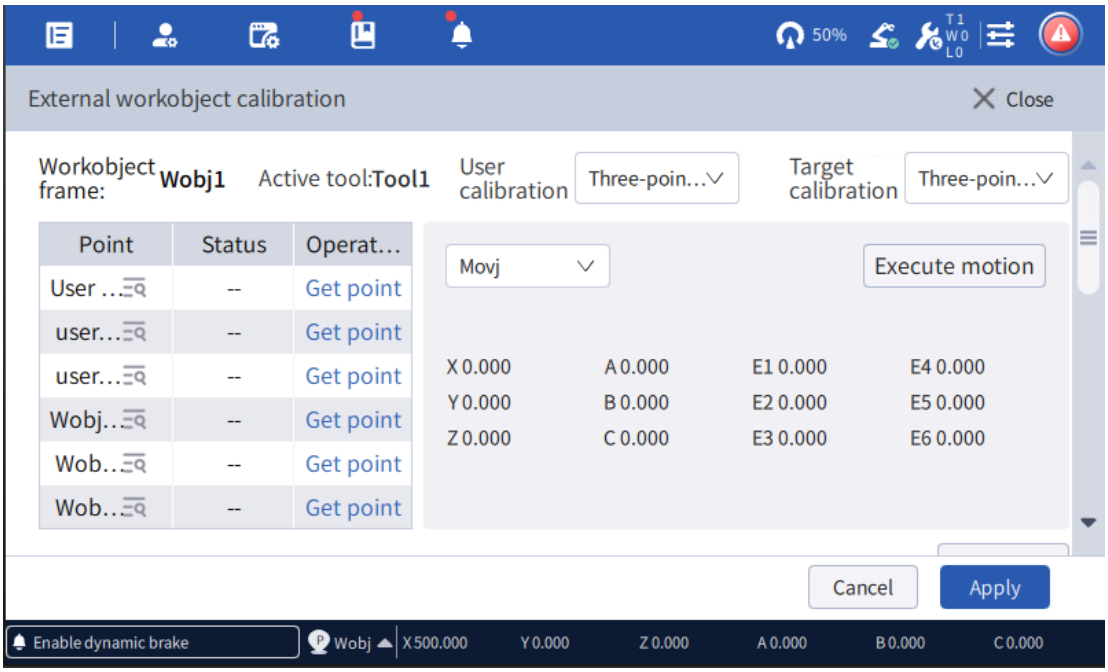


UFrame rotation method



Follow the steps below.

1. Set RobHold to "False", click the "Calibration" button to enter the calibration page, and select "Rotation method".
2. Mark a fixed point on the turnplate, align the TCP with this mark, select user point 1 and click "Get point".
3. Rotate the turnplate by an angle, align the TCP with this mark again, select user point 2 and click "Get point".
4. Rotate the turnplate by a random angle again, align the TCP with this mark again, select user point 3 and click "Get point".
5. Click "Calculate" to obtain the calibration result.
6. Click "Apply" to record the calibration result and complete the calibration.



Precautions for calibration

- In the 3-point method, the point 1 is not directly on the Y axis, but is a point in the XY plane that moves a distance from the start point 0 in the positive direction of the Y axis. In this way, the point 1 indirectly defines the Y-axis. Finally, the Z axis is obtained through the right-hand rule.
- For SCARA and Delta robots, if the component of the Z direction of the user frame in the Z direction of the base frame is negative, the software will automatically reverse the Z and Y directions of the user frame, leaving the X direction unchanged.
- Each grip workobject frame includes a user frame (UFrame) and a workobject/target frame (OFrame). The reference frame of the UFrame is the world frame of the robot. The reference frame of the OFrame is the user frame.

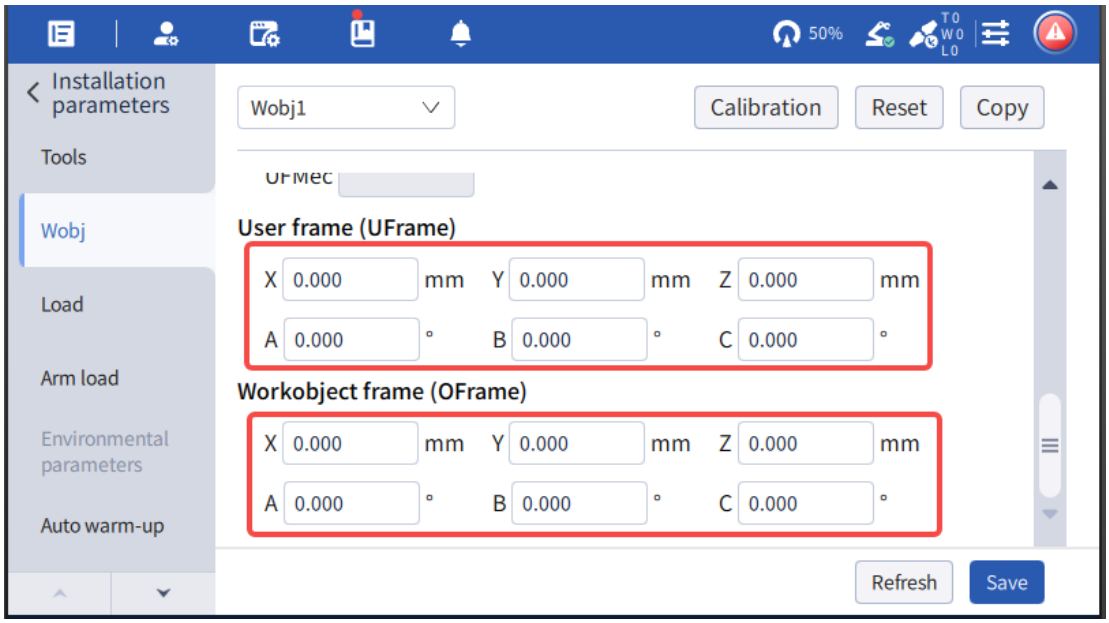
Calibration of the grip workobject frame in ECP mode

- When the non-grip workobject is calibrated, the active tool should be an external fixed tool that has been calibrated. You also need to change the grip attribute of the workobject (RobHold) to "True" and save the change.
- Both the user frame and the workobject frame can be calibrated by direct method and 3-point method.

Method	Description	Applicable scenario
Direct method	Directly enter the frame parameters.	Frame parameters are known.
3-point method	Calibrate the user/workobject frame using three points.	Values of the user/workobject frame need to be manually calibrated.

Direct method

If you know the values of the user frame or workobject/target frame, you can select direct method, enter the values and save them.



UFrame/OFrame 3-point method

The 3-point calibration process for the grip workobject is basically the same as that for the non-grip workobject described above. However, the calibration for the grip workobject requires the use of external fixed workobject for point acquisition.

Precautions for calibration of grip workobject

- Select the external fixed tool as the currently active tool and the grip workobject to be calibrated as the currently active workobject. It is recommended to clear the parameters of the workobject and change the grip attribute to "True" before entering the calibration page.
- Each grip workobject frame includes a user frame (UFrame) and a workobject/target frame (OFrame). The reference frame of the user UFrame is the flange of the robot. The reference frame of the OFrame is the user frame.

Non-fixed user frame

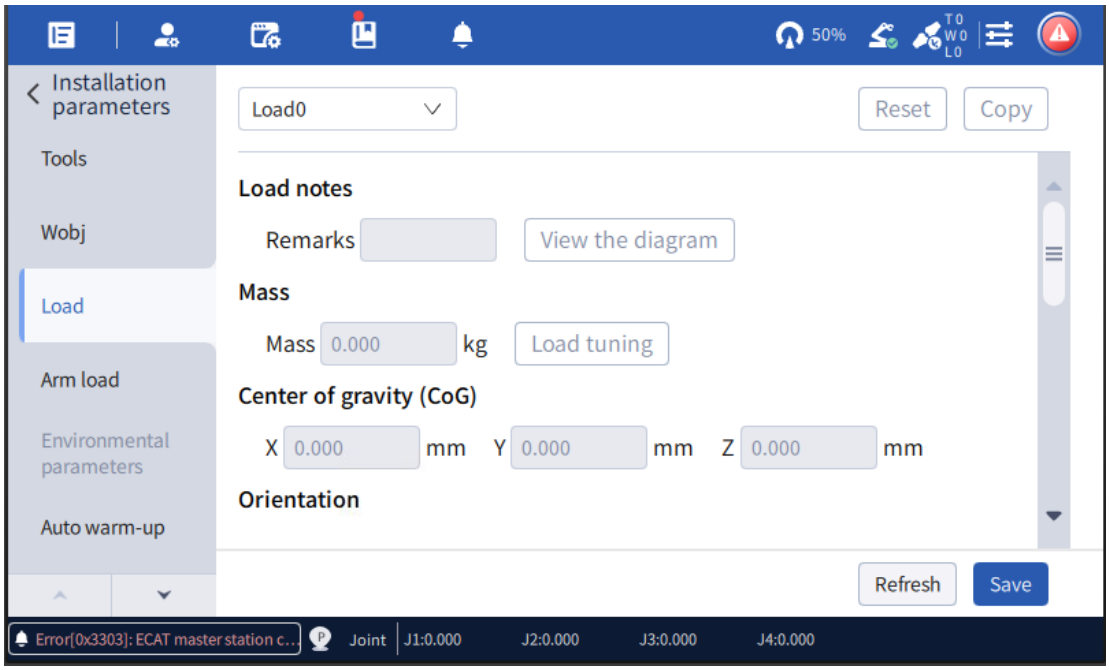
For non-fixed user frame, see 10.4.6.2 External Axis Coordination.

10.3.3 Setting the Load

You can set load parameters to improve the accuracy and stability of robot motion.

Steps

Select "Settings" > "Installation parameters" > "Load", as shown below.



- The load number range is 0 to 15. Load0 is the default value (default parameters cannot be changed). Load0 indicates no load. All other 15 loads except load0 can be configured as required.
- Load parameters include mass, center of gravity (CoG), orientation, and inertia.
- The mass is the weight of the load in kg.
- The center of gravity is the X, Y, and Z coordinates of the mass center relative to the object frame of the load to be tuned, in mm.
- The orientation is the A, B, C coordinates of the mass center relative to the object frame of the load to be tuned, in degrees (°).
- The inertia is the moment of inertia of the load around the X, Y, and Z axes of its CoG frame, in $kg \cdot m^2$.
- Pay attention to the unit of the load parameter and ensure that the input parameters are correct. Otherwise, the accuracy and stability of the robot will be degraded.

Results

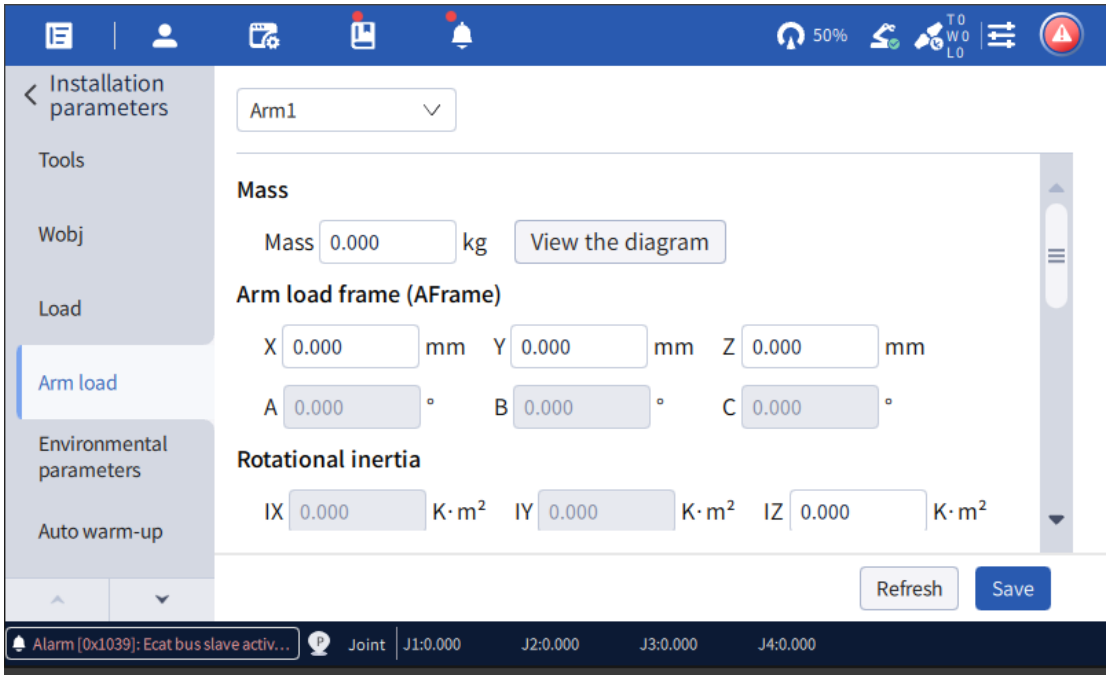
After setting and saving, you can check whether the accuracy and stability of the robot are improved by capturing the trajectory of the robot end.

10.3.4 Setting the Arm Load

The arm load is 0 by default. After setting, click the "Save" button in the upper right corner to make the setting take effect.

Parameters:

- Mass: Defines the weight of the load in kg.
- X, Y, Z: Define the coordinates of the load's centroid relative to the flange frame, in mm.
- A, B, C: Define the orientations of the load, currently not supported.
- IX, IY, IZ: Define the moment of inertia of the load around the X, Y, and Z axes of its CoG frame, in kg·m2.
- Pay attention to the unit of the load parameter and ensure that the input parameters are correct. Failure to do so may result in false collision detection alarms, cycle times that are too long or too short, or current anomalies.
- For a SCARA robot, you can set the joints with load on arm to joints #1 and #2, and for a 6-axis robot, you can set the joints with load on arm to joints #1, #2, and #4.

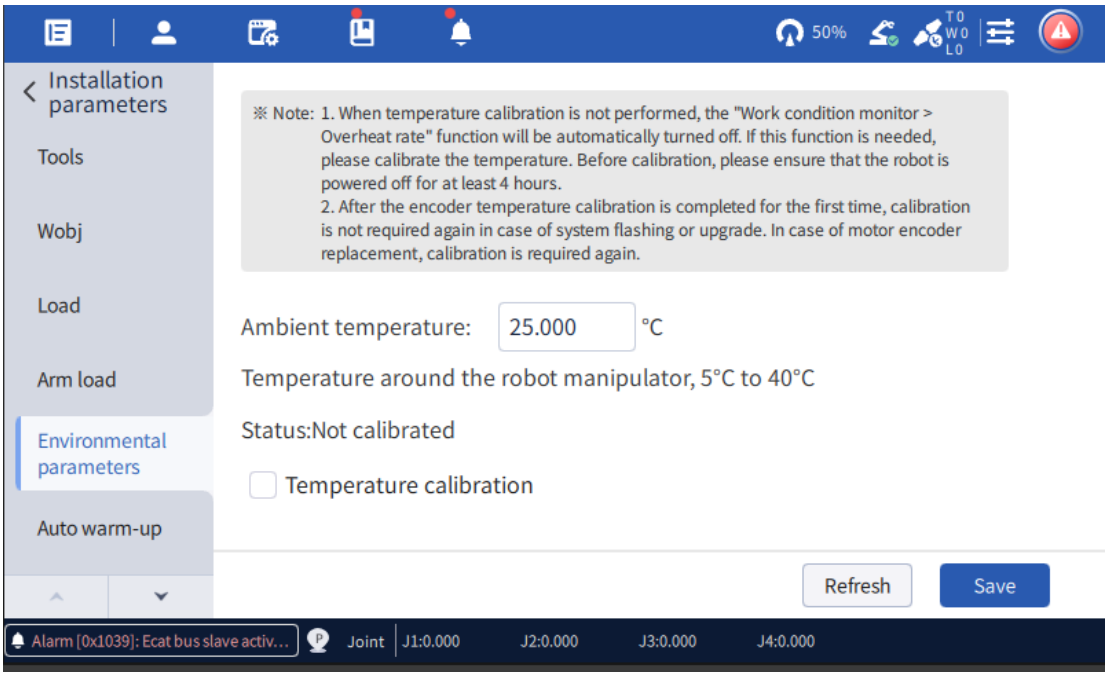


10.3.5 Setting the Environmental Parameters

Enter the real temperature of the site where the robot is installed and save the settings. Click "Save" in the upper right corner to make settings take effect. When you check the "Temperature calibration", temperature calibration is enabled. Enter the temperature value and click "Save" to perform the temperature calibration. After the calibration is complete, the calibrated temperatures of the axes are displayed.

CAUTION

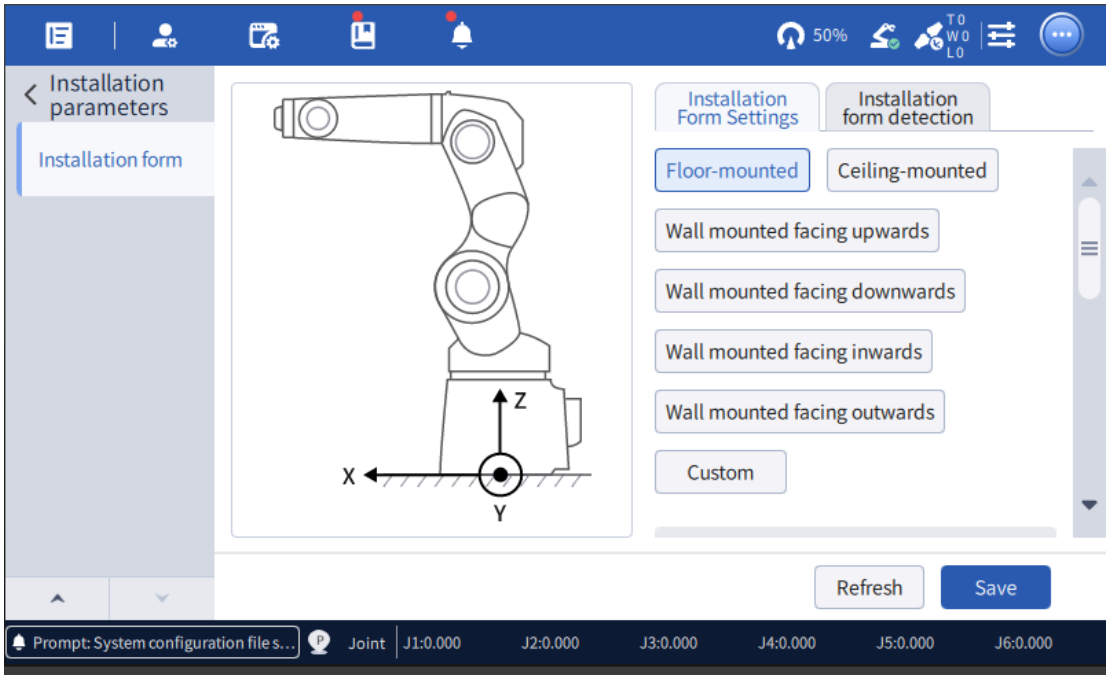
- When temperature calibration is not performed, the Overheat rate monitoring function will be automatically turned off. If this function is needed, calibrate the temperature properly. Before calibration, ensure that the robot is powered off for at least 4 hours.
- After the encoder temperature calibration is done for the first time, there is no need to recalibrate during subsequent robot flashing and upgrading. After the motor encoder is replaced, recalibration is required.
- The environmental parameters are used for temperature rise protection. Currently, only some robot models support this function. For detailed robot models, see 12.6.2 Temperature Rise Protection.



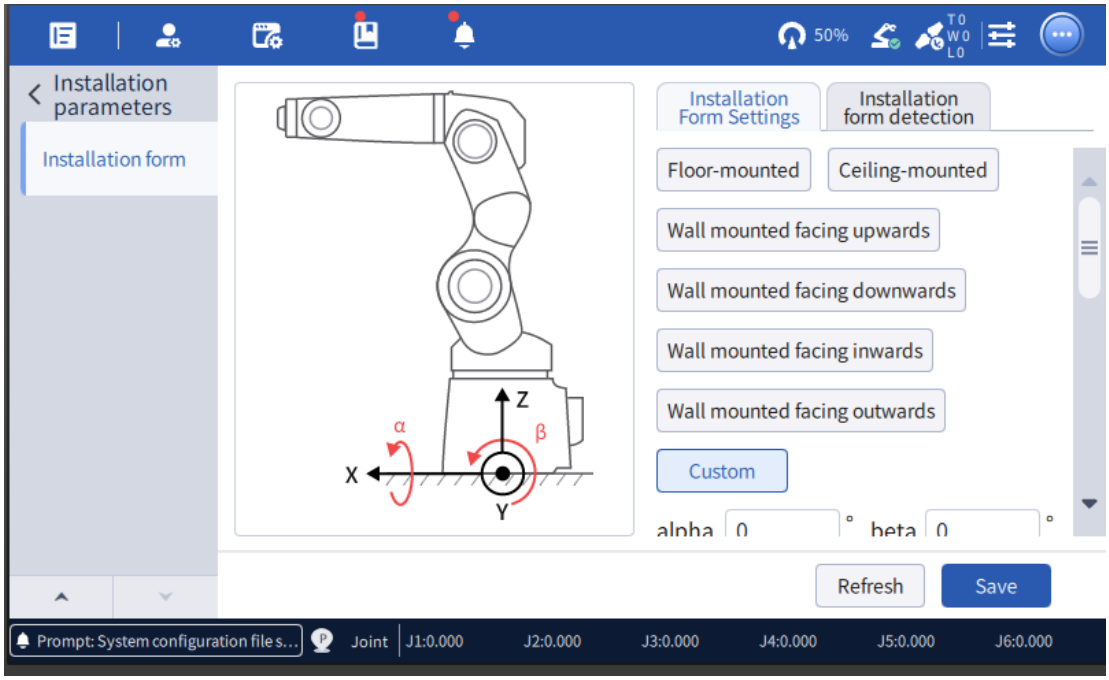
10.3.6 Setting the Installation Form

Select the installation form according to the actual conditions. Save the selection and restart the controller to make the selection take effect.

Set the installation form as shown below.



As shown in the figure below, when selecting the "Custom" installation form, correctly input the alpha and beta installation angles (unit: °). Alpha is the rotation angle around the X-axis of the fixed frame, and beta is the rotation angle around the Y-axis of the fixed frame. The settable range for alpha and beta is -180° to +180°.



CAUTION

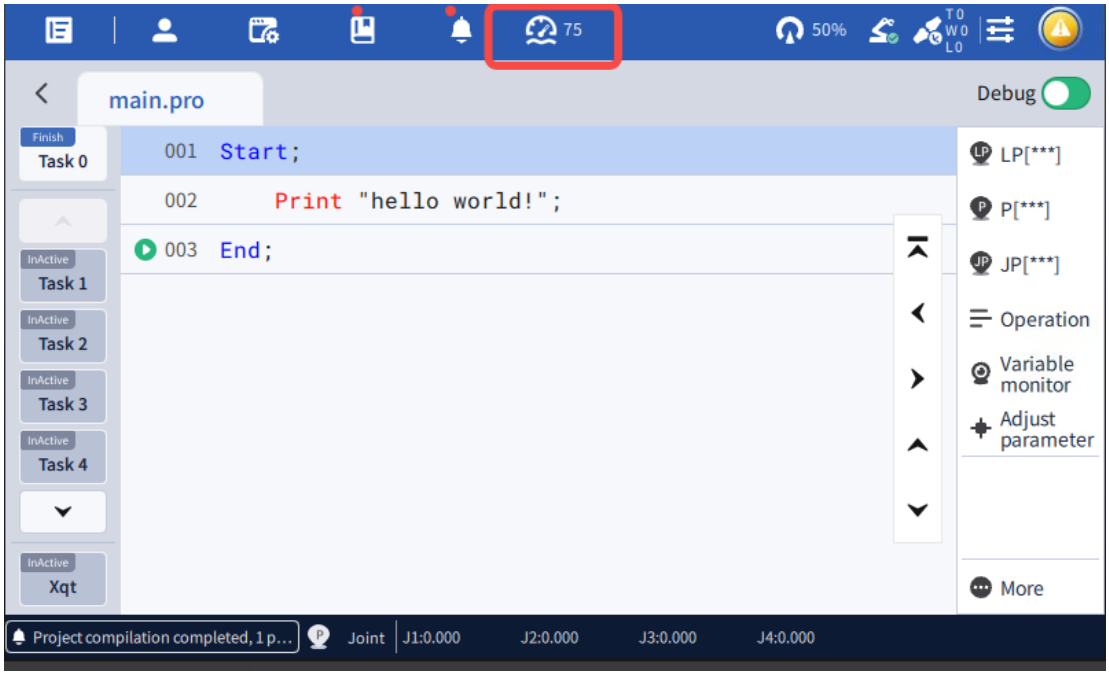
- The installation form function applies only to the 6-axis robots.
- Selecting an installation form other than "Floor-mounted" may reduce the performance and accuracy of the robot.
- This setting affects the robot motion. Ensure that the setting is consistent with the actual condition.

10.3.7 Setting Auto Warm-up

The automatic warm-up function with multiple policies is implemented to solve the torque overlimit/excessive tracking error caused by high friction when the robot is cold.



Setting interface



Warm-up speed status and speed display

You can set the warm-up policy, axis warm-up parameters (axis number, axis temperature threshold), and robot warm-up parameters (warm-up time, initial warm-up speed, and re-warm up interval).

Parameter	Description
Warm-up policy	• Close: Disables the function • Only consider warm-up time: The automatic warm-up is performed only according to the robot warm-up parameters (warm-up time, initial warm-up speed, and re-warm up interval). • Consider axis temperature and warm-up time: The automatic warm-up is performed only according to the axis warm-up parameters and robot warm-up parameters.

Parameter	Description
	CAUTION When the robot does not support temperature rise protection function, this option is not displayed.
Axis number	When the temperature threshold of the selected axis is reached, the automatic warm-up stops. CAUTION Axes with an overheat rate of 0 are grayed by default.
Axis temperature threshold	• When the predicted temperature of the selected axis reaches the set threshold, the current speed switches to the global speed. • If the predicted temperature of the robot axis is greater than or equal to the set threshold when the robot starts, the robot starts running at the global speed. CAUTION Calculation method of predicted axis temperature: Overheat rate of the axis * temperature threshold (110°C) of the axis.
Warm-up time	When the actual robot running time reaches the set time, the robot switches to run at the global speed.
Initial warm-up speed	The initial speed when the robot performs automatic warm-up. If the global speed set is smaller than the initial warm-up speed, the robot runs at the global speed; otherwise, it runs at the initial warm-up speed.
Re-warm up interval	If the robot is stopped during automatic warm-up and started again within this interval, the robot continues to warm up at the speed it was stopped. If the robot is started again when this interval is exceeded, the robot starts running again at the initial warm up speed. This interval includes the power failure time. In case of power failure, the configuration file is loaded and the robot is restarted. If the stop time is within the re-warm up interval, the actual initial warm-up speed will be the same with the actual global speed before restart.

Steps

Example of parameter settings

Parameter	Value
Warm-up policy	Consider axis temperature and warmup time
Axis No.	J1:R, J2: *, J3: *, J4: S, J5: S, J6: *

Parameter	Value
Axis temperature threshold (°C)	10
Warm-up time (min)	10
Initial warm-up speed (%)	75
Re-warm up interval (min)	20

1) The temperature of J1 is detected. If the temperature is greater than or equal to 10°C, the automatic warm-up is not performed. The robot motion speed is the same as when this function is not enabled. Otherwise, proceed to the next step.

2) The robot starts running at a 75% initial warm-up speed. The speed will be increased evenly to the global speed set within 10 minutes. If the temperature of J1 reaches 10°C within 10 minutes, the robot switches to run at the global speed set.

3) Run the robot for four minutes and then stop it. If the robot is started again within 20 minutes, the robot continues to warm up for six minutes starting from the speed it was stopped. If the robot is started again after 20 minutes, it will warm up for ten minutes again starting from the 75% initial warm-up speed.



- Automatic warm-up takes effect only when in automatic mode and when the motion instruction is executed.
- When automatic warm-up is performed, a warm-up status prompt will be displayed.
- During automatic warm-up, the robot increases the speed evenly every 30 seconds and reaches the global speed set within the configured warm-up time.
- When the "Consider axis temperature and warm-up time" option is selected, ensure that the robot supports the temperature protection function and has finished temperature calibration.
- After you save the warm-up parameter settings, the robot starts warm-up with the parameters set.
- User, administrator and manufacture all have access to set the warm-up parameters.
- The external axis unit does not support the automatic warm-up function.
- This function does not support control via bus and API.

10.4 Peripheral Configuration

10.4.1 Fieldbus Switch Settings

Fieldbus switch settings are divided into two types: robot as "Slave" or "Master".

10.4.1.1 Slave

You can switch on or off five types of buses including Modbus, EtherNet/IP, EtherCAT, MC, and PROFINET, and configure the bus parameters.

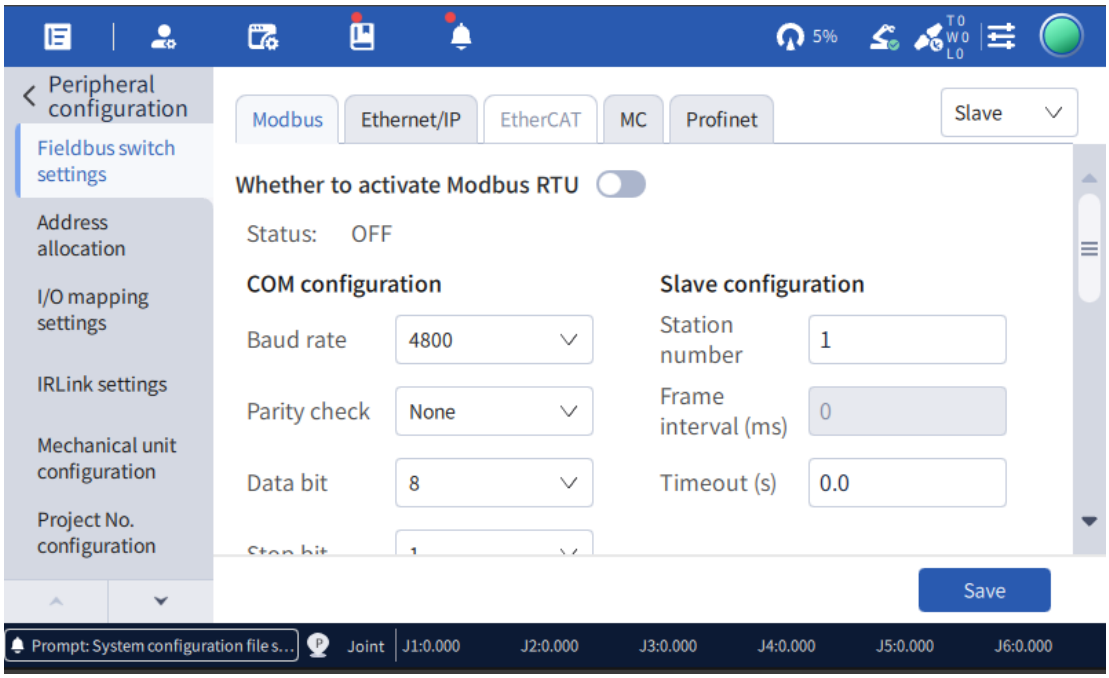
> **CAUTION**
>
> Only one fieldbus can be activated at a time.

(1) Modbus settings

- Modbus-RTU and Modbus TCP functions of the robot controller can be enabled simultaneously without conflict.
- Regardless of Modbus-RTU or Modbus TCP, the robot controller can only be configured as Modbus slave, not as Modbus master on teach pendant and InoRobotLab programing platform.

Steps

Click "Settings" > "Peripheral configuration" > "Fieldbus switch settings" > "Modbus", as shown below.



- Toggle the switch and click "Save" to turn on or off the Modbus-RTU and Modbus TCP functions.
- In the Modbus-RTU function, the frame interval depends on the baud rate. The larger the baud rate, the smaller the frame interval. If the baud rate is changed, the frame interval will be automatically changed accordingly.
- In the Modbus TCP function, the port number is fixed to 502 and the frame interval can be set as needed.
- The order of toggle switch operation and parameter setting is not limited. The settings are saved to the controller only when you click the "Save" button.

Results

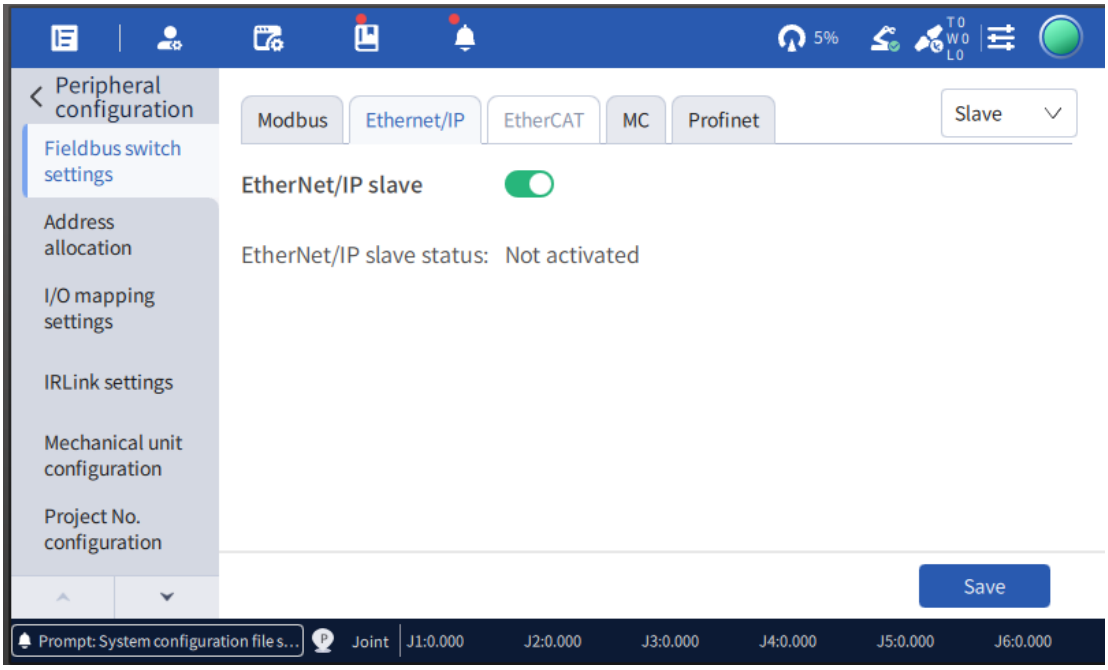
After the configuration is complete, you can verify the configuration through communication with the Modbus client.

Note

For details on the use of Modbus functions, see "Modbus User Guide of Inovance Robot" or contact the manufacturer.

(2) EtherNet/IP settings

You can enable or disable the EtherNet/IP slave function by toggling the switch and clicking the "Save" button. The interface also displays the port number and connection status of the slave. When a master is connected, the indicator is green. The IP address and port number of the master are displayed.



For details on the use of EtherNet/IP functions, see "EtherNet/IP User Guide of Inovance Robot" or contact the manufacturer.

(3) EtherCAT settings

The EtherCAT function is optional. It can only be used on controllers that support the EtherCAT function.

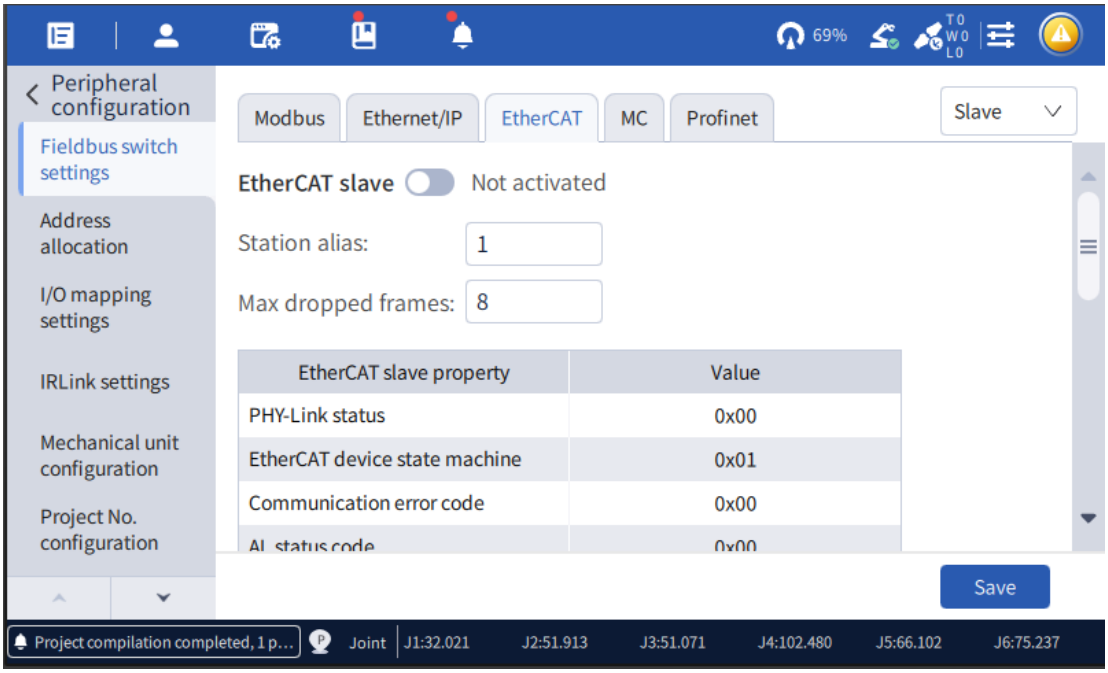
- You can enable or disable the EtherCAT slave function and configure the related parameters.
- You can enable or disable the EtherCAT slave function by toggling the switch and clicking the "Save" button. You can also configure the alias of the slave and the maximum number of dropped frames.
- The interface also displays the connection status of the EtherCAT slave. When no connection exists, the indicator is red. When a master is connected, the indicator is green.

The following table lists the properties of the EtherCAT slave:

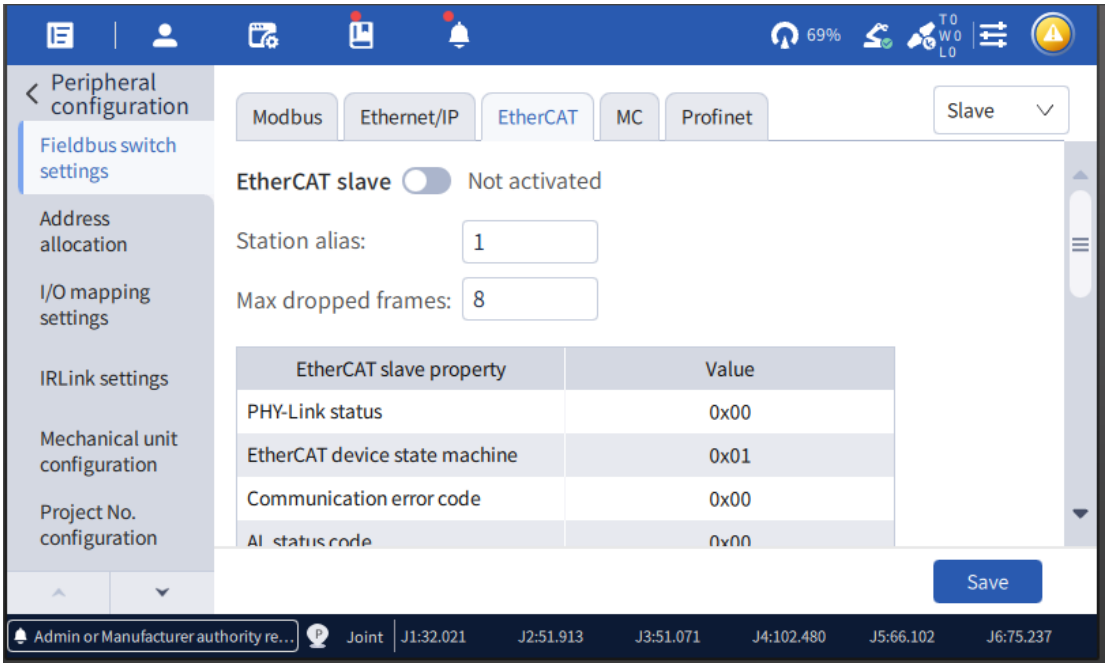
EtherCAT slave property	Description
PHY-Link status	The Link status of the port, where a value of 0 for the corresponding bit indicates LinkDown, and 1 indicates LinkUp. Bit0: status of port 0 Bit1: status of port 1
EtherCAT device state machine	Actual slave status 1: Init (initialization status) 2: PreOP (pre-operational status) 4: SafeOP (safe operational status) 8: OP (operational status)

EtherCAT slave property	Description
Communication error code	Communication error code, uploaded by MCU. The controller triggers the corresponding alarm if communication error code exists.
AL status code	Application layer status code, uploaded by MCU
Port0 invalid frame count	Invalid frame count received on port 0, uploaded by MCU
Port0 RX error count	Error frame count received on port 0, uploaded by MCU
Port1 invalid frame count	Invalid frame count received on port 1, uploaded by MCU
Port1 RX error count	Error frame count received on port 1, uploaded by MCU
Port0 forwarded RX error count	Forwarded error frame count on port 0, uploaded by MCU
Port1 forwarded RX error count	Forwarded error frame count on port 1, uploaded by MCU
ECAT processing unit error count	Data frame processing unit error count, uploaded by MCU
PDI error count	PDI error count, uploaded by MCU
Port0 link loss count	Link loss count on port 0, uploaded by MCU
Port1 link loss count	Link loss count on port 1, uploaded by MCU
Sync lost count	Accumulated frame loss count on slave, uploaded by MCU
Site name configured by master	MCU uploads the site name configured by the master.
ESC Version	ESC version information, uploaded by MCU
XML version	XML version information, uploaded by MCU
Software version	Software version number, uploaded by MCU

1. After the alias is modified, the robot needs to be powered on again to make the modification take effect.

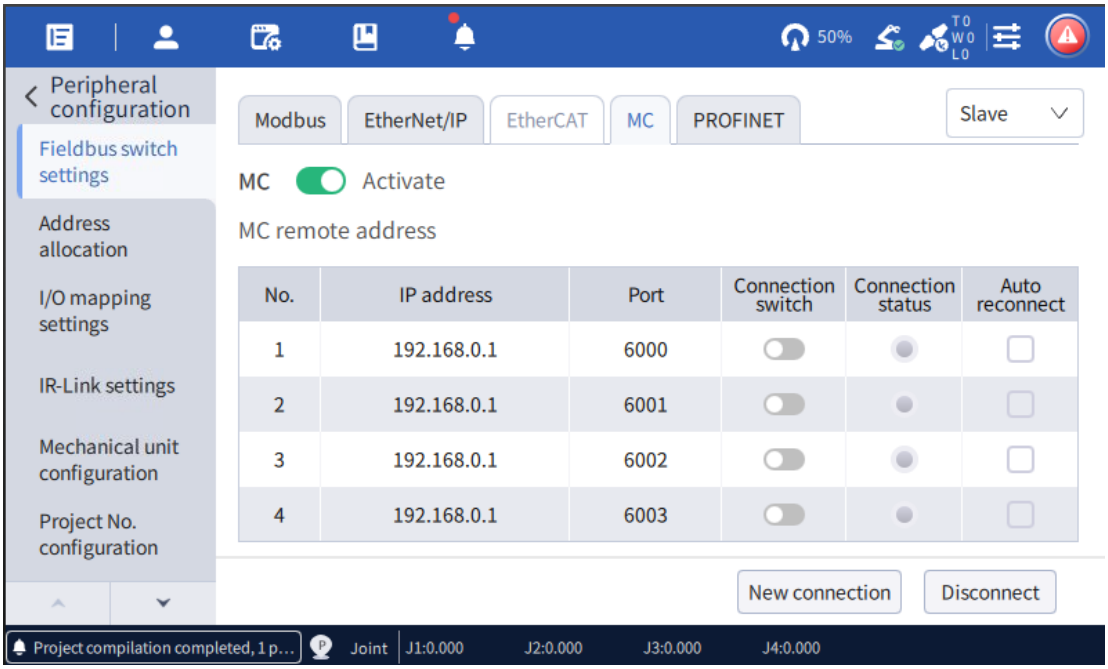


2. **For controllers with safety function, the interface has options for data link enhancement switch and XML reset switch. For both switches to take effect, the robot needs to be powered on again.**



(4) MC settings

You can activate the MC function of the robot controller. The robot acts as a slave.



Steps

- As shown above, select a connection item in the list to establish a connection or break the current connection.
- In contrast to the previous three protocols, the MC function can be enabled or disabled directly through the toggle switch. The interface displays the IP address, port number, connection switch, connection status, and automatic re-connection switch of the four masters. You can establish a connection to the master by entering the IP address and port number of the master and then clicking the "New connection" button.

Select a connection item and click "Disconnect" button to disconnect the controller from the external MC.

CAUTION

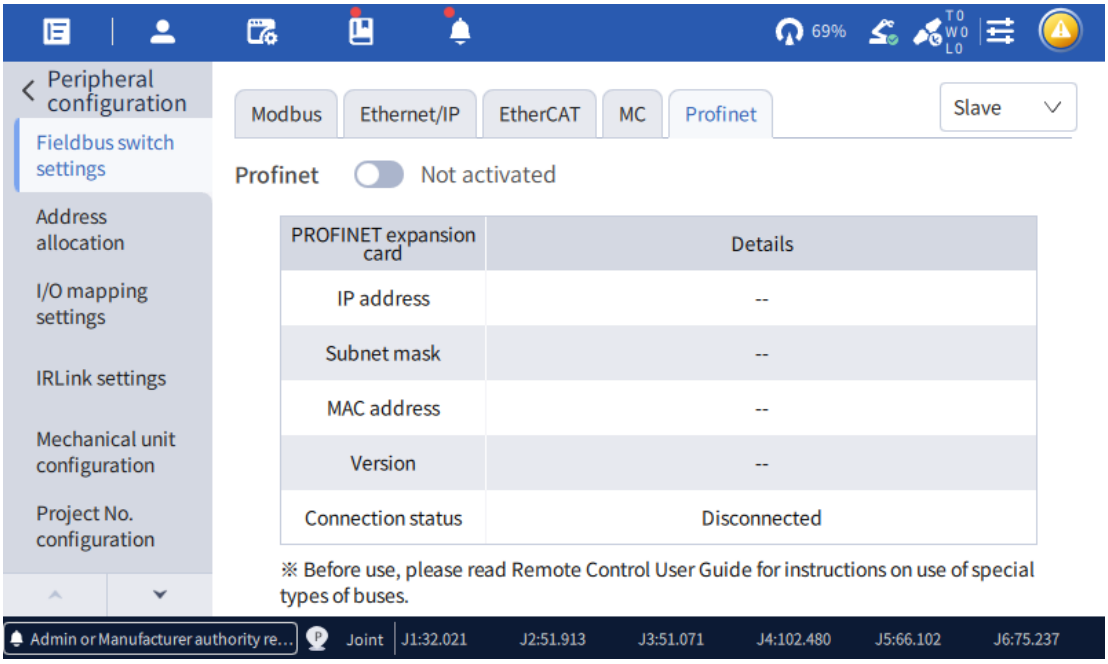
After the master connection is successful, the IP and port numbers of the master cannot be modified. The auto re-connect option can be checked only when the master connection is successful. When the auto re-connect option is checked, the IP address, port number, and connection switch cannot be modified.

For details on the use of MC functions, see the "MC Communication Guide between Mitsubishi PLC and Inovance Robot" or contact the manufacturer.

(5) PROFINET settings

To use this function, the controlled must be installed with an external PROFINET slave expansion card.

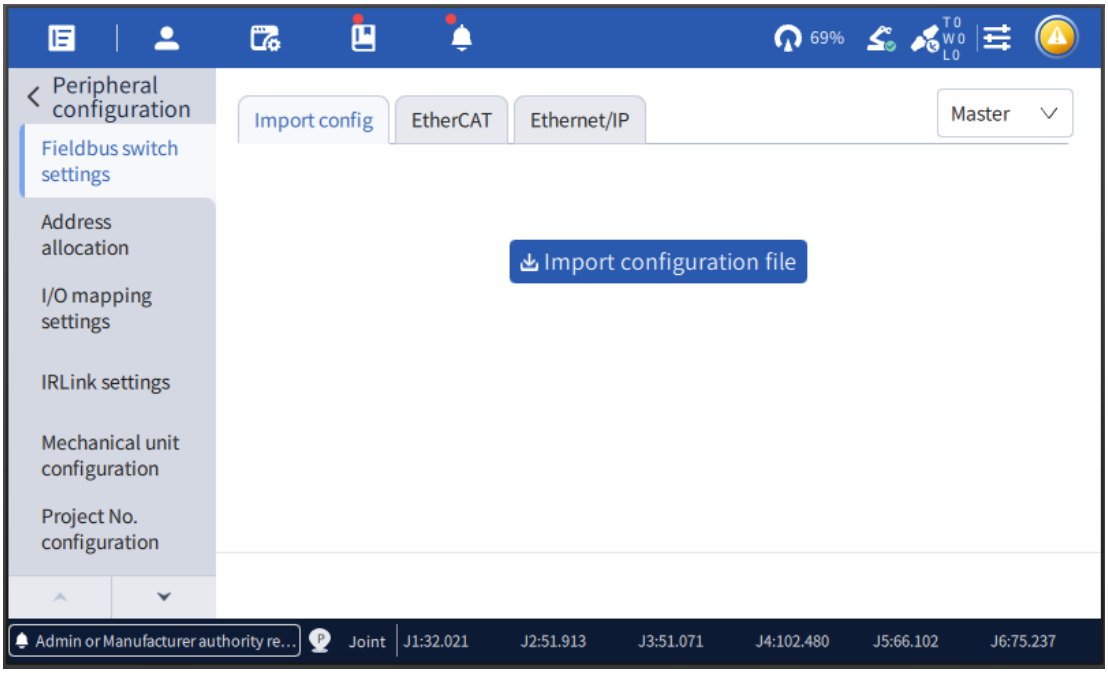
- It allows you to configure the PROFINET slave function of the robot.
- You can enable or disable the PROFINET slave function by toggling the switch and clicking the "Save" button.
- The interface also displays the IP address, subnet mask, MAC address, software version number, and master connection status of the PROFINET slave expansion card. When not connected, the status is displayed as "Disconnect". When a master is connected, it displays "Connected".

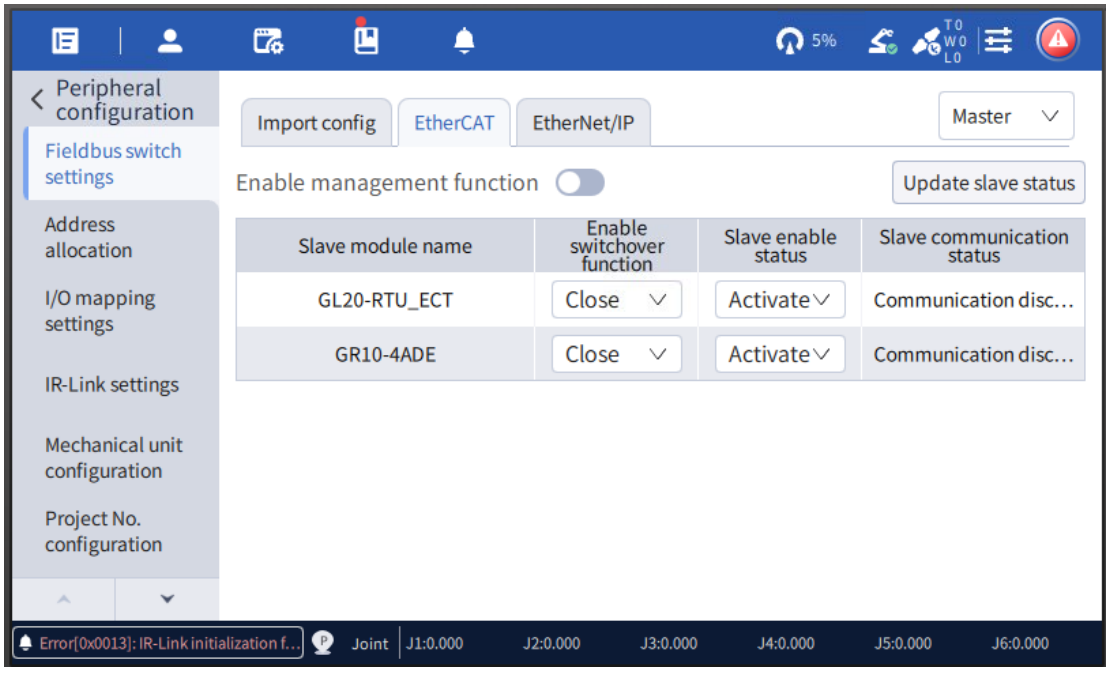


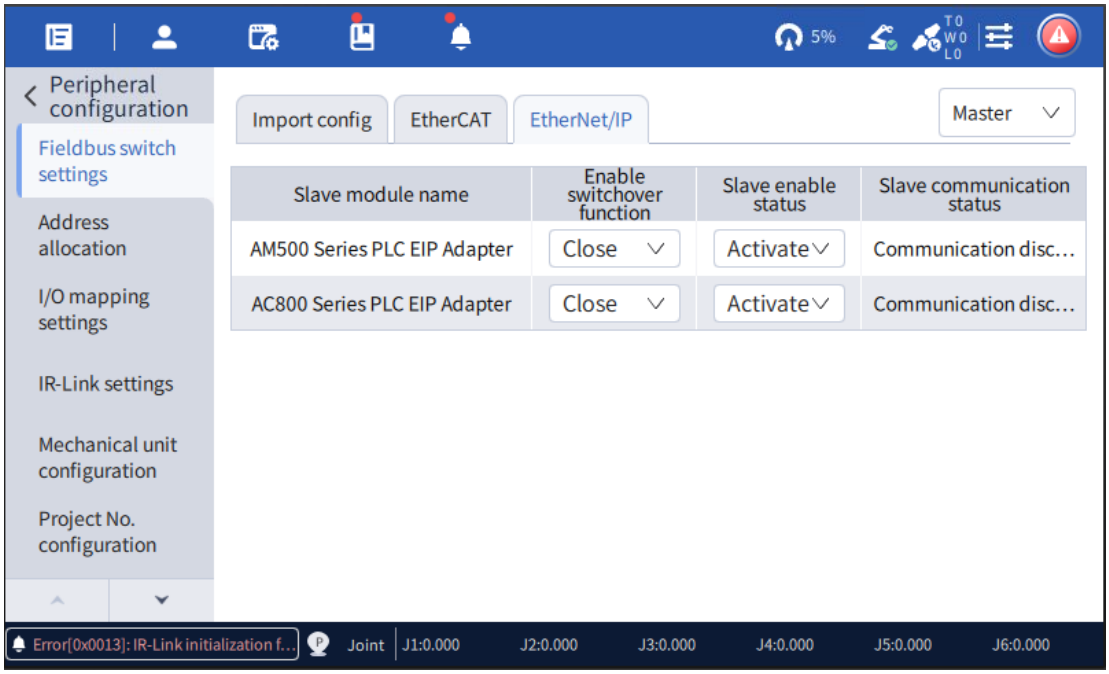
For details on the use of PROFINET functions, see the "PROFINET Communication Guide between Siemens PLC and Inovance Robot" or contact the manufacturer.

10.4.1.2 Master

When the robot acts as the master, currently only three functions are available, including the "Import configuration file", "EtherCAT slave status management", and "EtherNet/IP slave status management" functions.







(1) Import configuration file

This function is used to import the configuration exported from the InoRobotLab software after setup, through a USB drive connected to the teach pendant into the controller for use. The configuration can include CAN bus configuration (CANopen or DeviceNet), EtherCAT bus configuration, and EtherNet/IP bus configuration.

(2) EtherCAT slave management function

This page enables the slave management function of the EtherCAT bus master. To use this function, the enable management function must be activated, and all slave modules must be online. After a successful enable, the controller and all slave modules need to be restarted.

- Slave module name: Indicates the name of the slave module.
- Enable switchover function: Indicates whether the current slave supports status management (Open/Close);
- Slave enable status: Indicates the current management status of the module (Activate/Disable);
- Slave communication status: Indicates the communication status of the slave, (Disconnected/Init/Pre-OP/Safe-OP/OP/Communication separated).

CAUTION

- Activate: The EtherCAT master normally monitors and exchanges data; if a slave status is incorrect or offline, the alarm will be triggered;
- Disable: Shield slave status error/offline alarm, stop data exchange

(3) EtherNet/IP master

Currently, the teach pendant does not support the EtherNet/IP master function. Use InoRobotLab for configuration.

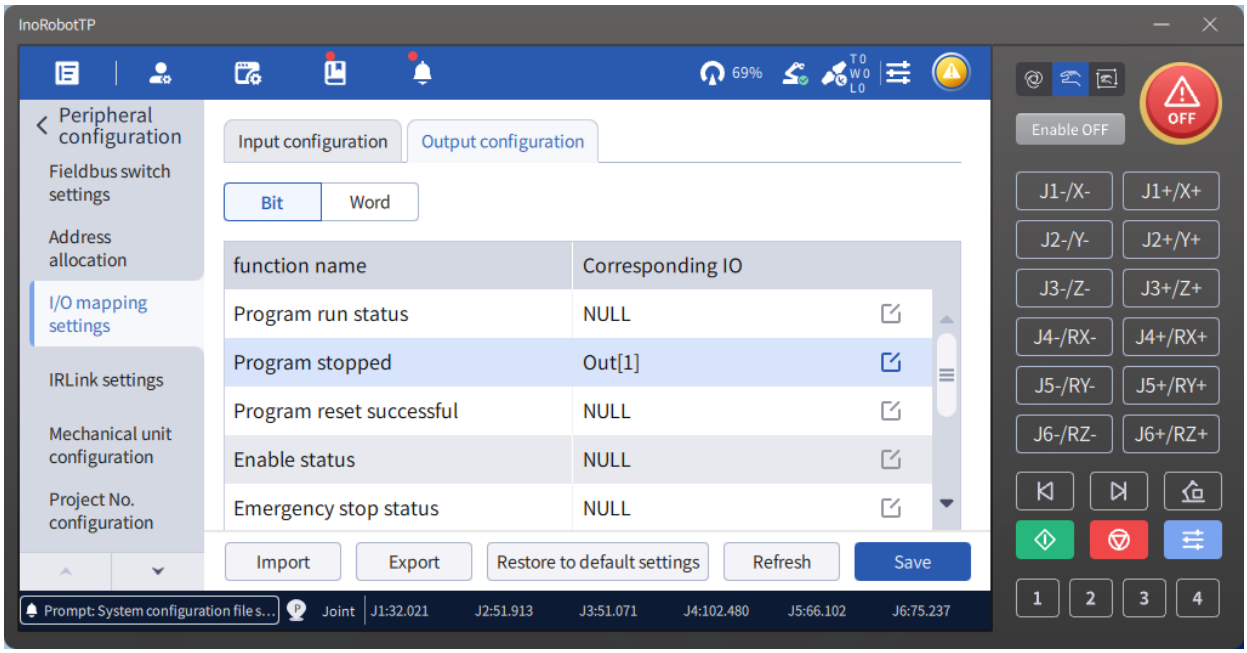
10.4.2 I/O Mapping

Remote I/O control allows you to control program start/stop, reset, and emergency stop of the robot via I/Os (including digital I/Os, fieldbus I/Os, and memory I/Os). You can also monitor the program running and fault state of the robot.

The I/O mapping is to bind some commands of the remote I/O control function to the input signals (In) of the robot, and the status of the robot to the output signals (Out). In this way, you can control the robot using the input signals and monitor the robot using the output signals.

Steps

Click "Settings" > "Peripheral configuration" > "I/O mapping settings", as shown below.



To modify the I/O mapping, click on an I/O. In the pop-up dialog, enter the I/O number. If you do not want to configure any I/O, enter "NULL".

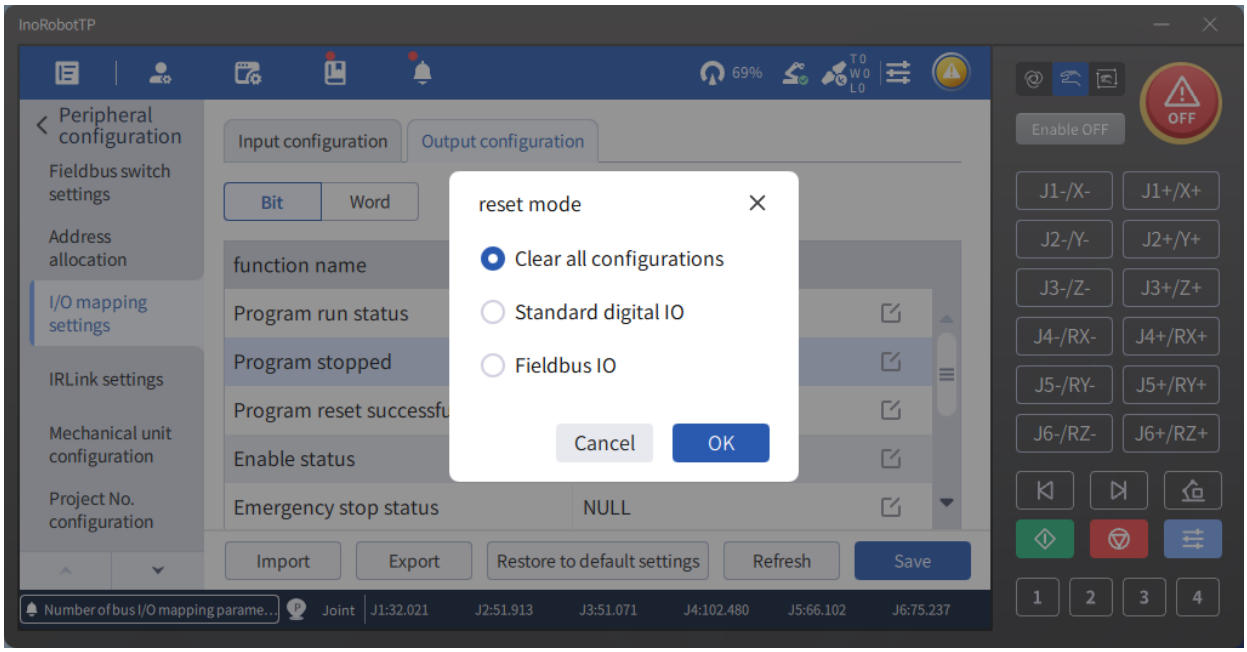
Click "Export" to export the current I/O mapping configuration in a dat file. Click "Import" to import the dat file and obtain the I/O mapping configuration information when needed.

Click the "Refresh" button to refresh the I/O mapping data on the current interface.

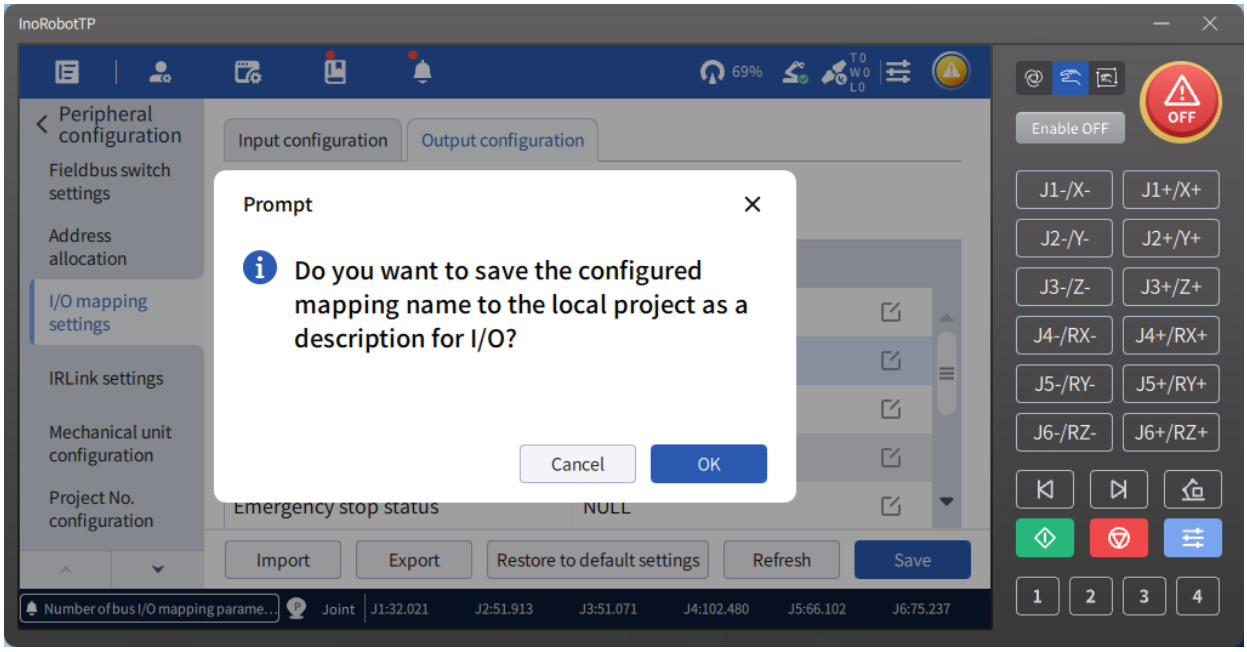
After modification, click the "Save" button to complete the configuration.

The default I/O mapping is empty. To facilitate user operation, two sets of default I/O configurations are provided. You can select the default I/O configurations by clicking the "Restore to default settings" button. One

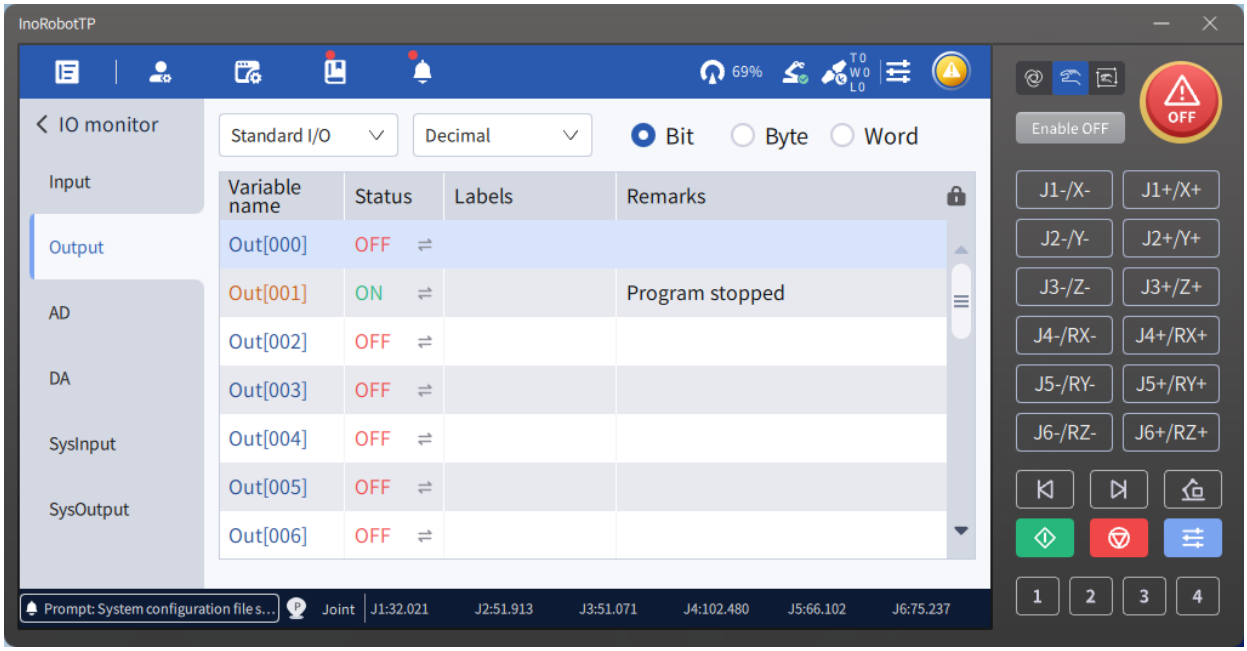
group is standard digital I/Os and the other group is fieldbus I/Os. You can also choose to "Clear all configurations" the existing setting values.



If you select "Standard digital IO" or "Fieldbus IO", the default I/O mapping is generated. You can adjust the default mapping as needed and click the "Save" button. When a project is currently open in InoRobotLab programming platform, a pop-up prompt displays after you click the "Save" button.



After mapping is complete, the corresponding signals can be seen in the "IO monitor" page. The monitoring interface shows the mapped I/O in orange.



The teach pendant only supports the I/O mapping configuration for the following functions:

I/O function		Description
Input (Used for external control)	Start program	Start the current program in the remote I/O control mode, active on rising edge
	Stop program	Stop the running program in the remote I/O control mode, active on rising edge
	Program reset	Reset the robot program in the remote I/O unit mode, active on rising edge (Program can be reset only when in stopped state.)
	Enable	Enable the robot in the remote I/O unit mode, active on both rising (enable) and falling (disable) edges
	Emergency stop	Impose emergency stop on the robot in the remote I/O unit mode. ON for non-emergency stop; OFF for emergency stop.
	Clear alarm	Clear the alarm in the remote I/O unit mode, active on rising edge
	Speed increase	Increase the global operating speed of the system by 5% in the remote I/O unit mode, active on rising edge
	Speed decrease	Decrease the global operating speed of the system by 5% in the remote I/O unit mode, active on rising edge
	Homing	Return the robot to the work origin 0 in the remote I/O unit mode, active on rising edge
	Manual/Auto mode	In Remote I/O control mode, switch the robot between the auto and manual modes. 0 for manual mode, and 1 for auto mode.

I/O function		Description
Output (Used for display status)	Program running state	Under any control permission, the specified I/O output an ON signal when task 0 is in running state
	Program stop state	Under any control permission, the specified I/O output an OFF signal when task 0 is in stopped state
	Program reset successful state	Under any control permission, the specified I/O output an ON signal when the program is set successfully
	Robot enable state	Under any control permission, the specified I/O output an ON signal when the system is enabled
	Robot emergency stop state	Under any control permission, the specified I/O output an ON signal when the system is in the emergency stop state
	System fault state	Under any control permission, the specified I/O output an ON signal when the system stops at an alarm
	System warning state	Under any control permission, the specified I/O output an ON signal when a warning occurs in the system
	Servo fault state	Under any control permission, the specified I/O output an ON signal when the servo drive reports a fault
	Servo warning state	Under any control permission, the specified I/O output an ON signal when a warning occurs on the servo drive
	Safety door warning state	Under any control permission, the specified I/O output an ON signal when a safety door warning occurs
	System startup completed state	Under any control permission, the specified I/O output an ON signal when the system is in the startup completed state
	Robot in motion state	Under any control permission, the specified I/O output an ON signal when the robot is in moving state
	Robot motion complete state	Under any control permission, the specified I/O output an ON signal when the robot finishes the direct motion command
	Bus communication heartbeat signal	Under any control permission, the ON-OFF state switchover occurs continuously as long as this I/O is configured. The default switchover interval is 1s.

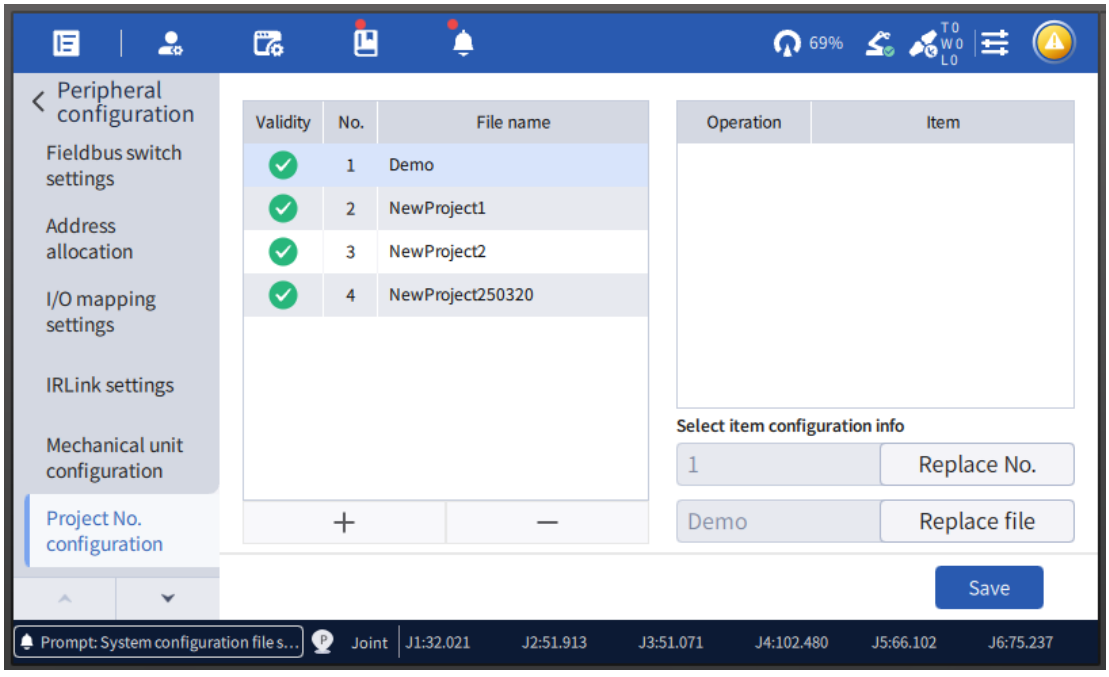
CAUTION

- If the message "Current I/O value is already used" is displayed when an I/O is selected, but the function bound to this I/O cannot be found on the I/O mapping interface, it indicates that this I/O has already been configured to a certain function through InoRobotLab. You can check the I/O configuration on InoRobotLab.
- The input signals in the I/O mapping configuration take effect only when the control permission is granted to the remote I/O unit. In contrast, the output signals can indicate any robot states except the motion complete state, regardless of to which device the control permission is granted.
- The output port selected in the I/O mapping will be occupied by the system and can no longer be controlled through the monitor panel or through the instructions.
- The run and stop state in the output configuration refer to the run and stop of the program, rather than the start and stop of robot motion. Once started, the robot remains in the running state until the stop command is received or a fault is encountered.
- After the robot is placed into emergency stop through an In signal, if you switch the robot control to the teach pendant, the emergency stop will be automatically released.
- I/O occupancy is not checked for I/O mapping.

For the configuration of standard digital I/O mapping and fieldbus I/O mapping, see section 3.1.3 of the "Remote Control User Guide".

10.4.3 Project Number Configuration

The program number configuration is to map the serial number and the project, which is used for the bus switch function.



- **I/O mapping settings**

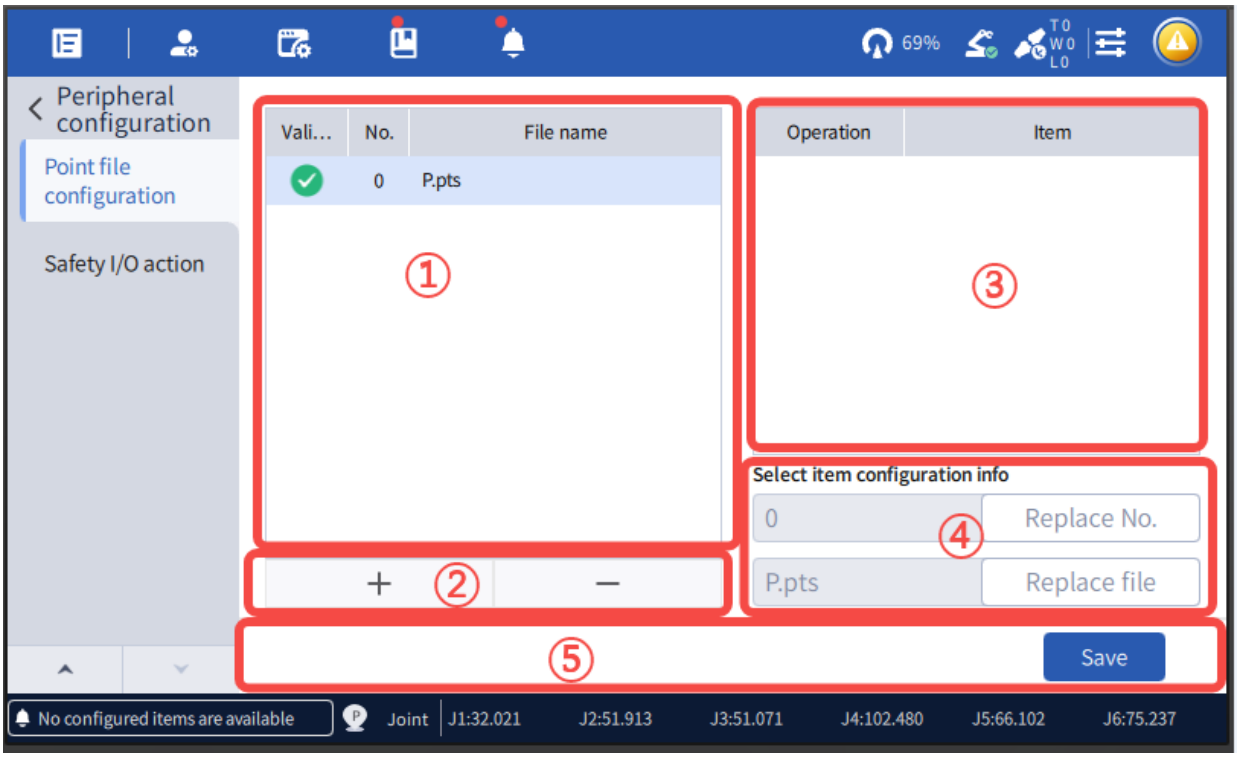
For details, see section 3.2.4 of the "Remote I/O User Guide".

- **Configuration modification**

See 10.4.4 Point File Configuration.

10.4.4 Point File Configuration

It allows you to bind a serial number to a point file to create a mapping between the two. At most 128 mappings are supported. In this way, you can switch the point files, or read/write point data of a specified point file via the fieldbus.



Position point file configuration page introduction

No.	Description
①	Configured item list : The configuration item is valid. : The configuration item is invalid. The cause is usually that the corresponding point file has been deleted or renamed.
②	Add and Delete buttons : Add button : Delete button
③	Optional item list
④	The configuration information of the selected item, and the replace button for corresponding information
⑤	Functional buttons area, used for saving interface settings

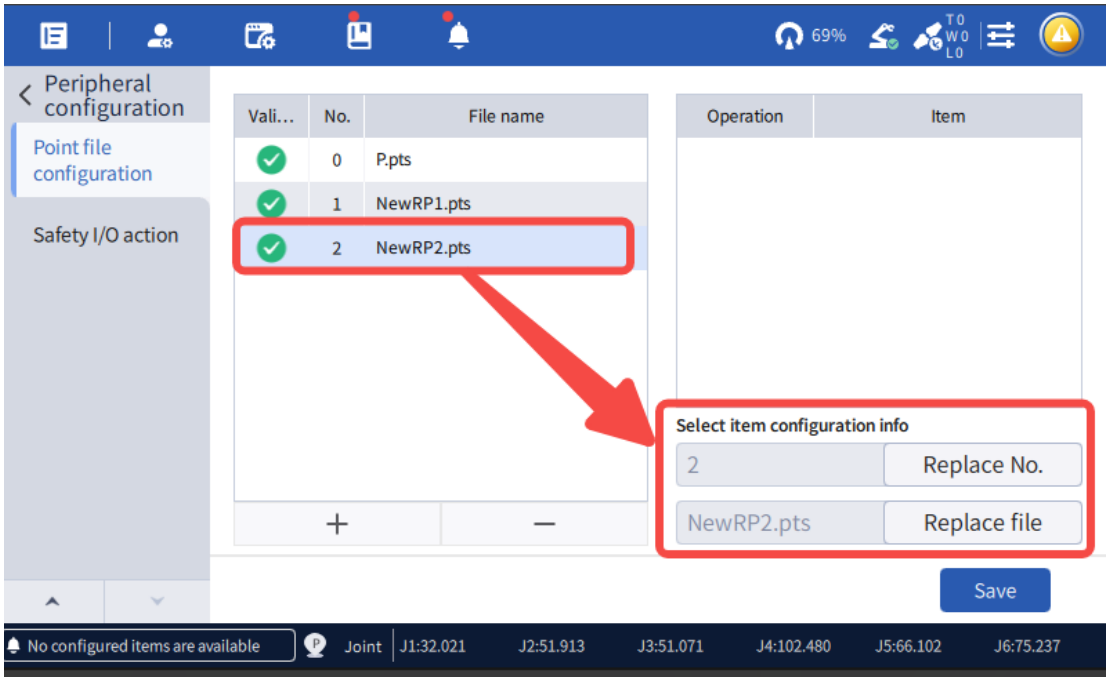
- **I/O mapping settings**

For details, see section 3.2.3 and "Appendix 2: Extended Remote Control Command List" in the "Remote I/O User Guide".

- **Configuration modification**

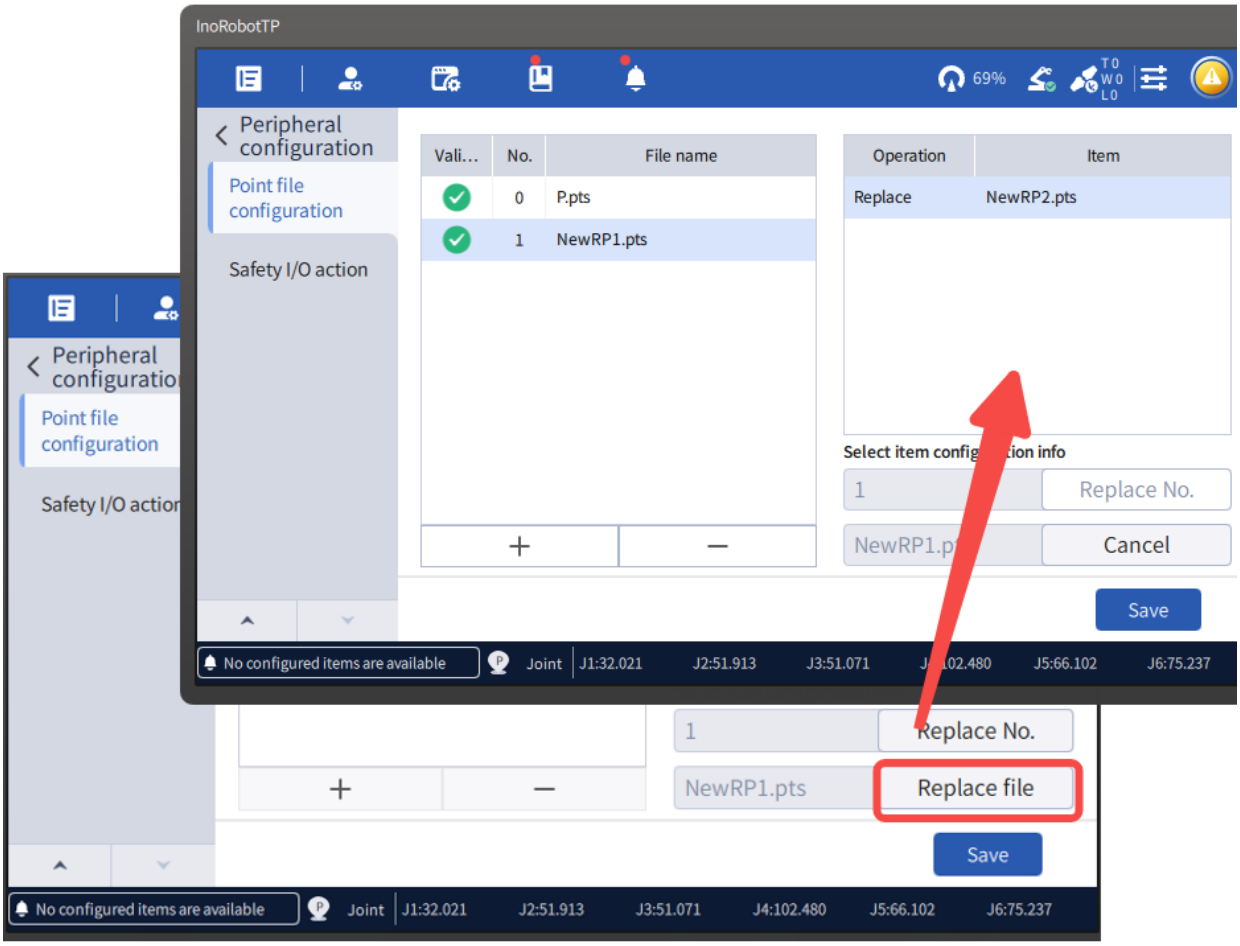
1. Select any line in the configured item list except for P.pts. The data in the configuration information area will refresh to display the data of the selected item, and the "Replace No." and "Replace File" buttons will be enabled.

> **CAUTION**
>
> The configuration item corresponding to P.pts is the default configuration item and cannot be modified or deleted.

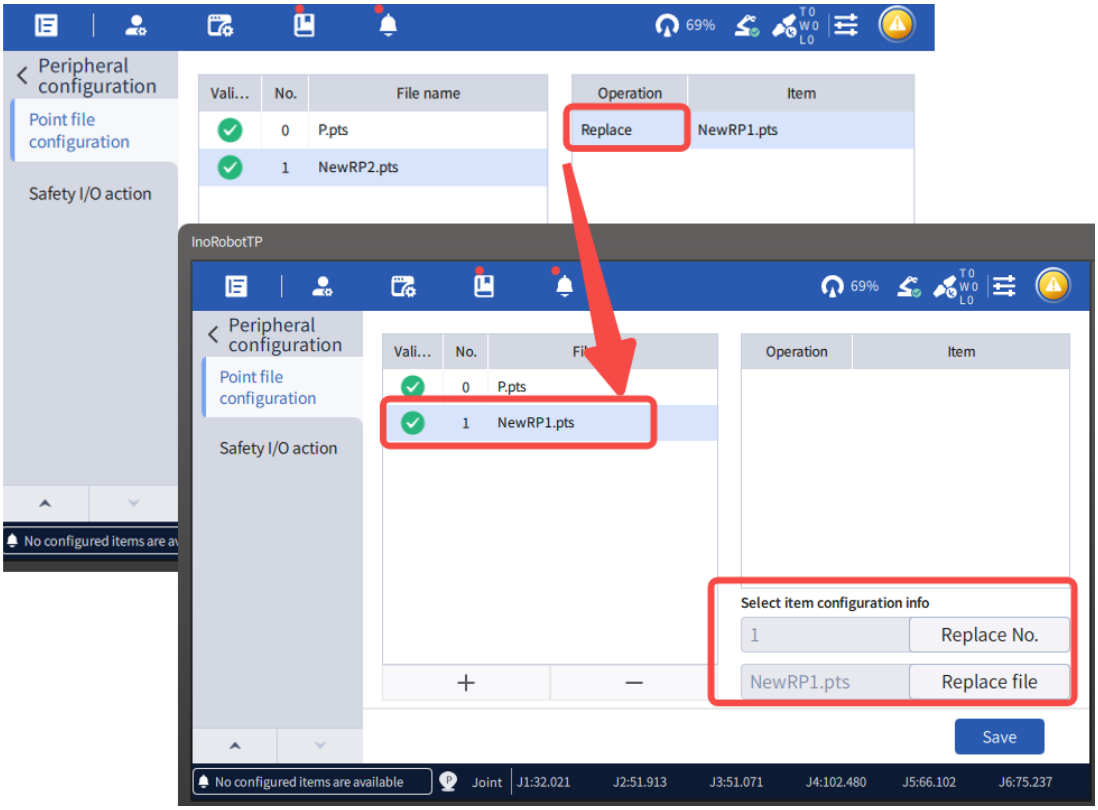


2. Click "Replace No.". The data in the optional item list will refresh to display the serial numbers that have not been configured.

Click "Replace file". The data in the optional item list will refresh to display the position point files that have not been configured.



3. In the optional items list, click "Replace" to replace the corresponding data of the currently selected item.



4. Click "Save" to save the current modifications and synchronize them to the controller.

10.4.5 IR-Link Settings

IR-Link is a customized communication protocol used by the IMC100 series expansion modules. This protocol is used to manage the networking pattern and parameter settings of expansion modules such as I/O, AD, DA, and encoder. Configuring IR-Link on the teach pendant requires IR-Link configuration permission.

IR-Link configuration specifications:

- For the IRCB10 series controllers, you can add I/Os only through the expansion modules.
- Each RTU (IR-Link communication expansion module) has power consumption limits. The overall IR-Link configuration is subject to resource limits.
- For the IRCB300, IRCB100 series controllers, you can add I/Os through expansion cards and expansion modules.
- Up to four expansion cards are supported, with no power consumption limits. The overall IR-Link configuration is subject to resource limits.
- For the IRCB500 series controllers, you can add I/Os sequentially only via expansion cards (up to four expansion cards are supported).



The expansion cards supported by the IRCB500 series controllers are different from those supported by the IRCB300 and IRCB100 series controllers!

(1) Power consumption specifications for the RTU

Each RTU can deliver 15 W power. The following table describes the power consumption of the respective modules.

Type	Power consumption
IMC100-0808-ETND	1.44 W
IMC100-1600-END	1.25 W
IMC100-0016-ETPD	1.25 W
IMC100-0016-ETND	1.25 W
IMC100-4DA	1.44 W
IMC100-8AD	2.88 W
IMC100-2ENID	2.88 W

Make sure the sum of the power consumed by the modules after each RTU does not exceed the power capacity of the RTU. If more modules are required, add a RTU and then cascade the modules after the RTU.

(2) Resource specifications

The total resources supported by the IMC100 are limited. Refer to the table below to configure the modules so that the total number of channels of the modules does not exceed the maximum capacity of the IMC100.

Target	Number of digital inputs	Number of digital outputs	Number of analog inputs	Number of analog outputs	Number of encoder channels
IMC100 capacity	64	64	16	16	8
Channels occupied per 1616 module	16	16	-	-	-
Channels occupied per 0808 module	8	8	-	-	-
Channels occupied per 1600 module	16	-	-	-	-
Channels occupied per 0016 module	-	16	-	-	-
Channels occupied per 8AD module	-	-	8	-	-
Channels occupied per 4AD module	-	-	4	-	-
Channels occupied per 4DA module	-	-	-	4	-
Channels occupied per 2ENC module	-	-	-	-	2

Code	Expansion module	Expansion card	Drive-control integrated expansion card
0808	IMC100-0808-ETND	-	-
1600:	IMC100-1600-END	IRCB-1600END-BD	IRCB500-1600END-BD
0016	IMC100-0016-ETPD IMC100-0016-ETND	IRCB-0016ETND-BD IRCB-0016ETPD-BD	IR-CB500-0016ETND-BD
8AD	IMC100-8AD	-	-

Code	Expansion module	Expansion card	Drive-control integrated expansion card
4AD	-	IRCB-4AD-BD	-
4DA	IMC100-4DA	IRCB-4DA-BD	-
2ENC	IMC100-2ENID	IRCB-2EN1D-BD	IRCB500-2ENID-BD

1616: IRCB-1616ETND-BD, standard inside the IRCB300 series controllers.

CAUTION

- For the IRCB300 series controllers, the system is equipped with one 1616 module as standard.
- For the IRCB100-6AT series controllers, the system is equipped with the following three modules as standard: 1616, 0016, 1600.
- For the IRCB500 drive-control integrated controllers, the system does not have a standard IR-Link module.

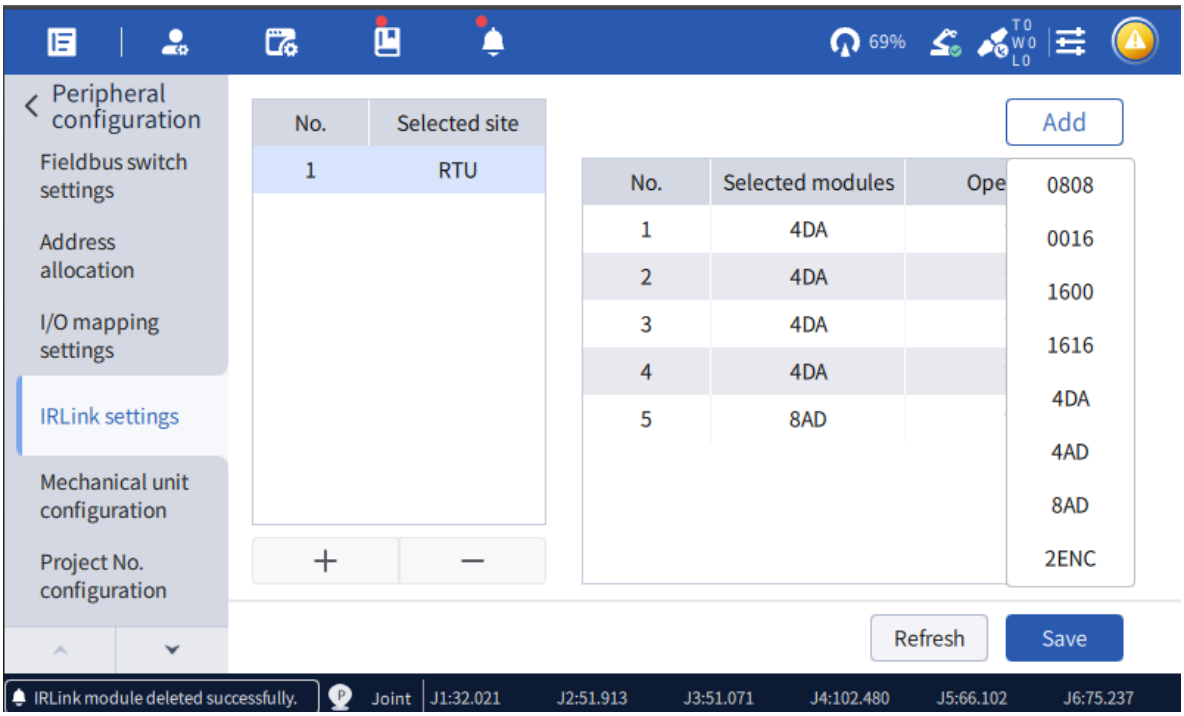
IR-Link configuration method (software)

After connecting the hardware device, you need to configure the IR-Link in the teach pendant software.

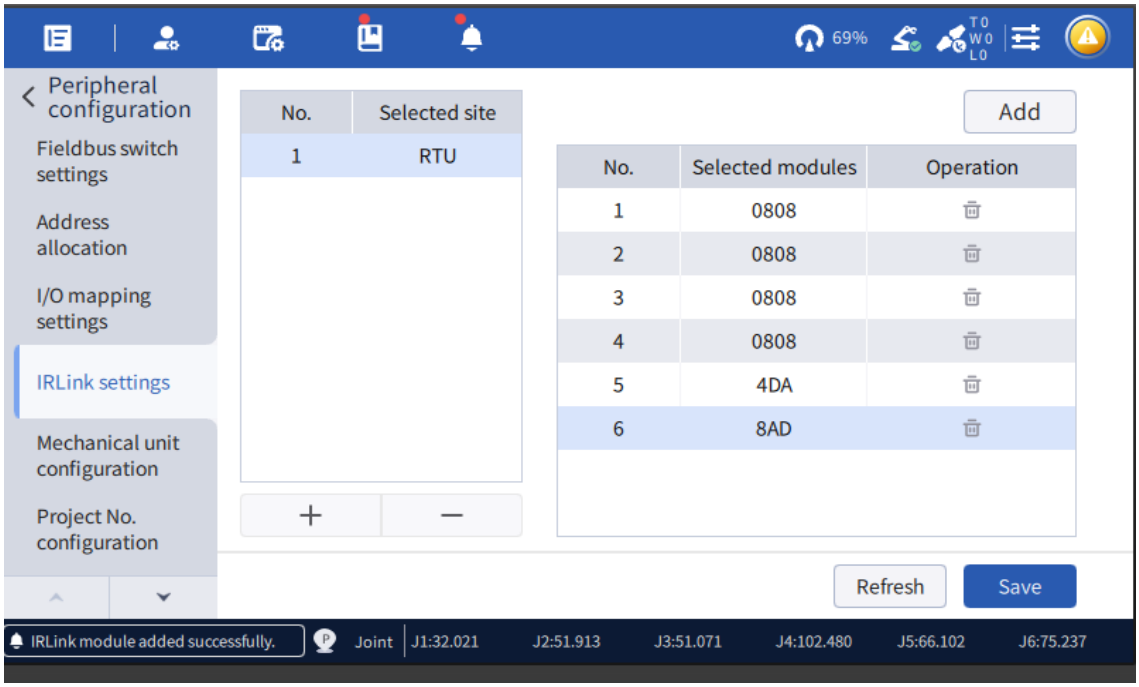
Click the + "Add" button on the left side of the page to generate an RTU. The details of the added RTU are displayed on the right side. You can add up to five RTUs. Click the "Delete" button next to the "Add" button to delete the currently selected RTU.

Click the Add "Add" button in the upper right corner, to pull out the drop-down list with eight options: 0808, 0016, 1600, 1616, 4DA, 4AD, 8AD, 2ENC. Click to select a module to generate. Click the button to delete the corresponding module.

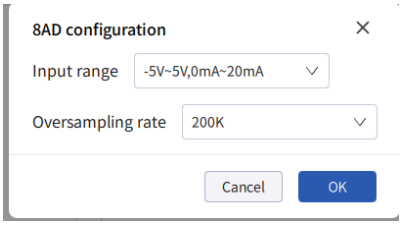
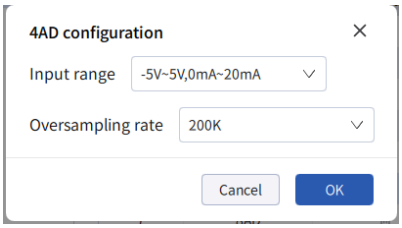
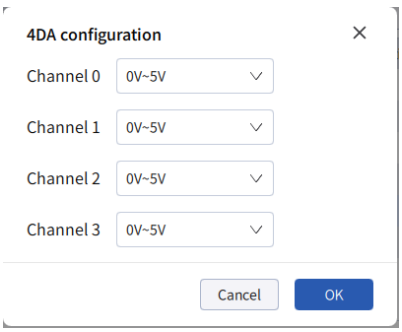
Add the expansion module according to actual connections.

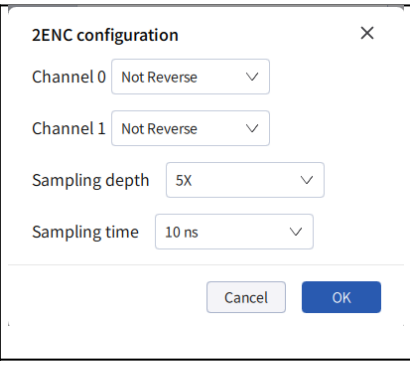


For example, add four 0808s, one 4DA, and one 8AD as shown in the figure below.



For the 8AD, 4AD, 4DA, and 2ENC modules, double-click the item to enter the configuration page.

Module	Configuration page	Configuration parameter
8AD (4-channel voltage, 4-channel current analog conversion input acquisition expansion module)		You can configure the analog input range and the oversampling rate. The same configuration applies to all channels. The range is -5V-5V, 0-20mA, and -10V-10V, 0-40mA. The over-sampling rate affects the sampling accuracy of the input value. The smaller the oversampling rate, the higher the sampling accuracy.
4AD (2-channel voltage, 2-channel current analog conversion input acquisition expansion module)		Input range: -5V-5V, 0-20mA; -10V-10V, 0-20mA. Oversampling rate: 3.125K, 6.25K, 12.5K, 25K, 50K, 100K, 200K. Recommended: 3.125K
4DA (4-channel voltage/current analog conversion output expansion module)		You can set the range of analog output for the four channels.
2ENC		You can set whether to reverse the channels and the signal filter time.

(2-channel differential input incremental encoder acquisition expansion module)		The filter time is the product of the sampling depth and sampling time. The longer the filter time, the lower the rated signal input frequency.

Results:

After the configuration, click the "Save" button at the lower right of the interface to save the configuration.

After saving, you need to reboot the controller to initialize communication. You can check whether the number of resources displayed on the I/O monitor and AD monitor pages is the same as the IR-Link configuration made and verify if the configuration takes effect.

References:

For the IR-Link configuration for IRCB10 series controllers, see the "IMC100 Series Controller Local Expansion Module User Guide".

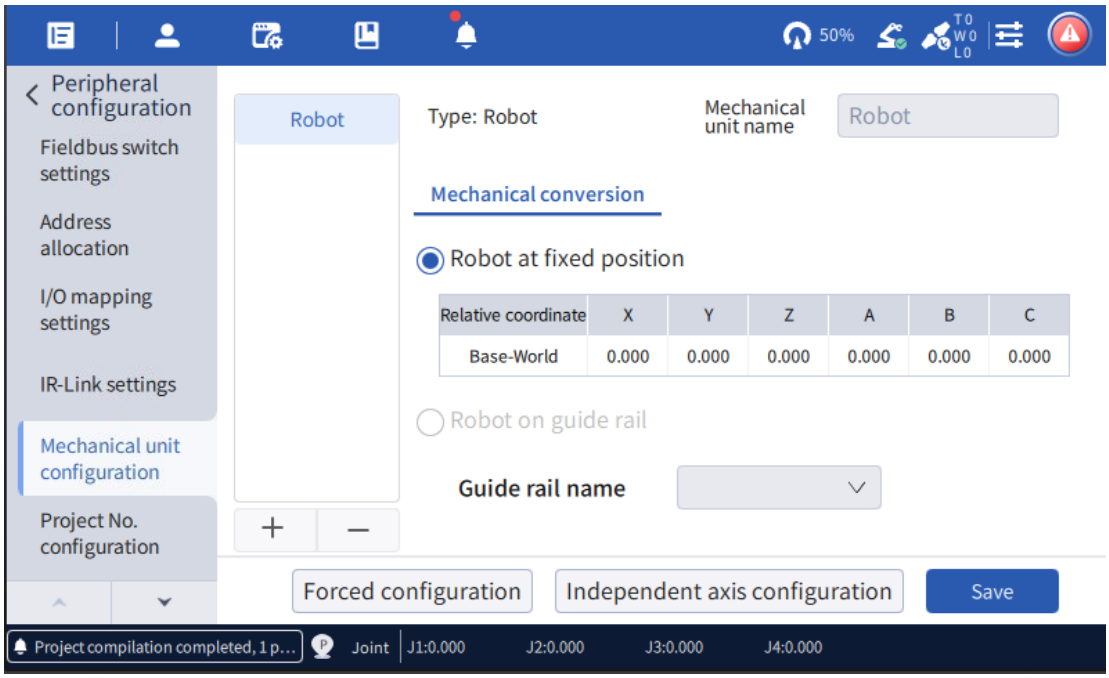
For the IR-Link configuration for IRCB300 series controllers, see the "IRCB300 Series 4-Axis Robot Controller User Guide".

For the IR-Link configuration for IRCB300 series controllers, see the "IRCB300 Series 6-Axis Robot Controller User Guide".

For the IR-Link configuration for IRCB500 series controllers, see the "IRCB500 Series Robot Controller User Guide".

10.4.6 Mechanical Unit Configuration

It allows you to configure the external axis. For details, see the external axis configuration in this section.



Forced configuration: Update and replace the external axis configuration of the mechanical unit into the master bus EtherCAT function.

10.4.6.1 External Axis Linked Motion

The external axis is linked to the robot, starting and stopping together with the robot axes simultaneously. However, the external axis does not satisfy the relative spatial positional relationship with the robot axes. It can be understood that the robot and the external axes start and stop simultaneously, but move independently. Currently, the external axis function is only supported by Inovance 680LN, 680N, 660N, and 620N series servos, and the 680LN only supports linear motors with incremental encoders.

(1) Prerequisite for using the external axis function

1) Software requirements: InoRobotLab software and servo configuration tool.

2) Hardware requirements: Network cables for communication between the servos and between the servos and the robot; servo motor encoder battery; and 24V power supply and relay if motor brake is used.

3) Servo debugging cable (part code: S6-L-T00-3.0) and RS232/485-to-USB serial port for 660N and 620N series; Type-C servo debugging cable for 680LN and 680N series.

4) Servo debugging knowledge.

(2) Wiring for external axis function

A 680LN/680N/660N/620N servo and motor is used. Connect EtherCAT port of the robot controller to the IN port of the servo controller using a network cable. If two servos are used, connect the OUT port of the servo controller #1 to the IN port of the servo controller #2 using a network cable. If three servos are used, connect the OUT port of the servo controller #2 to the IN port of the servo controller #3 using a network cable. The current version supports the connection of up to six external axis servos.

For example, configure two external axes of 660N. Connect EtherCAT port of the robot controller to the IN port of the servo controller #1 using a network cable, and connect the OUT port of the servo controller #1 to the IN port of the servo controller #2 using a network cable.

For the wiring of servo motor brake, see the user guide of the corresponding servo.

(3) Configuring the servo for external axis function

1) Prerequisite

Connect the CN5 port of the servo drive to the computer via a servo debugging cable and a RS232/485-to-USB converter (only required for 660N and 620N series).

Open the servo configuration tool and set the servo parameters.

2) Servo parameter settings

Parameter	Description	Setting value
H02-01	Absolute system selection	1-absolute position linear mode, select 0-incremental mode for the incremental encoder linear motor supported by 680LN
H02-09	Delay from brake output ON to command received	For motor with brake function, set the brake delay of the motor according to the motor user guide. For motor without brake function, skip this parameter.
H05-07	Numerator of electronic gear ratio	-
H05-09	Denominator of electronic gear ratio	1

Parameter	Description	Setting value
H08-00	Speed loop gain	Debug this parameter using the servo configuration tool
H08-01	Speed loop integral time constant	Debug this parameter using the servo configuration tool
H08-02	Position loop gain	Debug this parameter using the servo configuration tool
H08-15	Load moment of inertia ratio	Debug this parameter using the servo configuration tool

If $\frac{\text{Numerator of electronic gear ratio}}{\text{Denominator of electronic gear ratio}} \neq \frac{\text{Encoder PPR}}{1048576}$, an external axis servo check error will be reported. To clear the alarm, reset the correct numerator and denominator of electronic gear ratio and restart the controller. Check H00-31 for the encoder PPR.

3)Other servo parameter settings.

You can set other servo parameters as needed. For example, safety protection parameters, brake-related parameters, notch parameters, feedforward parameters, and so on.

(4) External axis properties

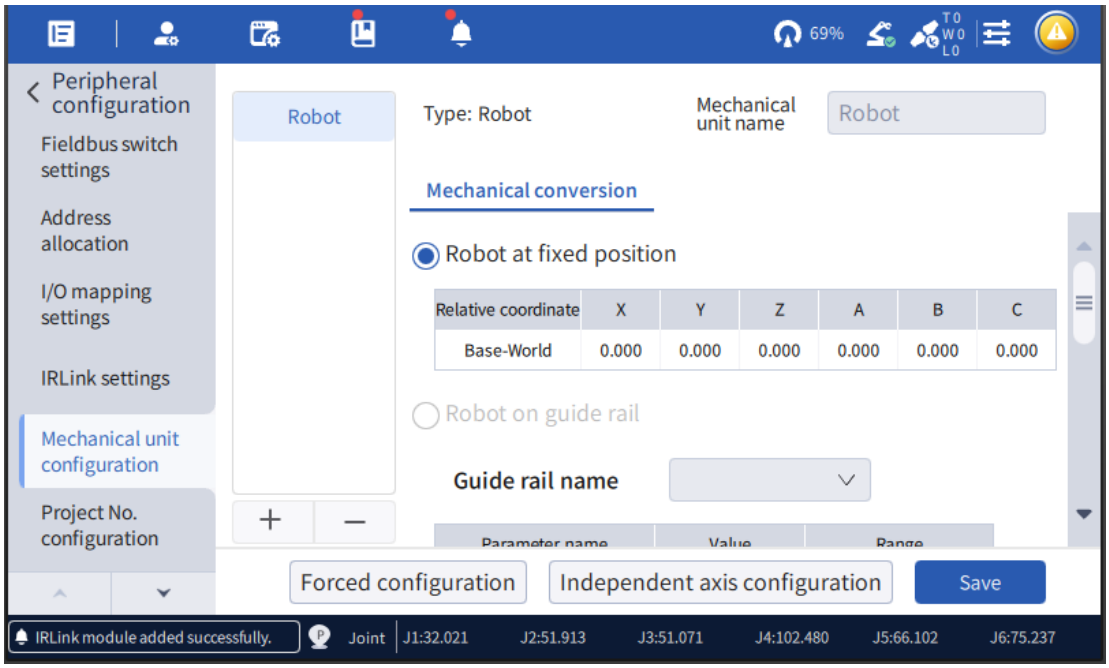
No.	Parameter	Setting value
1	Drive type	620N/660N/680N/680LN
2	Servo control mode	Position
3	Motor shaft property	Rotation axis, linear axis
4	Transmission mode	Motor motion (rotational/linear) - End actuator motion mode (rotational/linear)
5	Physical transmission ratio	Movement distance (°/mm) of the end of the external axis/Movement distance of the motor (°/mm) For example, if the external axis moves by 1° when the motor moves by 100°, then the physical transmission ratio is 100.
6	Zero point	After the external axis is configured, set the zero point of the external axis by clicking "Get current point as zero" in the lower right corner.
7	Positive limit	Set as needed
8	Negative limit	Set as needed
9	Teaching speed	Set as needed
10	Teaching acceleration	Set as needed

No.	Parameter	Setting value
11	Max speed	Max speed x Physical transmission ratio ⩽ Rated motor speed (the unit must be the same)
12	Max acceleration	Max acceleration ⩽ Stop deceleration
13	Stop deceleration	Stop deceleration ⩾ Max acceleration
14	Tracking error	Set as needed
15	Arrival error	Set as needed
16	Arrival time	Set as needed
17	Current limit	Set as needed
18	Average load rate limit	Set as needed

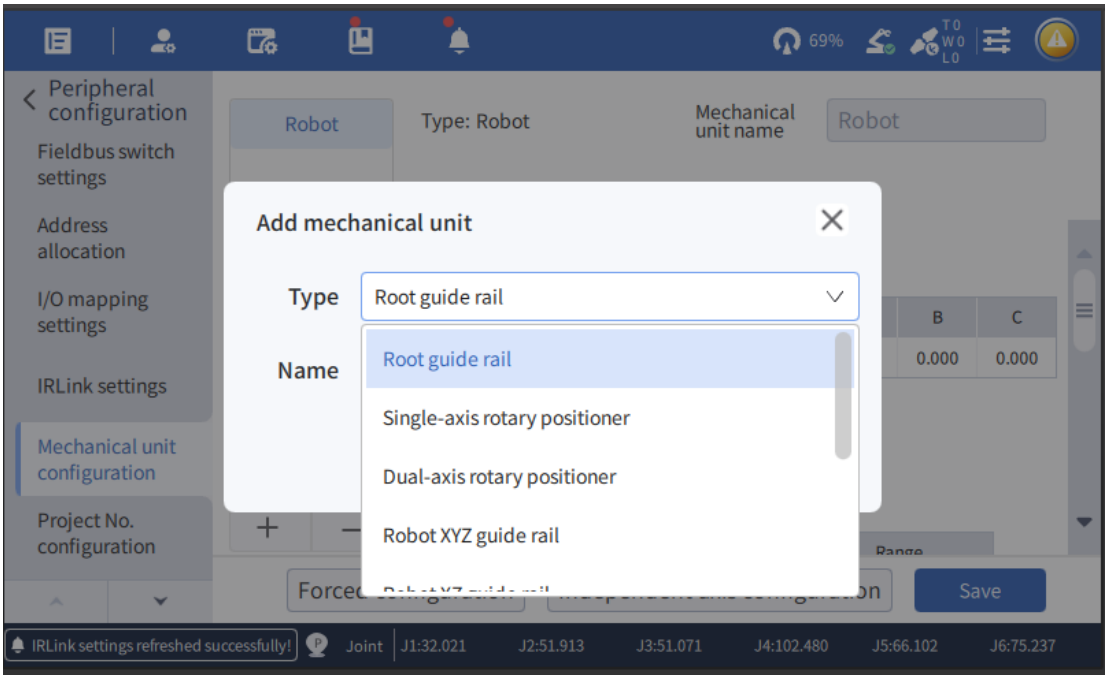
(5) Configuring the controller for external axis function

1) Open InoRobotLab software and go to "Controller parameter configuration" > "Peripheral configuration" > "Mechanical unit configuration".

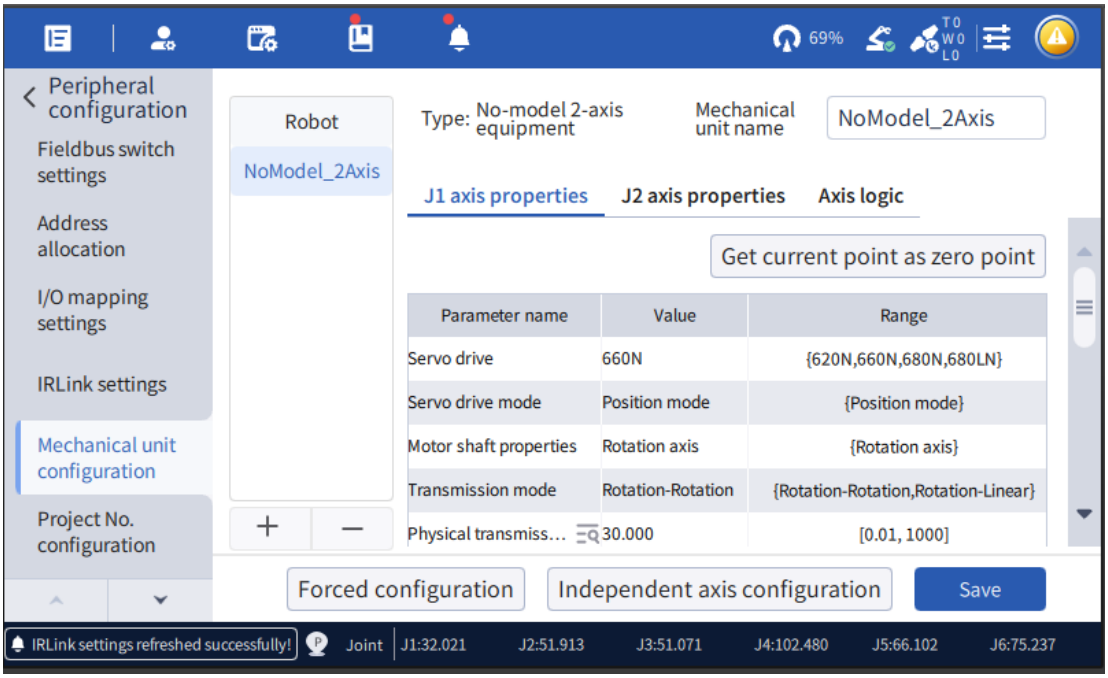
Currently, at most four mechanical units (including the robot, which is also a mechanical unit) are supported.



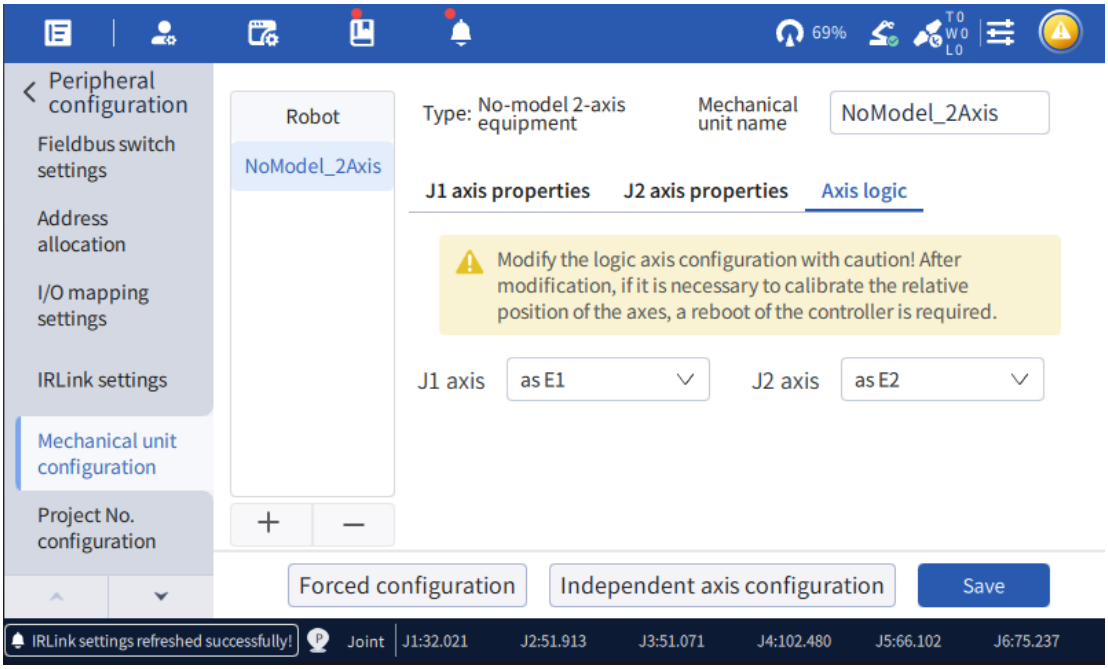
2) Click "New". A dialog pops up, where you can select the type of mechanical unit you want to add.



3) Take the no-model 2-axis equipment as an example. Select the correct servo type (680LN/680N/660N/620N) and the physical transmission ratio (If no other drive mechanism is connected other than the motor, it is recommended to change the physical transmission ratio to 20.



4) When configuring the axis logic, set the motor driven by the servo controller #1 to "E1", the motor driven by the servo controller #2 to "E2", and the motor driven by the servo controller #3 to "E3". Otherwise, mismatch between the servo and input parameters occurs.



① After configuring the mechanical unit, click "Save" (This operation must be done by manufacturer in emergency stop state). When no error occurs, restart the robot controller to complete the configuration of the external axis. If the robot controller is not restarted, it keeps an alarming state. After the robot controller is restarted, the alarm is cleared automatically.

② After the mechanical unit is configured, the mechanical unit selected in the axis control panel is reset to "Robot".

5) After configuring the mechanical unit, check if the configuration is correct.

(6) Other descriptions

1) The external axis cannot be used with the collision detection function. Therefore, the collision detection function will be disabled automatically after the external axis is configured. Ensure that the robot does not interfere with the outside world.

2) The external axis cannot be used with the high trajectory accuracy function. Therefore, the high trajectory accuracy function will be disabled automatically after the external axis is configured. The medium trajectory accuracy function can be used when accuracy is required.

3) When a guide rail is configured, the vibration suppression function will be disabled automatically. If the guide rail is configured as a no-model axis equipment and the robot is actually placed on the guide rail, the vibration suppression function may cause false alarms.

4) When an external axis is used, teach the external axis within its travel to ensure that the encoder does not overflow.

5) For the scenario where the robot moves to a fixed position using a guide rail and then operates independently, you can configure a no-model axis equipment as the guide rail.

6) If the joint value of the external axis changes dramatically, check whether the value of the servo parameter H02-01 of the external axis is 1. If it is 1, the encoder overflow occurs.

Cause	Troubleshooting Method	Solution
The number of forward revolutions exceeds 32767 or the number of reverse revolutions exceeds 32768.	Check whether the value of H0B 70 is 32767 or 32768 when the servo drive works in the absolute linear mode (H02 01=1).	Set H0D 20=2 to power on again. Perform zero point calibration if necessary.

7) The external axis function can be adapted to different 660N servo motors. The acceleration range allowed for the external axis is large to meet most operating conditions. You can set it according to actual needs.

8) If the tracking error of the external axis is reported to be too large, check whether the servo gain is correct. Check whether the maximum speed (actuator) in the properties of the external axis exceeds the maximum speed of the motor.

9) During Movc motion, the external axis does not pass through the points specified in the first Movc instruction.

10) If the network cable of the external axis is disconnected during operation, a slave offline error occurs. To clear this error, reconnect the network cable.

11) If $\frac{\text{Numerator of electronic gear ratio}}{\text{Denominator of electronic gear ratio}} \neq \frac{\text{Encoder PPR}}{1048576}$, an external axis servo check error will be reported. To clear the alarm, reset the correct numerator and denominator of electronic gear ratio and restart the controller. Check H00-31 for the encoder PPR.

12) After the external axis is configured or modified, a restart of the controller is required to make the configuration or modification take effect.

13) The servo gain of the external axis must be set properly. Otherwise, the position feedback fluctuates greatly when the external axis is enabled, causing an error.

14) Currently, the stop mode of the external axis can only be a controlled stop. If there are special requirements on the stop distance, use the stop function provided by the general-purpose servo.

15) If alarm "0x0007 Opening EtherCAT communication failed (Reboot required after error is fixed)" occurs after the external axes are configured, check whether the number of configured external axes match the number of actual connected external axes.

16) For the external axis function of 620N/660N/680N, only motors with multi-turn absolute encoders are supported. For 680LN, only motors with incremental encoders are supported.

17) The zero point of incremental encoders may be lost. Note the current configured zero point value and whether the limits are reasonable during use.

18) If the axis pulse of the start, middle, and target points of the motion instruction exceeds 2147480000, the motion instruction cannot be executed. Please check with the manufacturer whether the limit of the external axis can be reached under the current transmission ratio. Or adjust the zero point of the external axis so that the pulse of the start, middle, and target points of the motion instruction is within the range of -2147480000 to 2147480000.

19) The configuration process is affected by EtherCAT configuration. If EtherCAT configuration is not set, the external axis function will not work properly. For detailed notes, see section "9.4.4.2.3 Servo/Controller Compatibility Configuration" in the "InoRobotLab User Guide".

20) Before configuring external axes with gantry synchronization function, ensure that no gantry synchronization configuration has been performed for the external axes.

10.4.6.2 External Axis Coordination

The external axis coordination function is an advanced function based on the external axis linked motion. The external axis starts and stops together with the robot axes. Also, the trajectory of the external axis is coupled to that of the robot axes. It can be understood that the external axis moves in coordination with the robot axes, while the robot axes keep the original trajectory in the frame of the external axis. The external axis coordination function currently supports coordination of the guide rail, coordination of the single-axis rotary positioner, coordination of the dual-axis rotary positioner, and coordination of the guide rail and single/dual-axis rotary positioner.

(1) Prerequisite for the external axis coordination function

See the settings 10.4.6.1 External Axis Linked Motion. Ensure that the physical transmission ratio is set correctly.

(2) Coordinated Mechanical Units

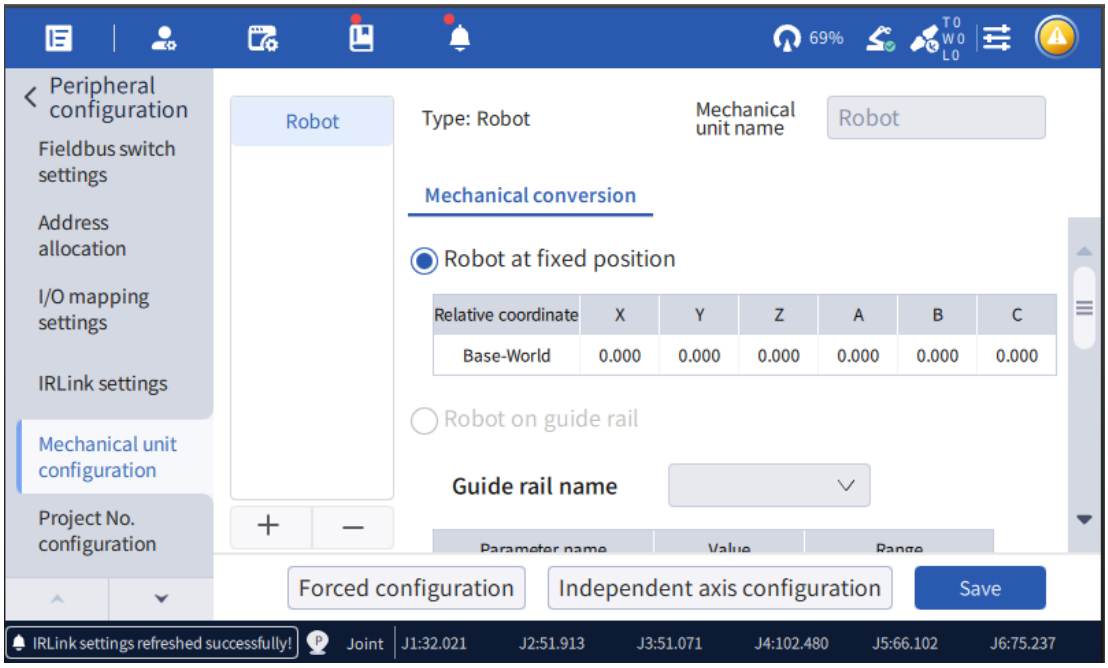
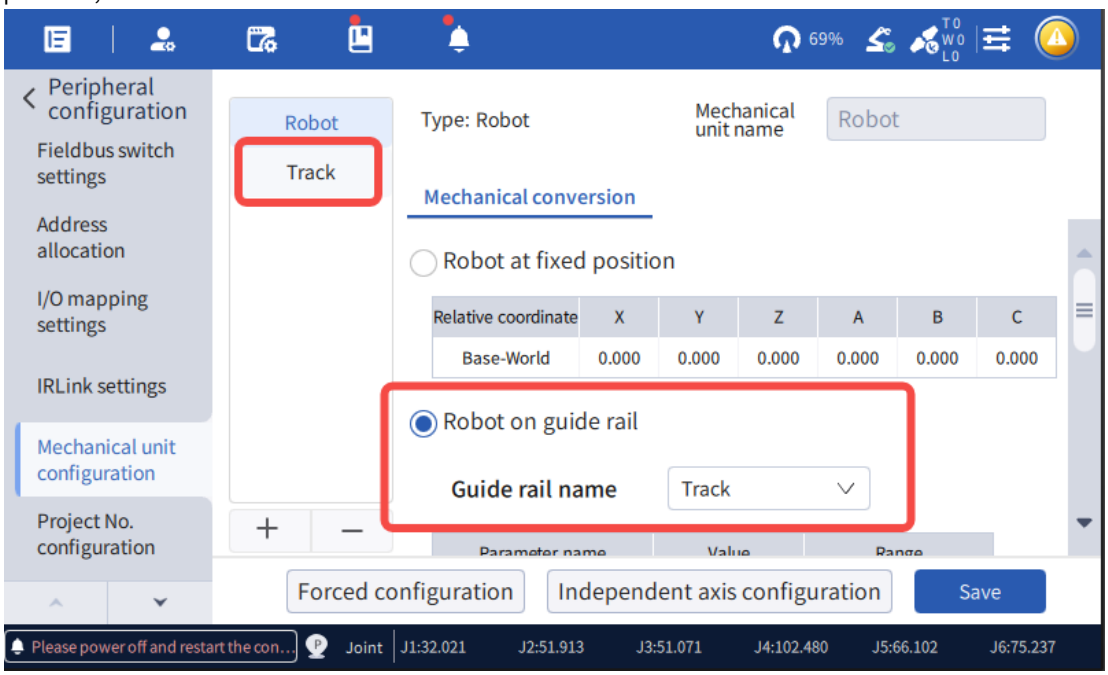
1) The types of supported mechanical units are as follows.

Type	Remarks
Robot base guide rail	 The guide rail acts as the guide rail only when a robot is located on it. Otherwise, it acts as a no-model axis equipment.
XYZ three-axis base guide rail	 The guide rail acts as the guide rail only when a robot is located on it. Otherwise, it acts as a no-model axis equipment.
Dual-axis base guide rail (XZ/YZ)	 The guide rail acts as the guide rail only when a robot is located on it. Otherwise, it acts as a no-model axis equipment.
Single-axis rotary positioner	
Dual-axis rotary positioner	

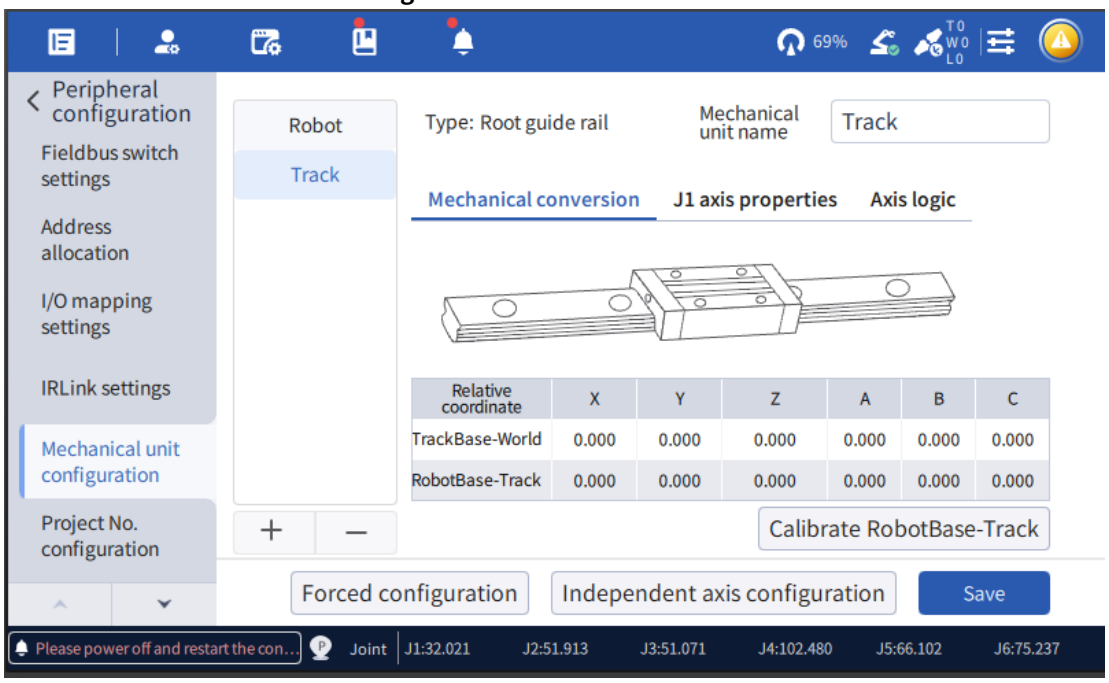
CAUTION

- Up to four mechanical units (including robots) are currently supported.
- Up to six external axes are currently supported.
- Up to one guide rail mechanical unit (single-axis/dual-axis/three-axis guide rail) are currently supported.
- The planes of each axis guide rail should be parallel or perpendicular to each other, and the axial motion direction of each guide rail axis and the frame definition must satisfy the right-hand rule.

2) Mechanical conversion: Describes the position of the mechanical unit and the position of its internal components.

Target	Content of mechanical conversion
Robot	 The fixed position of the robot cannot be modified temporarily. When the robot is in the fixed position, the base frame of the robot is the world frame.  As shown in the figure, "Track" is a configured guide rail. After the guide rail is configured, you can choose to place the robot on the guide rail. You can choose the name of the guide rail from the drop-down list. In this case, the base frame of the guide rail is the world frame. **CAUTION** If you choose "Robot on guide rail", after the robot controller is restarted, the coordination is enabled for Movl and Movc instructions by default.

Target	Content of mechanical conversion
X-axis robot guide rail	**I. Introduction to the X-axis robot guide rail**



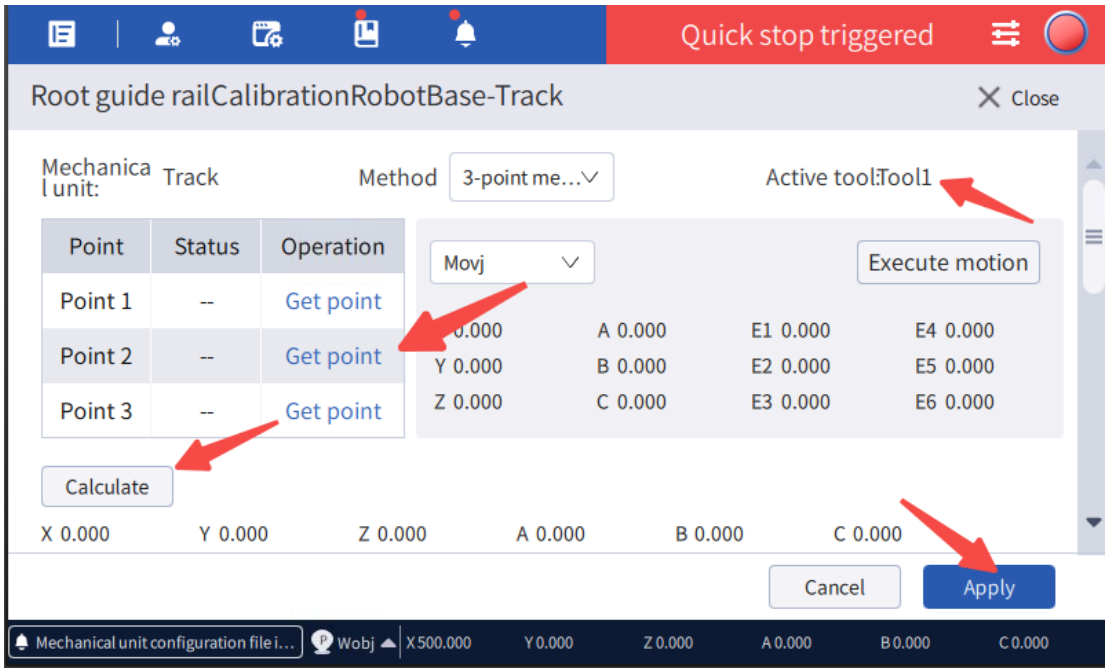
> **CAUTION**
>
> - Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value.
> - Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly.

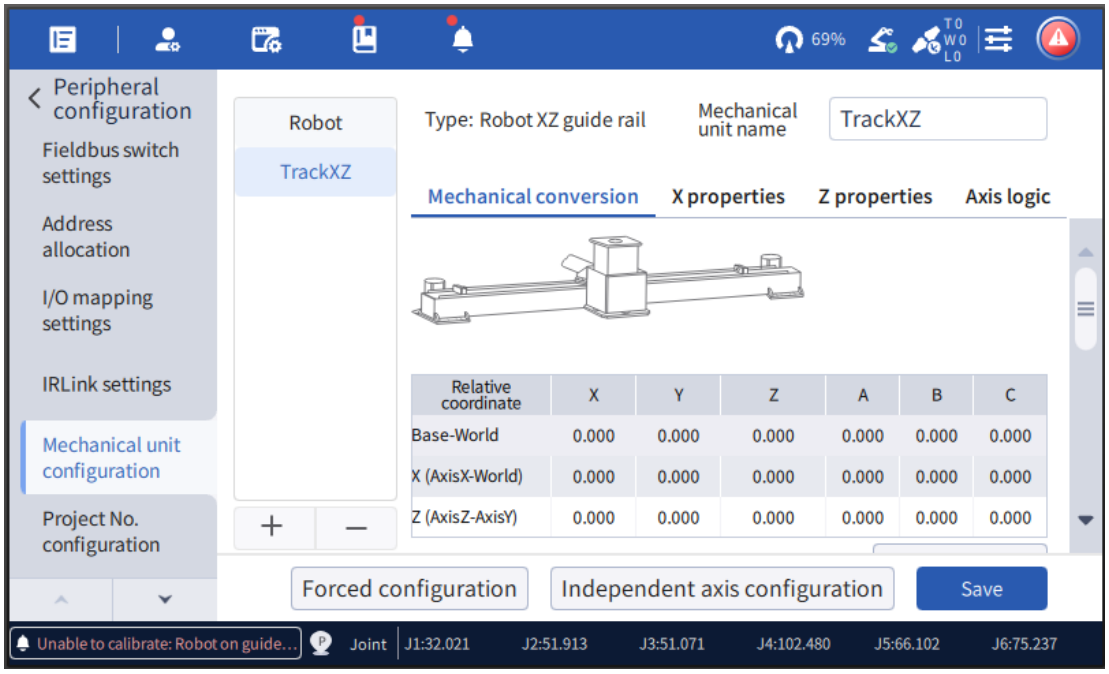
1. The forward motion direction of the guide rail is the X-axis direction of the guide rail base frame. The outward direction perpendicular to the guide rail is the Z-axis direction of the guide rail base frame. The Y-axis of the guide rail base frame is determined by the right hand rule. The origin of the guide rail base frame is also the origin of the robot base frame at the origin of the guide rail.
2. TrackBase-World is the positional relationship between the guide rail base frame and the world frame. When the robot is placed on the guide rail, the guide rail frame is the world frame. Therefore, the parameters of TrackBase-World are 0 and cannot be modified.
3. RobotBase-Track is the positional relationship between the robot base frame and the guide rail base frame. You can perform calibration by manual input or clicking the "Calibrate RobotBase-Track" button.

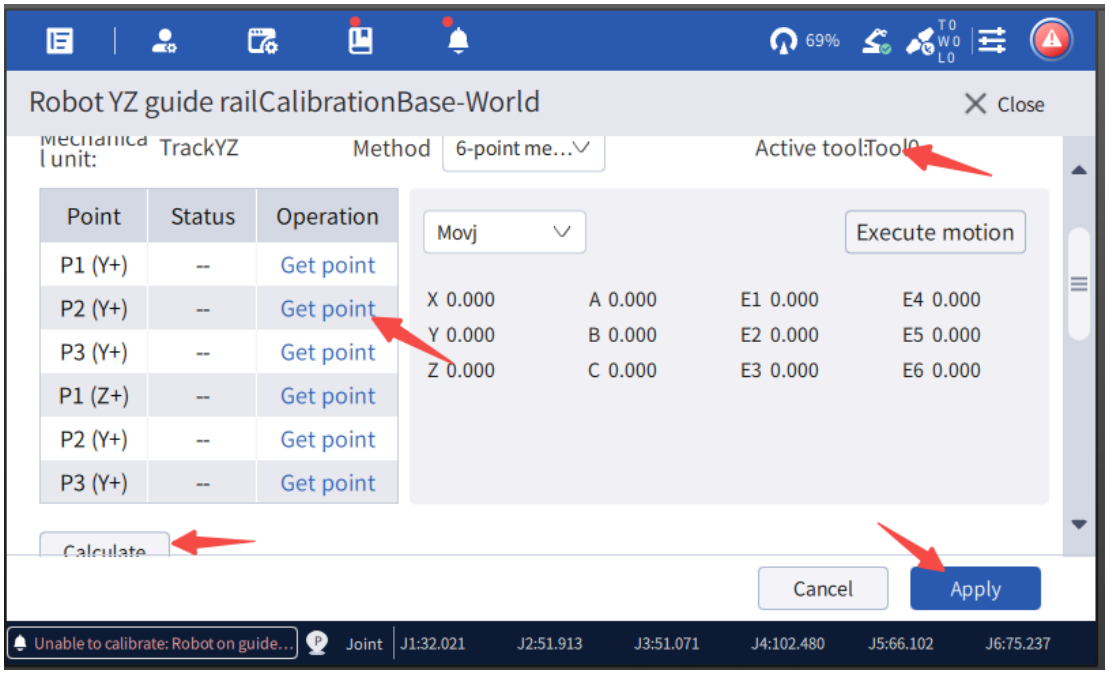
II. Axis properties and axis logic configuration of the X-axis robot guide rail

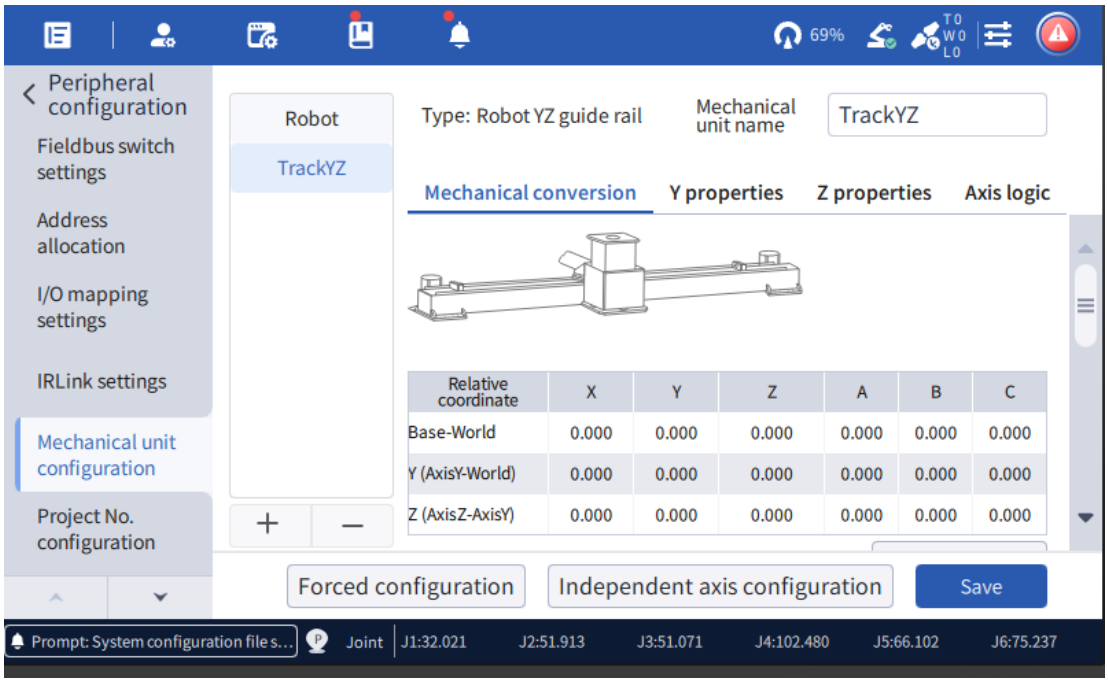
The axis properties and the axis logic configuration can be made according to section 10.4.6.1 External Axis Linked Motion. Make sure the physical transmission ratio is set correctly.

III. Calibration of the positional relationship between the robot and the guide rail

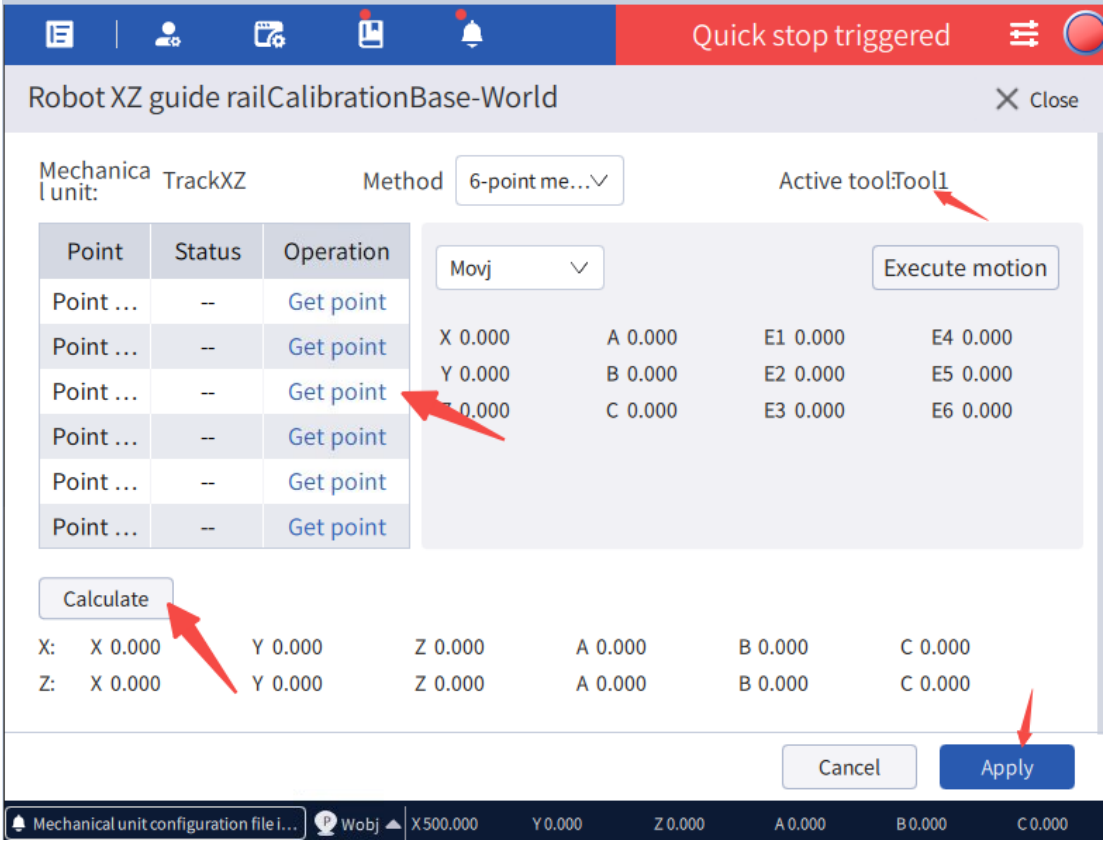
Target	Content of mechanical conversion
	CAUTION • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly.  Calibration method: 1. Set a fixed point as the reference point in the world frame. 2. Install a known tool at the end of the flange and set the tool as the active tool (Note: Ensure that the tool is calibrated correctly.) 3. Select "Point 1", move the guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 4. Select "Point 2", move the guide rail forward and then move the manipulator arm to align the TCP with the reference point. and click "Get point" button in the corresponding line. 5. Select "Point 3", move the guide rail forward and then move the manipulator arm to align the TCP with the reference point. and click "Get point" button in the corresponding line. 6. Click "Calculate" to automatically generate the result parameters and display the error value in a pop-up box. 7. Click "Apply". The calibration result indicates the positional relationship between the robot base frame and the guide rail frame. The coordinates of the intermediate points indicate the position of the tool in relation to the robot base frame. Note: When calibrating the guide rail, move the robot as far as possible for higher calibration accuracy.

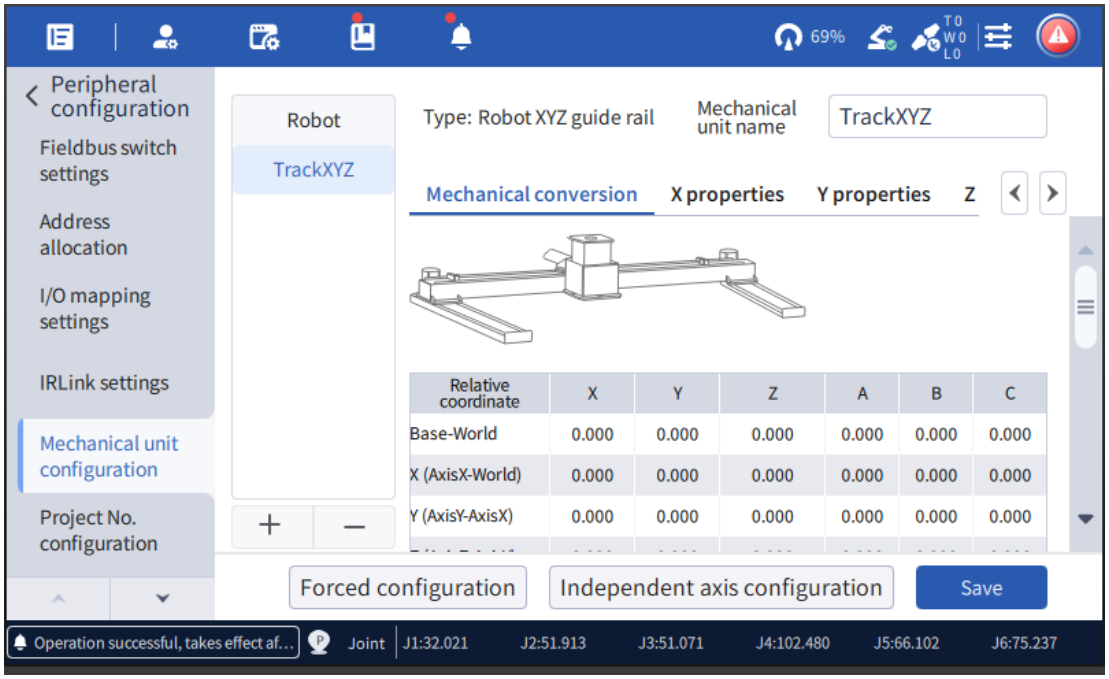
Target	Content of mechanical conversion
	Note: After the guide rail calibration is complete, select "Robot on guide rail" option in the mechanical unit configuration interface.
YZ base guide rail	**I. Introduction**  **CAUTION** • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly. Note: If the perpendicularity of the three-axis guide rail is sufficiently high and the guide base frame is perfectly aligned with the robot base frame during installation, calibration can be omitted. 1. Definition of the forward motion direction for each axis of the YZ dual-axis guide rail: The forward direction of the Y-axis guide rail is the Y-axis direction of the guide rail base frame, and the forward direction of the Z-axis guide rail is the Z-axis direction of the guide rail base frame. The forward direction of the X-axis is determined by the right-hand rule. 2. Definition of the guide rail base frame: The origin of the guide rail base frame is located at the zero position of the guide rail, and the axis directions of the guide rail base frame are consistent with the motion directions of the respective guide rail axes, conforming to the right-hand rule. 3. TrackBase-World is the positional relationship between the guide rail base frame and the world frame. When the robot is placed on the guide rail, the guide rail frame is the world frame. Therefore, the parameters of TrackBase-World are 0 and cannot be modified. 4. RobotBase-TrackY and RobBase-TrackZ are respectively the positional relationship between the robot base frame and the Y-axis guide rail frame, and that between the robot base frame and the Z-axis guide rail frame. You can perform calibration by manual input or clicking the "Calibrate RobotBase-Track" button. **II. Axis properties and axis logic configuration**

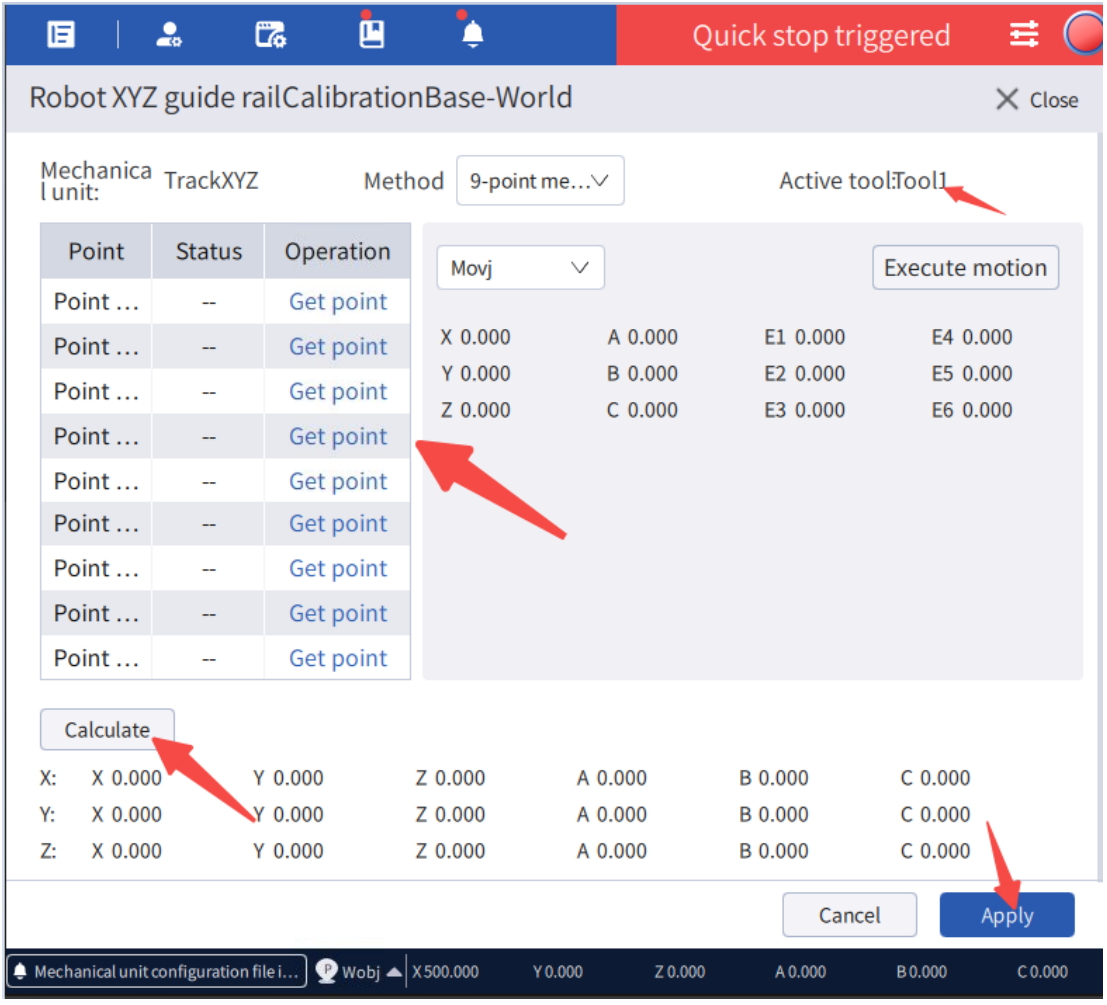
Target	Content of mechanical conversion
	The axis properties and the axis logic configuration can be made according to "Configuring the controller for external axis function" part in section 10.4.6.1 External Axis Linked Motion. Make sure the physical transmission ratio is set correctly. **III. Calibration of the positional relationship between the robot and the guide rail** CAUTION • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly. • When installing the robot on the guide rail, ensure that the guide rails of each axis are perpendicular to each other and that the axis directions of the guide rail align with those of the robot base frame.  Calibration method: 1. Set a fixed point as the reference point in the world frame. 2. Install a known tool at the end of the flange and set the tool as the active tool (Note: Ensure that the tool is calibrated correctly.) 3. Select "Point 1 (Y+)", move the Y-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 4. Select "Point 2 (Y+)", move the Y-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 5. Select "Point 3 (Y+)", move the Y-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 6. Select "Point 4 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line.

Target	Content of mechanical conversion
	7. Select "Point 5 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 8. Select "Point 6 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 9. Click "Calculate" to automatically generate the result parameters and display the error value in a pop-up box. 10. Click "Apply". The calibration result indicates the positional relationship between the robot base frame and the guide rail base frame. The coordinates of the intermediate points indicate the position of the tool in relation to the robot base frame. Note: When calibrating the guide rail, move the robot as far as possible for higher calibration accuracy. Note: After the guide rail calibration is complete, select "Robot on guide rail" option in the mechanical unit configuration interface.
XZ base guide rail	**I. Introduction**  **CAUTION** • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly.

Target	Content of mechanical conversion
	Note: If the perpendicularity of the three-axis guide rail is sufficiently high and the guide base frame is perfectly aligned with the robot base frame during installation, calibration can be omitted. 1. Definition of the forward motion direction for each axis of the X-axis guide rail: The forward direction of the X-axis guide rail is the X-axis direction of the guide rail base frame, and the forward direction of the Z-axis guide rail is the Z-axis direction of the guide rail base frame. The forward direction of the Y-axis is determined by the right-hand rule. 2. Definition of the guide rail base frame: The origin of the guide rail base frame is located at the zero position of the guide rail, and the axis directions of the guide rail base frame are consistent with the motion directions of the respective guide rail axes, conforming to the right-hand rule. 3. TrackBase-World is the positional relationship between the guide rail base frame and the world frame. When the robot is placed on the guide rail, the guide rail frame is the world frame. Therefore, the parameters of TrackBase-World are 0 and cannot be modified. 4. RobotBase-TrackX and RobBase-TrackZ are respectively the positional relationship between the robot base frame and the X-axis guide rail frame, and that between the robot base frame and the Z-axis guide rail frame. You can perform calibration by manual input or clicking the "Calibrate RobotBase-Track" button. **II. Axis properties and axis logic configuration** The axis properties and the axis logic configuration can be made according to the "Configuring the controller for external axis function" part in section 10.4.6.1 External Axis Linked Motion. Make sure the physical transmission ratio is set correctly. **III. Calibration of the positional relationship between the robot and the guide rail** CAUTION • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly. • When installing the robot on the guide rail, ensure that the guide rails of each axis are perpendicular to each other and that the axis directions of the guide rail align with those of the robot base frame.

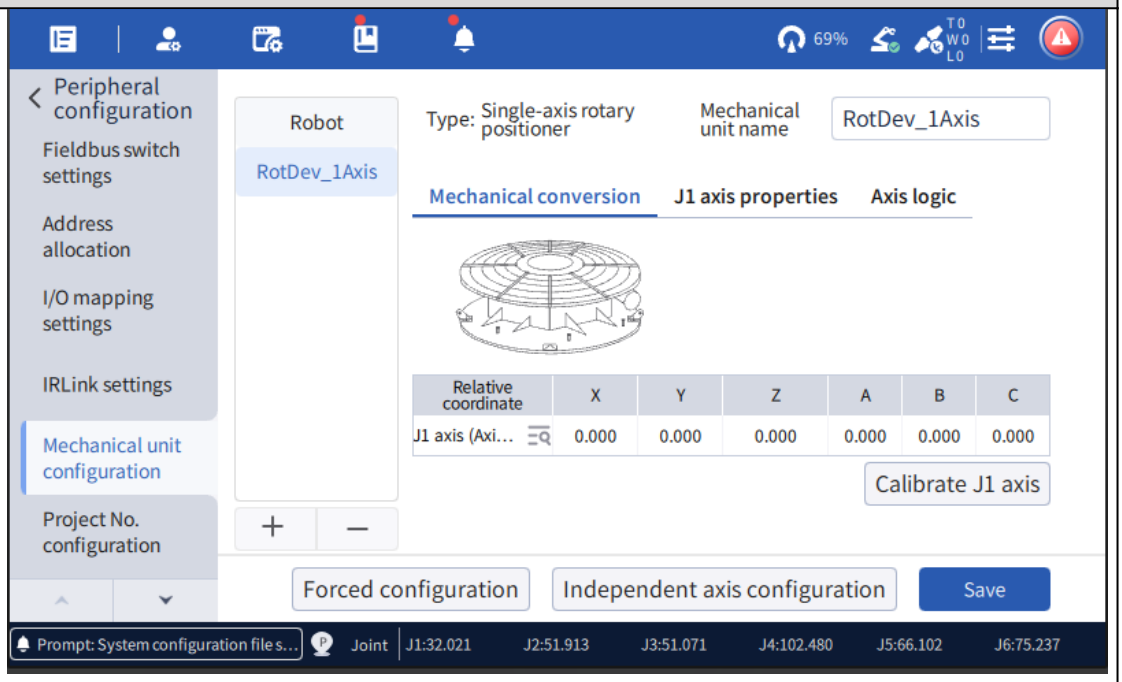
Target	Content of mechanical conversion
	 Calibration method: 1. Set a fixed point as the reference point in the world frame. 2. Install a known tool at the end of the flange and set the tool as the active tool (Note: Ensure that the tool is calibrated correctly.) 3. Select "Point 1 (X+)", move the X-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 4. Select "Point 2 (X+)", move the X-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 5. Select "Point 3 (X+)", move the X-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 6. Select "Point 4 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 7. Select "Point 5 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 8. Select "Point 6 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 9. Click "Calculate" to automatically generate the result parameters and display the error value in a pop-up box. 10. Click "Apply". The calibration result indicates the positional relationship between the robot base frame and the guide rail base frame.

Target	Content of mechanical conversion
	The coordinates of the intermediate points indicate the position of the tool in relation to the robot base frame. Note: When calibrating the guide rail, move the robot as far as possible for higher calibration accuracy. Note: After the guide rail calibration is complete, select "Robot on guide rail" option in the mechanical unit configuration interface.
XYZ base guide rail	**I. Introduction**  **CAUTION** • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly. Note: If the perpendicularity of the three-axis guide rail is sufficiently high and the guide base frame is perfectly aligned with the robot base frame during installation, calibration can be omitted. 1. Definition of the forward motion direction for each axis of the three-axis guide rail: The forward directions of the X, Y and Z-axis guide rail are respectively the X, Y and Z-axis directions of the guide rail base frame. 2. Definition of the guide rail base frame: The origin of the guide rail base frame is located at the zero position of the guide rail, and the axis directions of the guide rail base frame are consistent with the motion directions of the respective guide rail axes, conforming to the right-hand rule. 3. TrackBase-World is the positional relationship between the guide rail base frame and the world frame. When the robot is placed on the guide rail, the guide rail frame is the world frame. Therefore, the parameters of TrackBase-World are 0 and cannot be modified.

Target	Content of mechanical conversion
	4. RobotBase-TrackX and -/ RobBase-TrackY are respectively the positional relationship between the robot base frame and the robot base frame and the X-axis guide rail frame, and that between the robot base frame and the Y-axis guide rail frame. You can perform calibration by manual input or clicking the "Calibrate RobotBase-Track" button. **II. Axis properties and axis logic configuration** The axis properties and the axis logic configuration can be made according to the "Configuring the controller for external axis function" part in section 10.4.6.1 External Axis Linked Motion. Make sure the physical transmission ratio is set correctly. **III. Calibration of the positional relationship between the robot and the guide rail** CAUTION • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the guide rail, ensure that the physical transmission ratio is set correctly. • When installing the robot on the guide rail, ensure that the guide rails of each axis are perpendicular to each other and that the axis directions of the guide rail align with those of the robot base frame. 

Target	Content of mechanical conversion
	Calibration method: 1. Set a fixed point as the reference point in the world frame. 2. Install a known tool at the end of the flange and set the tool as the active tool (Note: Ensure that the tool is calibrated correctly.) 3. Select "Point 1 (X+)", move the X-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 4. Select "Point 2 (X+)", move the X-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 5. Select "Point 3 (X+)", move the X-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 6. Select "Point 4 (Y+)", move the Y-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 7. Select "Point 5 (Y+)", move the Y-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 8. Select "Point 6 (Y+)", move the Y-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 9. Select "Point 7 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 10. Select "Point 8 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 11. Select "Point 9 (Z+)", move the Z-axis guide rail forward and then the manipulator arm to align the TCP with the reference point, and then click "Get point" button in the corresponding line. 12. Click "Calculate" to automatically generate the result parameters and display the error value in a pop-up box. 13. Click "Apply". The calibration result indicates the positional relationship between the robot base frame and the guide rail base frame. The coordinates of the intermediate points indicate the position of the tool in relation to the robot base frame. Note: When calibrating the guide rail, move the robot as far as possible for higher calibration accuracy. Note: After the guide rail calibration is complete, select "Robot on guide rail" option in the mechanical unit configuration interface.
Single-axis rotary positioner	**I. Introduction to the single-axis rotary positioner**

Target	Content of mechanical conversion



CAUTION

- Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value.
- Before calibrating the single-axis rotary positioner, ensure that the physical transmission ratio is set correctly.
- For applications requiring coordination of the robot, guide rail, and rotation positioner simultaneously, calibrate the guide rail first and then the rotation positioner.

J1 axis (Axis1-World): The positional relationship of the frame of the single-axis rotary positioner relative to the world frame when the positioner is at the origin. Calibration can be performed by manual input or by clicking the "Calibrate J1 axis" button.

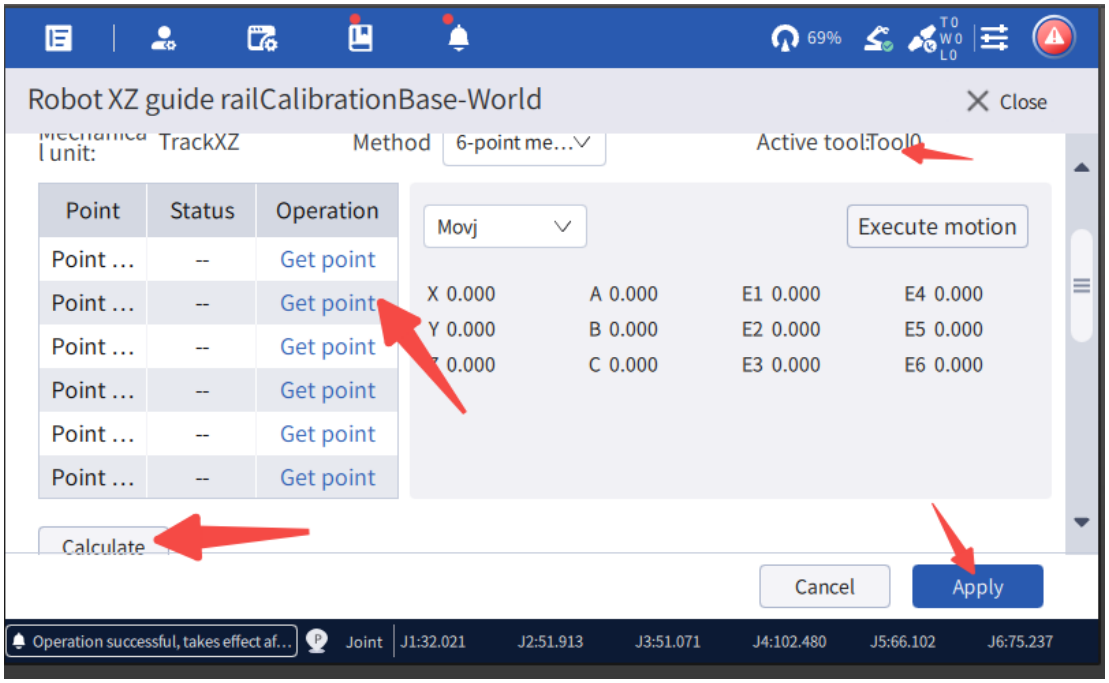
2. The frame used by the single-axis rotary positioner is located in the center of the rotary table. The Z direction coincides with the rotation axis. The X axis points to the zero-degree direction of the positioner when the first point is calibrated.

II. Axis properties and axis logic configuration

The axis properties and the axis logic configuration can be made according to the "Configuring the controller for external axis function" part in section 10.4.6.1 External Axis Linked Motion. Make sure the physical transmission ratio is set correctly.

III. Calibration of the positional relationship of the frame of the single-axis rotary positioner relative to the world frame

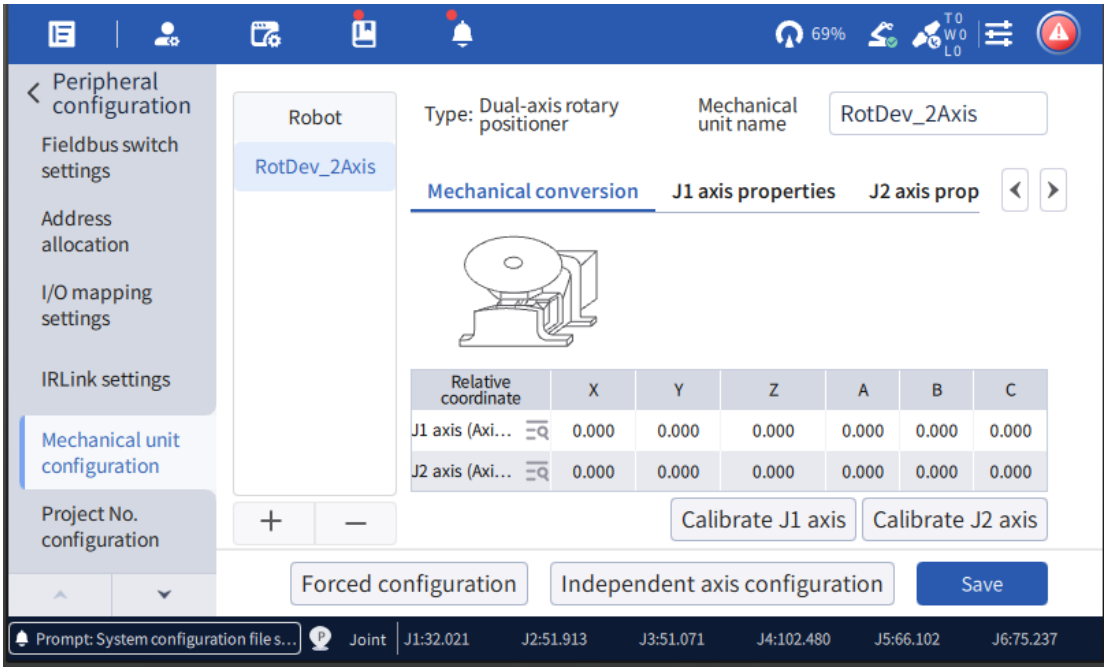
Target	Content of mechanical conversion
	CAUTION • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the single-axis rotary positioner, ensure that the physical transmission ratio is set correctly. • For applications requiring coordination of the robot, guide rail, and rotation positioner simultaneously, calibrate the guide rail first and then the rotation positioner.



Calibration method:

1. Install a known tool at the end of the flange and set the tool as the active tool.
2. Mark a reference point on the turn table of the rotary positioner.
3. Select "Point 1", move the manipulator arm to align the TCP with the reference point. and click "Get point" button in the corresponding line.
4. Select "Point 2", rotate the J1 axis of the rotary positioner by a certain angle in the positive direction, then move the manipulator arm to align the TCP with the reference point, and click "Get point" button in the corresponding line.
5. Select "Point 3", rotate the J1 axis of the rotary positioner by a certain angle in the positive direction, then move the manipulator arm to align the TCP with the reference point, and click "Get point" button in the corresponding line.
6. Click "Calculate" to automatically generate the result parameters
7. Click "Apply".

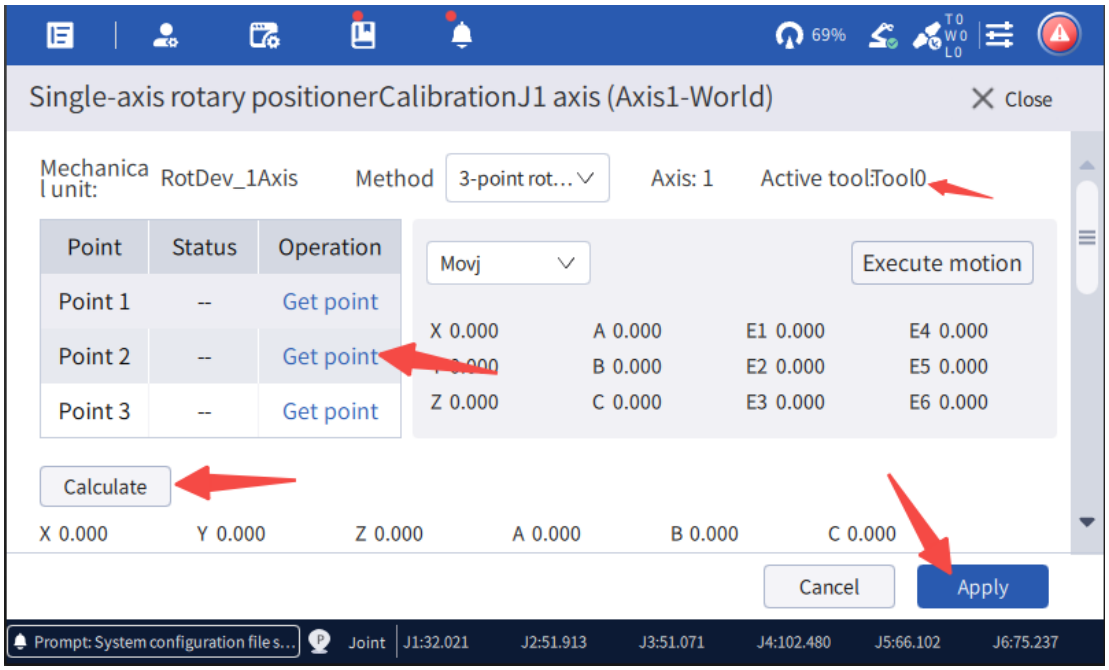
Note: When calibrating the rotary positioner, the rotation angle is preferably larger than 30° for higher calibration accuracy.

Target	Content of mechanical conversion
Dual-axis rotary positioner	**I. Introduction to the dual-axis rotary positioner**  **CAUTION** • Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value. • Before calibrating the dual-axis rotary positioner, ensure that the physical transmission ratio is set correctly. • For applications requiring coordination of the robot, guide rail, and rotation positioner simultaneously, calibrate the guide rail first and then the rotation positioner. 1. J1 axis (Axis1-World): The positional relationship of the J1 axis frame of the dual-axis rotary positioner and the world frame when the J1 axis is at the origin. Calibration can be performed by manual input or by clicking the "Calibrate J1 axis" button. 2. J2 axis (Axis2-Axis1): The positional relationship of the J2 axis frame of the dual-axis rotary positioner relative to the J1 axis frame when the J2 axis is at the origin. Calibration can be performed by manual input or by clicking the "Calibrate J2 axis" button. 3. The frame used by the dual-axis rotary positioner is located in the center of the rotary table. The Z direction coincides with the rotation axis. The X axis points to the zero-degree direction of the positioner when the first point is calibrated. **II. Axis properties and axis logic configuration** The axis properties and the axis logic configuration can be made according to the "Configuring the controller for external axis function" part in section 10.4.6.1 External Axis Linked Motion. Make sure the physical transmission ratio is set correctly.

Target	Content of mechanical conversion
	III. Calibration of the positional relationship of the frame of the dual-axis rotary positioner relative to the world frame

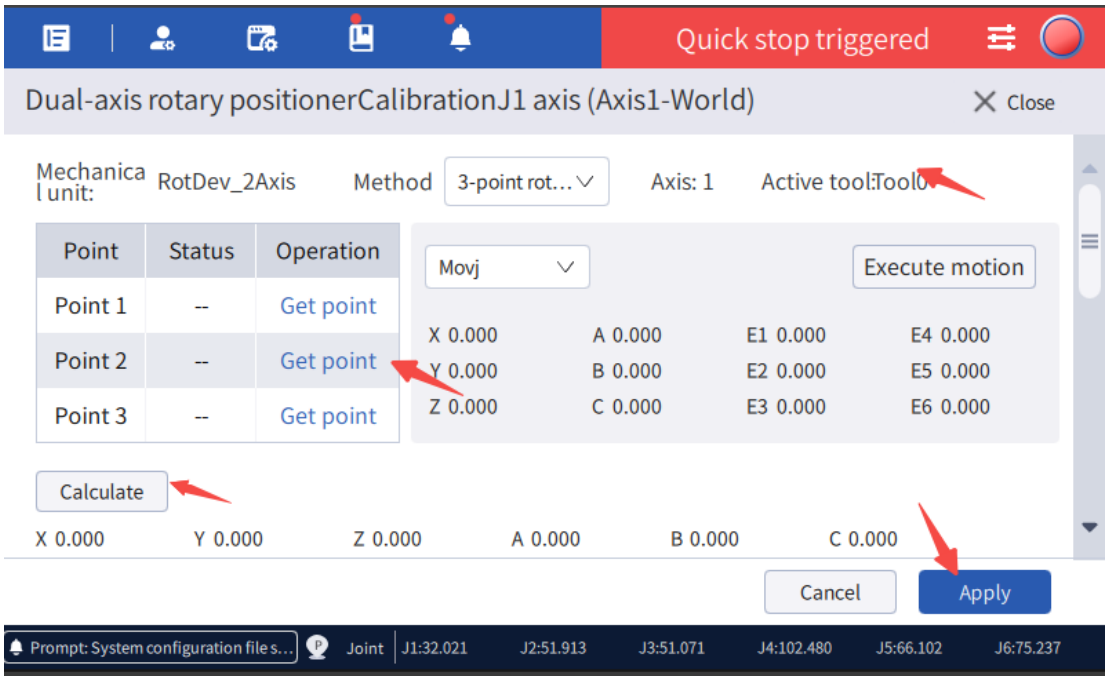
CAUTION

- Before calibrating the external axis, ensure that the axis properties and axis logic are set correctly and restart the robot controller. Otherwise, the calibration result will not match the actual value.
- Before calibrating the dual-axis rotary positioner, ensure that the physical transmission ratio is set correctly.
- For applications requiring coordination of the robot, guide rail, and rotation positioner simultaneously, calibrate the guide rail first and then the rotation positioner.



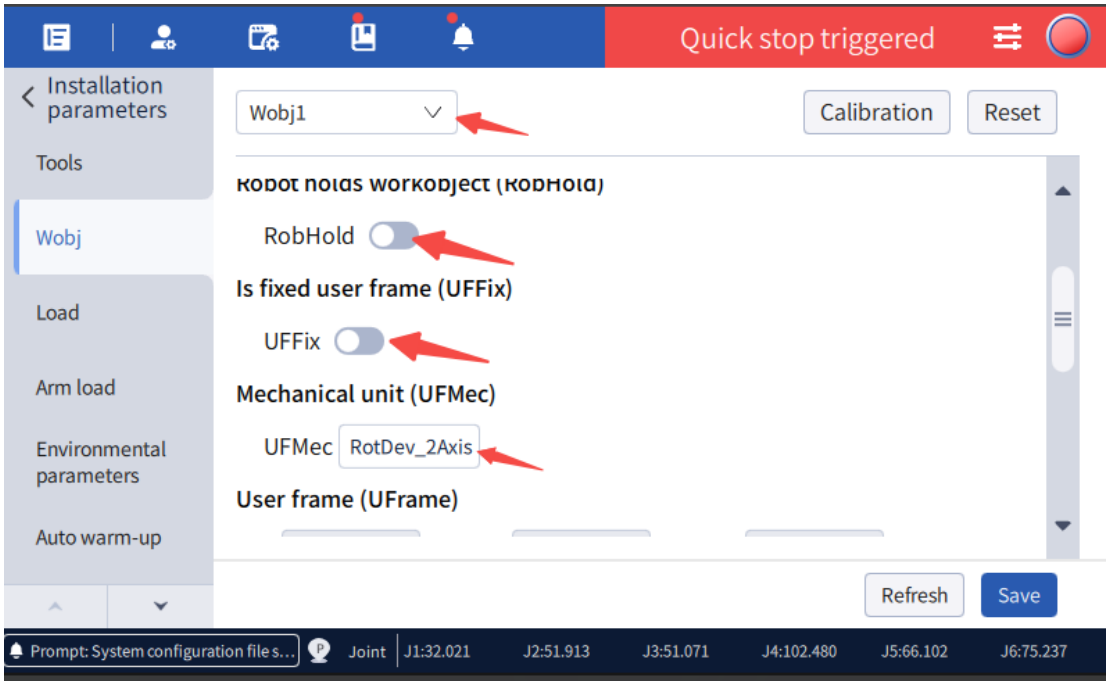
As an example, the following describes the calibration method of the J1 axis.

1. Install a known tool at the end of the flange and set the tool as the active tool.
2. Mark a reference point on the turn table of the rotary positioner.
3. Select "Point 1", move the manipulator arm to align the TCP with the reference point. and click "Get point" button in the corresponding line.
4. Select "Point 2", rotate the J1 axis of the rotary positioner by a certain angle in the positive direction, then move the manipulator arm to align the TCP with the reference point, and click "Get point" button in the corresponding line.
5. Select "Point 3", rotate the J1 axis of the rotary positioner by a certain angle in the positive direction, then move the manipulator arm to align the TCP with the reference point, and click "Get point" button in the corresponding line.
6. Click "Calculate" to automatically generate the result parameters The error value is displayed in the pop-up box.
7. Click "Apply".

Target	Content of mechanical conversion
	Note: When calibrating the rotary positioner, the rotation angle is preferably larger than 30° for higher calibration accuracy.  The calibration of J2 axis is the same with that of J1 axis. Note: When calibrating the rotary positioner, the rotation angle is preferably larger than 30° for higher calibration accuracy.

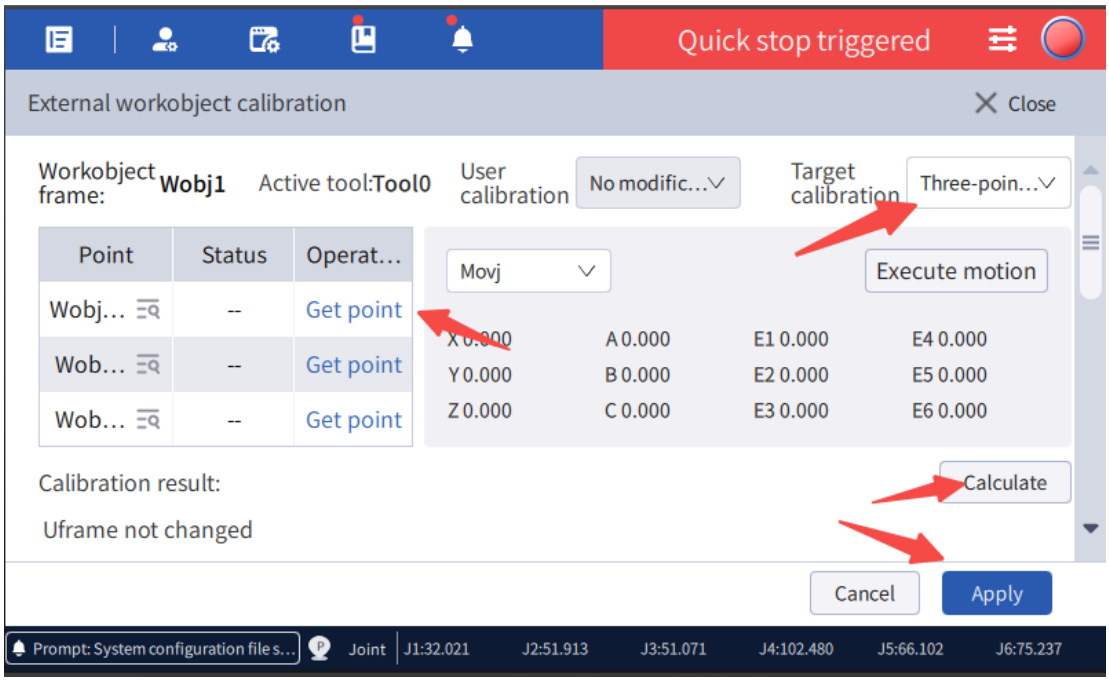
(3) Setting workobject for the coordinated mechanical unit

1) Select the workobject to be used, set "RobHold" to "False", "UFFix" to "False", and "UFMec" to the name of the single/dual-axis rotary positioner.



2) In coordination, the workobject frame changes with the rotation of the single/dual-axis rotary positioner.

3) You can set the workobject frame by clicking the "Calibration" button or directly entering the coordinate values of the workobject frame.



When calibrating a workobject frame for which the parameter "UFFix" is set to "False", you can use the 3-point calibration method. The calibration method is the same as the traditional workobject calibration method.

(4) Coordination

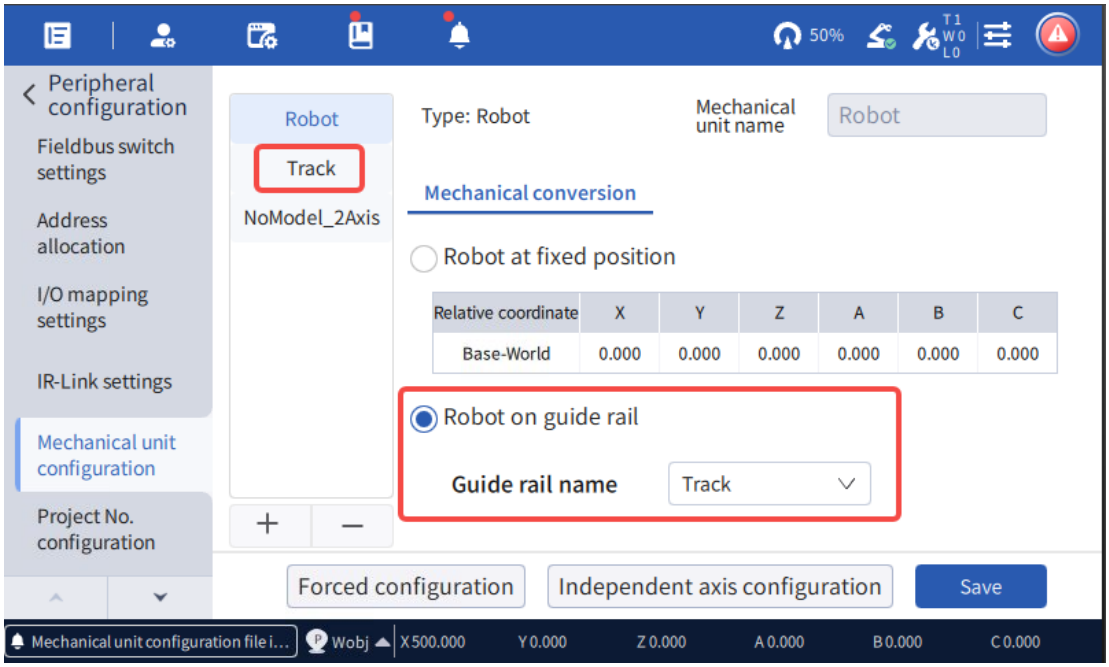
Currently, two types of coordinated movement are supported in the robot gripper scenario.

- Coordination between the robot and the base guide rail: When the guide rail is moved manually, the robot coordinates with the guide rail to keep the position of TCP in the world frame unchanged.
- Coordination between the robot and the positioner: When the positioner is moved manually, the robot coordinates with the positioner to keep the position of the TCP in the world frame unchanged.

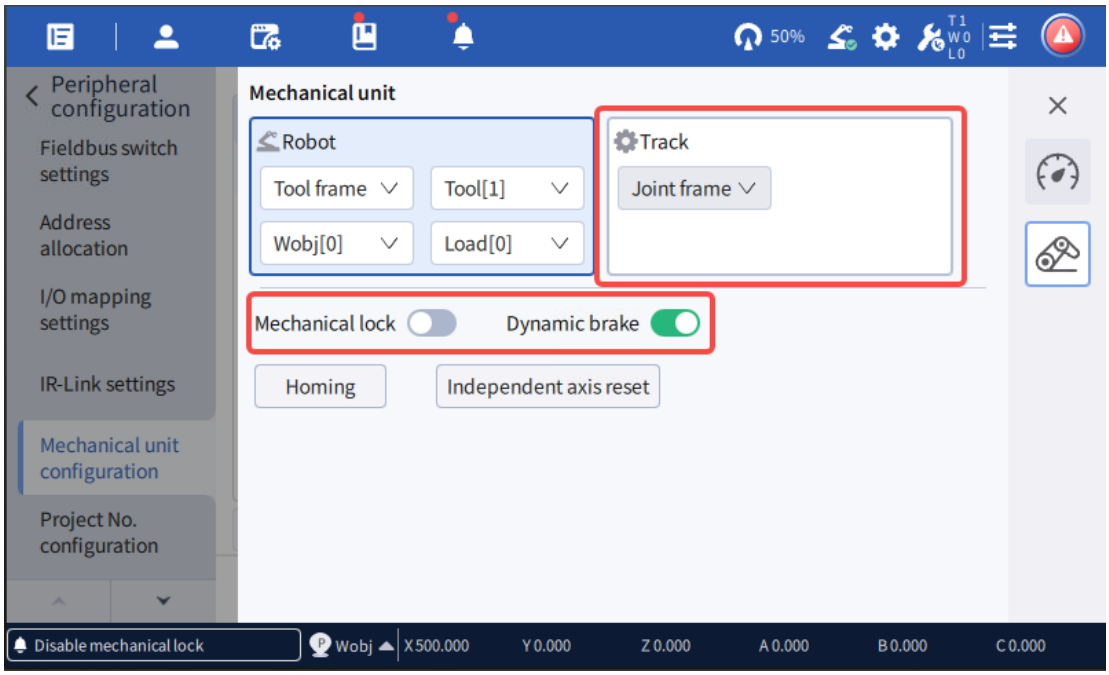
Steps

- Coordination between the robot and the base guide rail

Place the robot on guide rail and set the mechanical unit name of the guide rail.

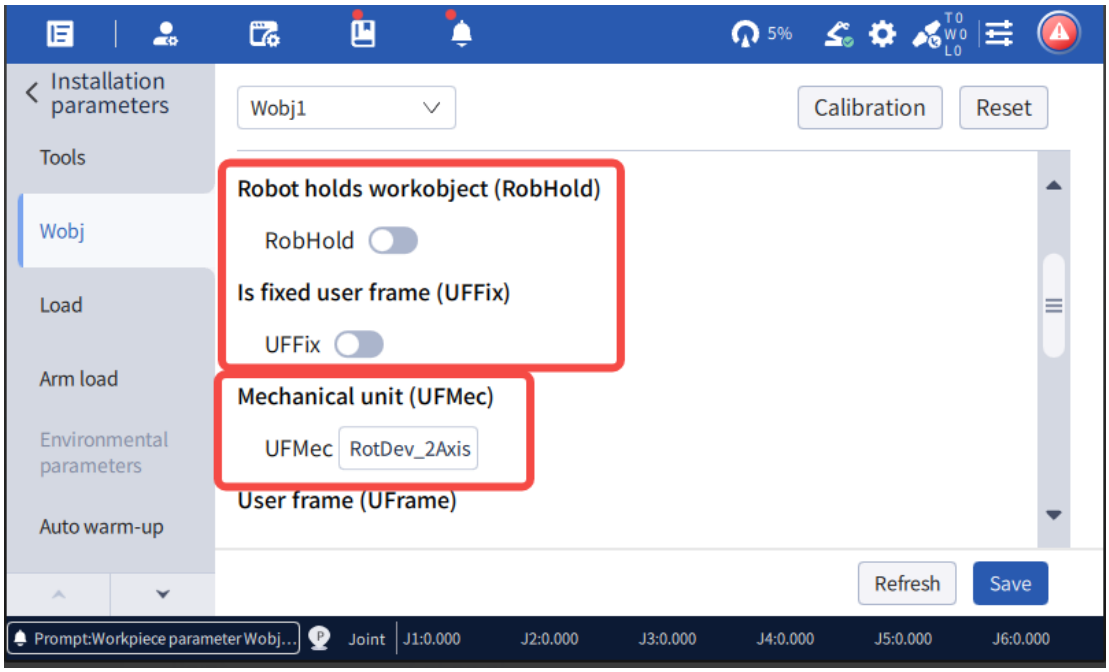


When the current mechanical unit is switched to the base guide rail in the axis control panel and the robot is a world frame or workobject frame, the robot automatically starts coordination, as shown below.

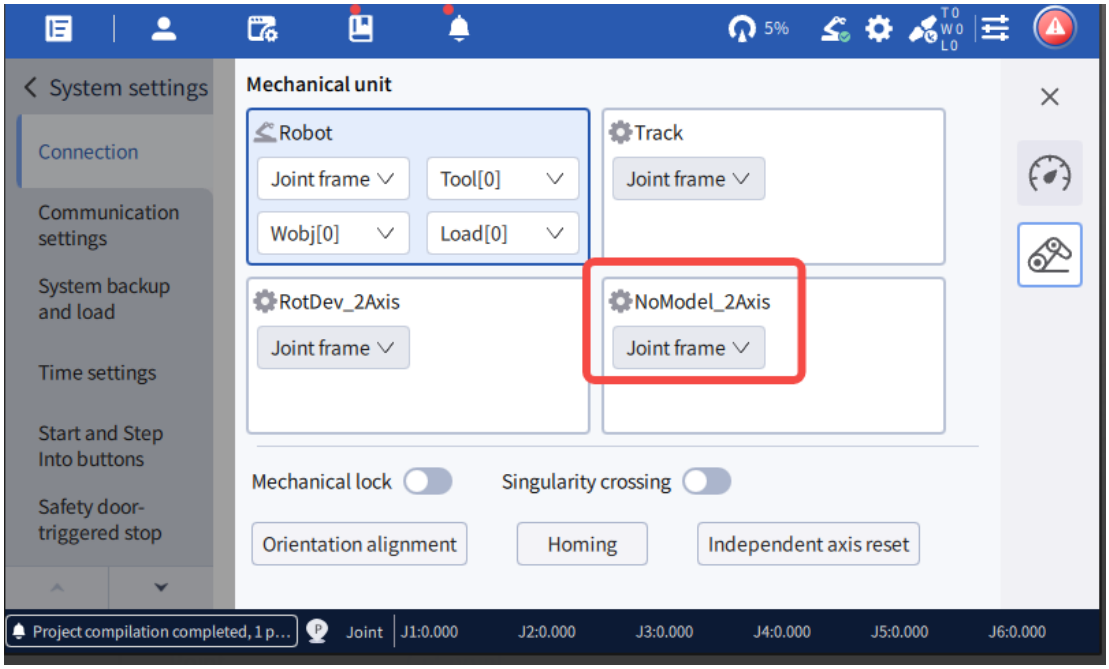


- Coordination between the robot and the positioner

Set UFFix to "False" and UFMec to the name of positioner coordinating with the robot.



When the current mechanical unit is switched to the positioner in the axis control panel and the robot is a workobject frame and a configured workobject is selected, the robot automatically starts coordination, as shown below.



(5) Coordinated motion instructions

1) When a guide rail is configured and the robot is placed on the guide rail, the Movl and Movc instructions perform coordinated motion.

2) When no guide rail is configured or a guide rail is configured but the robot is placed at a fixed position, if the workobject frame in the Movl and Movc instructions are associated with the name of single/dual-axis rotary positioner, then the Movl and Movc instructions are coordinated.

3) When a guide rail is configured and the robot is placed on the guide rail, and the workobject frame in the Movl and Movc instructions is associated with the name of a single/dual-axis rotary positioner, then the Movl and Movc instructions enable the robot, the guide rail and the single/dual-axis rotary positioner to move in coordination.

Movl

Linear motion of robot and external axis

Movl P, V, Z, Tool, [Wobj], [Acc],[Dec], [NWait], [Until In == value], [Out(No,value,Type)…]

> **CAUTION**
>
> If the workobject is movable and associated with a mechanical unit, then the motion between the robot and the mechanical unit is coordinated.

Movc

Circular motion of robot and external axis

Movc P, V, Z, Tool, [Wobj], [Acc],[Dec], [NWait], [Until In == value], [Out(No,value,Type)…]

CAUTION

- If the workobject is movable and associated with a mechanical unit, then the motion between the robot and the mechanical unit is coordinated.
- For the two Movc instructions, if they have the same robot axis points, they must also have the same external axis points.

(6) Precision of coordinated motion

For applications requiring high precision of the external axis coordination, pay attention to the following.

1) Check that the transmission ratio of the external axis is set correctly. Make sure the rotation angle (or distance) of the external axis set on the teach pendant is equal to the actual rotation angle (or distance) of the external axis.

2) The orientation of the tool needs to be calibrated to such a precision that the end position of the tool is not changed upon rotation around any axis of the tool. After completing calibration of the tool, calibrate the guide rail and the single/dual-axis rotary positioner.

3) When the workobject frame is associated with the positioner and not calibrated, check whether the origin of the workobject frame coincides with the rotation center of the positioner after calibrating the positioner.

4) If the robot is found to have poor coordination performance during automatic running, you can use the instruction to enable medium trajectory accuracy to improve the coordination performance.

5) If you choose the "Robot on guide rail" option, all movl and movc motions will be coordinated motions after you save the settings and restart the robot controller. If you just need to move the robot to a certain position and then move the robot independently, you can choose not to place the robot on the guide rail. This will reduce the error caused by the guide rail calibration.

6) For applications requiring simultaneous coordination of the guide rail and the positioner, configure the guide rail and the positioner first. After calibrating the guide rail, place the robot on the calibrated guide rail in the external axis configuration interface. Then restart the robot controller and calibrate the displacement positioner.

10.4.6.3 External Axis Supported Servo Gantry Synchronization Function

The external axis function can support the gantry synchronization function of Inovance 680N/680LN series servos. All 680 series servo types supported by the external axis can be configured for gantry synchronization. The slave axis not configured as an external axis can follow the master axis configured as the external axis for synchronized motion.

(1) Prerequisite

1) Guide: "SV680 Series Servo Gantry Synchronization Function Use Guide", "SV680 Series Servo Guide".

2) Encoder cables: Connect the encoder cables between two 680N/680LN servo drives.

3) Software requirement: InoDriverShop (can be downloaded from the Inovance official website).

4) Hardware requirement: Before using the gantry synchronization function, at least one external axis must be successfully configured (for master axis configuration).

(2) Wiring

For example, configure two external axes. Configure external axis #1 and external axis #2, with external axis #1 configured as the master axis and connected to the slave axis externally.

1) Wiring for external axis: Connect the IN port of external axis #1 to the controller, and the OUT port to the IN port of external axis #2.

2) Wiring for gantry synchronization: Use encoder cables to connect the second encoder port of the servo drive of external axis #1 with the second encoder port of the servo drive of the slave axis.

> CAUTION
>
> The slave axis cannot be configured as an external axis, meaning there is no need to connect the servo drive of the slave axis to the controller/master axis servo drive through IN/OUT ports.

(3) Configuring the servo

1) After completing the external axis configuration and the wiring between the external axis and the slave axis, use InoDriverShop to access to the servo background.

2) Check if the gantry synchronization function is available in the servo background parameters. If not, contact Inovance technical support.

3) Check the communication status of the two axes. If H14-02=1 for the two axes, they are in gantry synchronization status.

4) Set the master and slave axes. Set the external axis as the master axis by configuring H14-03, and check if H14-00 of the slave axis is 1. If yes, proceed to the next step.

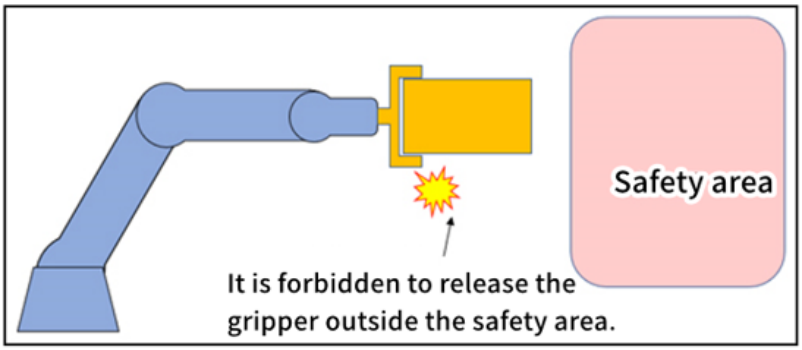
5) Confirm the forward direction of both axes. Push both axes simultaneously (the axes are connected through the gantry, pushing the gantry to rotate the axes in the same physical direction), and observe whether the signs of H14-40 and H14-41 of the master axis are consistent.

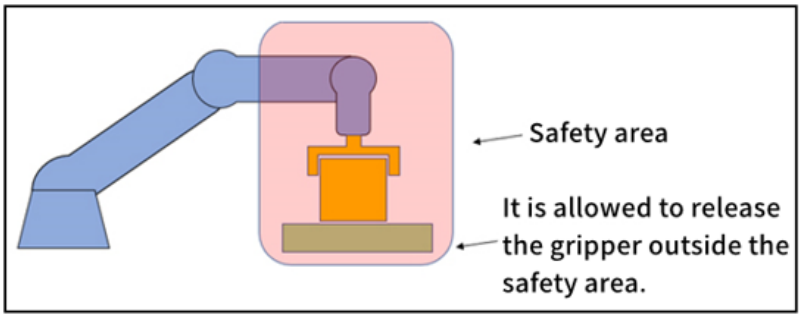
6) The basic servo configuration is now complete. For detailed usage and configuration methods of the gantry synchronization function, see the "SV680 Series Servo Guide".

> CAUTION
>
> If an axis drive alarm occurs during use, check whether the configuration of master and slave axes is correct, and connect to the servo background to view the alarm reason.

10.4.7 Safety I/O Action

This function is mainly for lithium battery customers. The opening and closing action of the gripper needs to be carried out within the designated area. Opening the gripper outside the safety area may cause the battery to accidentally fall, which may cause a safety accident, as shown below.





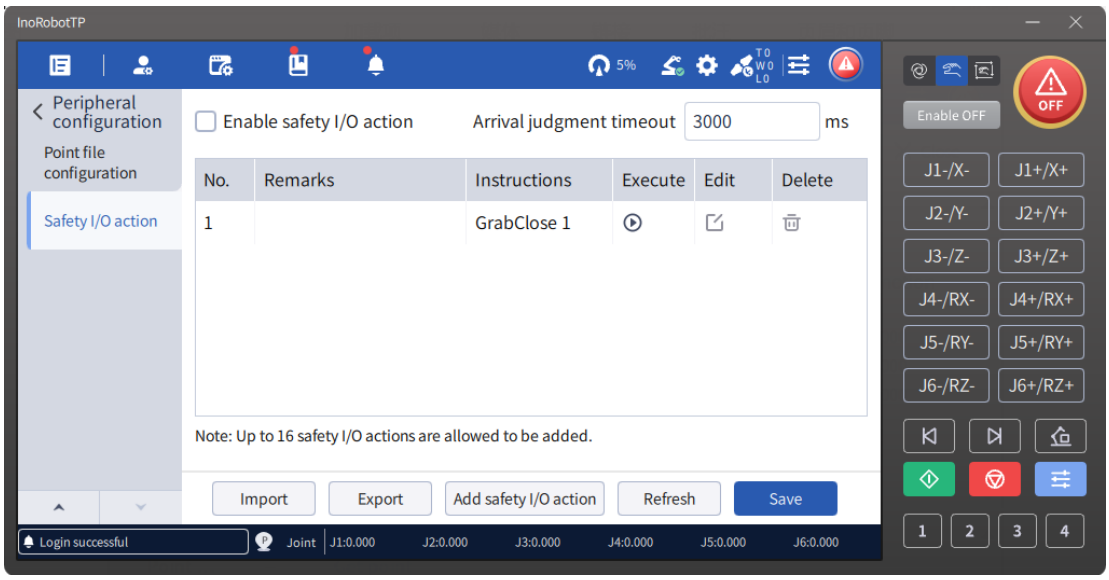
This problem can be solved by defining safety I/O actions and limiting the range of actions.

The safety I/O action is the action of the gripper rather than the motion of the robot. The user can define the area for executing the action, the output signal of the action, and the completion determination conditions of the action.

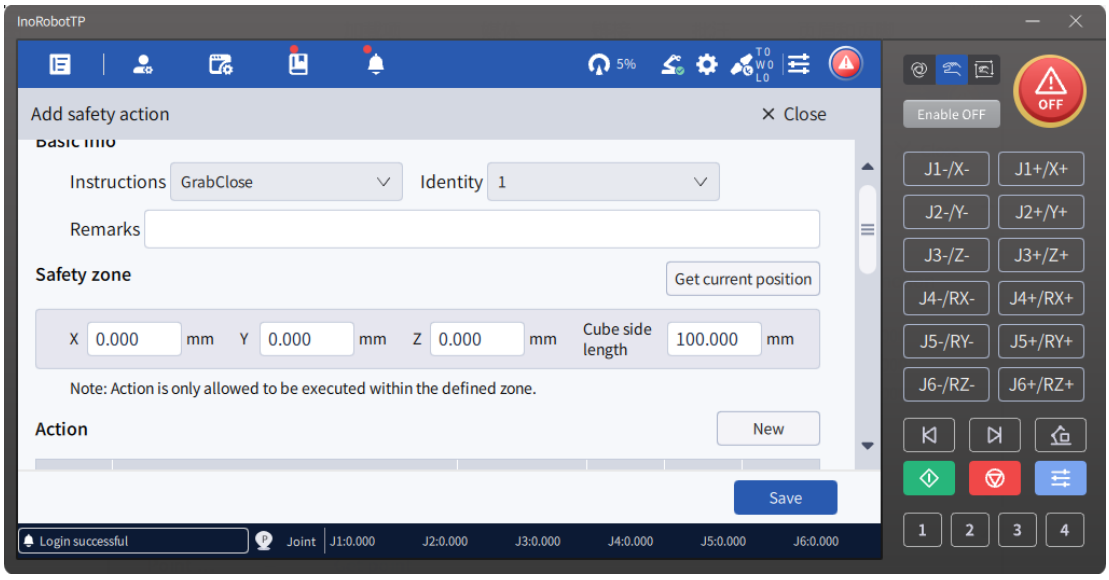
The safety I/O actions can be executed through user interface or through instructions in the program.

10.4.7.1 Steps

"Admin" mode is required to access this interface.



1. Click "Add safety I/O action" to enter the "Add safety action" interface. Add the GrabClose 1 instruction as example.

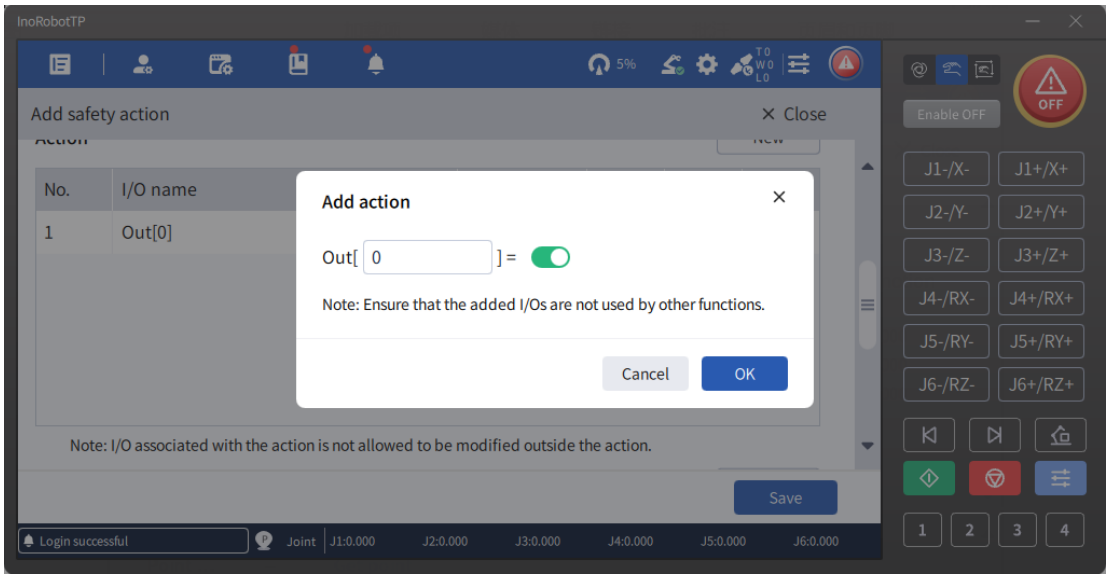


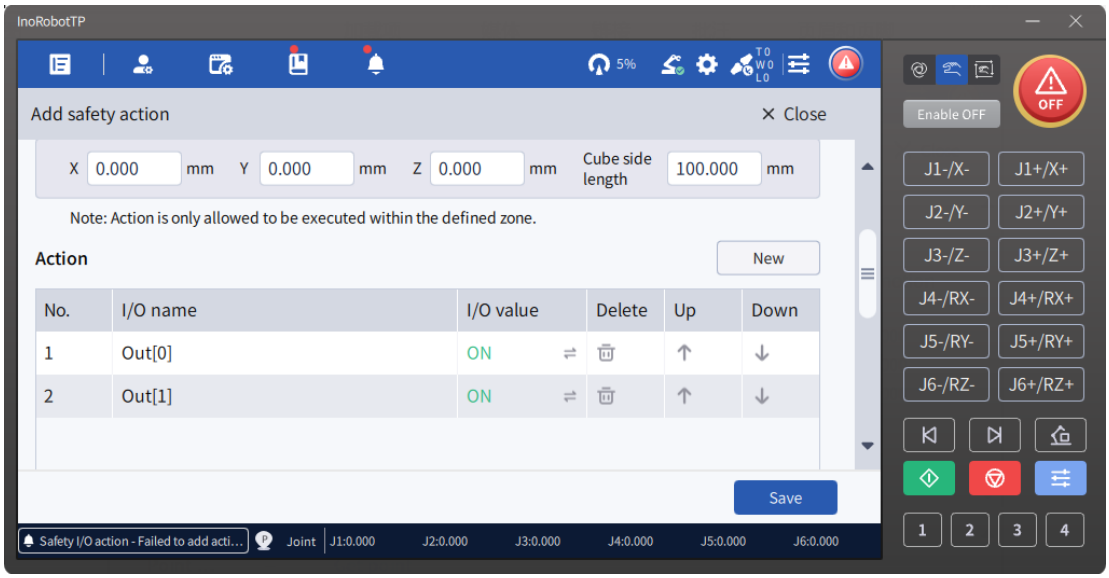
Description:

- "Instructions": GrabClose and GrabOpen instructions are available.
- "Identity": Select the unique identification number of the instruction.
- "Remarks": Add remark for the instruction, with a character limit of 16 characters.
- "Safety zone": Configure the center point of the safety zone and the side length of the safety zone (40 mm to 5,000 mm).

After confirming the content is correct, proceed to step 2.

2. Click "New" in the "Action" section to open the "Add action" window, and configure the I/O Out value during instruction execution. The number of configurable actions is limited to 16, with a minimum of 1.



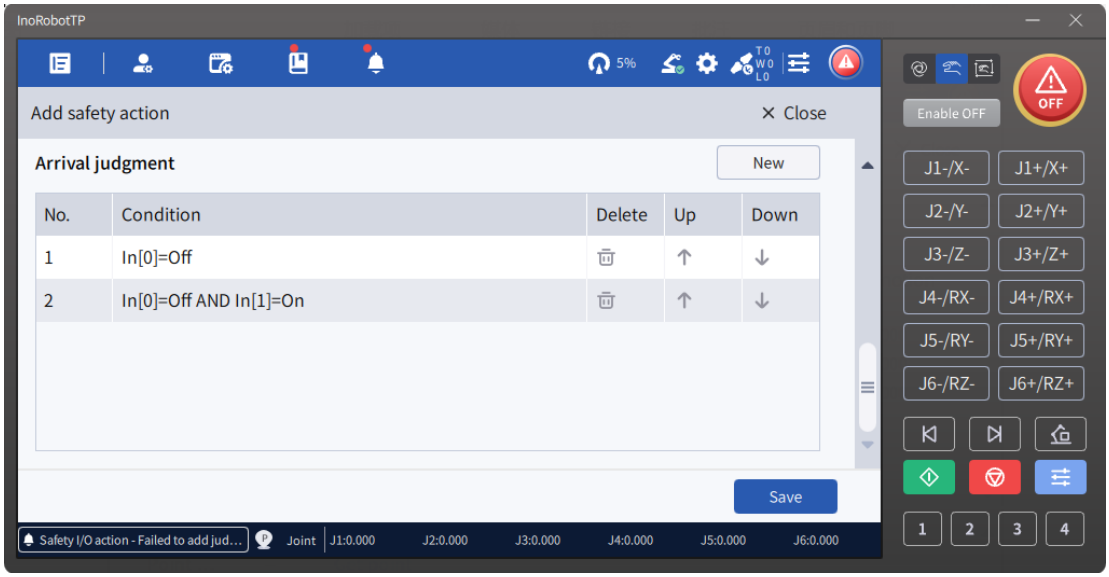


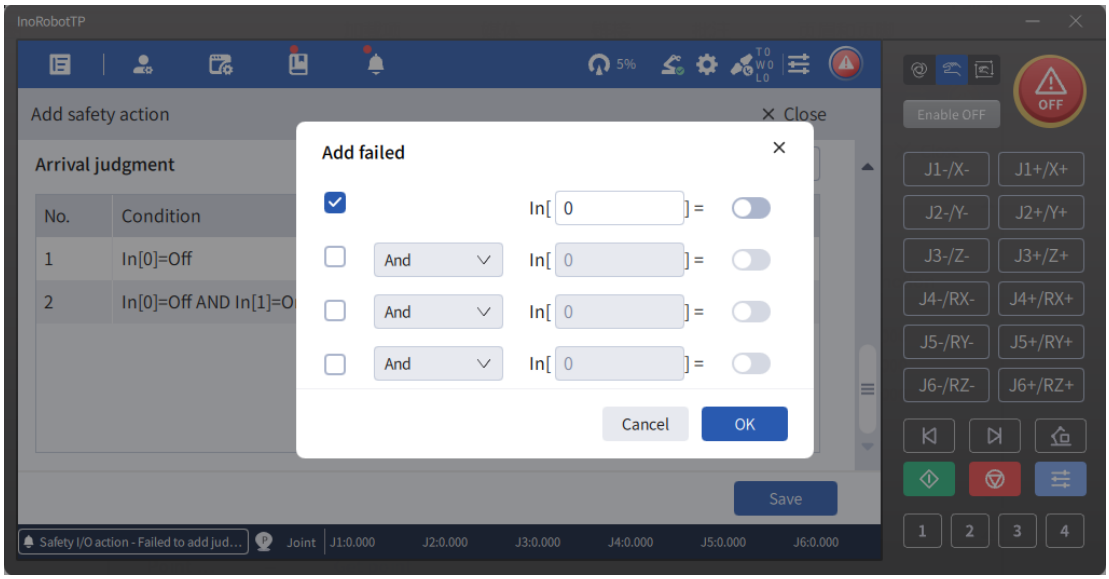
Description:

- The I/O number of Out is limited to [0, 127][512, 4607]. Double-click the I/O value column to set the I/O output value of the execution action.
- The "delete", " ↑ " and " ↓ " buttons can be used to configure the sequence of each execution action. When the GrabClose 1 instruction is called, the execution actions are executed in numerical order.

3. Click "New" in the "Arrival judgment" section to open the "Add failed" window, and configure the I/O signals that need to be waited for when the GrabClose 1 instruction ends.

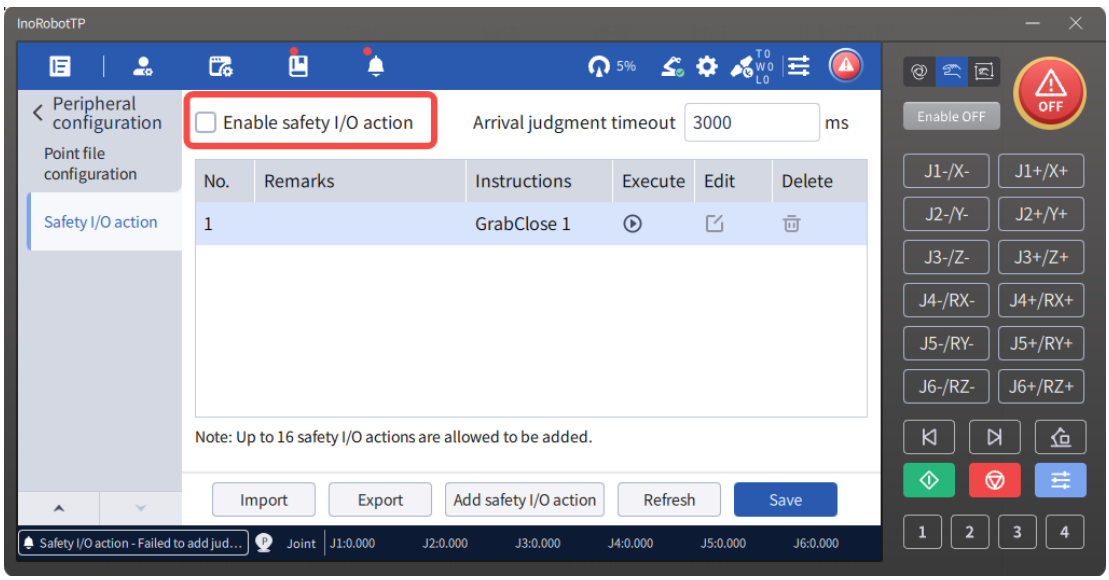
Description:



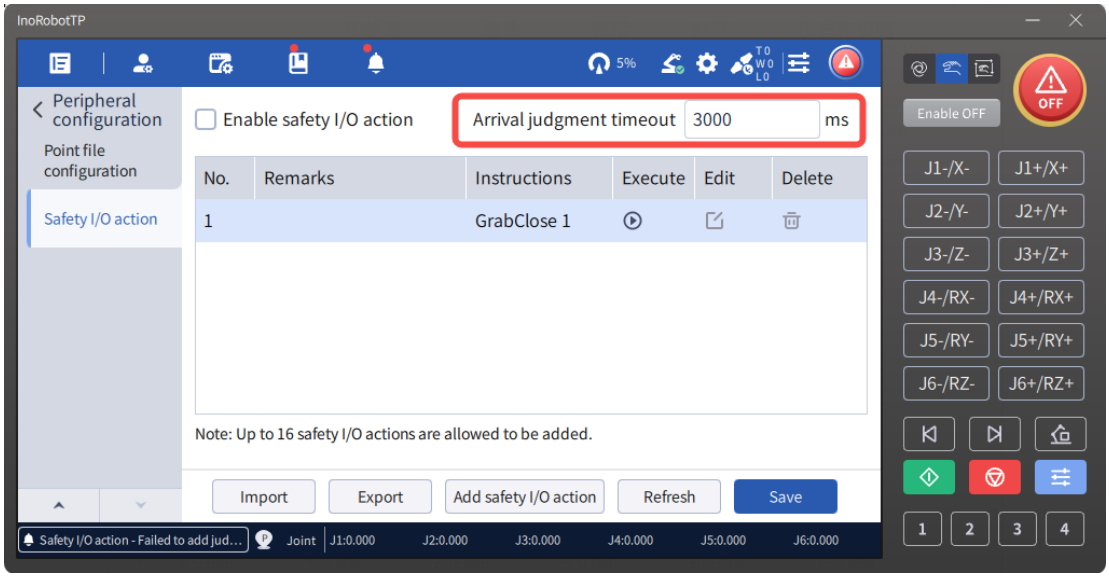


- The judgment condition can be left unconfigured or configured as an empty judgment condition.
- The I/O number of In is limited to [0, 127][512, 4607].
- You can configure duplicate judgment conditions, but all duplicate judgment conditions must be identical. For example, multiple judgment conditions can be configured using In[3], but all In[3] must be set to Off.

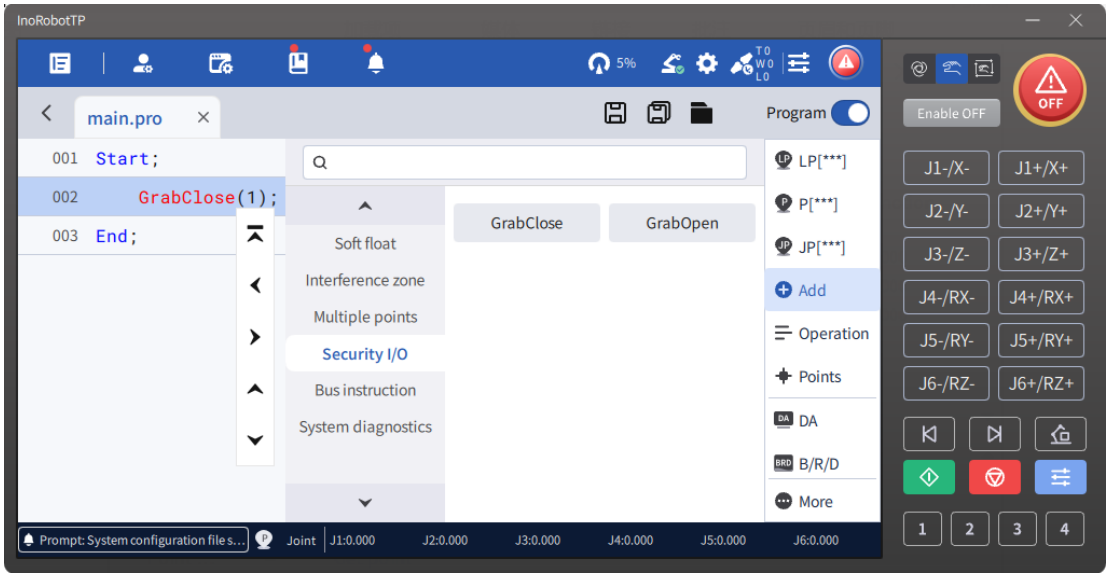
4. Click the "Save" button to complete the configuration of the GrabClose 1 instruction. At this point, you can check the "Enable safety IO action" to enable the function.

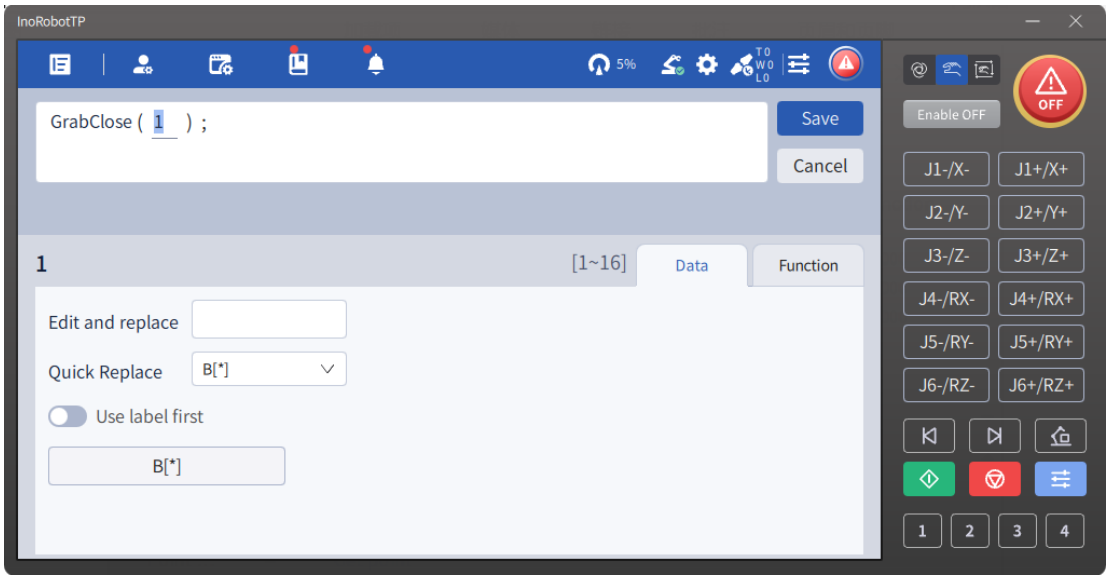


5. You can configure the "Arrival judgment timeout" time (ms) in the upper right corner of the interface and click "Save" to save the configuration. All GrabClose/GrabOpen actions will use this time as the maximum waiting time for In signals.



6. Call GrabClose1 in the instruction interface.

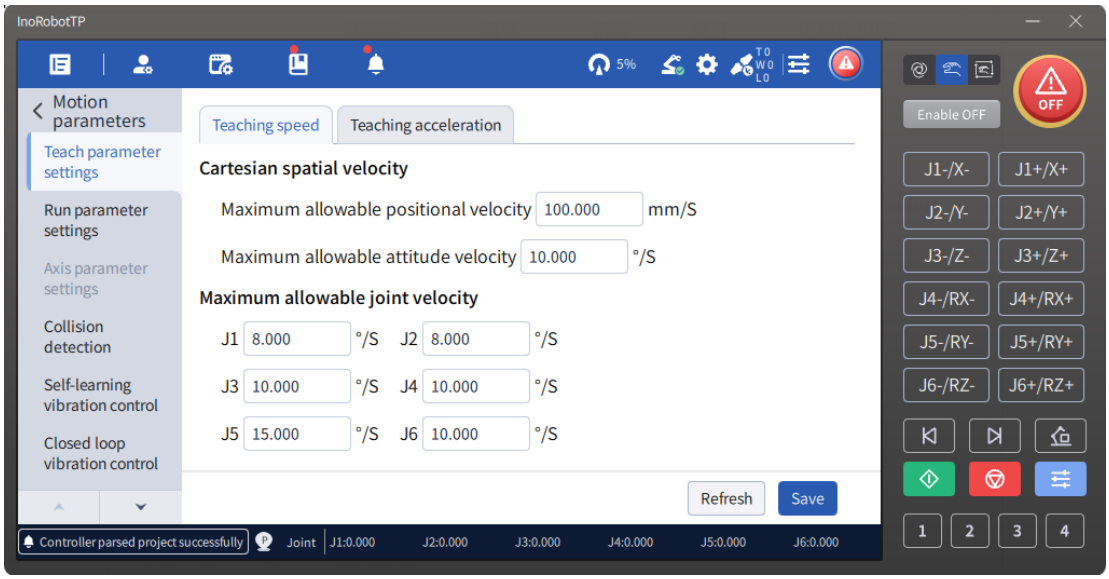




In the programming interface, click "Add" > "Security I/O" > "GrabClose/GrabOpen" to enter the instruction editing interface to change the corresponding parameters based on the configuration.

10.5 Motion Parameters Settings

10.5.1 Teach Parameter Settings



Teaching speed: The maximum speed during the teaching process.

Teaching speed = Maximum speed set here x Speed percentage set in the toolbar.

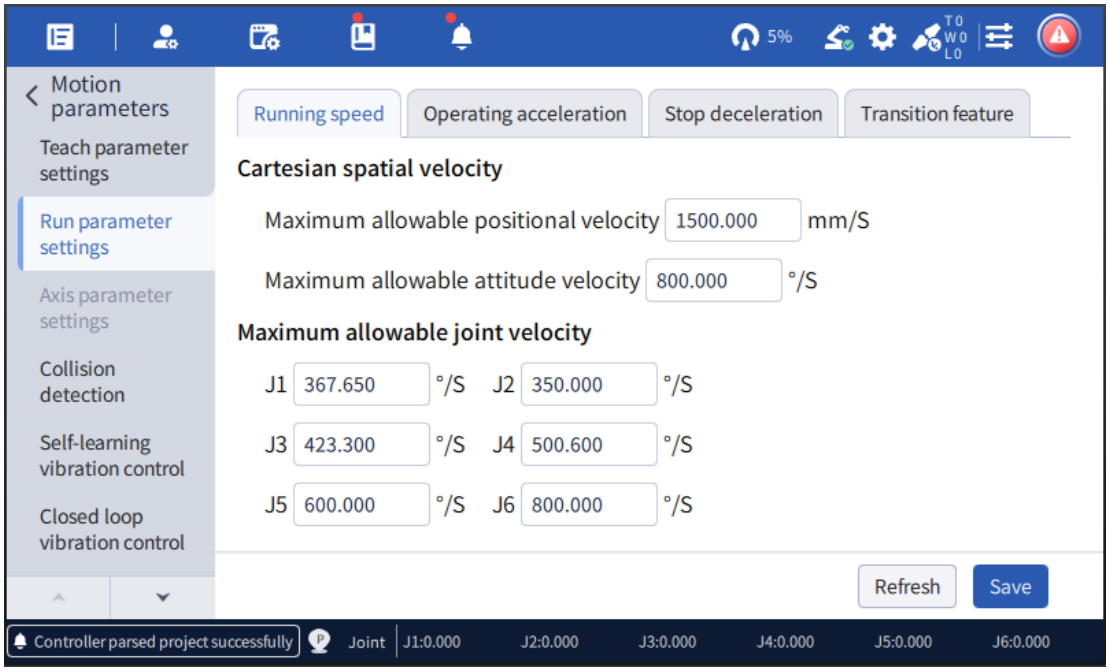
Teaching acceleration: The maximum acceleration during the teaching process.

> CAUTION
>
> The settings here is to set the speed and acceleration of the robot motion in various frames. In the manual mode of the program, the stepwise or continuous operation of the robot uses 50% of the operating speed and acceleration, rather than the parameters set here.

10.5.2 Run Parameter Settings

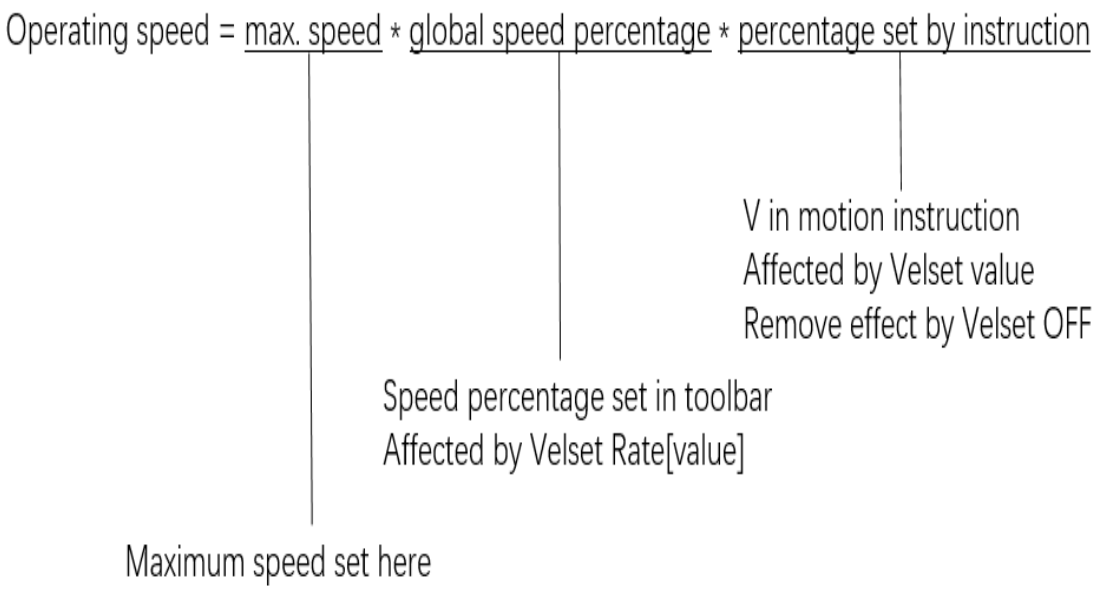
In the auto mode, the robot motion uses the parameters shown in the following figure.

In the manual mode, the stepwise or continuous operation of the robot uses 50% of the operating speed and acceleration. The stop speed parameters used are the same as those used in the auto mode.

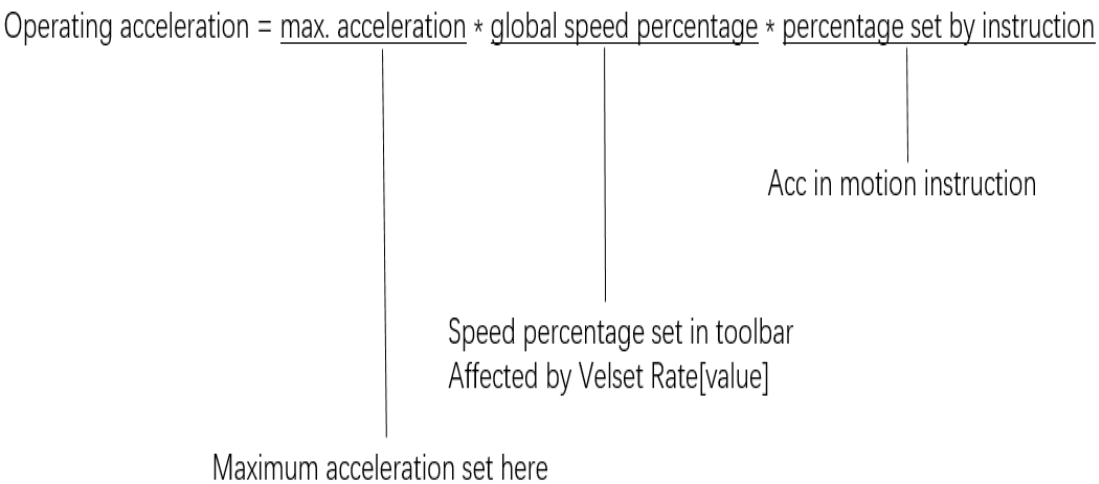


Running speed: The maximum speed during operation.

Relationship diagram of actual operating speed:



Operating acceleration: The maximum acceleration during operation.



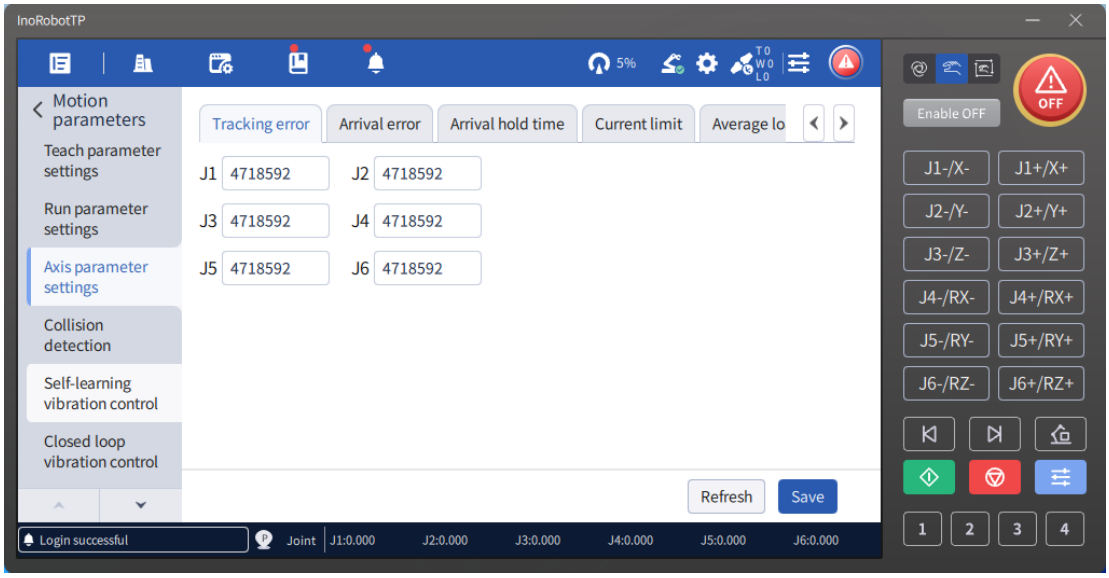
Stop deceleration: The deceleration during the stopping process.

> **CAUTION**
>
> The above parameters are subject to the performance of the servo system.

Transition feature:

Set the unit transition length.

10.5.3 Axis Parameter Settings



The "Manufacturer" mode is required to access the axis parameter settings interface.

Tracking error: This parameter is used to monitor whether the deviation between the planned position and the feedback position of the axis exceeds the limit. If the tracking error is reported to be too large, appropriately reduce the acceleration or increase the setting value of the tracking error.

Arrival error: This parameter determines the judgment condition for robot planning completion and servo actual arrival.

Current limit/Average load rate limit: Subordinates to the current protection function, see 12.6.1 Current Protection.

Temperature rise protection: This parameter can be used to enable or disable overload rate protection and overheating rate protection functions. Note that this page is displayed only on models that support temperature rise protection, see 12.6.2 Temperature Rise Protection.

> **CAUTION**
>
> For tracking error, arrival error, current limit, average load rate limit, and temperature rise protection, "Manufacturer" mode is required for adjustment.

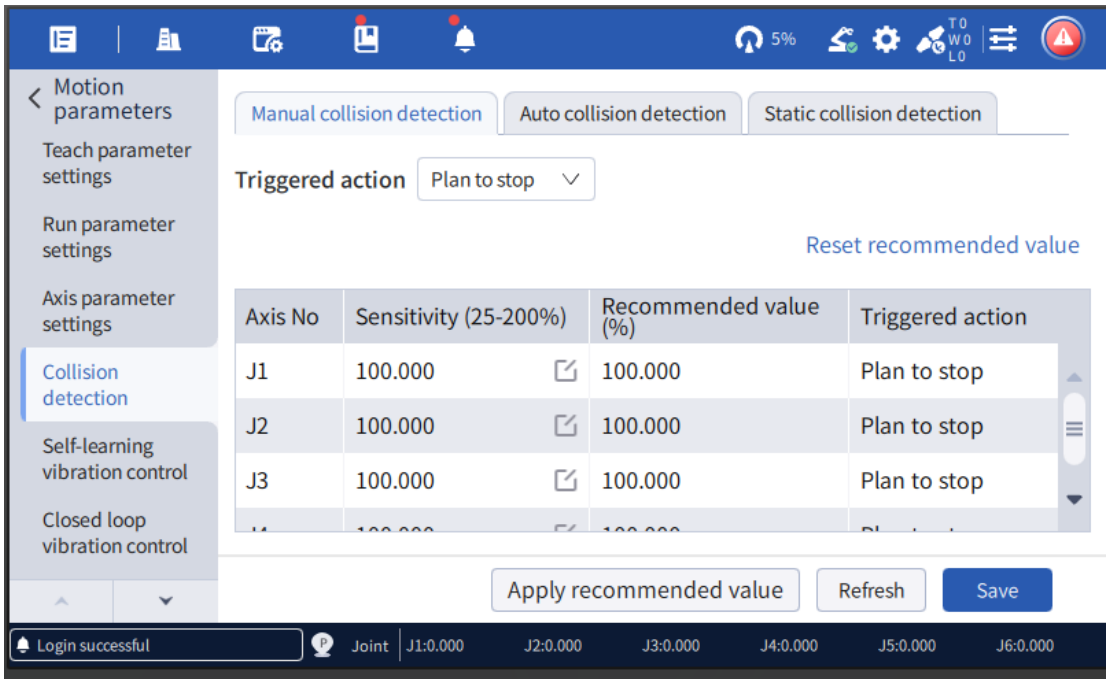
10.5.4 Collision Detection Settings

The collision detection parameters are divided into collision detection parameters in manual mode and collision detection parameters in auto mode. The collision detection parameters in auto mode are valid only in the automatic mode.

There are three types of collision detection parameters.

- The first is the collision detection switch provided for each axis. Click the switch to turn it on or off.
- The second is sensitivity, with a range of 25 to 300, the default being is 100.
- The third is the action triggered after collision, including alarm and stop, and alarm and move back.

> **CAUTION**
>
> "Alarm and move back" action requires special use scenarios. Before use, carefully read the 10.5.5 Collision Response section.



As shown in the above figure, the "Recommended value" column shows the recommended sensitivity and updates approximately every 3s. The recommended sensitivity is automatically reset to 75 after each power-on. Each time the robot moves, the system automatically calculates the recommended sensitivity. When the recommended sensitivity calculated by the system is greater than the sensitivity value displayed on the interface, the sensitivity value displayed is updated. The "Reset recommended value" button allows you to reset the displayed recommended sensitivity to 75. When the recommended sensitivity has increased unexpectedly due to minor contact of the robot, you can click this button to calculate the recommended sensitivity again.

There are several situations where changes in recommended sensitivity require special attention:

1. To avoid false alarms and ensure sufficient sensitivity when the operating conditions change significantly (such as a significantly larger or smaller load, a significantly faster or slower speed, or an abnormal increase in the recommended value due to a minor collision or contact), it is recommended to reset the recommended value and apply the latest recommended value after the robot runs for a period of time.
2. After the robot runs for a long time, the auto-recommended value may change even if the robot still runs under the same operating conditions due to joint friction. When the change is within 10%, it is not necessary to frequently adjust the collision detection sensitivity (unless a false alarm has occurred). If the change exceeds 10%, it is recommended to apply the latest recommended value.
3. When the recommended value is less than 100%, it is not recommended to change it to a value less than 100%. Otherwise, false alarms may occur when the operating conditions change. When and only when the requirement on the collision detection sensitivity is high, it is appropriate to set the sensitivity between 75% and 100%.

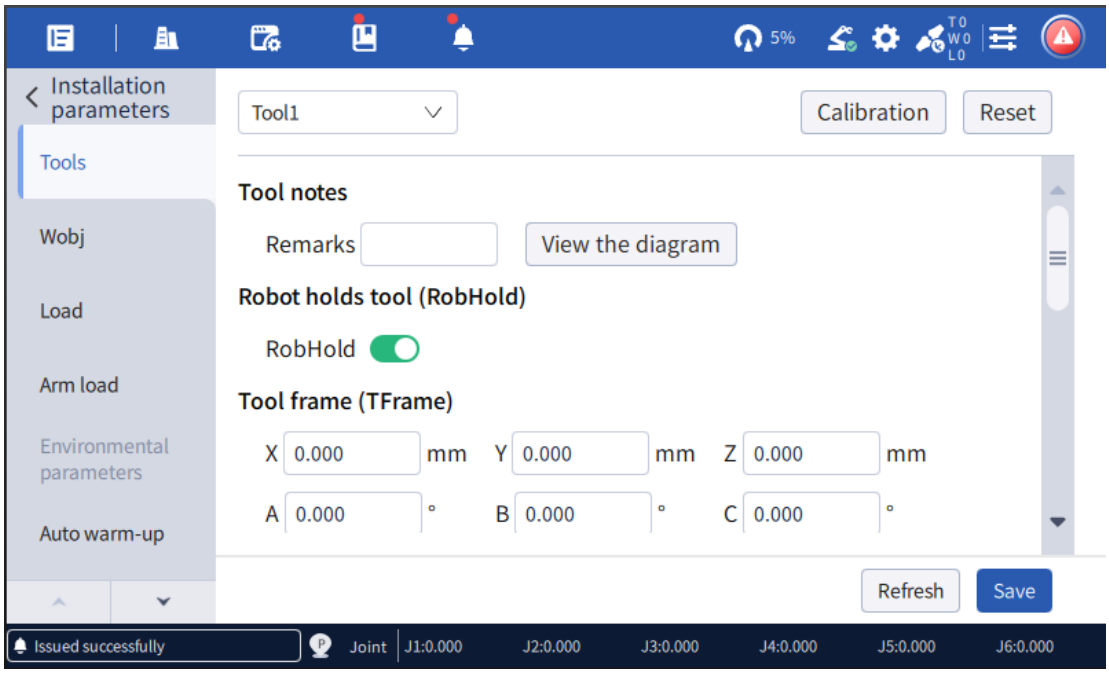
4. If you need to switch the speed manually during automatic motion, if the speed changes greatly (for example, directly from 25% to 100%), a false alarm may occur even if the recommended sensitivity at 100% speed is used. This is normal. If you need to switch the speed manually during automatic motion, it is recommended to switch the speed step by step. For example, switch from 25% to 50% first, then to 80% and finally to 100%.

The debugging steps for collision detection are as follows.

Check the load parameters.

The load parameters include mass, eccentricity, inertia, etc. and can be calculated from the 3D model of the load.

Enter the load parameters to the selected tool load or grip load, as shown in the figure below.



1. Activate the tool.

There are two methods to activate the tool load:

a) Add the corresponding tool number to the motion instruction. This method takes effect in the automatic, stepwise and continuous running states.

b) Switch the corresponding tool number in the tool frame interface. This method takes effect in the jog state.

2. Activate the corresponding grip load.

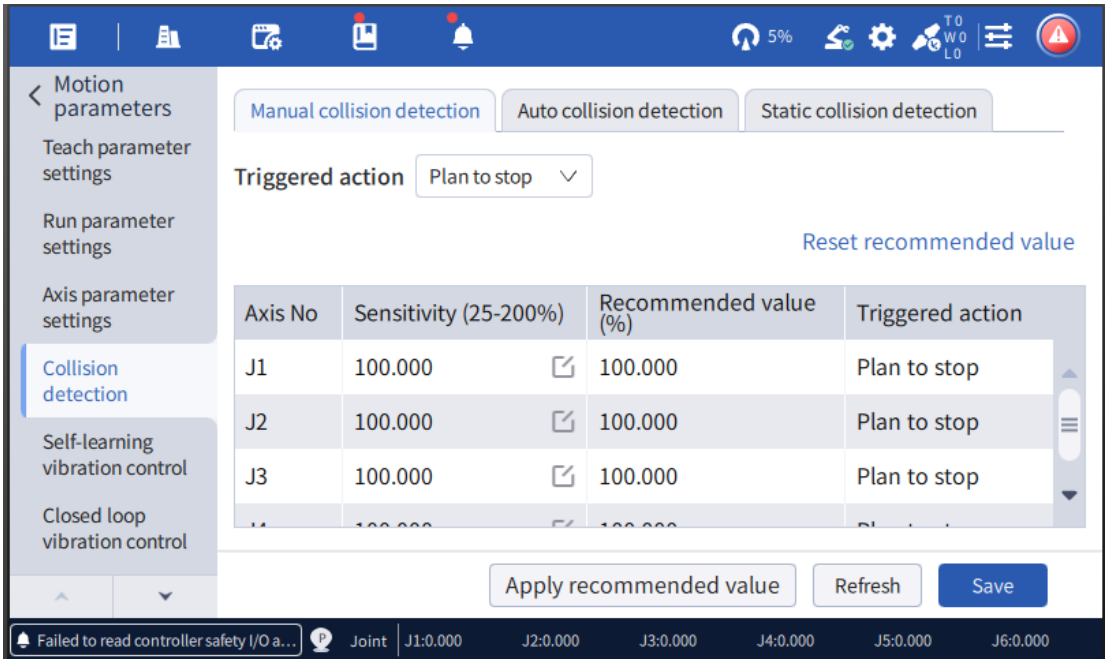
There are two methods to activate the grip load:

a) Activate the specified grip in the program through the GripLoad instruction. This method takes effect in automatic, stepwise and continuous running states.

b) Switch the corresponding grip load number in the monitoring interface. This method takes effect in the jog state (if the grip load number is not changed in the program by using the GripLoad instruction, the grip load number set in the monitoring interface is always active).

3. Set the collision detection parameters for manual mode.

Turn off the collision detection switch for manual mode and click the "Save" button.



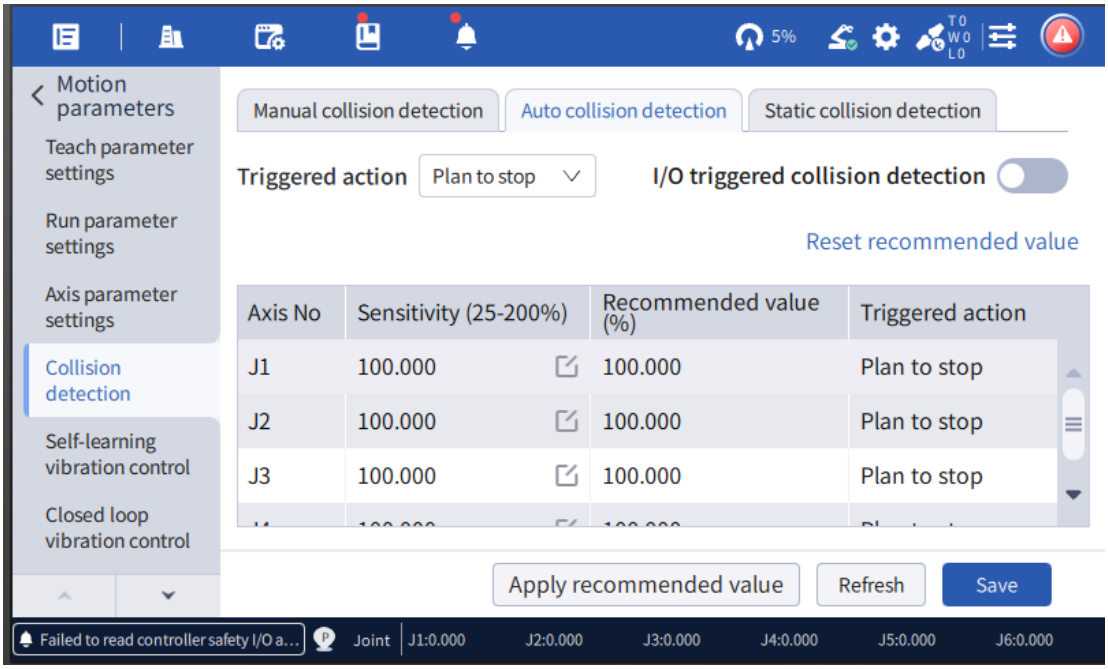
After normal movement in manual mode for a period, return to the manual collision detection parameter interface. Click "Apply recommended value" to write the recommended value to the "Sensitivity" column on the left. Then, turn on the collision detection switch and click "Save".

CAUTION

The recommended value is updated only when the motion in manual mode occurs. If the recommended value is less than 100, the interface will keep refreshing until the recommended value is more than 100. If the recommended value is less than 100, check whether the motion in manual mode has been performed or whether the motion time in manual mode is sufficient (about 30s required, 2 minutes and more recommended).

Set the collision detection parameters for auto mode.

Similar to the settings for the manual mode, turn off the collision detection switch and click the "Save" button.



After a period of automatic operation (5 minutes and more recommended), return to the auto collision detection parameter interface. Click "Apply recommended value" to write the recommended value to the "Sensitivity" column on the left. Then, turn on the collision detection switch and click "Save".

If a collision alarm is detected, do as follows.

1) Check whether parameters are set properly.
a) Check whether the collision detection sensitivity is too low. When the sensitivity is less than 100, false alarms are more likely to occur. Ensure that all sensitivity levels are greater than 100.
b) Check that the load matches the set tool load. Check whether the correct tool number is activated. If false alarm occurs in automatic, stepwise or continuous running, check whether the correct tool number is included in the instruction; check whether the corresponding tool load parameters are correct. Check whether the eccentricity is set correctly, especially when the eccentricity is large.
c) Check whether the load matches the set grip load. Check whether the correct grip load number is activated, whether the correct grip load number is activated using the GripLoad instruction, or whether the grip load number is correct on the monitoring interface; check whether the corresponding grip load parameters are correct. Check whether the eccentricity is set correctly, especially when the eccentricity is large.

2) If no fault is found in the preceding parameter check, check the operating conditions of the robot.

a) Check whether the operating conditions at the time of alarm are greatly different from those at the time of sensitivity setting. The required collision detection sensitivity may vary under different operating conditions. In addition, if the ambient temperature at the time of the alarm differs greatly from that at the time of parameter setting, collision detection may be affected. In this case, apply the latest recommended value.

b) Check whether the robot comes into contact with the outside world during motion. In case of contact, the contact force is unpredictable, as well as the torque fed back to the robot motor. Therefore, the set collision detection sensitivity cannot be used for a long time. In this case, it is recommended to temporarily increase the detection sensitivity by using SetAxisCollLevel instruction near instructions in the program that may have contact with the outside world, or temporarily disable the collision detection function using the SetAxisCollMode instruction. This method is available only in automatic mode.

c) Check whether there is strong vibration during robot motion. The strong vibration greatly affects the collision detection and easily causes false alarms. In this case, it is recommended to increase the set sensitivity by 10 to 30 on the basis of the recommended value.

3) Check the robot manipulator.

a) Check whether the robot base or robot end gripper is properly fastened.

b) Check whether the brake of the alarming axis is opened. Turn off collision detection, run the axis with false alarms (low-speed teaching) independently. Open the current protection interface, observe whether the average load rate and maximum current of the axis are too large, and whether an axis drive alarm occurs. If yes, check the servo parameters or cables related to the brake.

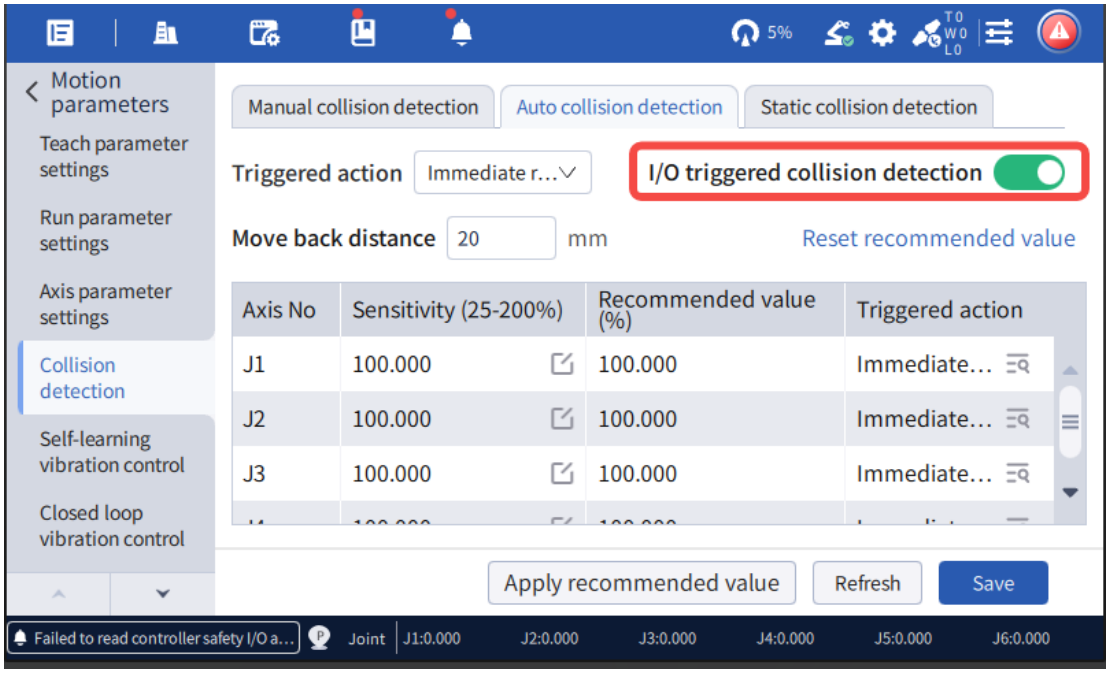
c) When the robot servo is enabled, rotate the robot axis (the axis with alarm) firmly and observe whether the robot has a large clearance. If the clearance is large, the reducer or timing conveyor is abnormal and needs to be dismantle for inspection. If no problem is found in above checks, it is possible that the reducer is damaged. Export the fault information promptly and contact the manufacturer for analysis.

4) If a collision alarm occurs with the collision detection function turned off, you can try to turn off the second-level collision detection if all previous checks cannot solve the problem. To turn off the second-level collision detection, set the collision detection sensitivity to 300 and at the same time turn off the collision detection switch on the software interface or via instructions. It is recommended to make such settings only near instructions prone to false alarms, and restore the normal collision detection settings as soon as possible in the subsequent program.

I/O triggered collision detection function

In auto mode under remote I/O mode, collision signals can be triggered by external inputs. The specific procedure is as follows:

Enable the I/O triggered collision detection function:



Configure the I/O mapping: See 10.4.2 I/O Mapping;

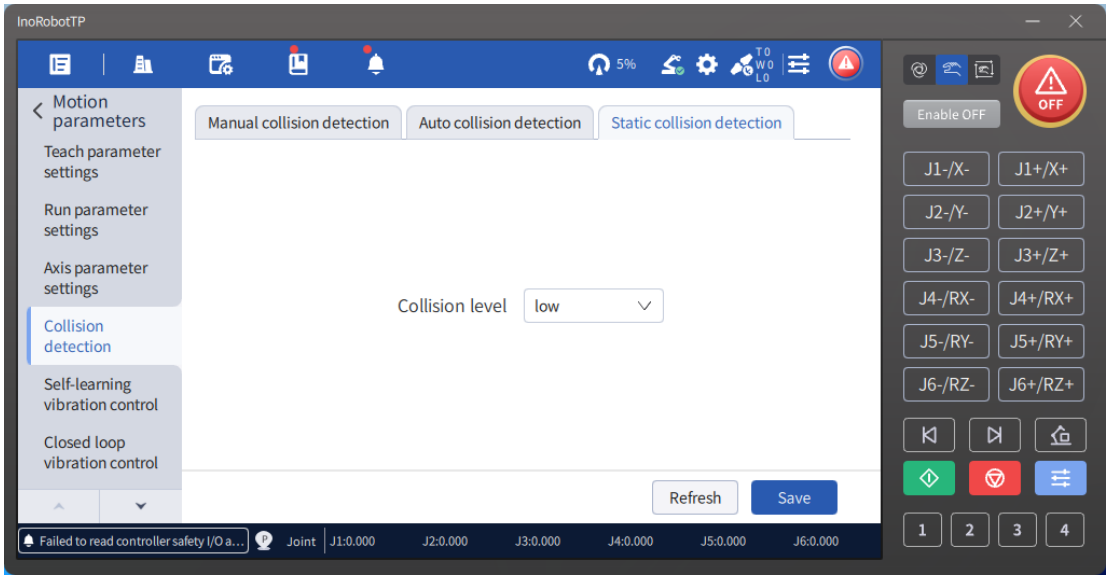
After the above configuration is completed, when the robot is in remote I/O mode and automatically running the program, upon receiving a rising edge signal from an external input, the robot will perform actions according to the user-set collision handling actions.

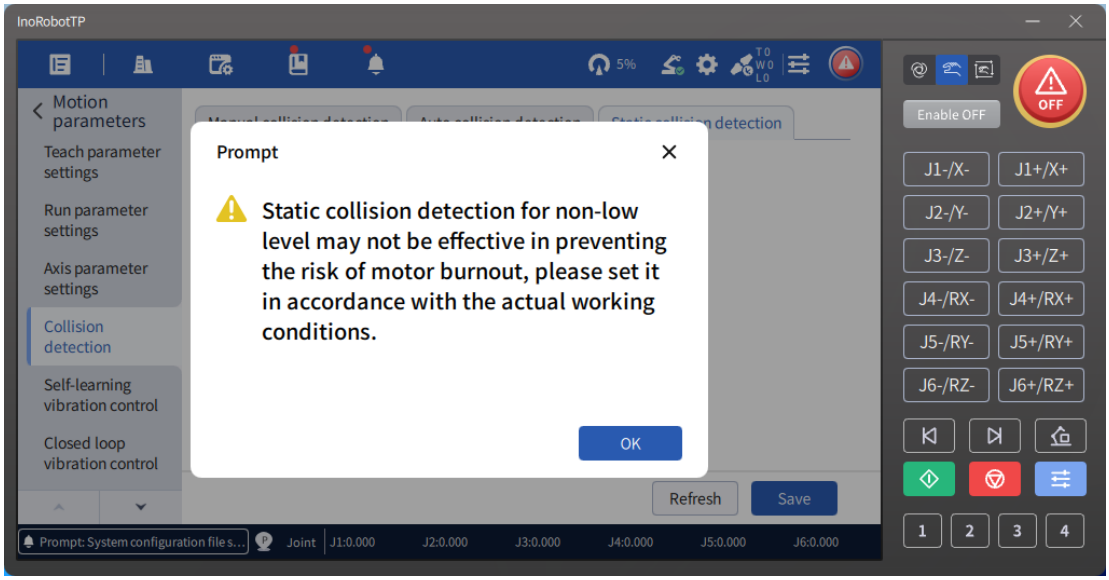
CAUTION

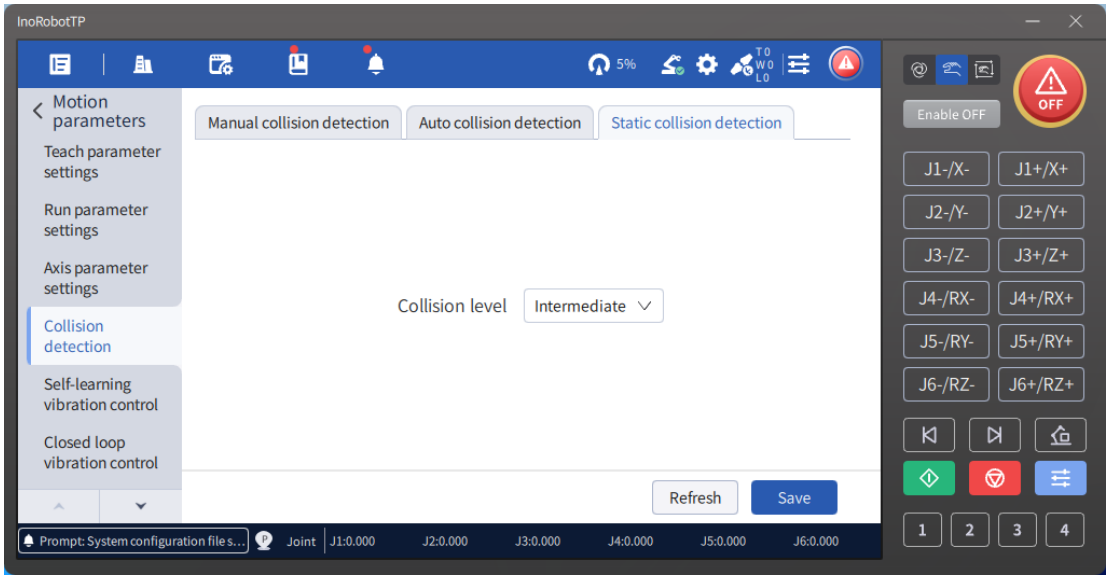
- This function is only effective in the auto mode under remote I/O mode.
- This function is triggered by a rising edge.

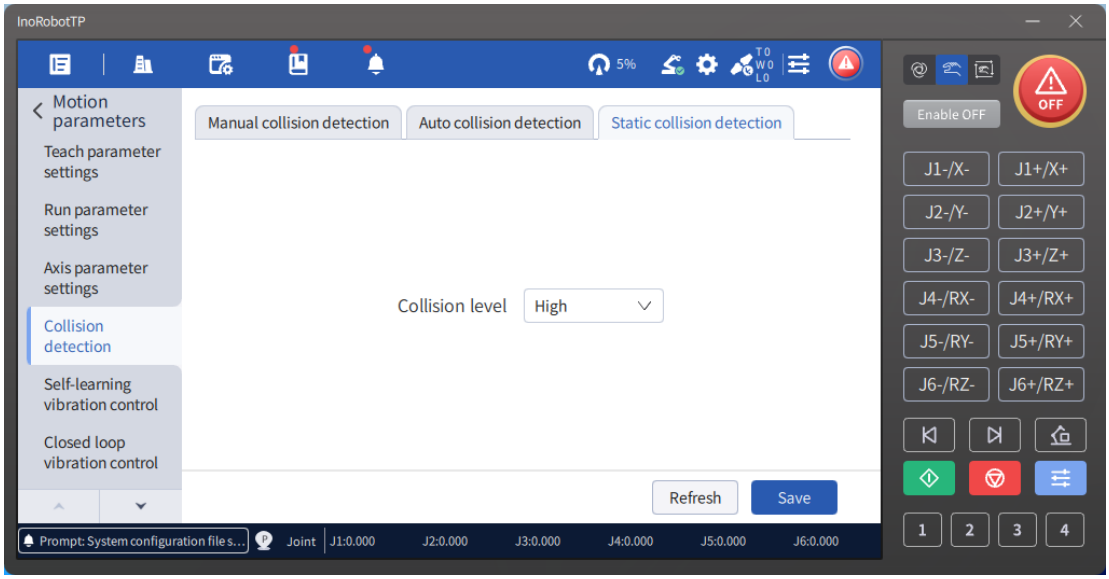
Static collision detection function (only for 6-axis robots)

As shown in the figure below, click "Settings" > "Motion parameters" > "Collision detection" > "Static collision detection" in sequence to set the collision level. The collision levels for static collision detection are "low" (default), "intermediate", and "high". When switching to intermediate or high, a prompt will pop up and require manual closure by the user, with the message "Static collision detection for non-low level may not be effective in preventing the risk of motor burnout, please set it in accordance with the actual working conditions."


InoRobotTP
Motion parameters
Teach parameter settings
Run parameter settings
Axis parameter settings
Collision detection
Self-learning vibration control
Closed loop vibration control
Manual collision detection
Auto collision detection
Static collision detection
Collision level
low
Refresh
Save
Enable OFF
OFF
J1-/X-
J1+/X+
J2-/Y-
J2+/Y+
J3-/Z-
J3+/Z+
J4-/RX-
J4+/RX+
J5-/RY-
J5+/RY+
J6-/RZ-
J6+/RZ+
1
2
3
4
Failed to read controller safety I/O a...
Joint
J1:0.000
J2:0.000
J3:0.000
J4:0.000
J5:0.000
J6:0.000


InoRobotTP
Motion parameters
Teach parameter settings
Run parameter settings
Axis parameter settings
Collision detection
Self-learning vibration control
Closed loop vibration control
Prompt
Static collision detection for non-low level may not be effective in preventing the risk of motor burnout, please set it in accordance with the actual working conditions.
OK
Refresh
Save
Enable OFF
OFF
J1-/X-
J1+/X+
J2-/Y-
J2+/Y+
J3-/Z-
J3+/Z+
J4-/RX-
J4+/RX+
J5-/RY-
J5+/RY+
J6-/RZ-
J6+/RZ+
1
2
3
4
Prompt: System configuration file s...
Joint
J1:0.000
J2:0.000
J3:0.000
J4:0.000
J5:0.000
J6:0.000


InoRobotTP
Motion parameters
Teach parameter settings
Run parameter settings
Axis parameter settings
Collision detection
Self-learning vibration control
Closed loop vibration control
Manual collision detection
Auto collision detection
Static collision detection
Collision level
Intermediate
Refresh
Save
Enable OFF
OFF
J1-/X-
J1+/X+
J2-/Y-
J2+/Y+
J3-/Z-
J3+/Z+
J4-/RX-
J4+/RX+
J5-/RY-
J5+/RY+
J6-/RZ-
J6+/RZ+
1
2
3
4
Prompt: System configuration file s...
Joint
J1:0.000
J2:0.000
J3:0.000
J4:0.000
J5:0.000
J6:0.000

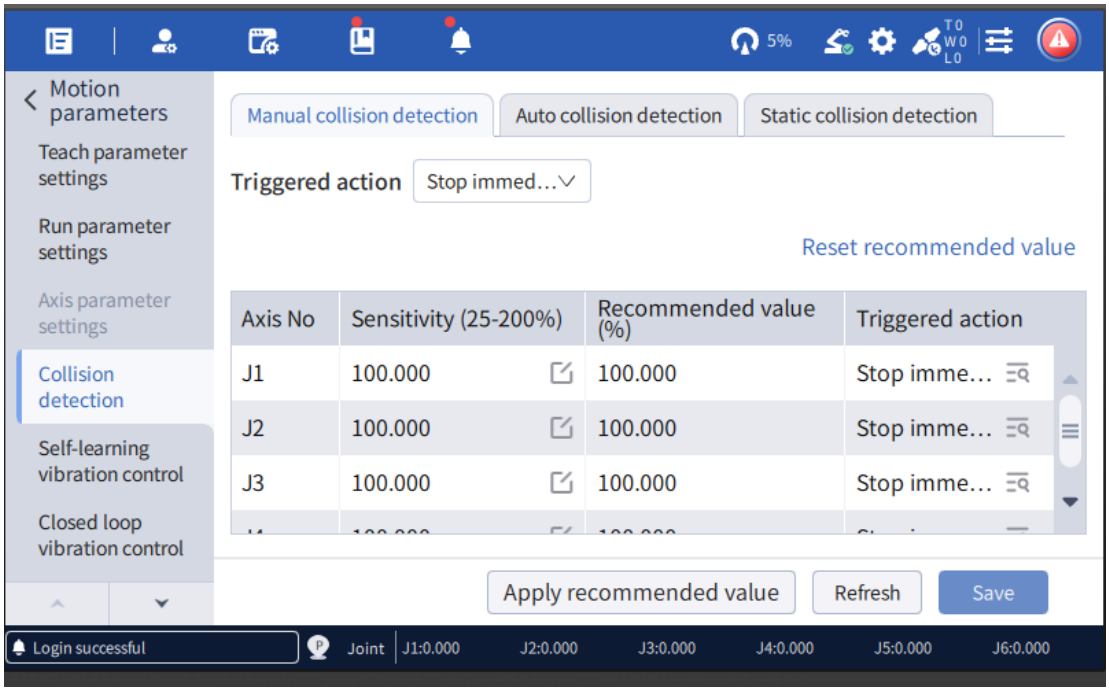


Description: This function is to add collision detection for the robot when the enable signal is active and not in motion. You can set the collision level to low, intermediate, or high. The low collision level is the default and also the safer setting. If you have special operating condition requirements, the collision level can be set to intermediate or high, but the protection effectiveness of these two levels will be reduced. You can set it as appropriate.

10.5.5 Collision Response

10.5.5.1 Overview

After a collision detection alarm is triggered in the robot, you can select the collision response method, i.e., the action triggered by the collision detection alarm. The available trigger actions include: plan to stop, stop immediately, and immediate rollback. In addition, external signals are supported to trigger the collision detection alarm, which can effectively avoid collisions of the manipulator. For the settings of this function, see 10.5.4 Collision Detection Settings.



10.5.5.2 Plan to Stop

10.5.5.2.1 Description

After selecting the trigger action as "Plan to stop", upon the occurrence of a collision detection alarm, the robot speed will be gradually planned to 0, completing the stop.

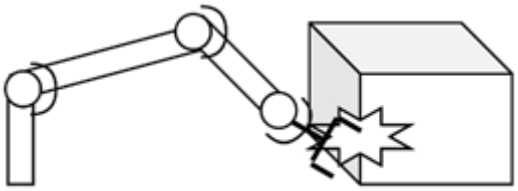
10.5.5.2.2 Steps

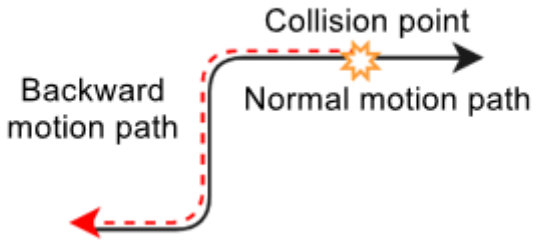
- In the manual mode, you can set the action triggered upon collision in the manual mode to "Plan to stop".
- In the auto mode, you can set the action triggered upon collision in the auto mode to "Plan to stop".
- In addition, in the auto mode, you can also enable the "Plan to stop" function by using instruction SetCollMode (ON,Coll_ PlanStop).

10.5.5.3 Immediate Rollback

10.5.5.3.1 Description

When the "Triggered action" is set to "Immediate rollback", upon the occurrence of a collision detection alarm, the robot will move back a certain distance along the planned path before the collision. Additionally, you can set the planning distance during moving back.





10.5.5.3.2 Steps

- In the manual mode, you can set the action triggered upon collision in the manual mode to "Immediate rollback", where you can also set the "Move back distance".
- In the auto mode, you can set the action triggered upon collision in the auto mode to "Immediate rollback", where you can also set the "Move back distance".
- In addition, in the automatic mode, you can also enable the immediate rollback function by using instruction SetCollMode (ON,Coll_Rebound).

10.5.5.3.3 Notes

- Before using the immediate rollback function, make sure that the collision detection function is enabled and the collision detection sensitivity is set correctly.
- The immediate rollback function can only ensure that the robot returns along the planned path before the collision. It cannot avoid secondary collision during moving back. Do not use the immediate rollback

function in places with high risk of secondary collision, such as narrow space and complicated environment.

- The robot stops rollback immediately when any one of the following conditions is met: The rollback planning distance exceeds the planned value; The rollback planning distances exceeds the distance planned at the time of 320 ms before alarm; There is a decreasing trend in the spatial distance between the planned rollback point and the collision point.
- Make sure the servo firmware version corresponds to the controller version.
- The move back function must be enabled manually.
- The move back function needs to be enabled respectively for the manual mode and auto mode.
- The instruction SetCollMode takes effect only in auto mode.
- For a robot that has performed the move back function, it is recommended to re-tune the collision detection sensitivity after using this function.
- The acceleration of move back is large and the impact on the robot joints is large. Avoid collision as much as possible. Use the recommended sensitivity to avoid false collision alarms.
- In the move back process after high-speed collision, the servo drive alarm is very likely to occur. This is normal as long as the servo drive alarm does not occur within the first 50 ms of the move back process.

10.5.5.4 Stop Immediately

10.5.5.4.1 Description

After selecting the trigger action as "Stop immediately", upon the occurrence of a collision detection alarm, the robot speed will be immediately decreased to 0, completing the stop.

10.5.5.4.2 Steps

- In the manual mode, you can set the action triggered upon collision in the manual mode to "Stop immediately".
- In the auto mode, you can set the action triggered upon collision in the auto mode to "Stop immediately".
- In addition, in the auto mode, you can also enable the "Stop immediately" function by using instruction SetCollMode (ON,Coll_ RapidStop).

10.5.5.4.3 Notes

- Before using the immediate stop function, make sure that the collision detection function is enabled and the collision detection sensitivity is set correctly.
- Make sure the servo firmware version corresponds to the controller version.
- The move back function needs to be enabled respectively for the manual mode and auto mode.
- The instruction SetCollMode takes effect only in auto mode.
- For a robot that has performed the move back function, it is recommended to re-tune the collision detection sensitivity after using this function.

10.5.5.5 Priority of Actions Triggered by Instruction Settings and Interface Settings

- During running in manual mode, the triggered action after a collision detection alarm will be consistent with the "Triggered action" setting under "Manual mode" in the interface settings. Note that when running

a program in manual mode, the trigger action set in the instruction settings will not take effect, and the trigger action will still follow the "Triggered action" setting under "Manual mode" in the interface settings. The same logic applies to "Move back distance".

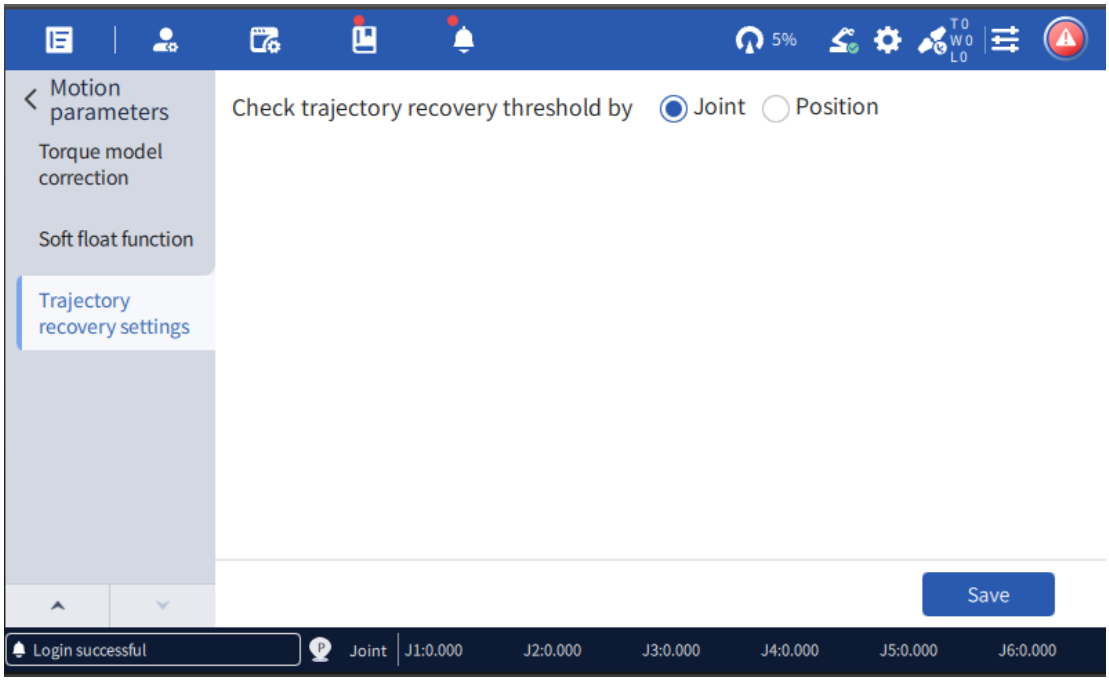
- During running in auto mode, before the instruction settings take effect, the triggered action after a collision detection alarm will be consistent with the "Triggered action" setting under "Auto mode" in the interface settings. After the instruction settings take effect, the triggered action after a collision detection alarm will be consistent with the "Triggered action" in the instruction settings. After compiling the project or returning to the start line of the main task or all start lines, the "Triggered action" under auto mode will be consistent with the that in the interface settings. The same logic applies to "Move back distance".

10.5.6 Trajectory Recovery Settings

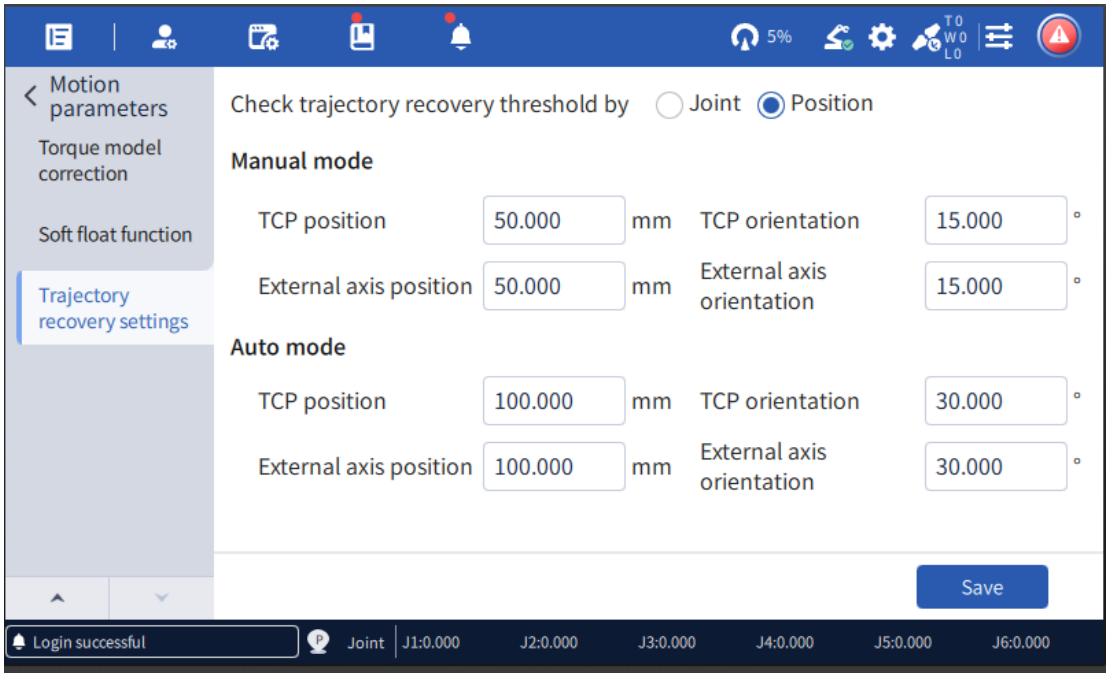
- You can choose to check the threshold for trajectory recovery of the robot by joint or by position. If you choose joint, the robot determines whether to pop up a prompt for trajectory recovery by comparing the changes in joints.
- If you choose position, the robot determines whether to pop up a prompt for trajectory recovery by comparing the change in position of the TCP and the external axis. When you choose position, you can set TCP position, TCP orientation, external axis position, and external axis orientation for the manual and automatic modes.

Steps

Go to "Settings" > "Motion parameters" > "Trajectory recovery settings".



Joint



Position

Results

When you choose the joint mode, the settings take effect after being saved. When you choose the position mode, enter the setting data and save the settings to make them take effect.

Note

This function is only available to the manufacturer. The settings must be saved with the robot disabled.

It is recommended that the threshold in position mode be set to a value above 0.1 mm or 0.1°.

> CAUTION
>
> When it is set to 0, the prompt keeps popping up.

Parameter description:

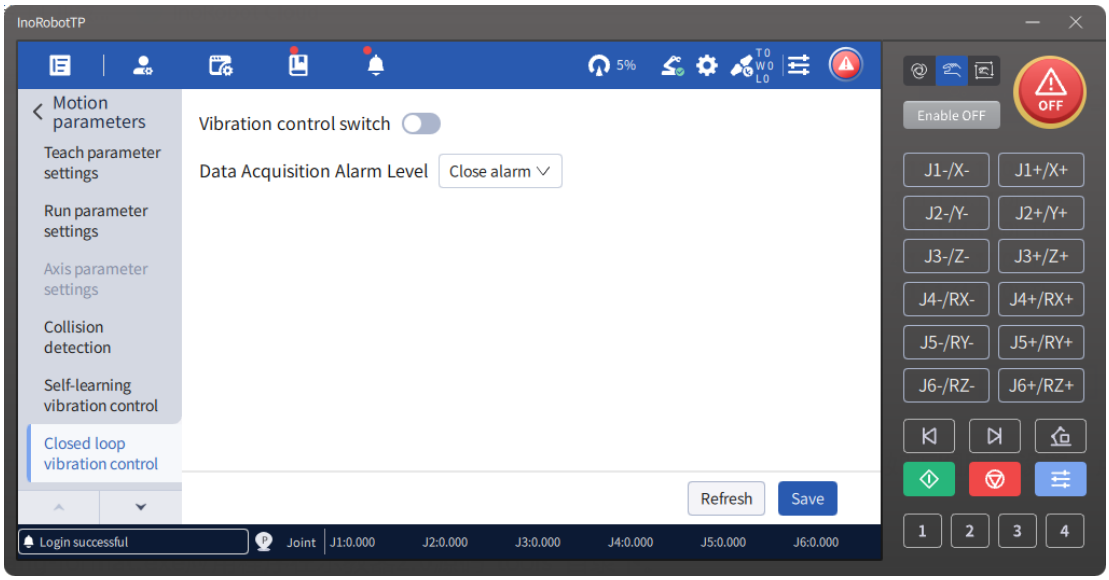
Parameter	Description	Default for manual mode	Default for auto mode	Unit	Range
TCP position	The maximum allowable TCP distance between the robot arm deviation point and the point to be reached.	50	100	Millimeter (mm)	[0, 20000]
TCP orientation	The maximum allowable TCP orientation deviation between the	15	30	Degree (°)	[0, 360]

Parameter	Description	Default for manual mode	Default for auto mode	Unit	Range
	robot arm deviation point and the point to be reached.				
External axis position	The maximum external axis distance between the external axis deviation point and the point to be reached.	50	100	Millimeter (mm)	[0, 20000]
External axis orientation	The deviation of the rotation angle of the external axis between the external axis deviation point and the point to be reached.	15	30	Degree (°)	[0, 360]

10.5.7 Closed-loop vibration Control

This function is only available for IRCB500 series and IRCB501 series controllers, which come with a data acquisition board. Configurable parameters are as follows:

- Vibration control switch: Enable, Disable
- Data acquisition alarm level: 0-Close alarm, 1-Low sensitivity, 2-Medium sensitivity, 3-High sensitivity



CAUTION

When the data collection board is missing or damaged, set the data collection board alarm sensitivity to "Disable alarm" to avoid continuous alarms.

10.5.8 Self-learning Vibration Control

10.5.8.1 Function Introduction

Application scenario: When significant vibration is observed during program motion, the self-learning vibration control function can be used to reduce the vibration.

1. Observe program execution and identify motion instructions upon significant vibration, and add SLOn to these motion instructions.
2. Add the SLMode instruction at the beginning of the program to set the vibration suppression level.
3. Re-execute the program, and the system automatically performs learning during motion. (The self-learning process will cause the motion instruction to pause approximately 1.5s longer after motion completion.)
4. Afterward, the machine can be used normally with suppressed vibration (since the learning has already been completed in step 3, the system will not re-learn when running the program again, but will suppress vibration under the influence of the SLMode instruction for all motion instructions with SLOn).

CAUTION

- The learning data of self-learning vibration control does not move with projects, so the suppression effect will not directly follow the projects.
- If using self-learning vibration control on one device and then transferring the project to another device, the vibration suppression needs to be re-learned. Alternatively, after moving the project, the learning data from the original device can be exported to the new device. This can save time on self-learning for robots in batch production lines.

10.5.8.2 Related Instructions

The instructions related to self-learning vibration control are as follows:

(1) SLVSMode

Name	SLVSMode
Function	Sets the self-learning vibration control mode.
Description	This instruction is used to enable or disable the self-learning vibration control function.
Format	SLVSMode modePara
Parameter	The modePara parameter includes four modes: HighLevel, MidLevel, LowLevel, Off.
	Supported under all control authorities, including API

Control authority	
Scope of instruction	1) Only effective in main tasks, not supported in multitasking. 2) Project level: Initialization is triggered when the program is compiled and the program returns to the start of the main program, and this parameter restores the default value, which is Off.
Detailed description	1) HighLevel, MidLevel and LowLevel indicate that the self-learning vibration control function is turned on, and Off indicates that the vibration control function is turned off. 2) The higher the level of vibration control, the better the effect of vibration suppression. In terms of vibration amplitude, HighLevel<=MidLevel<=LowLevel, and in terms of motion execution time, HighLevel>=MidLevel>=LowLevel. 3) When the self-learning vibration control function is required, it is recommended to use MidLevel first for testing. If the vibration does not meet the requirements, switch to HighLevel for testing. If the motion execution time does not meet the requirements, switch to LowLevel for testing.
Example	In the following program, after the instruction SLVSMode MidLevel is executed, the self-learning vibration control mode will be set to a medium-level mode. For B[0]=0,B[0]<2,Step[1] Movj LP[0],V[30],Z[0],SLOn; Delay T[1]; Movj LP[1],V[30],Z[0],SLOn; Delay T[1]; SLVSMode MidLevel; EndFor;
Remark	-

(2) SLOn/SLOff/SLReset

Name	SLOn/SLOff/SLReset
Function	It marks motions that require self-learning to suppress vibration.
Description	This parameter is the default parameter of motion instruction, marking motions that require self-learning to suppress vibration.
Format	Movj/Movabsj/Movl/Movc/Jump/JumpL ,…, [SLOn/SLOff/SLReset];
Parameter	1) SLOn indicates that this segment of motion requires self-learning, SLOff indicates that this segment of motion does not require self-learning, and SLReset indicates that this segment of motion requires re-learning. 2) The default is SLOff, which means that self-learning is not required for this segment of motion.
	API not supported

Control authority	
Scope of instruction	Consistent with motion instruction, not supported in multitasking.
Detailed description	1) In case of SLOn, self-learning is carried out only when the global motion speed is equal to or greater than 49%. In case of SLReset, self-learning is carried out regardless of the global motion speed. 2) The time for each self-learning is approximately 1.5s. 3) In case of SLOn, when the instruction is executed for the first time, the robot stops for about 1.5s after it reaches the target, automatically learning the relevant information and saving it in the learning data file. Normally, the information required can be learned automatically after one run. Therefore, the robot does not need to stop again to learn when the instruction is called repeatedly later. 4) In case of SLReset, the robot stops for about 1.5s each time it reaches the target to automatically learn relevant information and save it in the learning data file. 5) If the vibration suppression effect cannot be met after self learning with the SLOn parameter, you can use the SLReset parameter, which is equivalent to forcing self-learning every time the motion is executed. Generally, it is only used for commissioning. When it is confirmed that the vibration meets the requirements, change SLReset to SLOn or SLOff. 6) For motion segments with good vibration conditions, do not mark them (SLOff). Otherwise, the robot may stop for self-learning when it first runs to the marked positions. 7) Generally, the more obvious the vibration, the better the likelihood of self-learning effect. However, if the vibration is too obvious, it may lead to self-learning of incorrect data. 8) For a motion instruction with SLOn or SLReset parameter, if self-learning is needed, the subsequent instructions will not be executed before the motion instruction is complete. In this case, the transition parameters do not take effect while the Nwait parameter takes effect. For a motion instruction with SLOn parameter, if self-learning is already completed, the transition parameters take effect. That is, the motion instruction with SLOn parameter supports transition after the self-learning is completed. 9) For a motion instruction with Until and SLOn/SLReset parameters at the same time, if Until is not triggered, the instruction moves normally to the target point where the robot stops and performs self-learning. If Until is triggered during self-learning, the robot stops self-learning and executes the next motion instruction. If the Until is triggered during execution of the instruction, the robot does not perform self-learning. 10) In the following special conditions, the instruction that has completed self-learning may perform self-learning again: a) The user clicks stop when the instruction is running, and the robot stops near the target point. Then the user clicks start and the robot executes the next instruction directly. If the next instruction includes SLOn, the next instruction will perform self-learning again. b) The user disables the robot servo when the instruction is running. The robot stops near the target point. Then the user enables the robot servo and click start. The robot executes the next instruction directly. If the next instruction includes SLOn, the next instruction will perform self-learning again.

	c) Whether the previous instruction triggers Until or not affects the start point of the subsequent instruction containing SLOn. Therefore, if the subsequent instruction has completed self-learning when the previous instruction has not triggered Until, the subsequent instruction performs self-learning again when Until is triggered. d) When 0x1040, 0x1041, and 0x1042 errors occur during self-learning, the learning data of the current running instruction may not be saved successfully. After the robot is powered off and restarted, the motion instruction may need to perform self-learning again. It is recommended to perform self-learning again after the robot is powered off and restarted. 11) For a Jump instruction with SLOn/SLReset, by default the robot automatically determines whether the Jump instruction is suitable for segmentwise self-learning based on the motion parameters of the instruction. The robot necessarily stops at the end of the third (descending) segment where it performs self-learning. In addition to this, the robot determines whether additional self-learning is needed at the end of the first (ascending) segment and second (horizontal) segment of the Jump instruction. If segmentwise self-learning is not needed, you can set the self-learning mode of Jump motion through the SetJumpSLMode instruction. For details, see the SetJumpSLMode instruction.

Example	1) In the following program, after executing the instruction SLDataClear All, all historical self-learning data will be cleared. Therefore, regardless of whether self-learning has been performed previously, self-learning will be performed when moving to LP[1] and LP[2]. The motion to the LP[2] continues self-learning before jumping out of the for loop. Since the self-learning parameter is SLOff or default, self-learning will not occur when moving to LP[0] and LP[3]. Due to the presence of the SLReset parameter, the motion to LP[2] will not have transition effects. When the self-learning is completed at LP[1], the transition parameter for motion to LP[1] will produce a transition effects.
	SLDataClear All;
	For B[0]=0,B[0]<10,Step[1]
	Movj LP[0],V[30],Z[0],SLOff;
	Movj LP[1],V[30],Z[CP],SLOn;
	Movj LP[2],V[30],Z[CP],NWait,SLReset;
	Movj LP[3],V[30],Z[0];
	Set Out[1];
	SLVSMode MidLevel;
	EndFor;

Remark	-

3) SetJumpSLMode

Name	SetJumpSLMode
Function	Sets the self-learning mode for the Jump/JumpL instruction.
Description	Sets whether to perform segmentwise self-learning on the Jump/JumpL instruction.

Format	SetJumpSLMode(iMode)
Parameter	iMode parameter includes two modes: SL_Auto, SL_LastSeg.
Control authority	API not supported
Scope of instruction	1) Only effective in main tasks, not supported in multitasking. 2) Project level: Initialization is triggered when the program is compiled and the program returns to the start of the main program, and this parameter restores the default value, which is SL_Auto. 3) Forced blocking, subsequent instructions will not run until this instruction is completed.
Detailed description	1) Includes SL_Auto and SL_LastSeg. a. SL_Auto: Automatic mode, which is the default mode. The robot automatically determines whether the Jump instruction is suitable for segmentwise self-learning based on the working conditions. The robot determines whether the first (ascending) segment and second (horizontal) segment are suitable for self-learning. If suitable, the robot stops at the end of the first and second segments respectively and performs self-learning. b. SL_LastSeg: The robot performs self-learning at the last segment of motion, i.e., it stops at the target specified in the Jump instruction where it performs self-learning. This mode is intended for special situations where segmentwise learning is not needed. 2) Once this instruction is set, it remains in effect for the motion after the instruction, unless it is set again.
Example	1) In the following program, after executing the instruction SetJumpSLMode(SL_LastSeg), the Jump/JumpL instructions will not perform segmentwise self-learning judgments and will only perform self-learning at the target point of the instruction. Self-learning will only occur at points P[1] and P[2] in the following instructions. ... SetJumpSLMode(SL_LastSeg); ##Sets to perform self-learning only at the target point of the instruction. Jump P[1] ,V[30], Z[3], Tool[1],Wobj [1],LH[60],MH[-130],RH[60],SLOn; JumpL P[2] ,V[30], Z[3], Tool[1],Wobj [1],LH[60],MH[-130],RH[60],SLOn; SetJumpSLMode(SL_Auto); ##Sets automatic mode. The algorithm determines whether to perform segmentwise self-learning. ...
Remark	-

(4) SLDataClear

Name	SLDataClear
Function	Clears learned data.

Description	This instruction is used to clear data that has been learned. When it is called, the robot needs to perform self-learning again.
Format	SLDataClear ClearPara
Parameter	ClearPara includes All and Current, which respectively represent the erasure of all learning data and the erasure of learning data at the current position of the robot.
Control authority	API not supported
Scope of instruction	Only effective in main tasks, not supported in multitasking.
Detailed description	1) When SLDataClear All is called, all learning data from previous learning will be restored to factory defaults. 2) If the robot's self-learning effect is still poor after increasing the global motion speed (the robot's vibration is visible to the naked eyes), SLDataClear All can be called to clear all historical learning data, and then self-learning can be re-started, or the robot can be moved to a position with poor self-learning effect and SLDataClear Current can be called to clear the learning data of the current position, and then re-start self-learning at that position. 3) If the weight or inertia of the end load of the robot changes significantly (more than 30%), SLDataClear All needs to be called to clear all historical learning data before learning again. 4) If you need to clear the historical learning data and re-learn, you generally only need to call the instruction SLDataClear All at the beginning of the program, and only need to call it once. 5) The instruction SLDataClear All is generally only used during debugging. After debugging is completed, it needs to be deleted or commented out. Otherwise, the learning data that has been learned from each SLDataClear All execution will be completely cleared, resulting in vibration suppression failure and the robot needs to learn again.

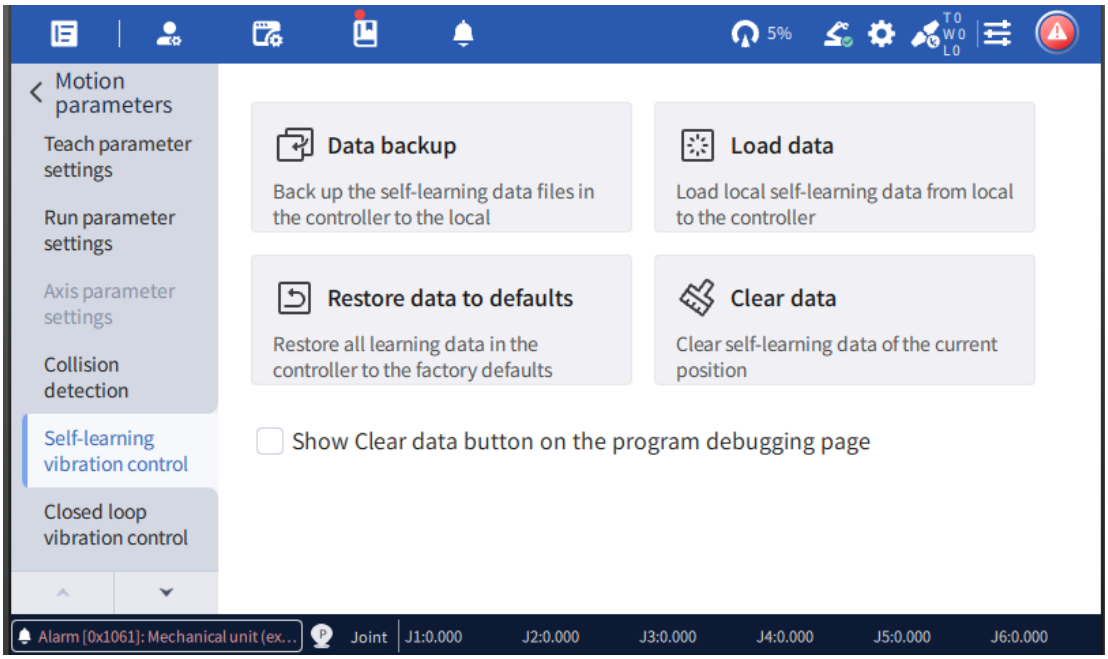
Example	In the following program, after the instruction SLDataClear All is executed, all historical self-learning data will be cleared. When the motion instruction with SLOn or SLReset parameter is executed later, self-learning will be performed again, that is, self-learning will be performed upon the first execution of statement Movj LP[1],V[30],Z[0],SLOn.
	SLDataClear All;
	For B[0]=0,B[0]<2,Step[1]
	Movj LP[0],V[30],Z[0];
	Delay T[1];
	Movj LP[1],V[30],Z[0],SLOn;
	Delay T[1];
	SLVSMode MidLevel;
	EndFor;

Remark	-

10.5.8.3 Backup, Load, Restoring, and Clear of Self-learning Data

As shown in the figure below, you can configure the self-learning vibration control function in "Settings" > "Motion parameters" > "Self-learning vibration control" interface.

This interface includes 4 sub-functions: data backup, load data, restore data to defaults, and clear data.



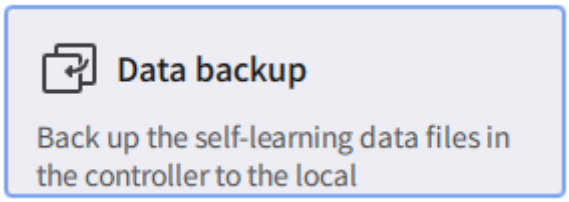
(1) Data backup

1. Description

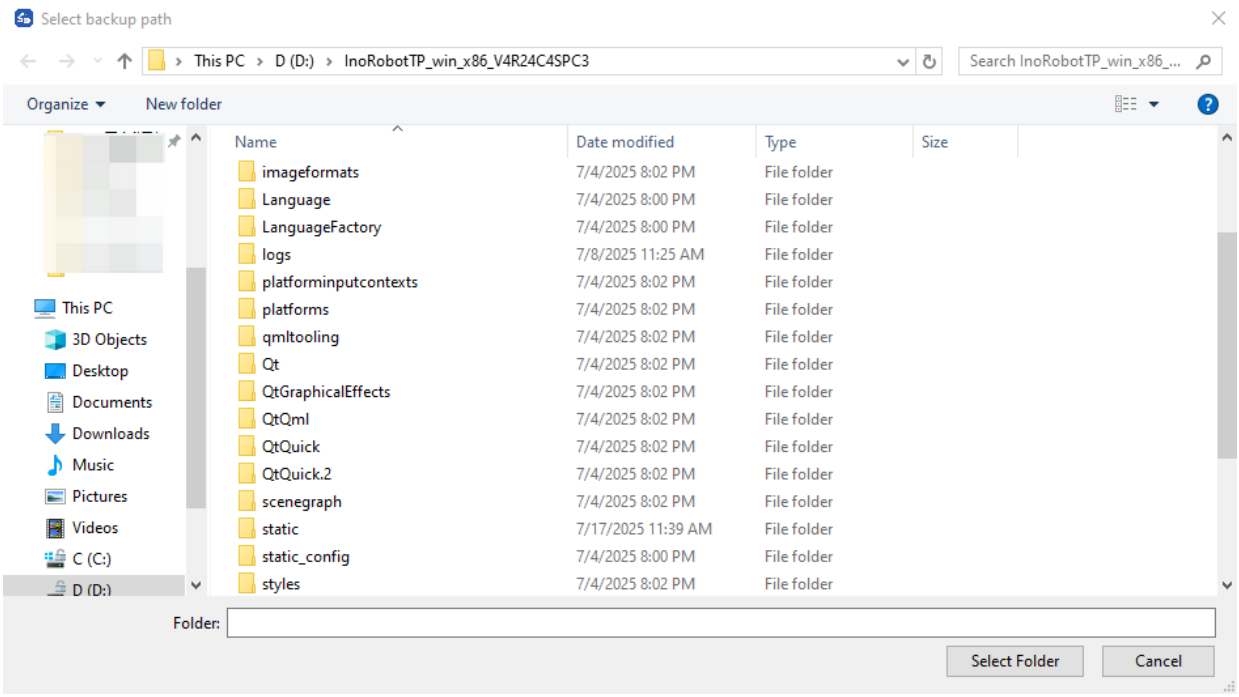
It allows you to save the self-learning data in the robot controller to the learning data file and store the file to the local disk of the computer.

2. Procedure:

1) Click the "Data backup" button.



2) Select the backup path and enter the file name in the dialog, as shown below.



3) After the backup is complete, you can find the backup file in the specified path.

3. Note:

The default file name automatically includes the project name and time information for ease of file management.

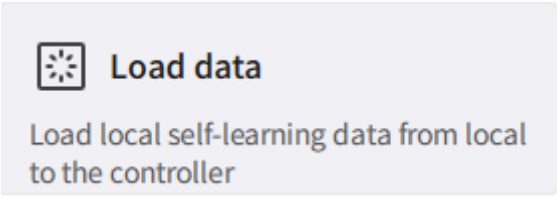
(2) Load data

1. Description

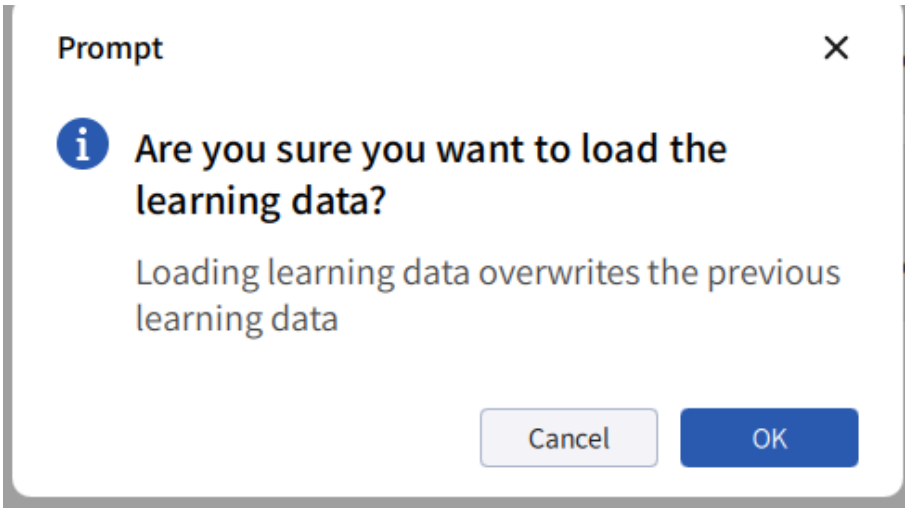
It allows you to load the locally stored learning data file into the robot controller.

2. Procedure:

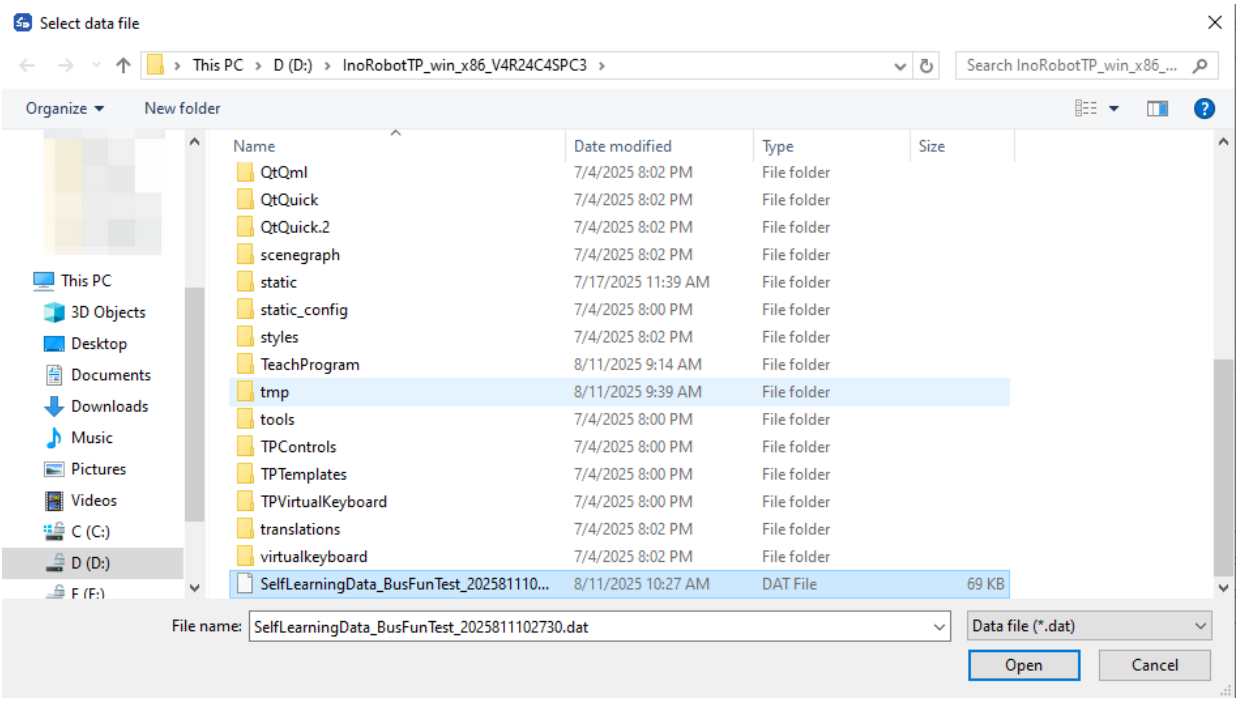
1) Click the "Data backup" button.



2) Click the "Load data" button, you will be prompted whether to load the learning data. Select "OK" to load the learning data, or "Cancel" to cancel the current operation.



3) In the file dialog shown below, select the path and file to load. After the data is loaded successfully, the original learning data will be overwritten and a message "Loaded successfully" will be prompted.



3. Note:

1) When the learning data is loaded, the file type, robot model, software version, and check code information are verified. If the robot model, software version, and controller model of the loaded learning data file do not match, you will be notified in the message output box that the load fails.

2) If the content of the learning data file is changed, you will also be notified in the message output box that the load fails.

3) If you import the learning data from versions before V4R24C2 into V4R24C2 and later versions, the robot may stop to learn the same project again. When the old version of learning data is imported, it is recommended that the robot run the program once for program debugging, and then put the robot into formal operation after confirming that the learning is complete.

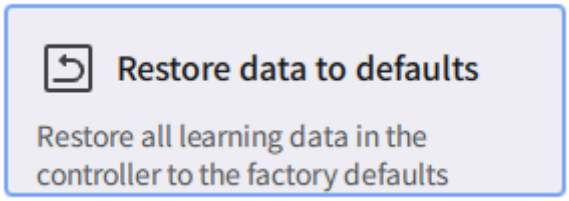
(3) Restore data to defaults

1. Description

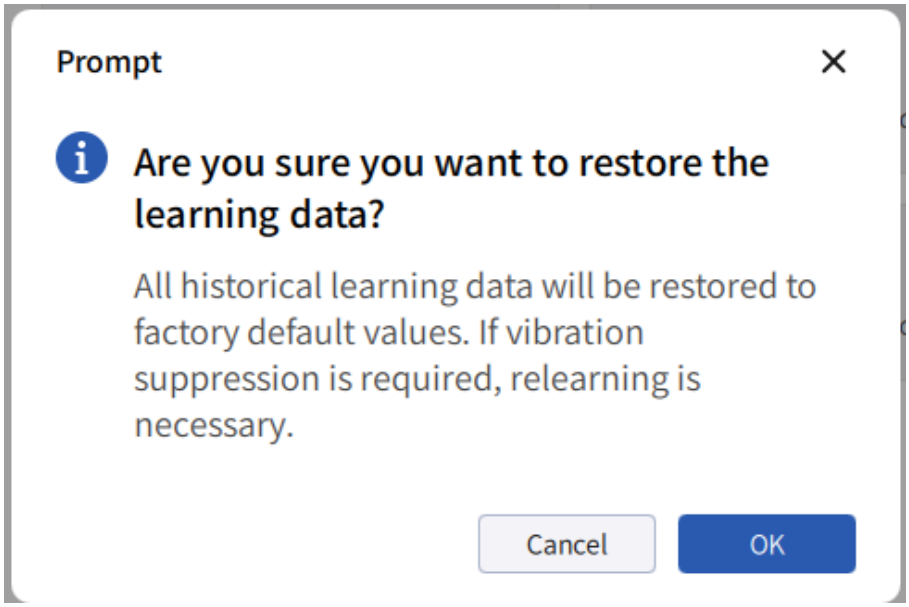
It allows you to restore all self-learning data in the controller to default values.

2. Procedure:

1) Click the "Restore data to defaults" button.



2) After clicking the button, you will be prompted whether to restore the learning data to defaults. Select "OK" to restore the learning data to defaults, or "Cancel" to cancel the current operation.



3. Note:

1) After the learning data are restored to default values, the self-learning vibration control function is not effective because there is no valid learning data. You need to perform self-learning again to make the function take effect.

2) When the system is re-programmed, the learning data are restored to the default values. During system upgrade, the data file will not be automatically upgraded. If the data file is not compatible after the upgrade, you will be prompted to upgrade the data file.

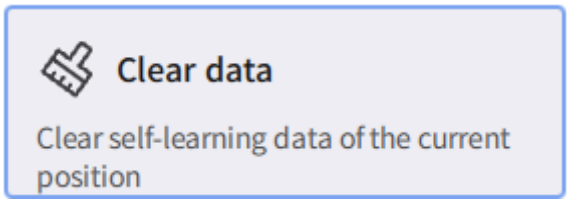
(4) Clear data

1. Description

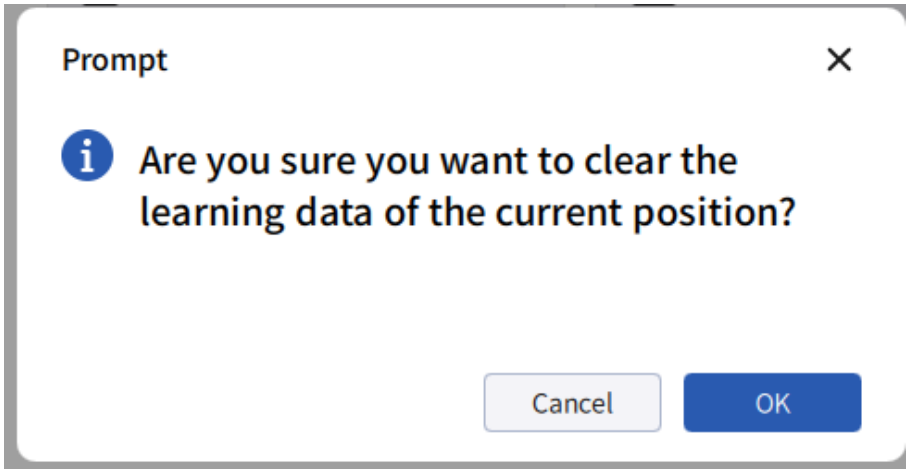
It allows you to clear the self-learning data of the robot's current position in the controller.

2. Procedure:

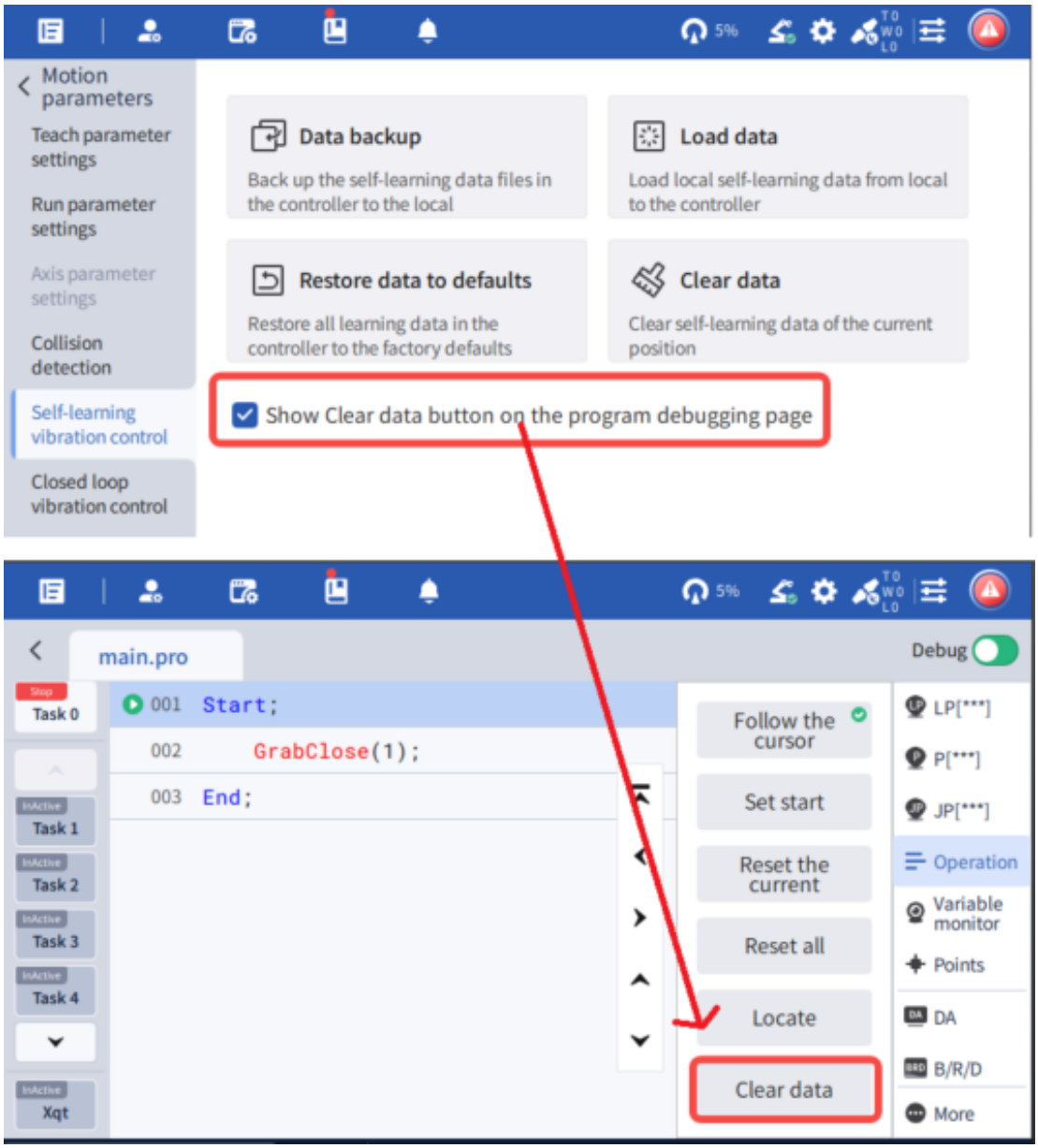
1) Click the "Clear data" button.



2) After clicking the button, you will be prompted to confirm whether to clear the learning data of the current position. Select "OK" to clear the learning data, or "Cancel" to cancel the current operation.



3) Also, you can choose to display the "Clear data" button on the program debugging page for quick access to this function.



CAUTION

The robot model included in the loaded file must correspond to the currently connected model. However, if the user manually modifies the model in the file to the correct one, the system cannot detect incompatibility issues. Any resulting problems will require the user to assume full responsibility.

10.5.8.4 Application Example

RapidMove(All, OFF); //To avoid significant robot vibration after enabling optimal trajectory, which may adversely affect the learning outcome.

VelSet 100;

SetAccRamp(100,100);

```
SLDataClear All;    //Place this instruction before motion instruction to clear learning data before execution.
For B[0]=0,B[0]<2,Step[1]
  Movj LP[1],V[30],Z[0];
  Movj LP[2],V[30],Z[CP],SLOn; //The robot stops when it reaches the current motion instruction and automatically performs self-learning.
  Delay T[1];
  Movl LP[3],V[30],Z[0],SLOn; //The robot stops when it reaches the current motion instruction and automatically performs self-learning.
  Delay T[1];
  SLVSMode MidLevel;
EndFor;
```

- After the SLVSNode MidLevel instruction is executed for the first for loop, the self-learning vibration control mode is set to the medium level mode. If effective data has been learned, the second for loop will not perform self-learning again. The vibration of the two motions Movj LP[2] and Movl LP[3] is effectively suppressed.
- For motion instructions with SLReset parameter, the transition parameter is automatically shielded. Therefore, it is best to remove the SLReset parameter after it is confirmed that the vibration suppression effects meet the on-site requirements. For motion instructions with SLOn parameter, after the self-learning is complete, the transition takes effect normally.
- To determine whether vibration has been effectively suppressed, you can add a delay instruction to the instruction that require vibration suppression, which can make it easier to determine whether the suppressed vibration can meet on-site requirements.

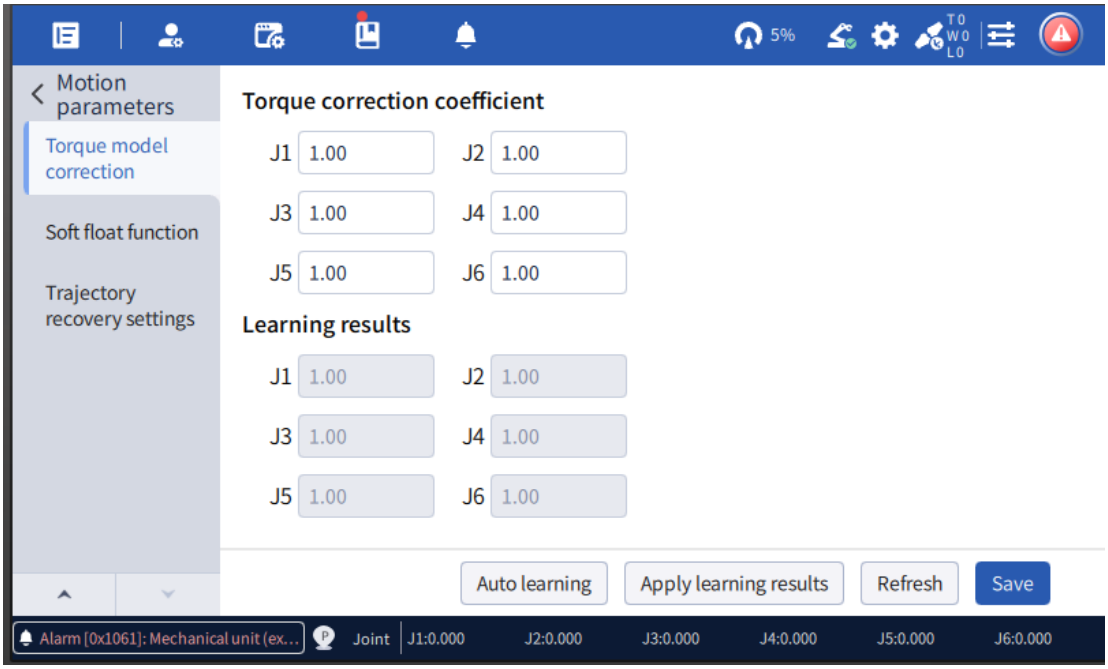
10.5.9 Torque Model Correction

When the RapidMove function is enabled, the system automatically generates motion trajectories based on the model. If the model is inaccurate, the current will be too large, which will cause an alarm. In this case, you need to correct the model to avoid the alarm.

Manual correction: If the overcurrent alarm persists when the load is set correctly, set the torque correction coefficient of the corresponding axis to a value less than 1. The smaller the parameter value, the smaller the current, and the slower the motion.



This coefficient changes the joint output. If this coefficient is reduced, all motion instructions with RapidMove enabled will become slower. Therefore, if high current is present only at one point, try to reduce the local acceleration coefficient of the instruction corresponding to that point first.



Automatic correction: The automatic correction function automatically identifies the deviation between the theoretical current and the actual current based on the data recorded before the alarm, and automatically calculates the model correction coefficient. Follow the steps described below.

1. Wait for the overcurrent alarm to occur and robot is stop.
2. Click "Auto learning" and wait until a pop-up box appears, indicating that the learning is completed.
3. Click "Apply learning results". The learning results will be copied to the "Torque correction coefficient" section.
4. Click "Save" to save the parameters to the project file and then execute the program for verification.

CAUTION

The auto learning is based on data from a period of time before the alarm. The result of the learning only ensures that no more alarms will occur for this period of motion. Alarms may still occur when a new motion is executed, requiring learning again.

10.5.10 Soft Float Function

10.5.10.1 Overview

- When the soft float function enabled, the robot changes from a rigid body to a compliant body. This enables the robot to change its position and orientation based on changes in external forces when the robot is subjected to external forces, preventing the robot from being damaged.
- The soft float function includes Cartesian soft float function and joint soft float function.
- With the Cartesian soft float function, the robot becomes compliant relative to the Cartesian frame. It can be applied to processes such as die-casting parts pick-up. With the joint soft float function, the robot becomes compliant relative to the joint frame.

10.5.10.2 Steps

For a detailed description of the soft float function, see the instruction manual.

(1) Enabling soft float function

You can enable the soft float function using the SoftModeAct(SoftNum) instruction. The system includes 16 sets of soft float function settings, which can be called directly through the "SoftNum" parameter in the instruction. After this instruction is executed, the robot switches from position control mode to soft float control mode. This instruction is a blocking type instruction.

(2) Disabling the soft float function

You can disable the soft float function using the SoftModeDeact instruction. After this instruction is executed, the robot switches from soft float control mode to position control mode. When the SoftModeAct instruction is active, the SoftModeDeact instruction is a blocking type instruction. This instruction can be used independently. If it is called when the SoftModeAct instruction is not active, the robot functions will not be changed.

(3) Soft follow function

You can enable the soft follow function using the SoftFollow instruction. After the soft float function is enabled, when you push the robot, the robot returns to the teaching points if there is no external force. However, when this instruction is executed, the current position is considered as the teaching point. In this case, the robot will not return to the original teaching point even if the external force is canceled. When the SoftModeAct instruction is enabled, this instruction is a blocking type instruction. This instruction can be used independently. If it is called when the SoftModeAct instruction is not active, the robot functions will not be changed.

(4) Soft float function parameter configuration

The configuration interface of the soft float function is as follows. The soft float function is only supported by 6-axis robots including the models of IR-R4-56S5-A1L_01740496, IR-R35-185S7-B1NH_01740676, IR-R35-185S7-B1ZD_01740679, IR-R60-210S5-E1N_01740415, IR-R80-210S5-E1ZY_01740464, IR-R80-210S10-E1N_01740465, IR-R170-270S5-E1N_01740669 and IR-R220-270S5-E1N_01740513. The teach pendant interface for the soft float function is shown below:

Go to "Settings" > "Motion parameters" > "Soft float function".

2) Parameter description

① On the configuration interface of the soft float condition parameters, you can configure 16 sets of condition parameters. The condition parameters include soft float parameter, soft float mode, soft float switch, reference frame, soft float direction, soft float ratio, direction of movement, and range value. The parameters can only be modified in the manual mode.

② Soft floating parameter: Indicates the condition parameter number, which ranges from 0 to 15.

③ Soft float mode: Indicates the soft float mode, including joint mode and Cartesian mode.

④ Switch: You can decide whether to activate each set of parameters. Only the activated set of parameters can be called in the instruction.

⑤ Reference frame: This parameter is available only when the soft float mode is set to "Cartesian". The reference frame includes world frame, tool frame, and workobject frame. The default value is "World frame".

⑥ Soft float direction:

1. For the soft float relative to the joint frame, you can custom the joints including J1 to J6.

2. For the soft float relative to the Cartesian frame, you can custom the Cartesian parameters including X direction, Y direction, Z direction, X rotation (rotation around X axis), Y rotation (rotation around Y axis), and Z rotation (rotation around Z direction).

⑦ Soft float ratio: Indicates the degree of compliance in the respective directions or axes. For soft float relative to the Cartesian frame, the soft float ratio includes 0% and 100%. For the soft float relative to the joint frame, the soft float ratio includes 0%, 1%, 25%, 50%, 75%, and 100%, which can be selected by the drop-down box. 0% indicates that soft float function is disabled. The larger the value, the more compliant the robotic arm. The value of soft float ratio in the respective directions and axes can be adjusted independently. The default value is 0%.

⑧ Direction of movement: Indicates the direction of the soft float motion relative to the Cartesian frame. It includes X, Y and Z directions.

⑨ Range value: This parameter is available only when the soft float mode is set to "Cartesian". It indicates the maximum amount of movement the robot is allowed to perform. The range value varies depending on the robot model. For example:

- For IR-R60-210S5-E1N_01740415 robot, the range is 0–500 mm, and the default value is 200 mm.
- For IR-R4-56S5-A1L_01740496 robot, the range is 0–200 mm, and the default value is 100 mm.

10.5.10.3 Notes

When using the soft float function, pay attention to the following.

1. The soft float function can be enabled only by the instruction.

2. The soft float function will be automatically disabled by:

(1) Executing instruction to disable the soft float function.

(2) Starting to execute a program.

(3) Disabling the robot (normal disable, disable upon alarm, disable upon emergency stop).

(4) Running the program to the end.

(5) Powering on/off the controller.

(6) Switching the project, changing the program cursor line number, returning the program to the start line, or setting the start line.

(7) Performing homing, orientation calibration, point to point motion, and jog motion.

3. When enabling or disabling the soft float function, make sure that no external force is applied to the robot.

4. The soft float function is incompatible with the following robot functions: Collision detection function, trajectory accuracy function, optimal trajectory function, trajectory recovery function, independent axis function, dynamic tracking function, and self-learning vibration control function. The current soft float function is only supported by the floor-mounted robot.

5. When the soft float function is enabled, after the robot is pushed beyond the set safety alarm threshold, the robot reports an alarm message and stops.

6. Before enabling the soft float relative to the Cartesian frame, move the robot and make sure the target of movement is different from the current position of the robot.

7. After the soft float function is enabled, if you click the Stop or Exit button on InoRobotLab or teach pendant, the robot stops and the soft float function remains active. If you click the Start button when the robot is still moving, the start action does not take effect.

8. It is not recommended to use the soft float relative to the Cartesian frame near the singular position. Otherwise, the robot motion may become not compliant.

9. When the robot runs in single steps, the soft float instruction cannot be executed.

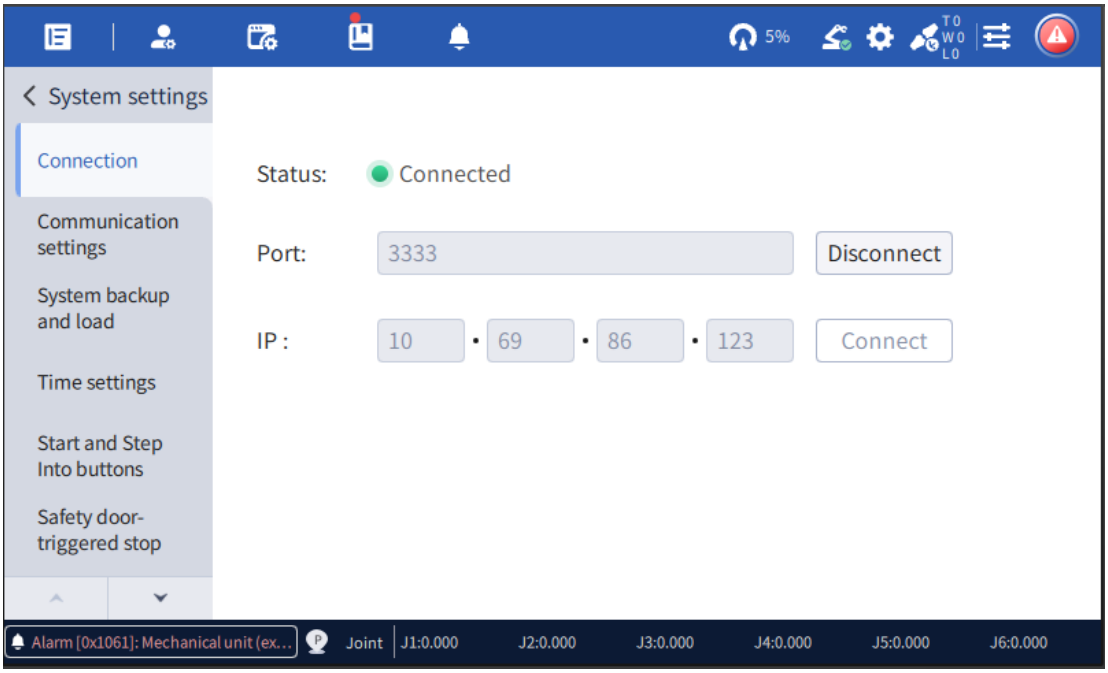
10.6 System Settings

System settings include the following functions: Connection, Communication settings, System backup and load, Time settings, Start/Step Into buttons, Safety door-triggered stop, Quick stop trigger method, TP Port Setting, Emergency stop mode, Flying trigger IO, Arm parameter offset mode, Program quantity setting, Remote line number reset, Remote stop policy, Robot maintenance, and Language settings.

10.6.1 Connection

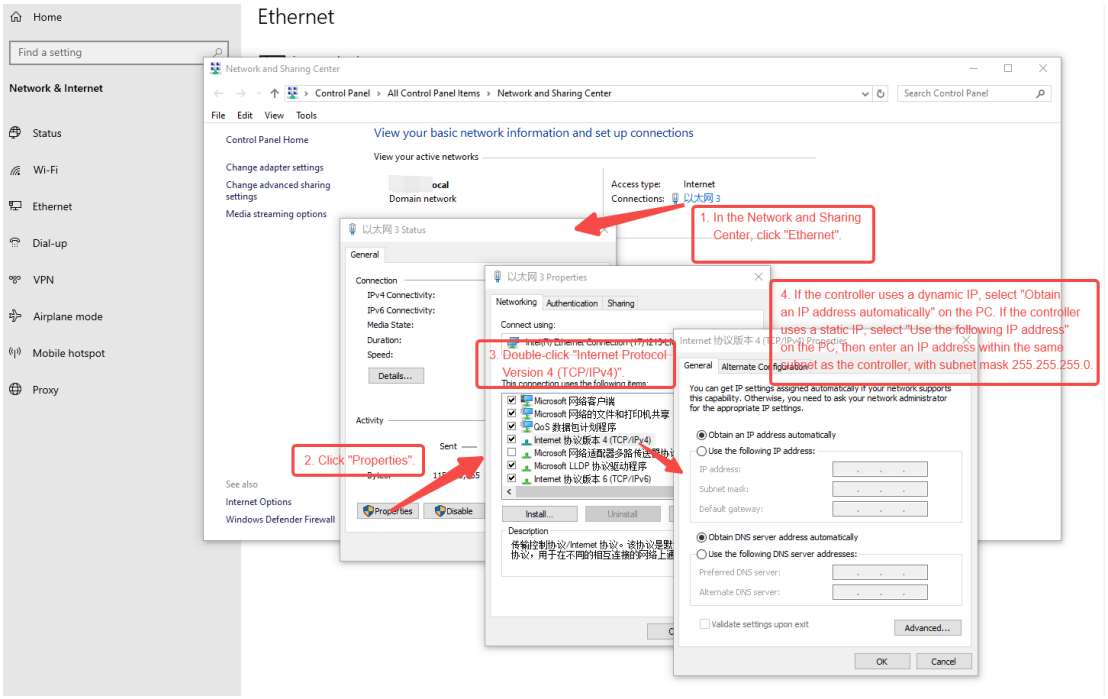
The connection between the teach pendant and the controller is divided into two main types:

Connection type	Connection mode	Description
Connection to Ethernet port 2 of the controller (the IP address of Ethernet port 2 is fixed, 192.168.23.25)	For the hand-held teach pendant, plug its connector into the TP port of the controller.	The IP address of Ethernet port 2 is static, 192.168.23.25.
	For the PC-based teach pendant, connect the PC directly to the PC port of the controller via a network cable.	The IP address of Ethernet port 2 is static, 192.168.23.25. Set the IP address of the PC so that it is on the same subnet as the controller. For example, since the controller IP is fixed at 192.168.23.25, you can set the IP address of the PC to 192.168.23.26.
Connection to Ethernet port 1 of the controller	For the PC-based teach pendant, connect the PC where it is installed to the Ethernet port of the controller (or LAN port on some controllers) via a network cable.	The controller IP can be set to either dynamic IP or static IP. If the controller IP is set to a static IP, the IP address needs to be set on the PC so that it is on the same subnet as the controller.



Setting IP address for connecting to the controller

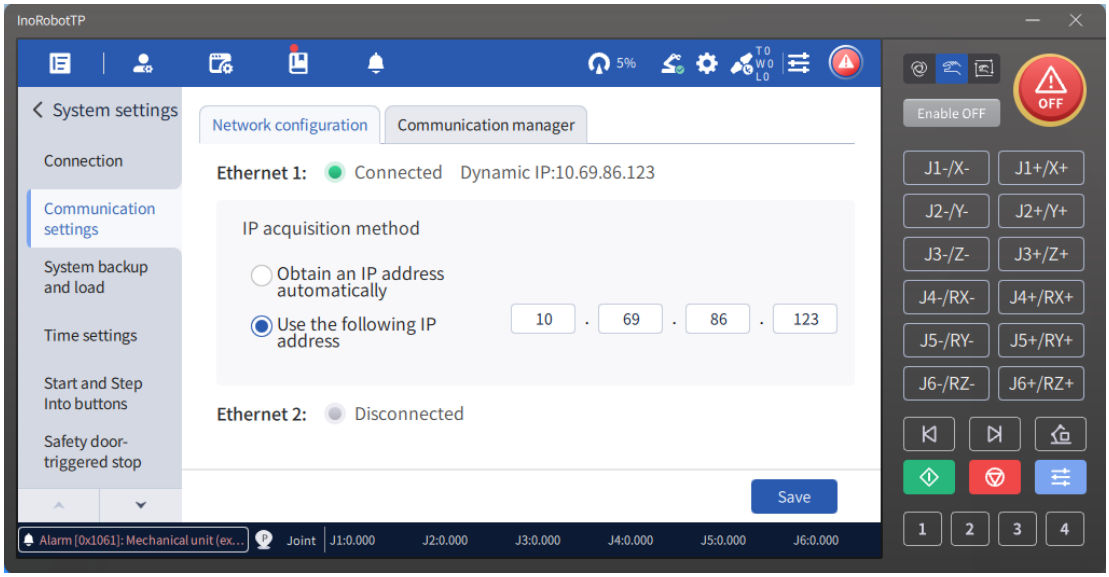
For the PC-based InoTeachPad, you need to set an IP address on the PC to be in the same subnet as the controller to connect to the controller. The following figure shows the modification procedure.



10.6.2 Communication Settings

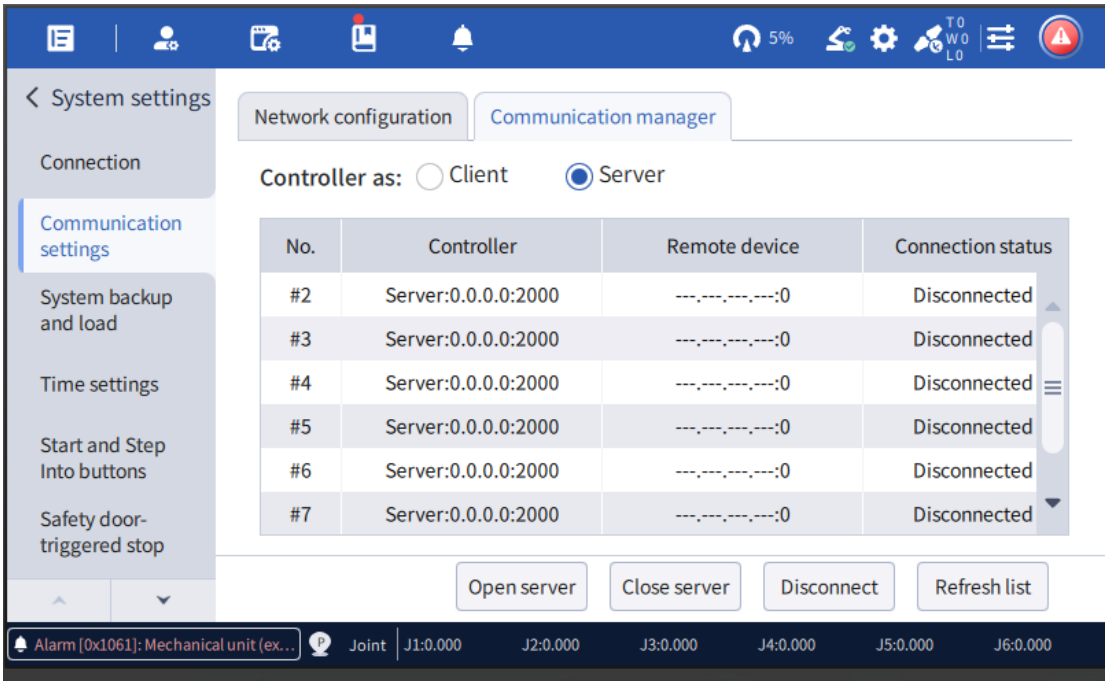
10.6.2.1 Network Configuration

When you need to modify the IP address of Ethernet port 1, do as follows.



10.6.2.2 Communication Manager

It is used to display the connection status of the controller as a server or client socket, and to set up the socket.



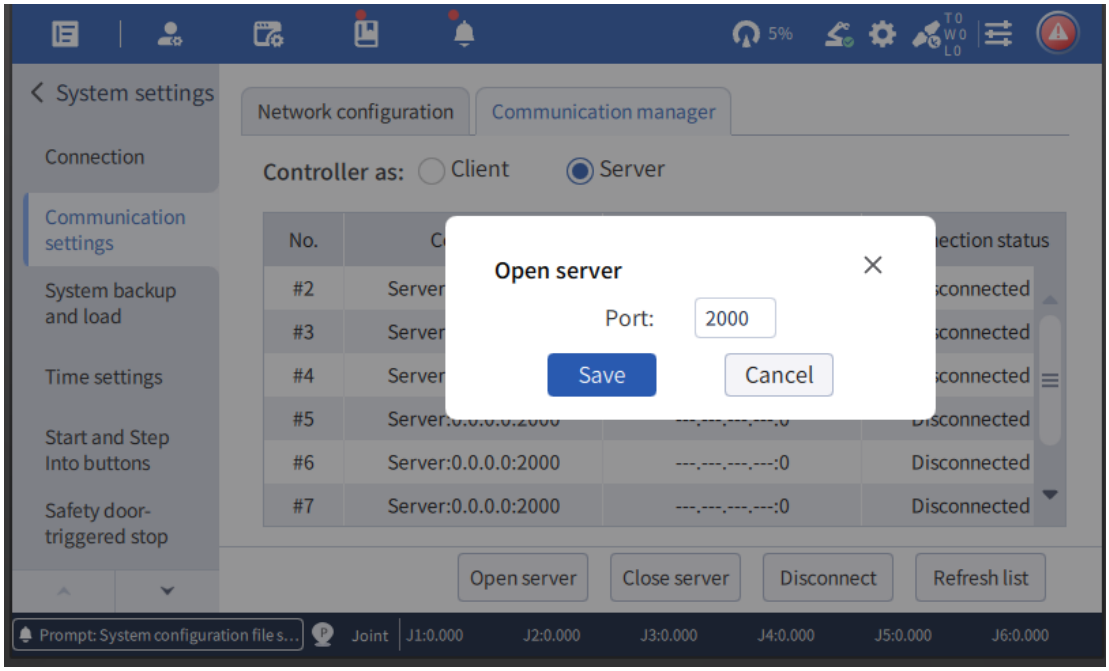
Description of client and server:

The robot can be selected as a client or server , or as both a client and a server during communication with an external device. This function is mostly used for vision and designates the role of the robot in the vision function as a client or server.

- Server mode:

In this mode, the robot only acts as a server. Up to 16 clients connections are supported.

"Open server" sets the port number for the robot to act as a server, and opens the server after port number setting. At this point, the external device acting as client can actively connect to the controller for communication.



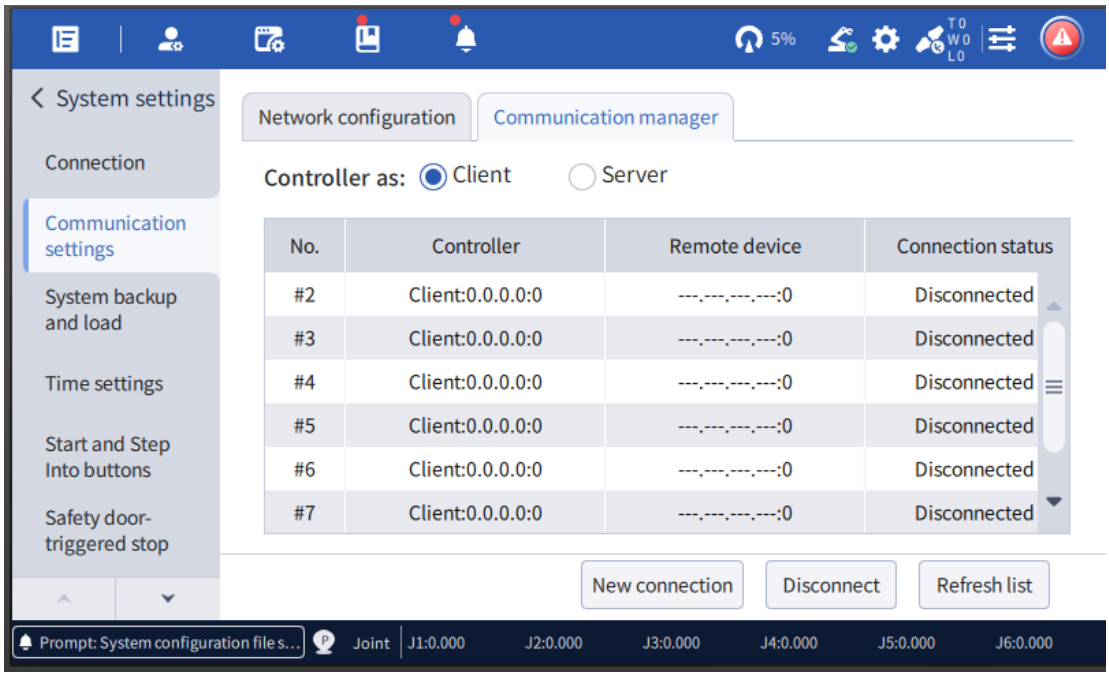
"Close server" disables the server function of the controller and disconnects all clients connected to this server.

"Disconnect" disconnects the selected client from the server.

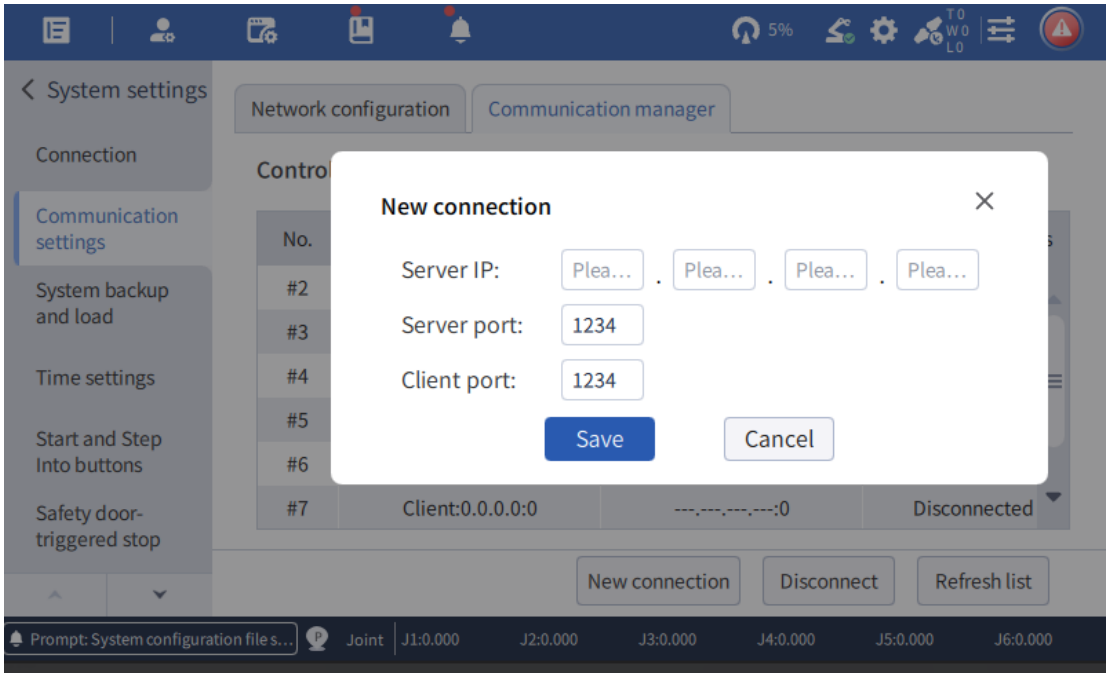
"Refresh list" updates the latest connection information and status in the list.

- Client mode:

In this mode, the robot controller acts only as a client, with the external device acting as the server. Up to 16 socket connections are supported.



"New connection" sets the remote "Server IP" address and "Server port" number, as well as the "Client port" on the local controller, and creates a connection to the external server after connection setting.

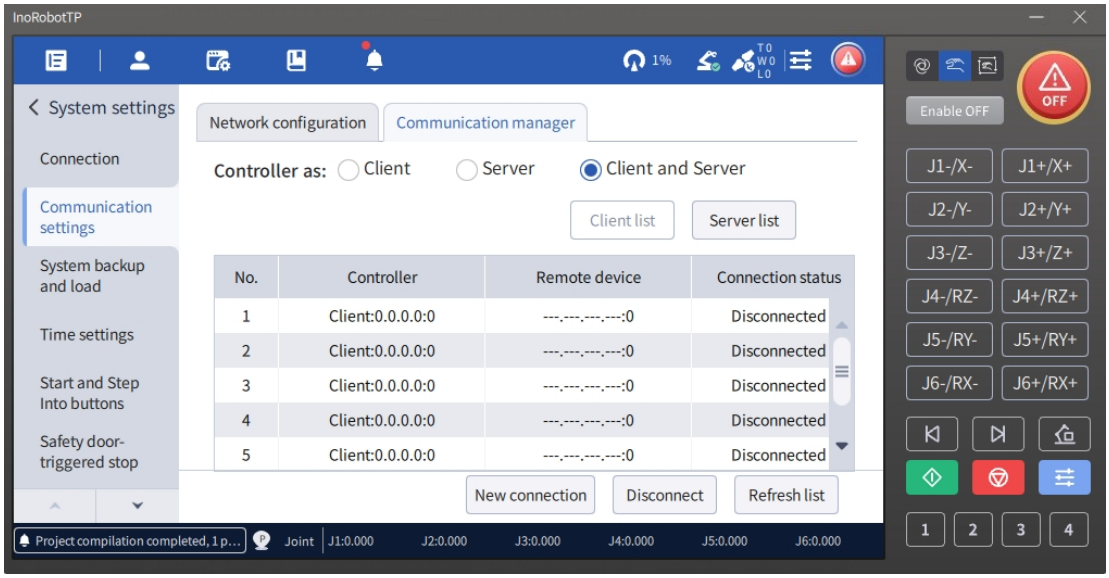


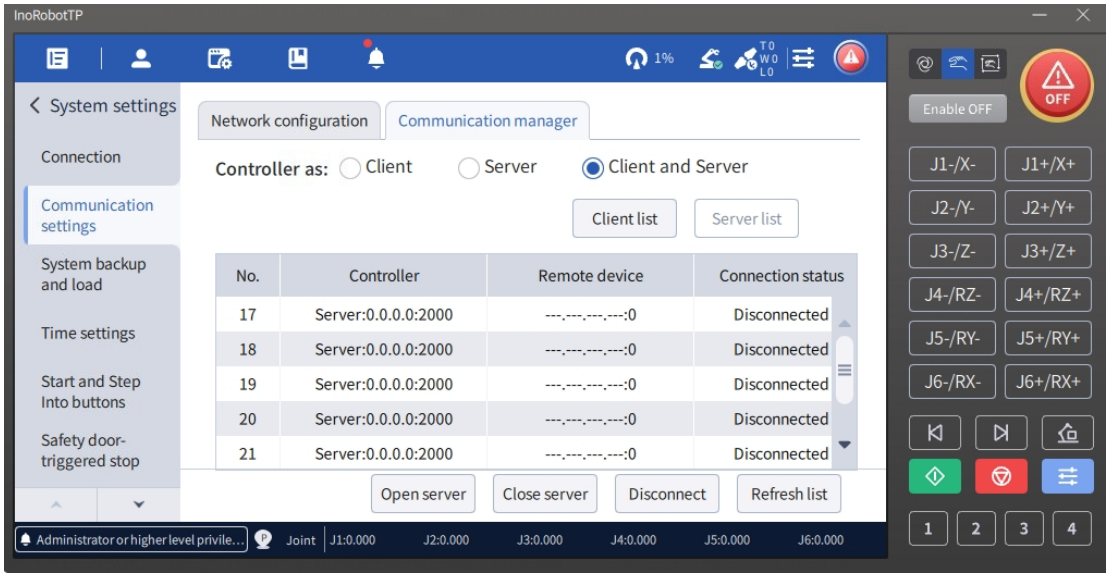
"Disconnect" disconnects the selected client from the external server.

"Refresh list" updates the latest connection information and status in the list.

- Client and server mode:

In this mode, the robot controller can act as both a client and a server. Up to 16 socket connections are supported, with connection information displayed in the client list and server list respectively. The communication configuration steps in this mode are identical to those in the "Client" mode and "Server" mode.





CAUTION

1. In the "Settings" > "More" > "Vision calibration", communication with the camera is process-specific and is not displayed in the "Communication manager" interface.
2. When the controller is powered on after a firmware update, it defaults to "Server" mode with the default port set to 2000 and the server enabled.
3. When the controller loses power, all TCP connections are disconnected. The current communication mode and the server port number support backup and load through the configuration file. After a controller reboot, it will revert to the saved communication mode. If the saved mode is "Server", the server will use the saved port number and be automatically enabled.
4. Enter a proper port number before you open the server. The port number must be an integer between 1024 and 65535. Special port numbers cannot be used, including 1111, 2222, 3333, 4444, 5555, 6666, 7777, 8888, 9999, 1217, 8080, 11226, 11740, 4003, and 44818.
5. When the controller acts as a client to establish a new connection, the client port number ranges from 2 to 17, and 1024 to 65535. Special port numbers cannot be used, including 1111, 2222, 3333, 4444, 5555, 6666, 7777, 8888, 9999, 1217, 8080, 11740, 4003, and 44818. Ports 2 to 17 are port aliases representing the 1st to 16th Socket connections. When using 2 to 17 as client port numbers, the system automatically assigns a real port number.
6. In the "Client and server" mode, port aliases #2 to #17 are not supported. Numbers 1 to 16 and 17 to 32 in the interface only indicate the connection list sequence.

10.6.3 System Backup and Load

It includes functions such as Configuration file backup, Load configuration file, Memory card backup, Load memory card, Load point file, Format memory card, System upgrade, Restore factory settings, and Clear historical alarms.

10.6.3.1 Configuration File Backup

About configuration file, all robot-related setting parameters are saved in the robotcfg.cfg.bk file, It covers follows:

Function	Parameter
Configuration file backup and loading item	1. PLC program. 2. Parameters in the settings bar: Robot settings, Zero point settings, Installation parameters, Motion parameters, Peripheral configuration, Communication settings and system functions in system settings. 3. Robot user account and password. 4. Robot model and controller model information. 5. Process data files (vision calibration and conveyor tracking process). 6. Mechanical unit configuration parameters. 7. Tool, work object, and load parameters. 8. BRD variables and PR variables.

Insert a USB drive into the controller. Click this button to back up the robot configuration file to the root directory of the USB drive.



Before operation, insert a USB drive into the controller and check connection status. If the monitored communication status in the teaching software displays "The USB controller has been inserted into the device and successfully mounted", it indicates that communication is normal. Otherwise, check the connection. Keep the USB drive in good communication during operation.

10.6.3.2 Load Configuration File

Prepare the configuration file robotcfg.cfg.bk in the root directory of the USB drive in advance, insert it into the controller, and click this button to load it into the controller. Then power on the controller again to be valid.



- Before operation, insert a USB drive into the controller and check connection status. If the monitored communication status in the teaching software displays "The USB controller has been inserted into the device and successfully mounted", it indicates that communication is normal. Otherwise, check the connection. Keep the USB drive in good communication during operation.
- Loading configuration files of different models is not allowed.

10.6.3.3 Memory Card Backup

Backup content:

	Version 14 and Earlier	Version 15 and Later	Version 17 and Later
Memory card backup	1.TeachProgram 2.PalletInfo	1.TeachProgram 2.PalletInfo 3.TecParameter	1.TeachProgram 2.PalletInfo 3.TecParameter 4.robot_other_pfile
Load memory card	1.TeachProgram 2.PalletInfo	1.TeachProgram 2.PalletInfo 3.TecParameter	1.TeachProgram 2.PalletInfo 3.TecParameter 4.robot_other_pfile

- TeachProgram: Program file folder containing all program files
- PalletInfo: Pallet file folder containing information about the stacking, pallet and imported external point files ".pt". It needs to be used when pallet variables are used.
- TecParameter: Process folder containing information about the conveyor tracking process, visual calibration, screw driving and dispensing processes.
- robot_other_pfile：BRD global variables, global translation variables, string variables, global position variables P.
- Insert a USB drive into the controller, click this button to back up the program on the memory card to the root directory of the USB drive.

CAUTION

- Before operation, insert the USB drive into the controller and check connection status between the USB drive and the memory card. If the monitored communication status in the software displays "The USB controller has been inserted into the device and successfully mounted" and "The memory card has been inserted and successfully mounted", it indicates that the communication is normal. Otherwise, check the connection. Keep the USB drive and memory card in good communication during operation.
- Notes for backup and load between different versions:
  - For files backed up in versions earlier than S01.15, they can be loaded for normal use in S01.15 or later versions, but the TecParameter will not be loaded as it will not be included in the backup file. A prompt will appear: "The teach pendant version is too low, S01.15 or a higher version is required".
  - For files backed up in S01.15 and later versions, they can be loaded for normal use in versions earlier than S01.15, but the TecParameter will not be loaded.
  - For the robot_other_pfile folder, it is only backed up and loaded in versions 17 and later. If it is not detected during loading, it will be ignored by default, and for versions earlier than 17, the folder is neither backed up nor loaded.
  - For versions 21 and later, the global variable values will no longer be updated through the backup and loading of robot_other_pfile.
- Due to differences in file storage types between Windows and Linux, please do not edit the backed-up files, as this may cause global string variables, I/O notes, etc., to display as garbled text after program loading.

10.6.3.4 Load Memory Card

Prepare the corresponding file in the root directory of the USB drive in advance, then insert USB drive into the controller. Click the "Load memory card" button to load the program from the USB drive to the memory card. After the loading is completed, reboot the robot according to the prompt.

CAUTION

Before operation, insert a USB drive into the controller and check connection status between the USB drive and the memory card. If the monitored communication status in the software displays "The USB controller has been inserted into the device and successfully mounted" and "The memory card has been inserted and successfully mounted", it indicates that the communication is normal. Otherwise, check the connection. Keep the USB drive and memory card in good communication during operation.

10.6.3.5 Format Memory Card

It allows you to format the memory card on the controller into a program storage card suitable for use by the robot. This operation will clear the program in the memory card. It is recommended to back up the program before this operation.

CAUTION

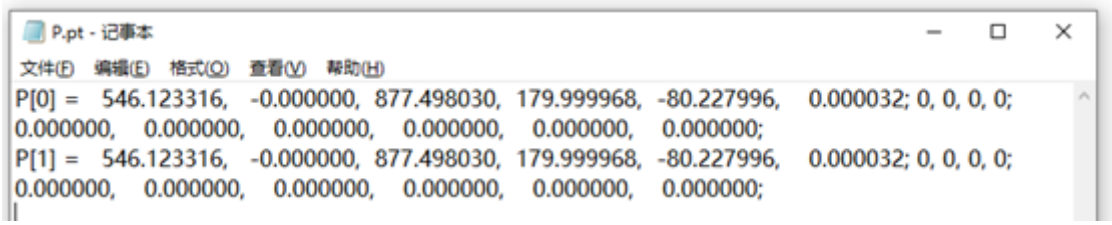
- Before formatting the SD card, check the memory card status in "monitor" > "Communication status". If the monitored communication status in the software displays "Connected and successfully mounted", it indicates that the communication is normal. Otherwise, check the connection.
- Formatting the memory card clears all files in the memory card, resets the slave configuration, and deletes the mechanical unit configuration. However, the EtherCAT master configuration will not be affected.
- Some functions may affect the normal operation of the formatting function, such as digitization log, plugin, system diagnostics, mechanical unit, EtherCAT slave enable management, etc. If the device is busy during formatting, check whether any of the above functions are in use.
- The memory card cannot be formatted during task operation, including static tasks. Stop the task before formatting.

10.6.3.6 Load Point File

Prepare the point file on the USB drive in advance, insert the USB drive into the teach pendant, browse the target point file, and load it into the robot system for instruction calls. It is often used in conjunction with the instructions LoadPointFromFile and GetAPointFromFile.

* About point file: A point file uses .pt as a name suffix. The file contents are data information of position variables. One line indicates one piece of position variable information. For the format of every line, refer to the definition of position variable. Each line is divided into three subparagraphs. The first six parameters, which are robot coordinates, compose the first subparagraph. The middle four parameters, which are arm parameters, compose the second subparagraph. The last six parameters, which are the robot external axis data, compose the third subparagraph. The subparagraphs are separated with ";", and numbers in a subparagraph are separated with ",".

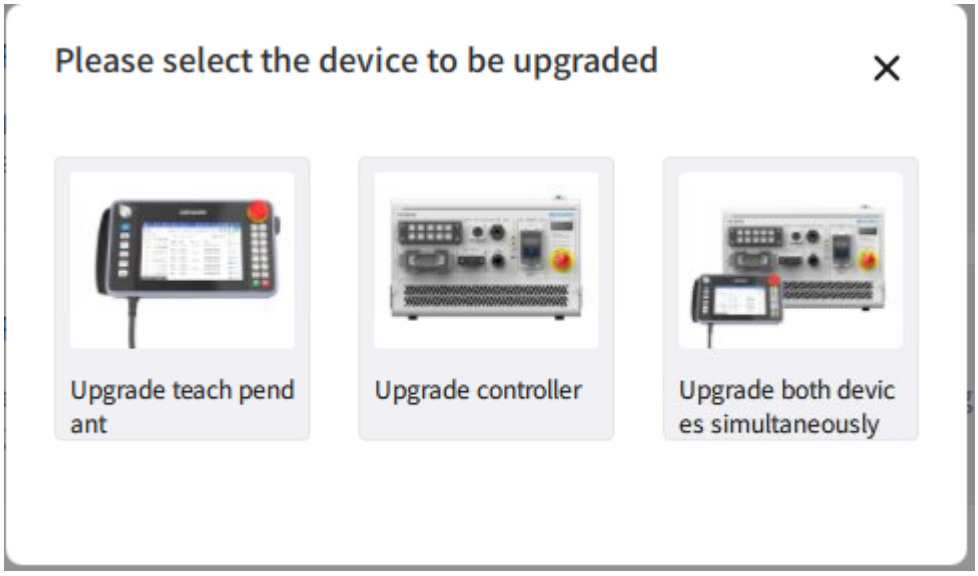
An example is shown below.



10.6.3.7 System Upgrade

Procedure:

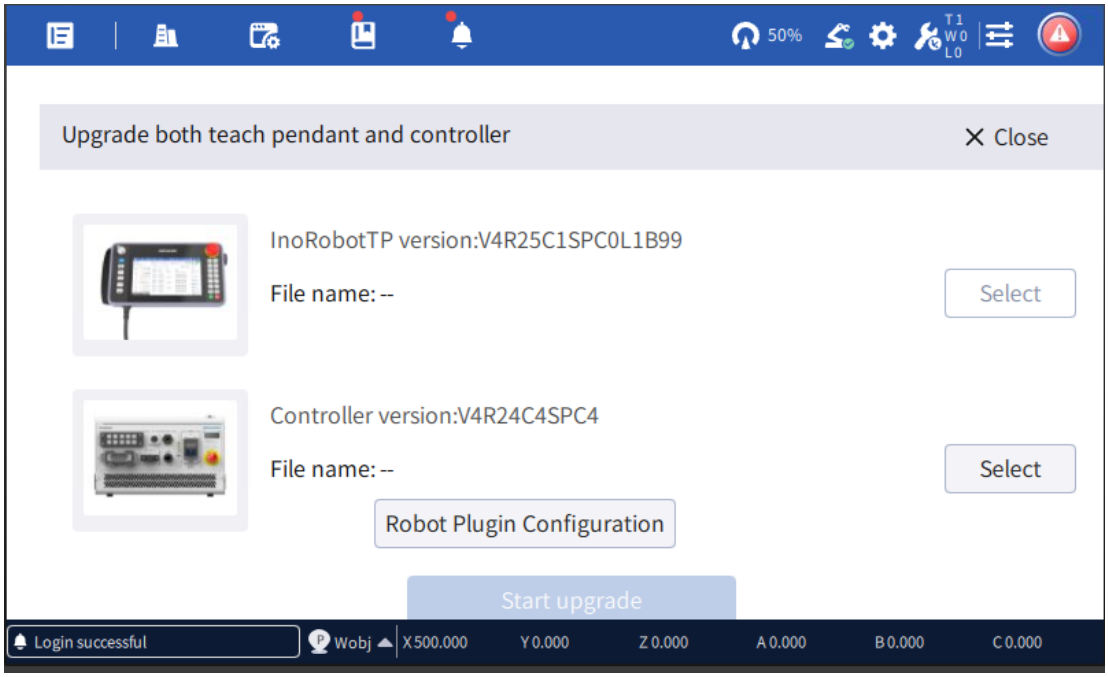
1. Log in with manufacturer authority.
2. Click the project to be upgraded.



3. You can select a new version of the software package using the "Select" button.

4. After selection, click "Start upgrade" to start the upgrade.

5. Check the "Update underlying system images" option to update the underlying system of the controller. If only "Upgrade controller" is checked, the default is to not update the underlying system of the controller.



CAUTION

- The PC-based teach pendant cannot be upgraded. Teach pendant upgrades are only applicable to the hand-held teach pendant.
- Do not cut off the power supply during controller upgrading, otherwise it may result in abnormality and the controller can be recovered only by refurbishing it.

10.6.3.8 Restore Factory Settings

It allows you to initialize all robot parameters to the factory defaults.

CAUTION

This operation will cause the zero point loss. Use with caution.

10.6.3.9 Clear Historical Alarms

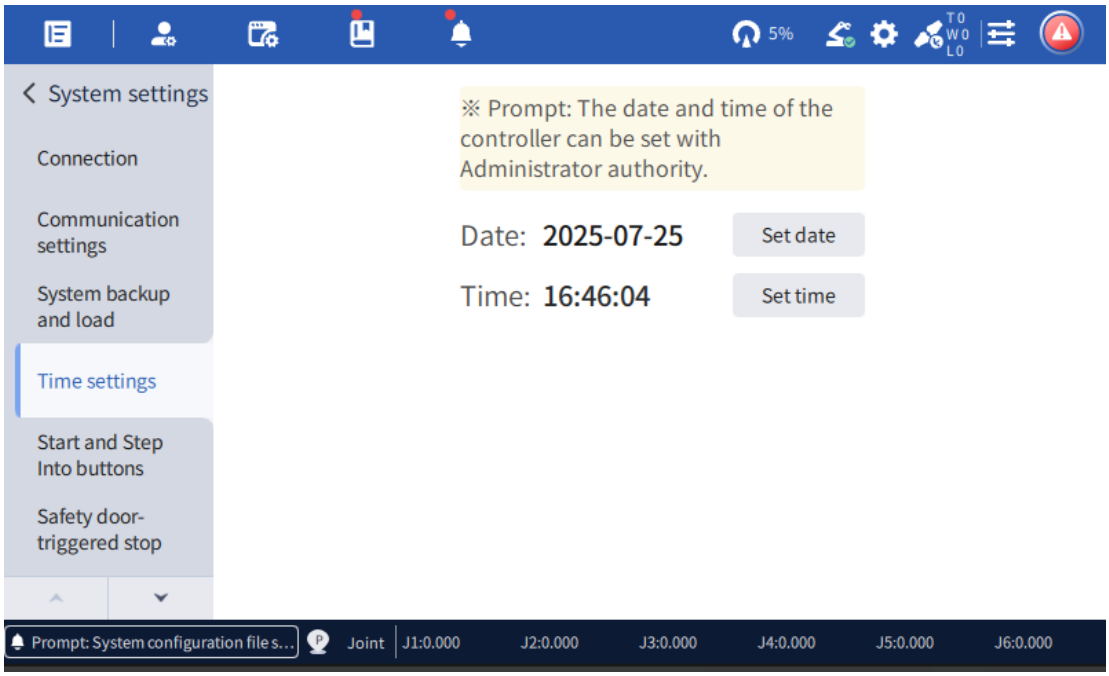
Clear operation logs and alarm logs in monitoring.

CAUTION

This operation will clear both operation logs and alarm logs.

10.6.4 Time Settings

This page displays the time on the controller. You can adjust the controller time using the "Set time" and "Set date" buttons.

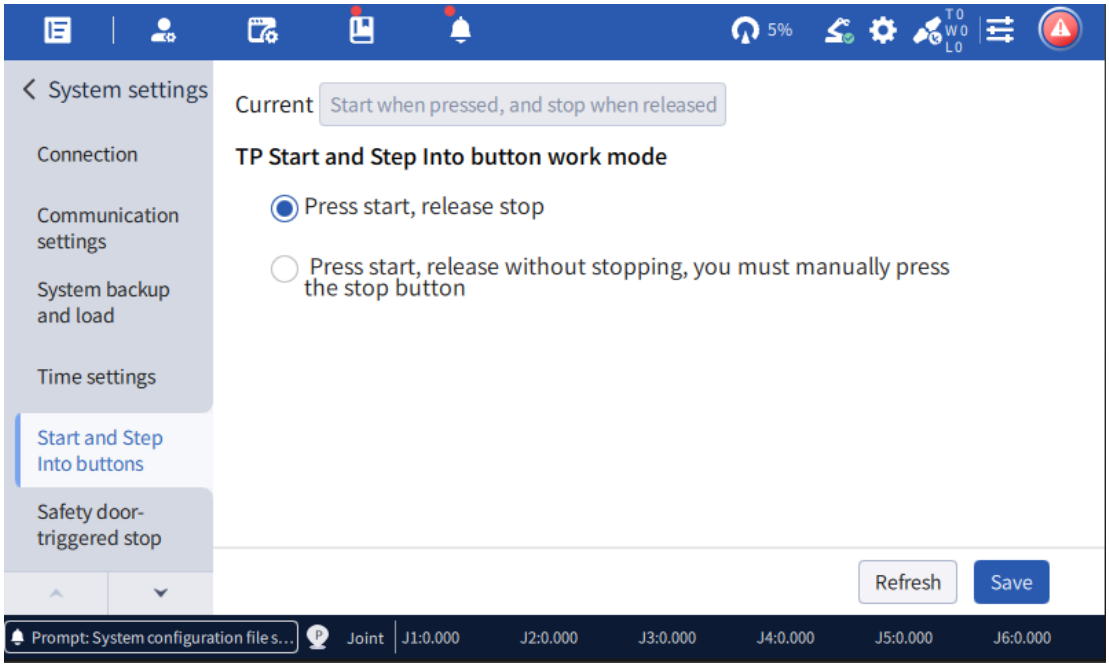


CAUTION

Admin mode is required.

10.6.5 Start/Step Into Buttons

It allows you to configure the work mode of the  "Start" button and  "Step Into" button in the debug mode.



(1) Two modes are available.

1) Mode 1: Press start, release stop

2) Mode 2: Press start, release without stopping, you must manually press the stop button

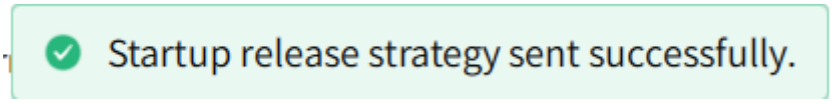
> CAUTION
>
> By default, mode 1 is selected.

(2) Change mode

1) Select the mode you want to use.

2) Click the "Save" button.

3) When a success prompt pops up, the save is successful.



(3) Mode description

1) Mode 1 (Press start, release stop)

 : Ensure that the program is edited and switched to the debugging mode. The program starts running when this button is clicked, and stops running when this button is released. If you want to keep the program running to the end, keep the "Start" button held.

 : Ensure that the program is edited and switched to the debugging mode. The program starts running from the cursor line when this button is clicked, and stops running when this button is released. If you want to keep the current line running to the end, keep the "Step Into" button held.

(2) Mode 2: (Press start, release without stopping, you must manually press the stop button)

 : Ensure that the program is edited and switched to the debugging mode. The program starts running when this button is clicked and keeps running to the end of the program unless the "Stop" button is clicked.

 : Ensure that the program is edited and switched to the debugging mode. The program starts running from the cursor line when this button is clicked, and keeps running to the end of the line unless the "Stop" button is clicked.

> **CAUTION**
>
> When non-static tasks are running, the "Start/Step Into buttons" function cannot be used to change the current mode.

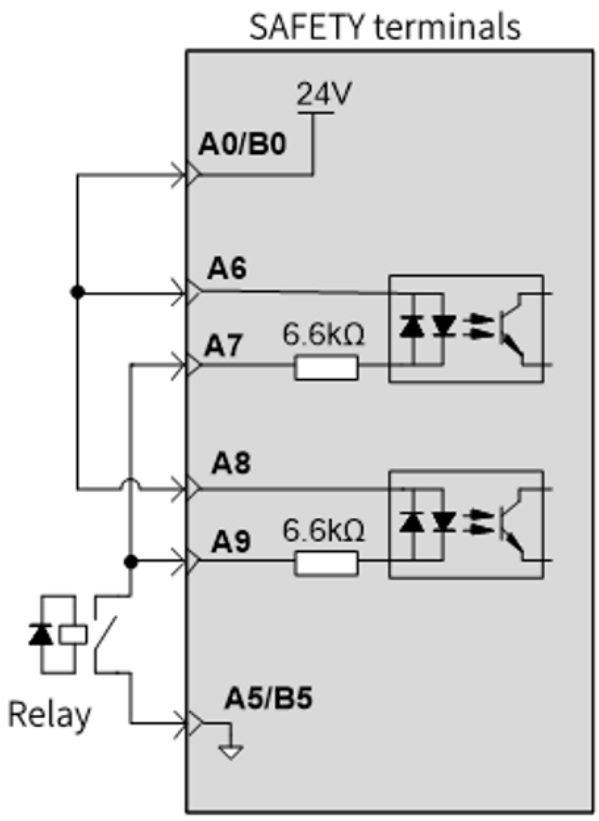
10.6.6 Safety Door-Triggered Stop Mode

- Safety door function is supported for the IRCB300 series, IRCB100-6AT series, and IRCB500 drive-control integrated controllers.
- Safety door function is not supported for the IRCB10 series controller.

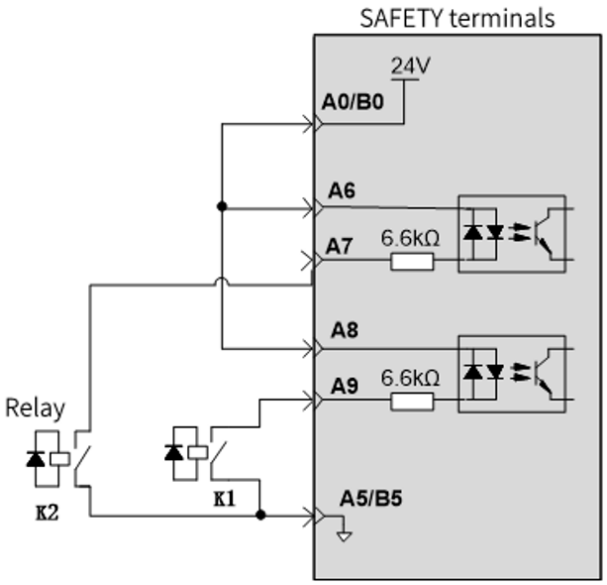
10.6.6.1 Safety Door Activation

(1) Hardware wiring

The safety door consists of two circuits and supports dual-channel safety door function. When wiring, connect the safety door circuits to the safety door interface specified by the System I/O (A6 and A7 for one circuit, A8 and A9 for the other). When using only one safety door circuit, set the wiring of the other safety door circuit to the normally closed status. Taking the use of the controller power supply as an example, the wiring diagrams for two safety door I/Os sharing one relay and using separate relays are shown as follows:



Two safety door I/Os sharing one relay



Two safety door I/Os using separate relays

There are three stop categories:

- **Category 0 stop**: Power to the robot motor power is removed. The robot is stopped under the action of the brake and dynamic braking of the motor together.
- **Category 1 stop (joint)**: All robot joints are decelerated to a stop at maximum deceleration. After the robot is stopped, the power to the robot motor is removed.
- **Category 1 stop (original trajectory)**: All robot joints are decelerated along the original trajectory to a stop at maximum deceleration. After the robot is stopped, the power to the robot motor is removed.
- **Category 2 stop**: The robot performs a controlled stop according to the motion trajectory and the program stops. When the safety door is closed, the robot can continue to run from the program line where it was stopped.

For more information, see the robot controller guides:

"IRCB300 Series 4-axis Robot Controller User Guide", data code: 19010612.

"IRCB300 Series 6-axis Robot Controller User Guide", data code: 19010712.

"IRCB500 Series 4-axis Robot Controller User Guide", data code: PS00001641.

"IRCB500 Series 6-axis Robot Controller User Guide", data code: PS00001641.

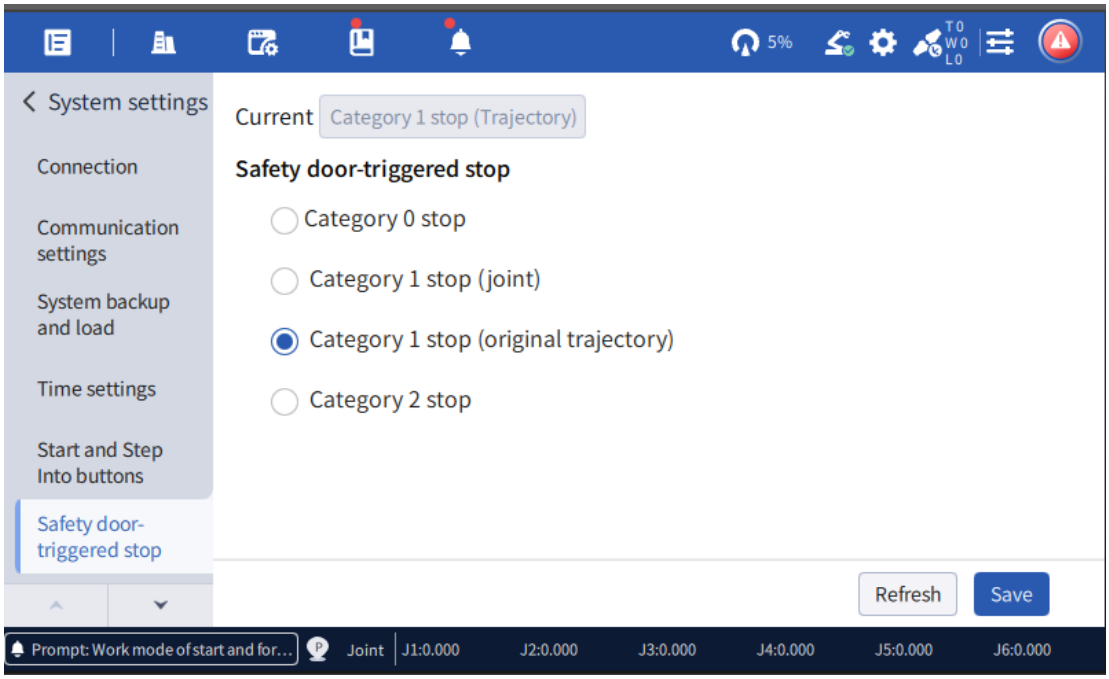
(2) In the software, enable the safety door and select the safe stop mode.

Safety door switch:

For the IRCB500 series controllers, there is no safety door switch and the safety door function is enabled by default in order to meet the safety requirements.

For other controllers, the safety door function is disabled by default for the SCARA robots, and enabled by default for the 6-axis robots.

Stop mode:



10.6.6.2 Safety Door Use

When the safety door function is activated, the safety door signal will be detected in the auto mode. In the auto running mode, when the safety door is opened, the program pauses or stops (depending on the user configuration) and a prompt is displayed on the interface.

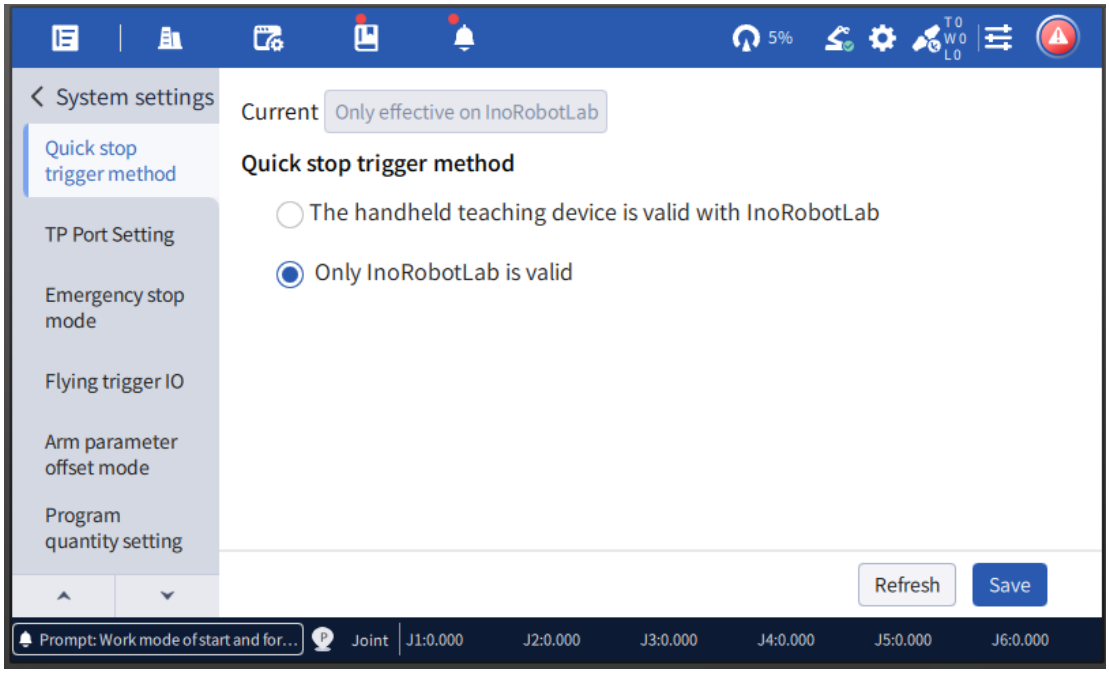
CAUTION

For the IRCB500 series controllers, the system also generates an alarm "Safety door triggered" when the stop mode is set to "Category 0 stop" or "Category 1 stop".

10.6.7 Quick Stop Trigger Method

For the IRCB500 series controller, you can configure the "Quick stop trigger method" as "The handheld teaching device is valid with InoRobotLab" or "Only InoRobotLab is valid".

- When the controller is connected to the hand-held teach pendant, select "The handheld teaching device is valid with InoRobotLab" method.
- When the controller is connected to the PC-based teach pendant, select "Only InoRobotLab is valid".



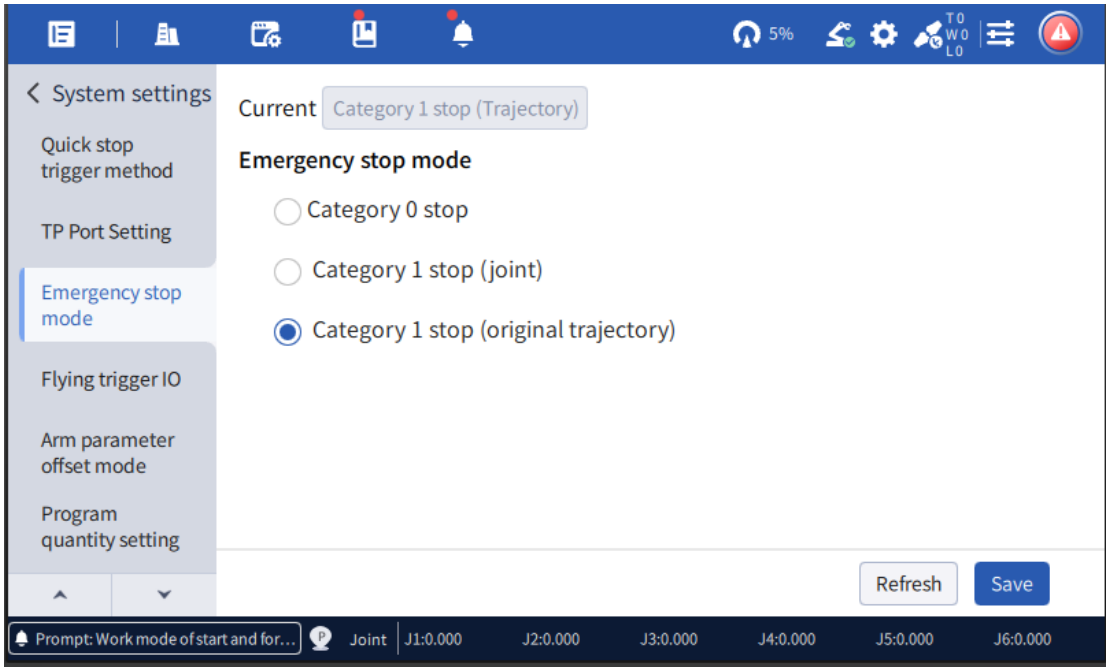
CAUTION

- When the controller is currently connected to the PC-based teach pendant, If you need to switch to the hand-held teach pendant, select "The handheld teaching device is valid with InoRobotLab". In this case, you will be prompted "Do you want to disconnect the PC software?" Select "OK" to automatically disconnect the PC-based teach pendant from the controller so that the hand-held teach pendant can connect to the controller.
- When the controller is currently connected to the hand-held teach pendant, If you need to switch to the PC-based teach pendant, select "Only InoRobotLab is valid". In this case, you will be prompted "Do you want to disconnect the handheld teach pendant?" Select "OK" to automatically disconnect the teach pendant from the controller so that the PC-based teach pendant can connect to the controller.

10.6.8 Emergency Stop Mode

For the IRCB500 series controllers, you can configure the emergency stop mode as "Category 0 stop", "Category 1 stop (joint)" or "Category 1 stop (original trajectory)". The three stop modes are detailed as follows:

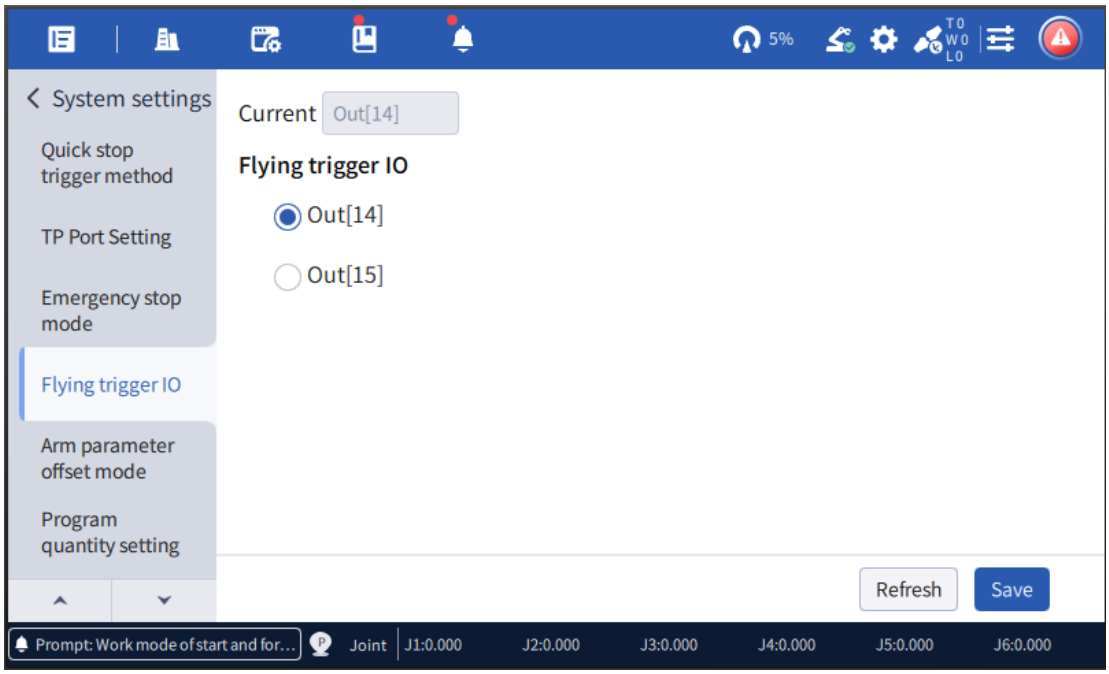
- Category 0 stop: An uncontrolled stop by immediate removal of power to the actuators, realized through hardware circuits.
- Category 1 stop (joint): A controlled stop realized through software planning.
- Category 1 stop (original trajectory): A controlled stop realized through software planning, stopping along the original trajectory.



10.6.9 Flying Trigger I/O

For the IRCB500 series controllers, the flying trigger-related I/Os can be configured.

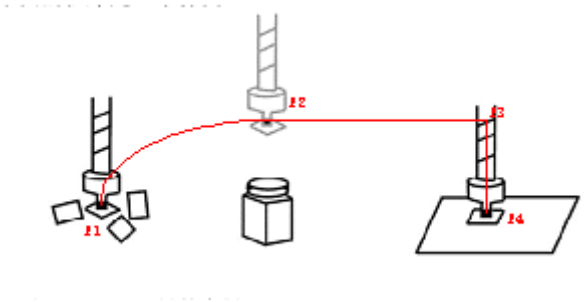
User I/O Out[14] or Out[15] can be selected as the output port that triggers the servo latch function.



10.6.9.1 Overview

The flying trigger function allows the robot to take photos and adjust the pose of the part accordingly without stop during movement from the part pickup point to the part placement point. This function reduces the cycle time.

As shown below, P1 is the part pickup point, P2 is the photo taking point, P3 is the transition point, and P4 is the part placement point. Normally, the robot needs to pause at P1, P2, P3 and P4 respectively. With the flying trigger function enabled, the robot does not stop at P2. Instead, when the robot is predicted to reach P2 during the movement from P1 to P3, the controller controls the digital output (DO) to trigger the camera to take photos and the servo to latch the position. Then the controller determines the position and orientation at which the part will be placed at P4 based on the vision processing results and the latched servo position.



The flying trigger is not a stand-alone function. It is implemented by the combination of three functions including position latching, I/O in motion, and motion without wait.

For programming examples of the flying trigger function, see the Programming Guide. The trigger signals that can be used include Out[14] and Out[15].

CAUTION

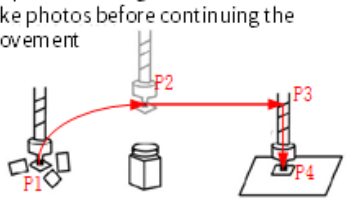
- The IRCB500 and IRCB300 series controllers support the position latching function. You only need to connect the corresponding I/O to the camera as a trigger for taking photos.
- The IRCB10 series controller does not support the flying trigger function.
- The IRCB300 series controller position latching triggered by one signal (fixed to "Out[15]"). To prevent the position latching function from being unavailable due to damage, the IRCB500 series controller supports position latching triggered by two signals: Out[14] or [Out15], and the default is Out[14].

10.6.9.2 Case Description

The following is a comparison between normal photo-taking and flying trigger photo-taking.

Common photo taking

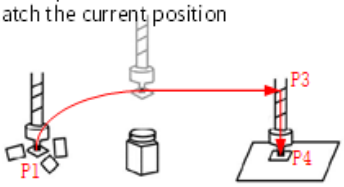
Stop at P2 and signal the camera to take photos before continuing the movement




```
START;
#Vision initialization
...
#Move to pickup point
Jump P[1],V[100],Z[0],LH[0],MH[0],RH[10];
Set Out[15],OFF;
#Motion transition point, output rising edge when passing P2, preprocess subsequent instructions
Jump P[2],V[100],Fine,LH[10],MH[0],RH[0];
Set Out[15],ON;
Movj P[3],V[100],Z[5],LH[0],MH[0],RH[0];
#Acquire vision data and store it to P[10]
...
#Correct the coordinates of the placement point according to P[20] and P[10]
P[4]=...
#Move to discharge point
Movj P[4],V[100],Z[0];
END;
```

Flying trigger

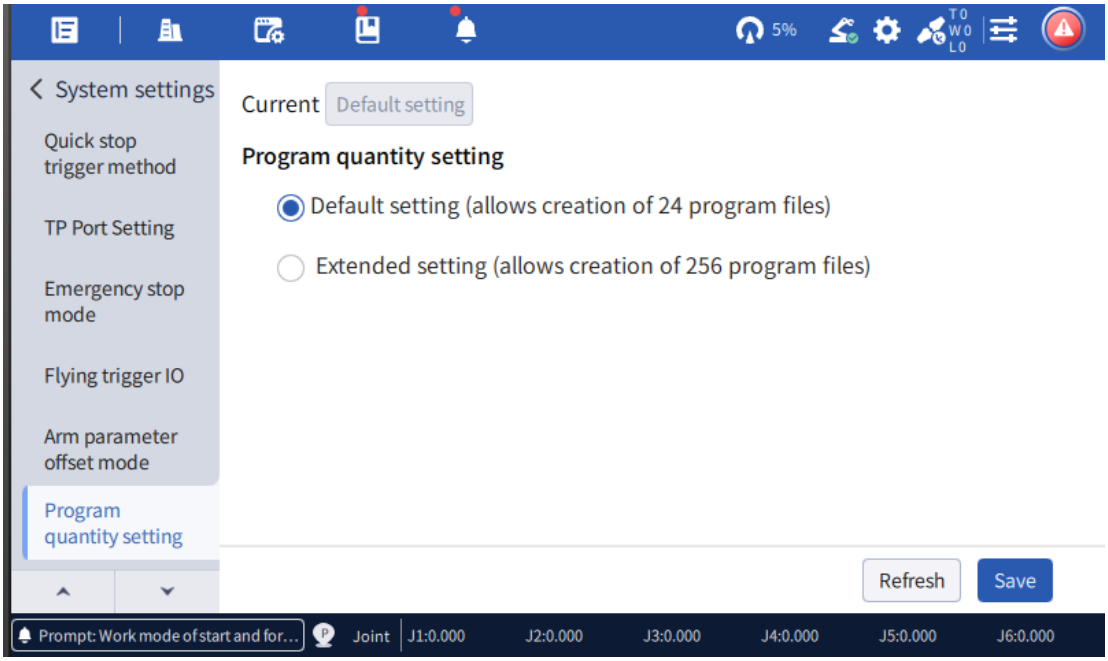
During movement, signal the camera to take a picture while and the servo to latch the current position




```
START;
#Enable latch function
LatchEnable ON;
ClearLatchPos;
#Vision initialization
...
#Move to pickup point
Jump P[1],V[100],Z[0],LH[0],MH[0],RH[10];
#Motion transition point, output rising edge when passing P2, preprocess subsequent instructions
Jump
P[3],V[100],Z[5],NWait,Out{15,OFF,D[0]},Out{15,ON,T[50]},LH[10],MH[0]
,RH[0];
B1=0;
#Wait for latch to be triggered by rising edge
While B1 == 0
B1=GetLatchPos{P[20],2,0,0};#Save latched position to P[20]
EndWhile;
Print P[10];
#Acquire vision data and save it to P[10]
...
#Correct the coordinates of the placement point according to P[20] and P[10]
P[4]=...
#Move to the placement point
Movj P[4],V[100],Z[0];
END;
```

10.6.10 Program Quantity Setting

This function extends the number of program files available for use.



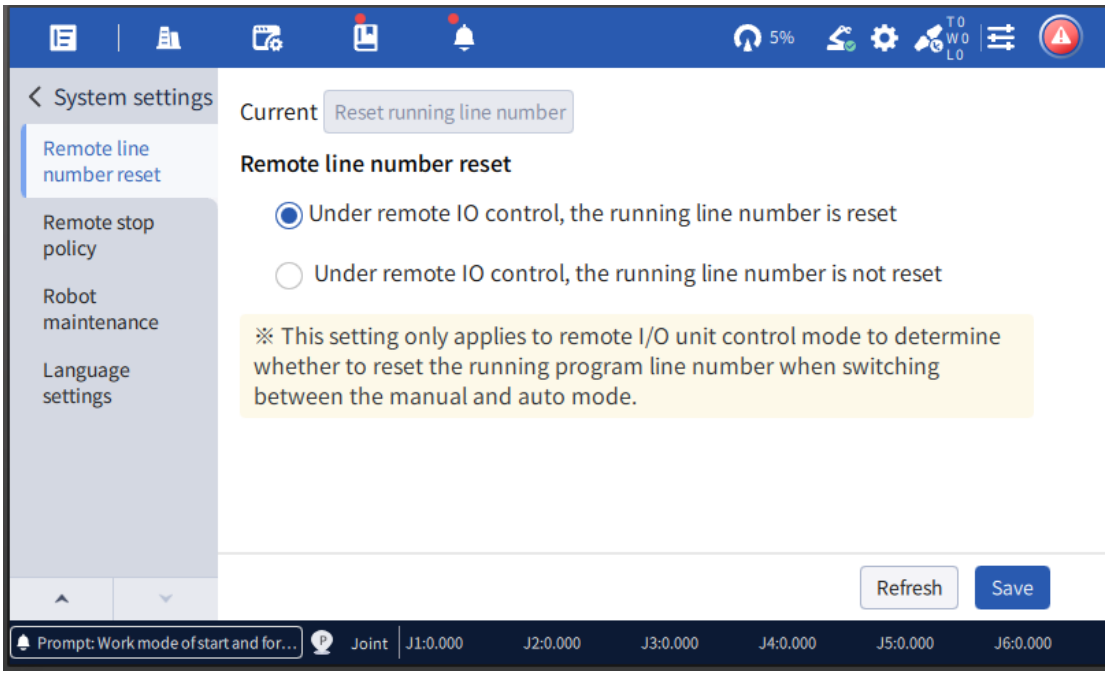
Currently, only two settings are supported:

- Default setting (allows creation of 24 program files).
- Extended setting (allows creation of 256 program files).

> **CAUTION**
>
> When using the extended setting, add program files with caution. An excessive number of program files or an overly large project may cause issues during loading, compiling, or synchronization.

10.6.11 Remote Line Number Reset

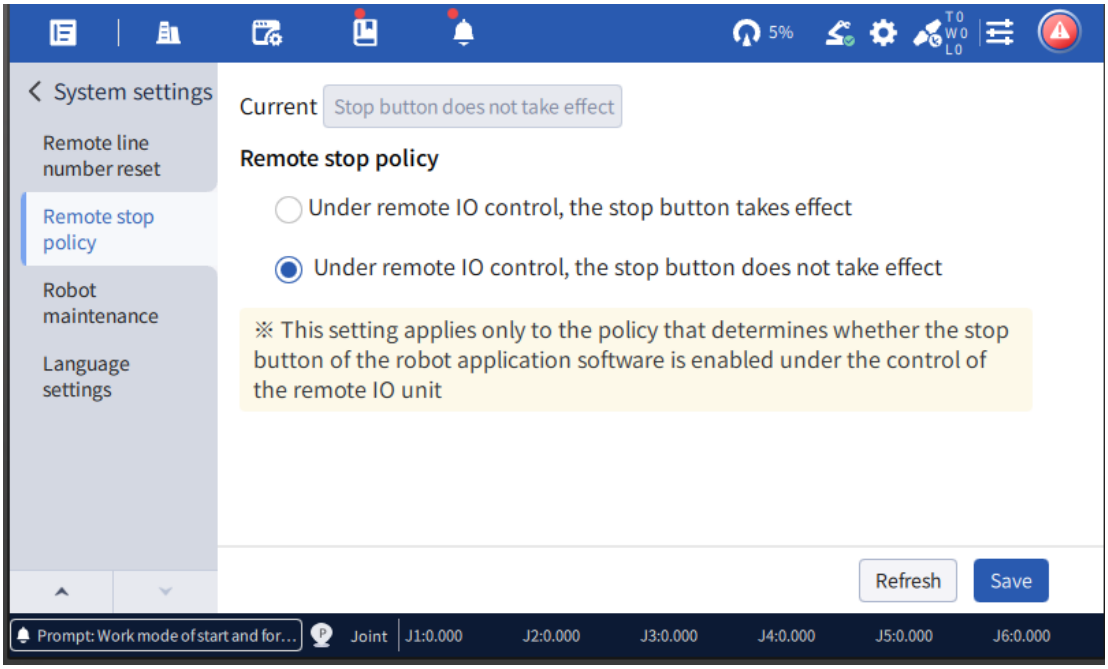
It allows you to configure whether to reset the running program line number when a switchover between manual and auto modes occurs, under the control of the remote I/O unit (when effective in both auto and manual modes, or only effective in auto mode).



- Reset running line number: When a switchover between manual and auto modes occurs under the control of the remote I/O unit, the program running line number will be reset.
- Do not reset running line number: When a switchover between manual and auto modes occurs under the control of the remote I/O unit, the program running line number will not be reset.

10.6.12 Remote Stop Policy

It allows you to configure whether the stop button of the robot application software is enabled when a switchover between manual and auto modes occurs, under the control of the remote I/O unit (when effective in both auto and manual modes, or only effective in auto mode).



- Stop button to take effect: When the stop button of the robot application software is pressed under the control of the remote I/O unit, the running will be stopped.
- Stop button does not take effect: When the stop button robot application software is grayed out under the control of the remote I/O unit, the running can only be stopped through the remote control end.

10.6.13 Robot Maintenance

This function is used to display the lifespan of partially worn components of the robot and related maintenance information, reminding you to perform maintenance operations on the robot. This function monitors the usage of each component. When the component lifespan reaches the set lifespan threshold, a warning will be triggered to remind you to perform related maintenance operations. This warning can be cleared. After completing the maintenance settings operation, no warning will be generated again within the lifespan threshold.

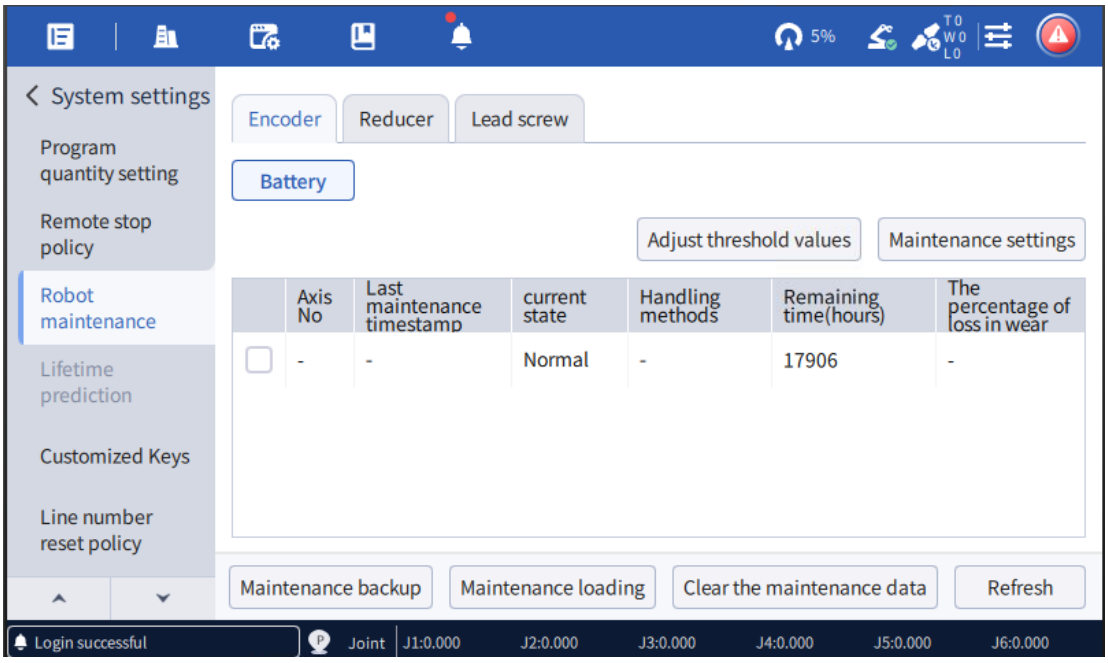
You can access this function by navigating to "Settings" > "System settings" > "Robot maintenance". The function main interface displays all currently maintainable component types, with each row in the table corresponding to one maintenance component. The component types are displayed according to the models. The table includes:
Last maintenance timestamp, current state, handling methods, remaining time (hours), and the percentage of loss in wear.

1. If no maintenance has been performed, the value of "Last maintenance timestamp" is displayed as "1".
2. If the "Current state is "Normal", the value of "Handling methods" is displayed as "1". If the "Current state" is "Pending maintenance", the value of "Handling methods" is displayed as the corresponding method.

The maintenance data for each component is described as follows:

Maintenance component	Description
Encoder battery usage time	The power-off time of the controller is the usage time of the encoder battery.
Reducer grease usage time	The power-on time of the controller
Conveyor usage time	The power-on time of the controller
Ball screw grease usage time	The power-on time of the 4-axis robot controller

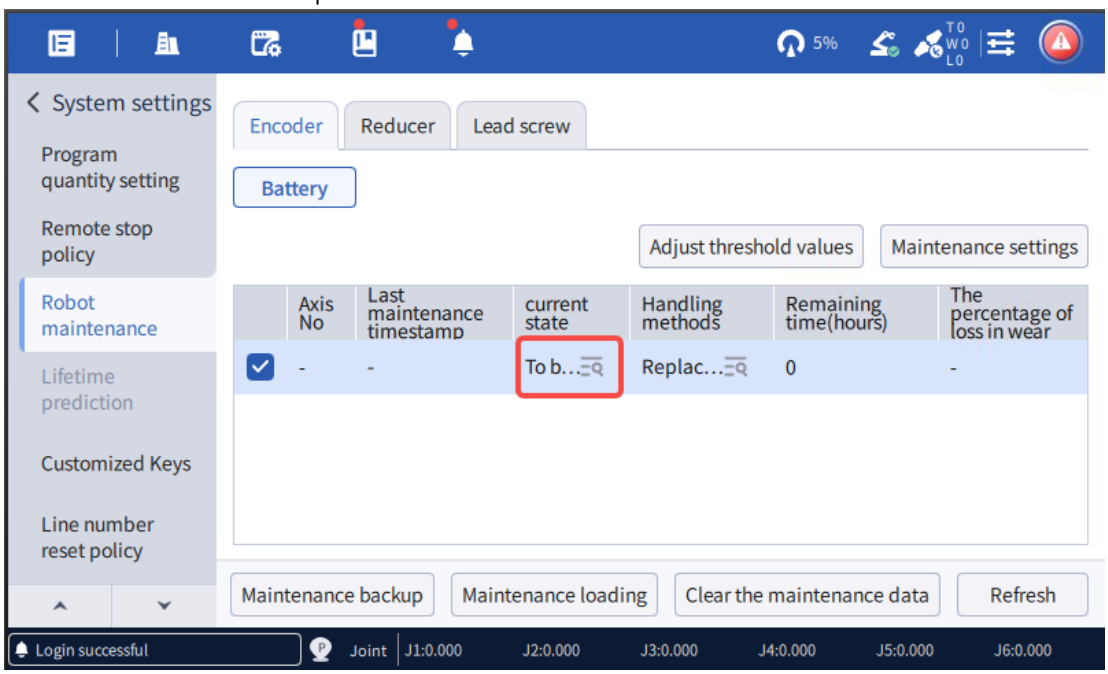
Maintenance component	Description
Ball screw wear ratio	The ratio of the ball screw motion distance to the maximum stroke
Balance cylinder	The ratio of the usage count to the maximum allowable count for balance cylinder spring

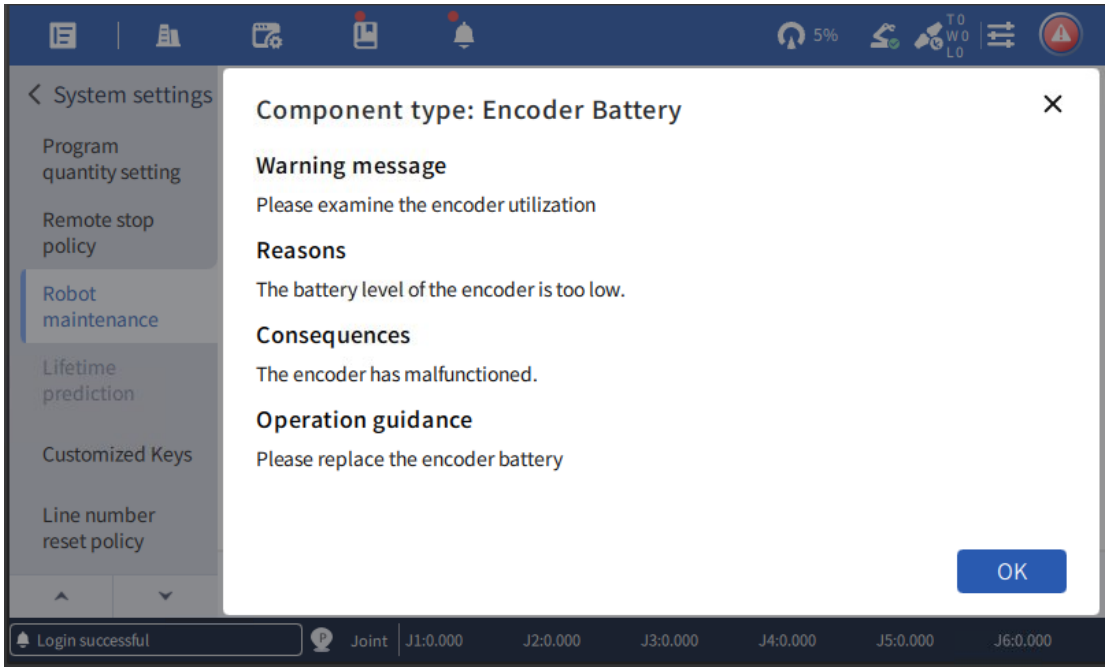


Operation description:

1. **View maintenance handling method**

   Double-click a certain component in the table. If the current status of the component is "To be maintained", a small floating window will appear (as shown in the figure), displaying detailed maintenance method information of the component.

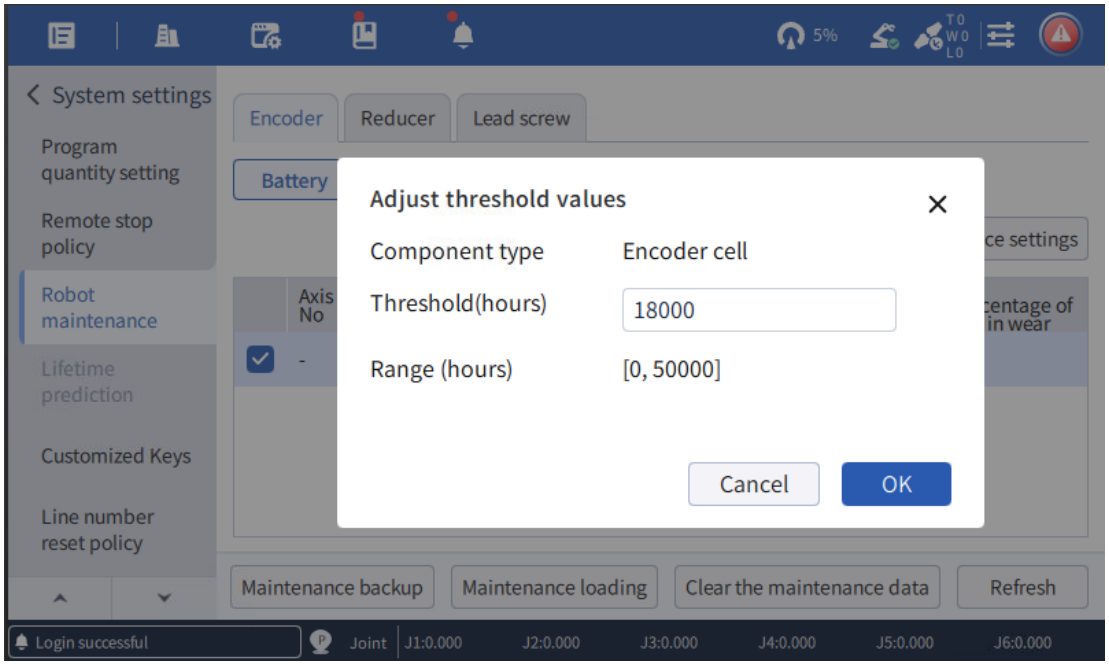




2. **Modify the lifespan threshold.**

   In the User mode, the "Adjust threshold values" button is not displayed.

   Be sure to operate in Admin or Manufacturer mode, and in the non-motion state under manual mode: Select the maintenance component, click the "Adjust threshold values" button to open the threshold modification interface. The interface includes the threshold modification related settings. Enter the parameter, and click "OK" to send the data. There will be a second confirmation prompt, and a success dialog will pop up after successful modification.



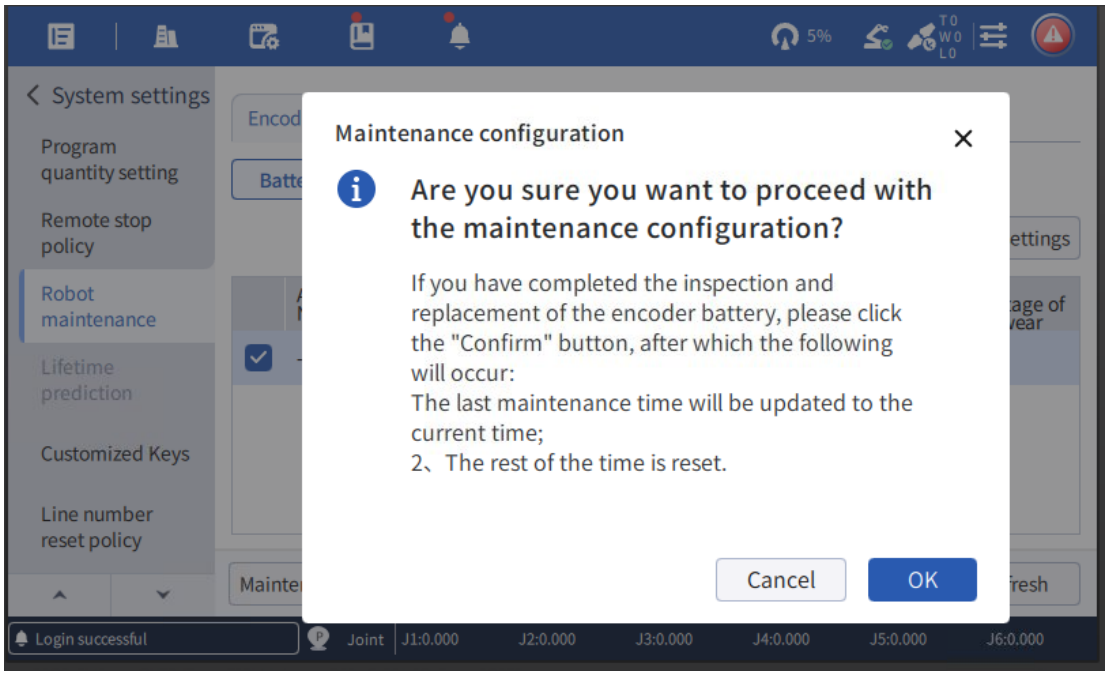
3. **Perform the maintenance settings.**

   After completing the maintenance of the robot components, you need to perform maintenance settings to reset the maintenance function of the robot components. In the User mode, the "Maintenance settings" button is not displayed.

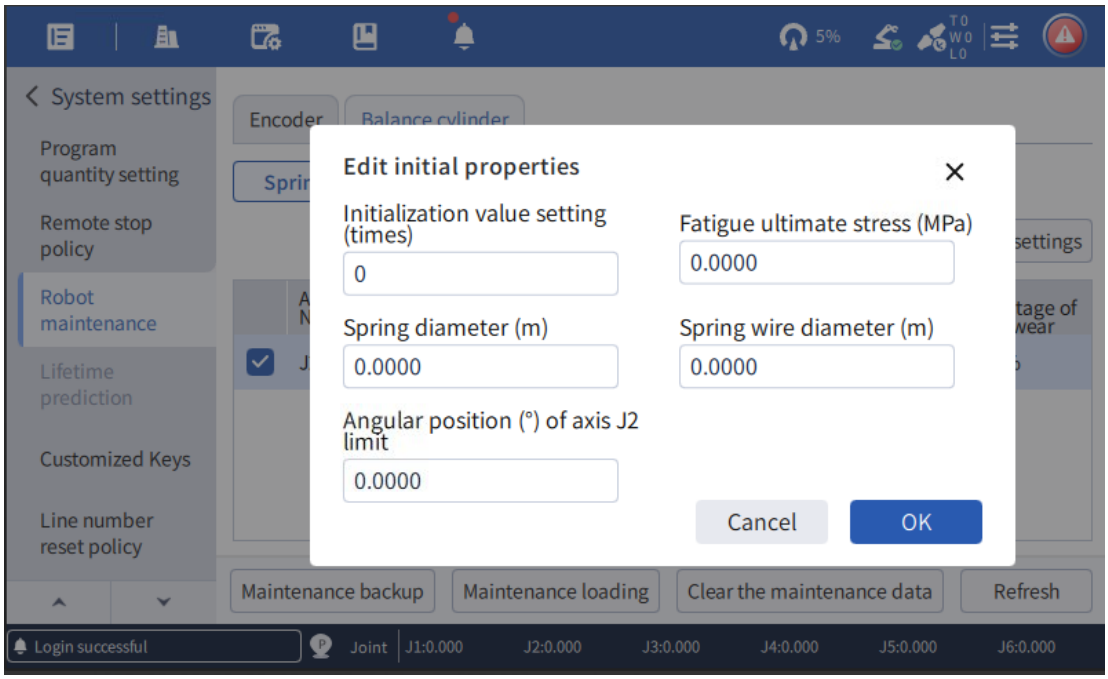
   Be sure to operate in Admin or Manufacturer mode, and in the emergency stop mode and the non-motion state under manual mode: Select the maintenance component, click the "Maintenance settings" button. Maintenance settings related operation information will be displayed. Click "OK", and an operation confirmation prompt will be popped up. After confirmation, the component maintenance data will be

reset to the threshold set by the user (or to the default value if not set), and the last maintenance time will be recorded as the current time.

After the warning is triggered, if maintenance is not performed, the warning will be triggered again one hour later.



For the balance cylinder component, if a spring with parameters different from the original factory parameters needs to be replaced, click the "Modify initial attributes" button in Manufacturer mode to display the interface for setting the initial parameters of the spring and other parameters, and enter the correct parameters. Click "OK" or "×" to return to the "Maintenance settings" interface. If you click "OK", a secondary confirmation prompt will be displayed. After confirmation, the current usage count will reset to the "Initial value" parameter in the "Modify initial attributes" interface, and the last maintenance time will be recorded as the current time.

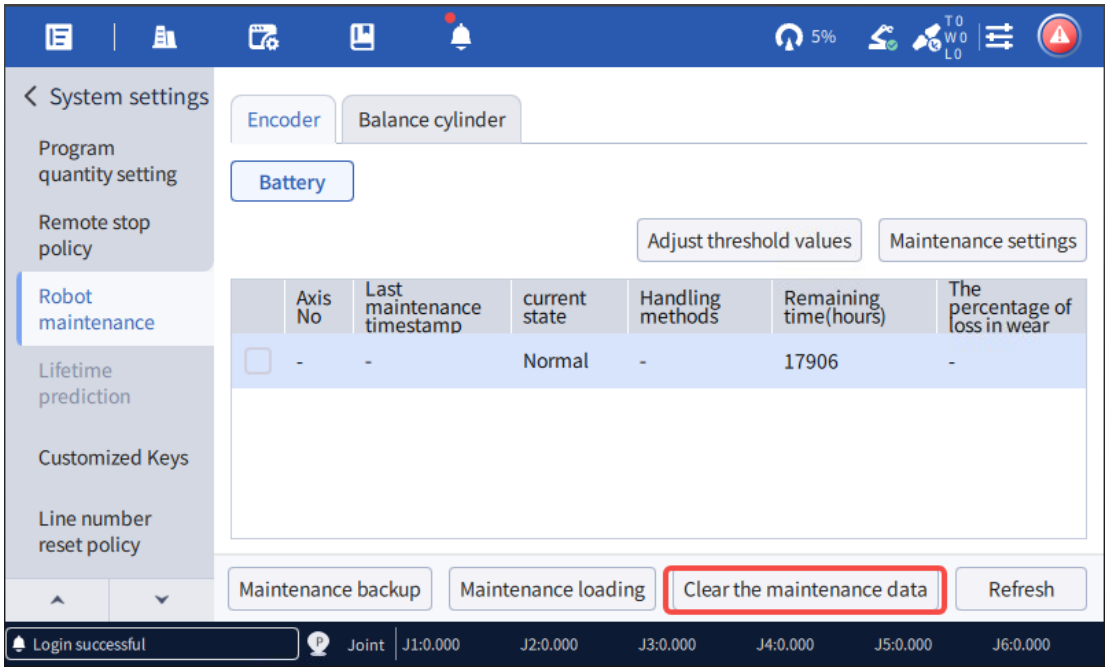


4. **Clear the maintenance data.**

   To reset the pre-maintenance function, you need to clear the maintenance settings. In the User mode, the "Clear the maintenance data" button is not displayed.

Be sure to operate in Admin or Manufacturer mode, and in the emergency stop mode and the non-motion state under manual mode: Select the maintenance component, click "Clear the maintenance data" and "OK" to reset all maintenance data to default values.

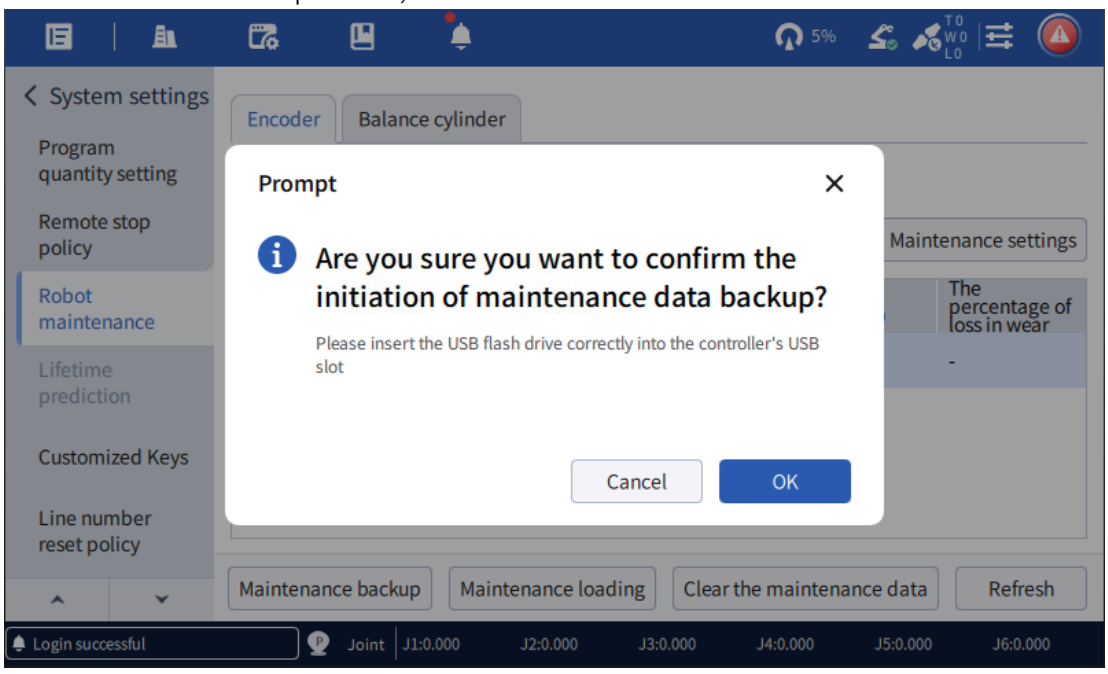
Note: If the controller is flashed to a different model, alarm 0x1058 will occur. In the Admin or Manufacturer mode, click "Clear the maintenance data" to prevent alarm 0x1058 from recurring after each reboot.



5. **Back up the maintenance data.**

   To back up maintenance data, perform a "Maintenance backup". In the User mode, the "Maintenance backup" button is not displayed.

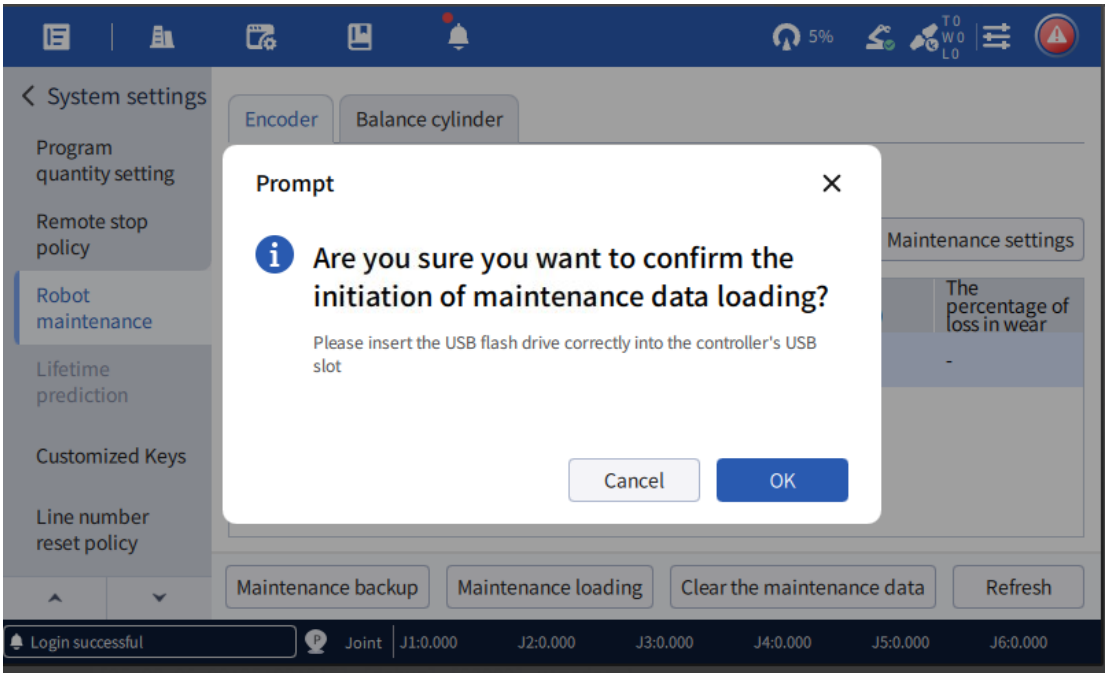
   Be sure to operate in Admin or Manufacturer mode, and in the non-motion state under manual mode, with a USB drive inserted and the /Maintain directory existed in the root of the USB drive: Click the "Maintenance backup" button, and then click "OK".



6. **Load the maintenance data.**

   To load the maintenance data, perform a "Maintenance loading" operation. In the User mode, the "Maintenance loading" button is not displayed.

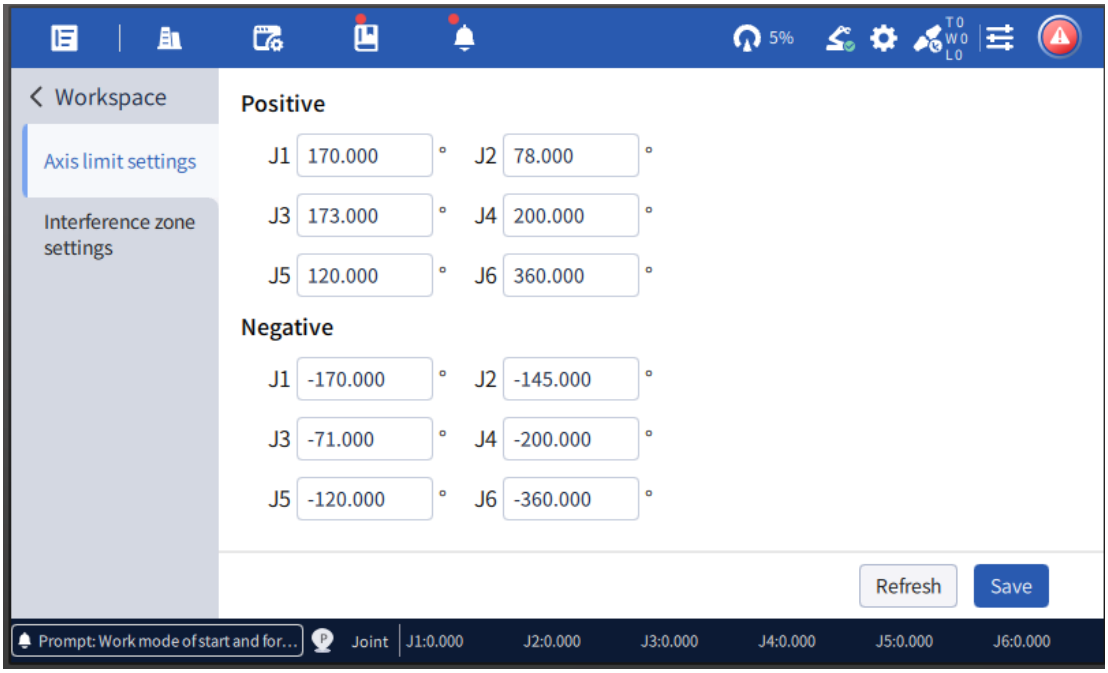
Be sure to operate in Admin or Manufacturer mode, and in the non-motion state under manual mode, with a USB drive inserted and the /Maintain/Maintain.cfg configuration file existed in the root of the USB drive: Click the "Maintenance loading" button, and then click "OK".



10.7 Workspace

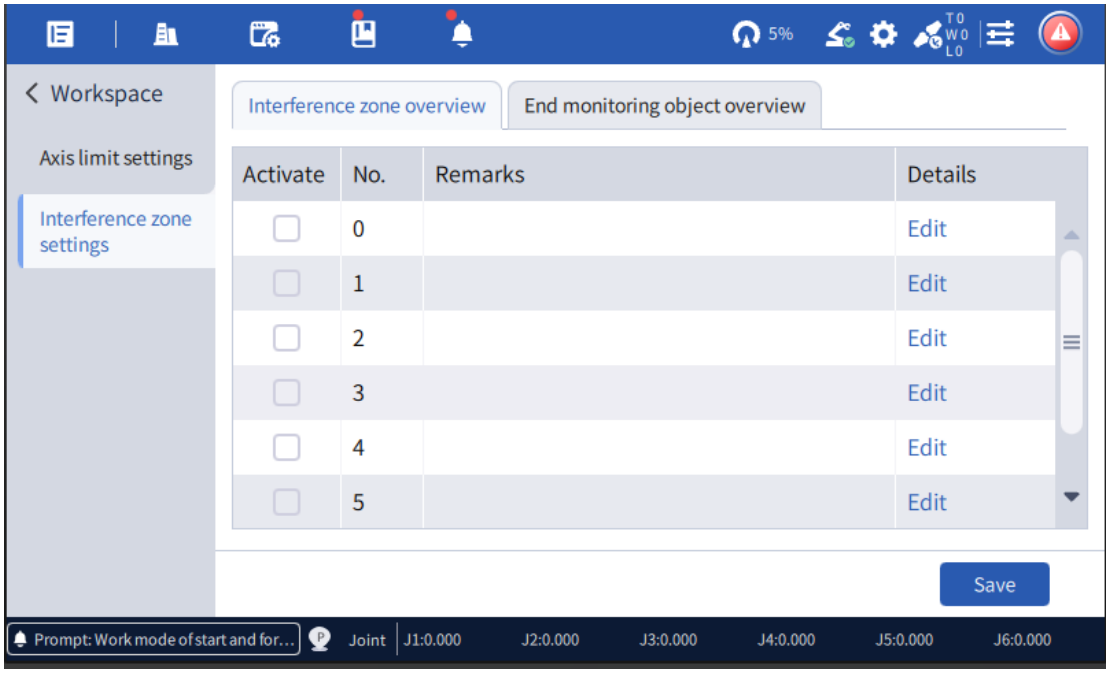
10.7.1 Axis Limit Settings

Axis limit settings: The limit positions of each axis, defining the working range of the robot in joint space. For safety reasons, always set the axis limits within the range of the mechanical stops.



10.7.2 Interference Zone Settings

Open the "Workspace" module on the main page as shown in the figure below, and select "Workspace" > "Interference zone settings".



The interference zone is the area where the robot end monitoring object cannot reach. A total of 16 interference zones and 16 monitoring objects can be set.

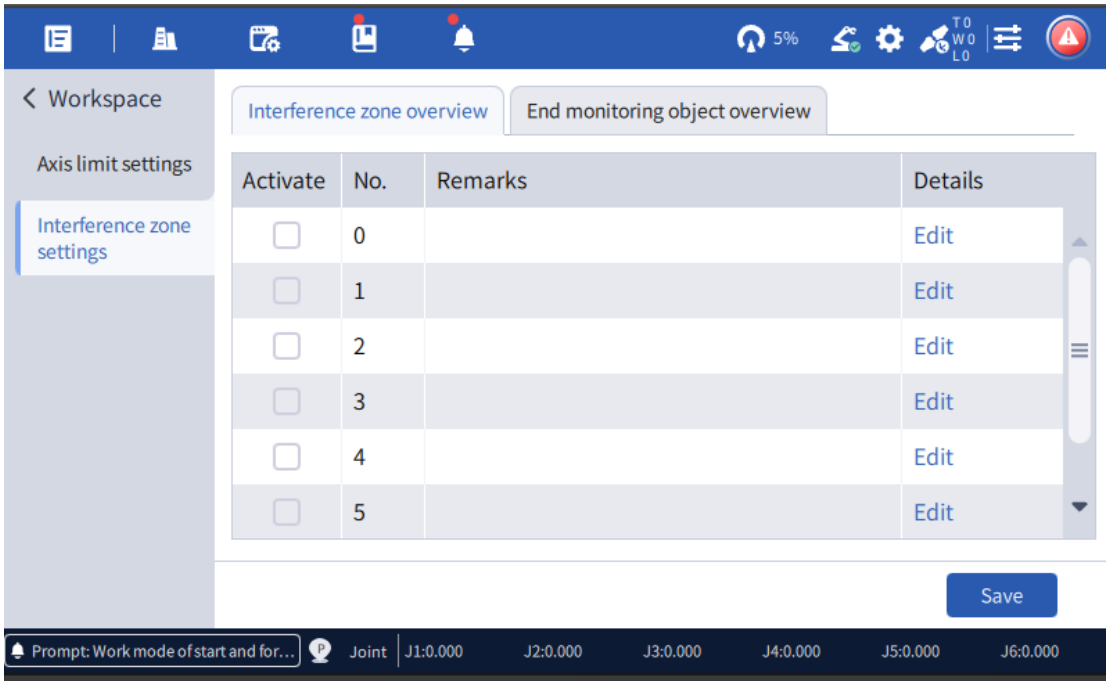
10.7.2.1 Overview

The interference zone function prevents the monitoring objects at the end of the robot from entering the interference zone to avoid collision with obstacles or other devices. You can control whether to allow the robot to enter the interference zone through external input signals, and interact with the robot or other devices through output signals. You can configure a total of 16 interference zones and 16 monitoring objects.

10.7.2.2 Steps

See the instruction manual for the description of the interference zone instruction SetInterferZone and the monitoring object instruction.

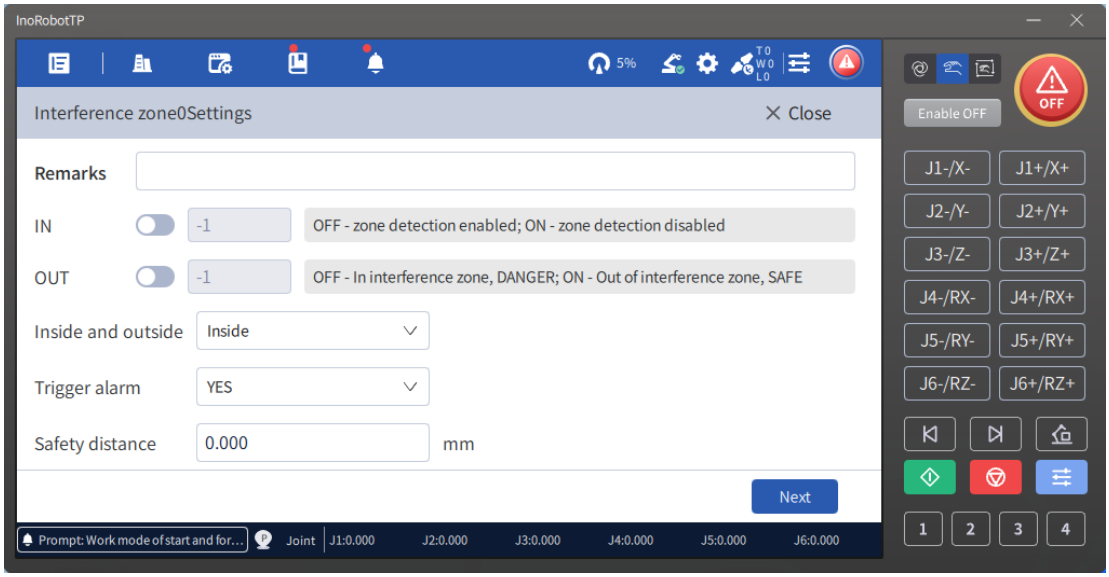
The interference zone function interface is shown below.



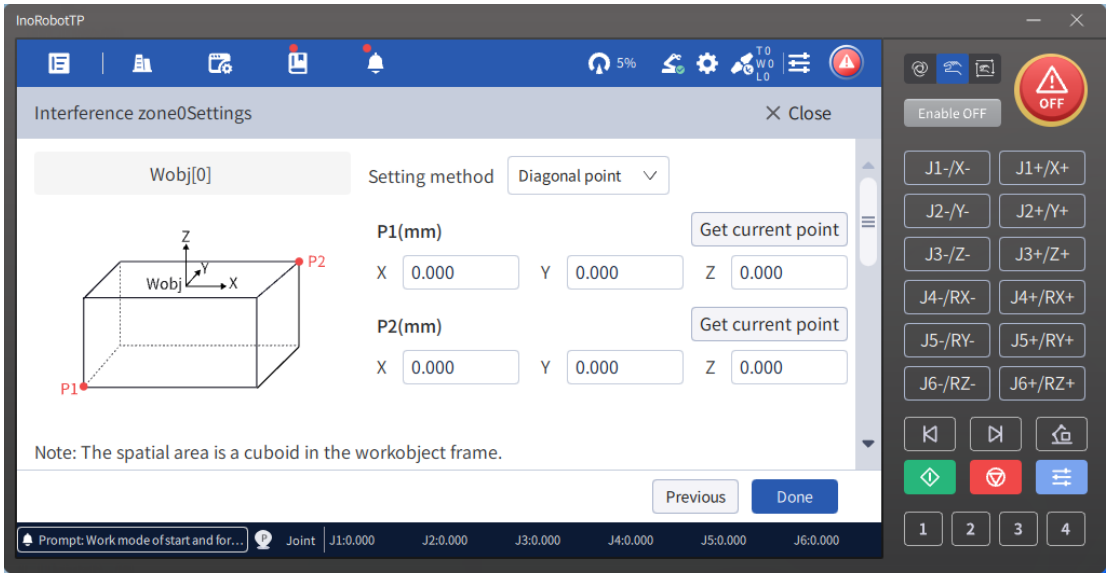
You can activate or deactivate the 16 interference zones and 16 monitoring objects, and view the description of the interference zones and monitoring objects.

CAUTION

- Multiple interference zones can be activated simultaneously, but only one end monitoring object can be activated.
- Select an interference zone and click the "Edit" button in the corresponding line to open the parameter setting interface.



Parameter	Description
Remarks	Descriptive information of the current interference zone
IN	By default, this parameter is disabled. Enable this parameter to set the input signal.
OUT	By default, this parameter is disabled. Enable this parameter to set the output signal.
Input signal	Sets the input signal of the interference zone. When the input signal is OFF, the interference zone detection is enabled. When the input signal is ON, the interference zone detection is disabled.
Output signal	Sets the output signal of the interference zone. When the output signal is OFF, it indicates that the robot is in the interference zone and is in a dangerous state. When the output signal is ON, it indicates that the robot is out of the interference zone and is in a safe state.
Inside and outside	Specifies the inside or outside of the interference zone as the interference zone.
Trigger alarm	Trigger alarm and stop: Sets whether to generate an alarm when the robot enters the interference zone. The default is "YES". When it is set to "NO", the robot does not alarm and stop when it enters the interference zone.
Safety distance	Increases or decreases the interference zone as a whole according to the "Inside and Outside" option. The range of safety distance is [0,10000], in mm.



Parameter description:

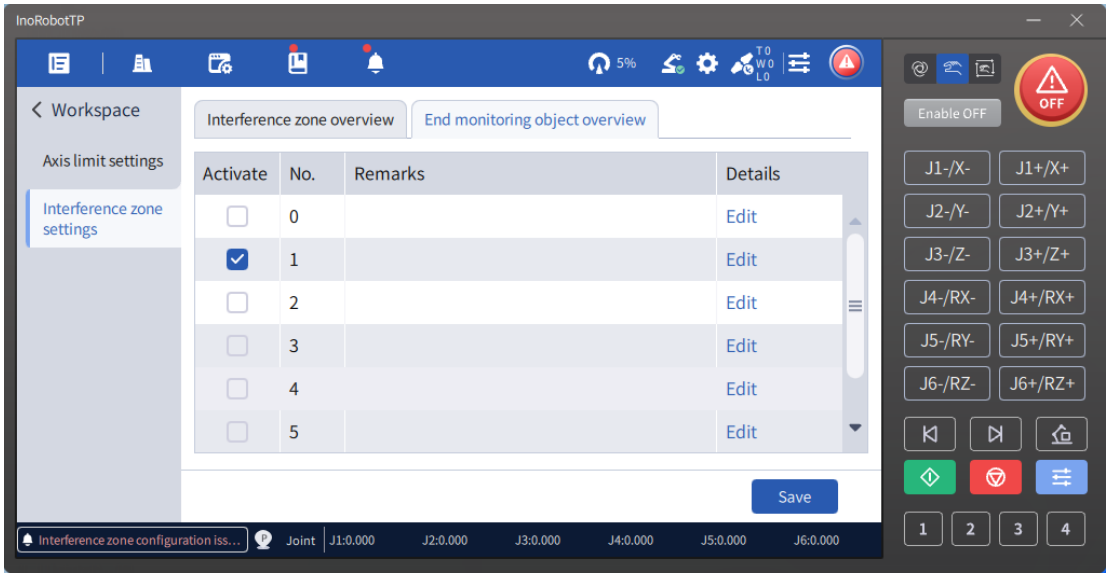
- Setting method: Sets the interference zone by diagonal point, or by datum point + offset. The points are taken in the current workobject frame.
- You can enter the point manually or click the "Get current point" button to acquire the current point automatically. The range of the point value is [-10000,10000], in mm. The range of the offset value is [-10000,0), (0,10000], in mm.
- After getting the points or configuring the points of the interference zone, you can view the frame parameters in the lower part of the interface.

CAUTION

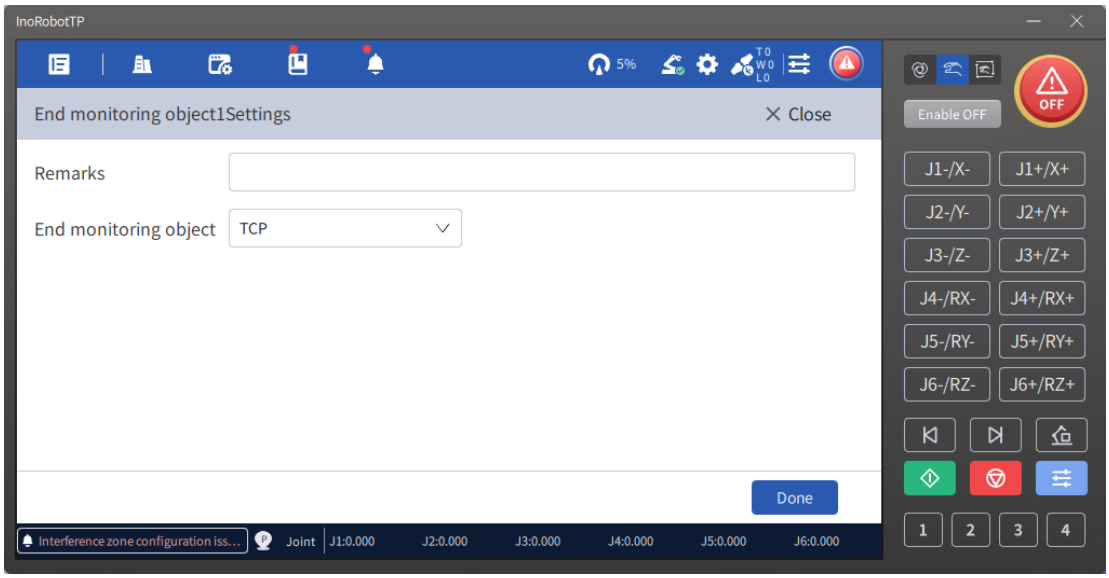
- The value of the safety distance cannot be less than 0.
- The position of the interference zone is relative to the active workobject frame.
- You cannot get the points of the interference zone in a workobject frame where the workobject is not held by the robot.
- You cannot get the points of the interference zone in a workobject frame where the user frame is not fixed.
- If the points cannot form a cuboid, the settings cannot be saved.
- The robot decelerates to stop from the time the end monitoring object enters the interference zone. Therefore, the actual stop position of the robot is inside the interference zone, or the robot passes through the interference zone when the interference zone is small. Note that the greater the robot speed, the greater the distance the robot enters the interference zone. Therefore, set the interference zone as large as possible.

Click the "Done" button to save the interference zone parameters and return to the interference zone overview interface.

Switch to the end monitoring object overview, as shown in the figure below:



Select an end monitoring object and click the "Edit" button in the corresponding line open the parameter setting interface:

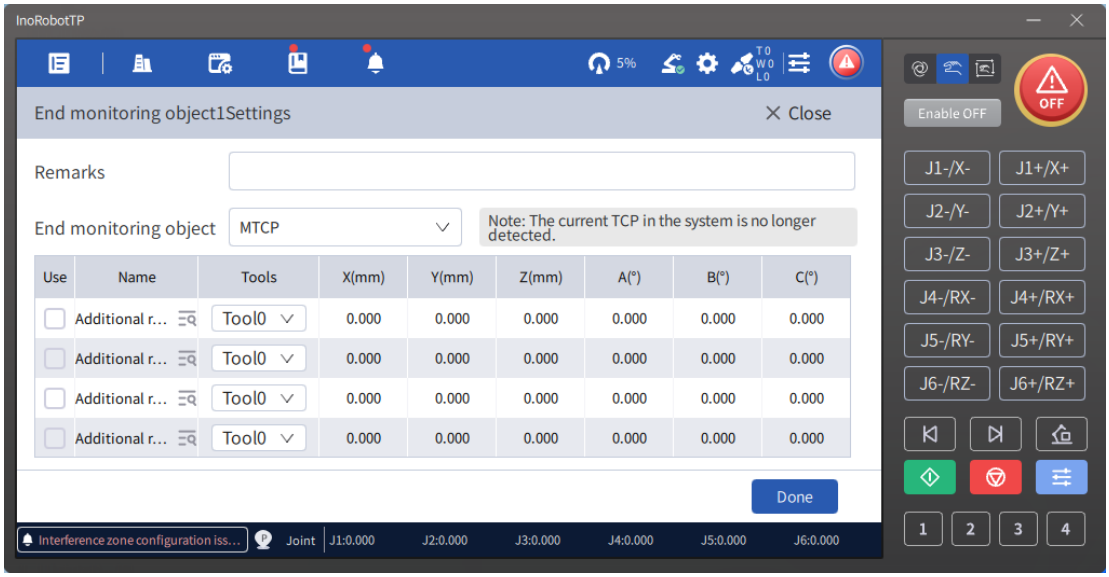


Parameter description:

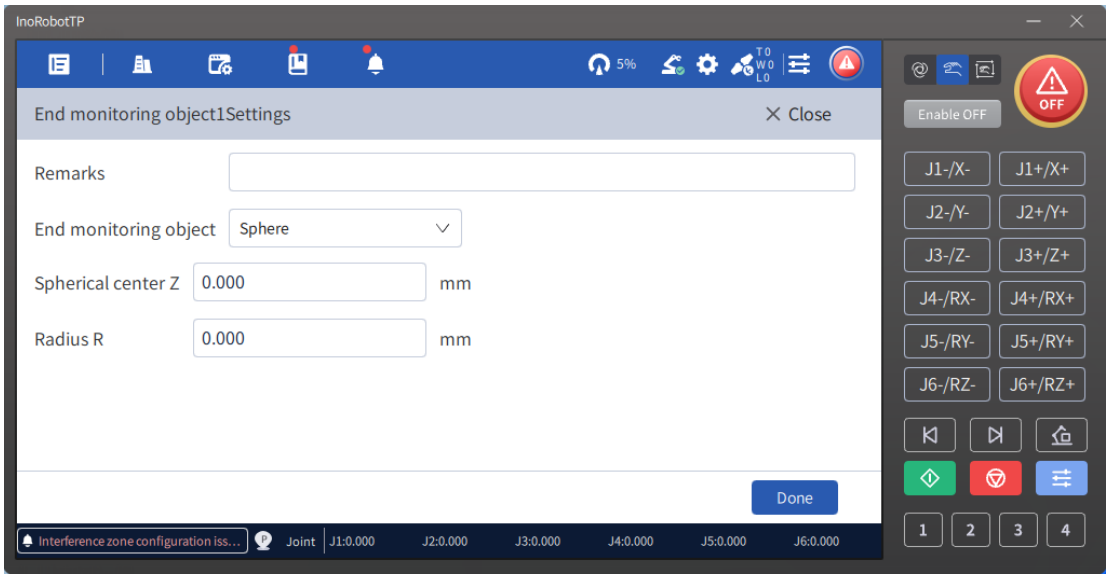
- Remarks: Descriptive information of the current monitoring object.
- Monitoring object type: Includes TCP, MTCP, sphere, and cuboid bounding box. TCP by default.

TCP: When the robot grips the tool, the current TCP is used for monitoring. When the robot grips the workobject, the flange center is used for monitoring.

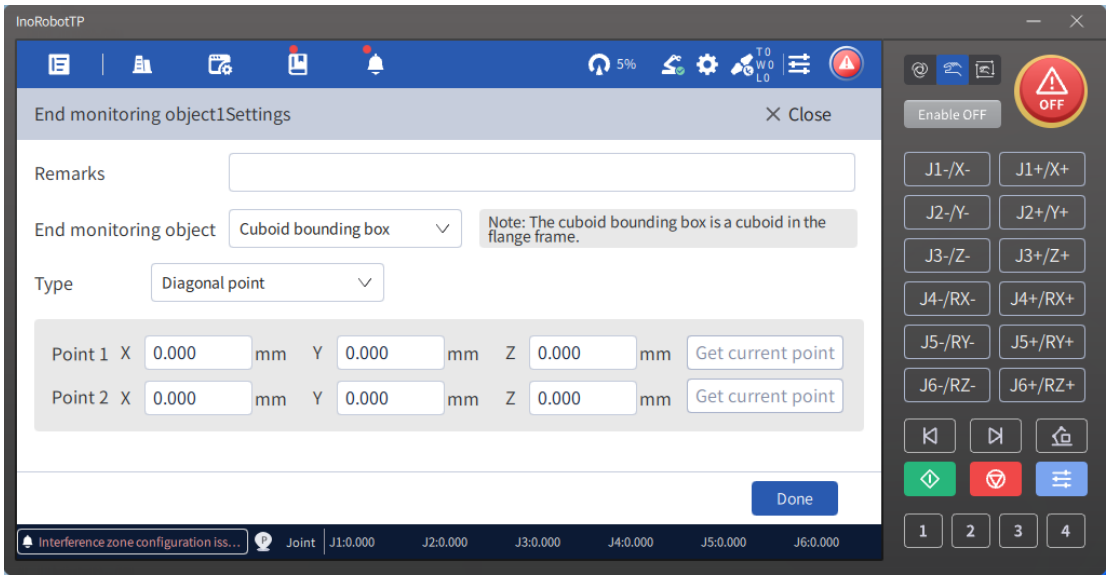
MTCP: Supports up to four tools at the same time. You must select a reference point for the tool. The current TCP of the robot is not used for monitoring any more.



Sphere: The spherical center is offset from the Z direction of the flange frame, the spherical center range is [-10000,10000] and the radius range is (0,10000], in mm. The eccentric sphere is not supported.

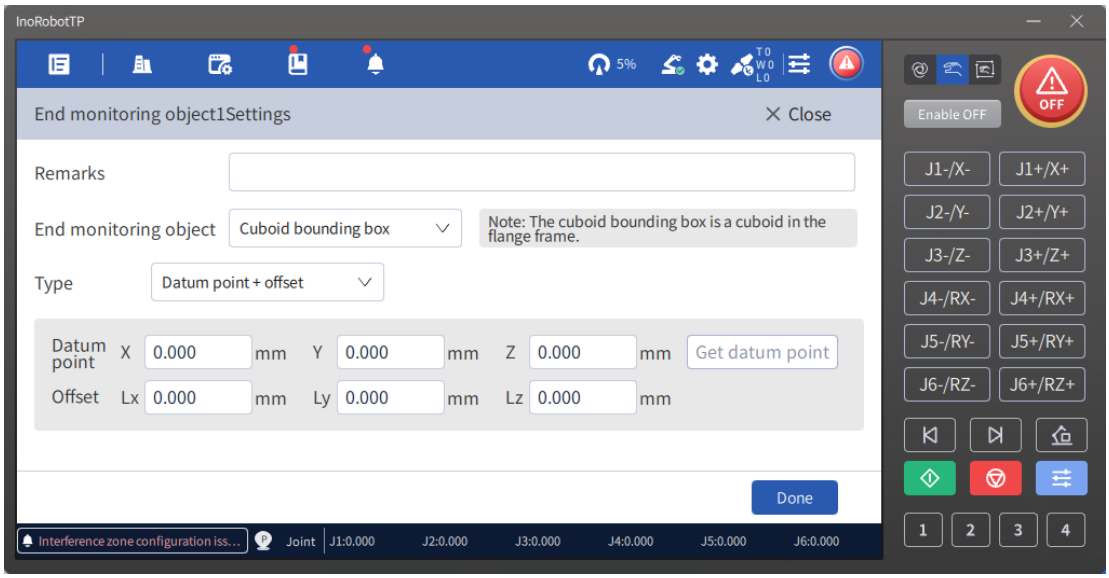


Cuboid bounding box: There are three methods to acquire the points, namely, diagonal point, datum point + offset, and get point.

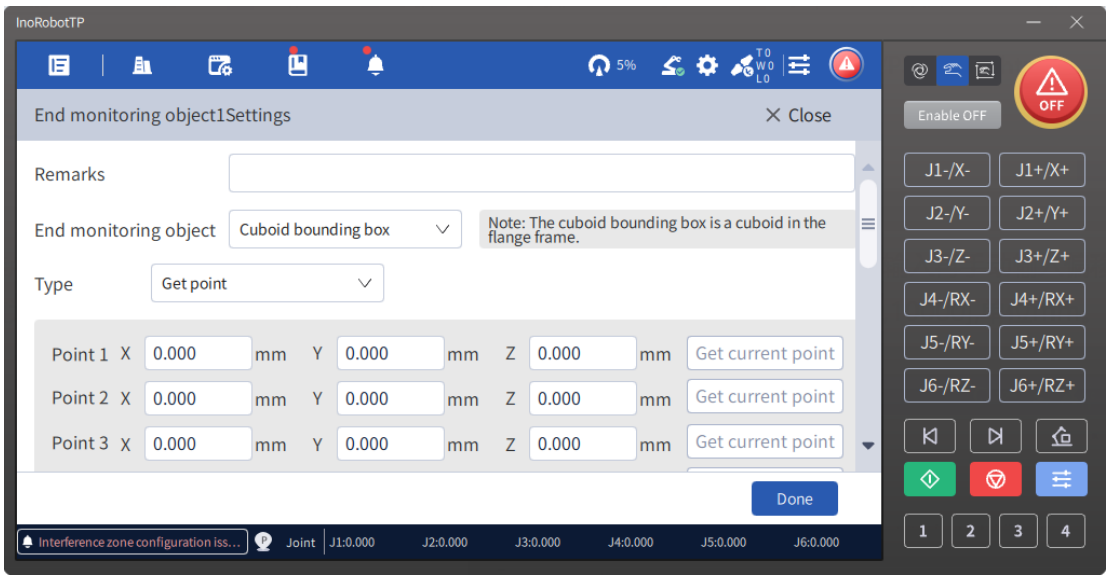


When the point acquisition method is set to "diagonal point", you can enter the point manually or click the "Get current point" button to acquire the current point automatically. Note that the "Get current point" button is

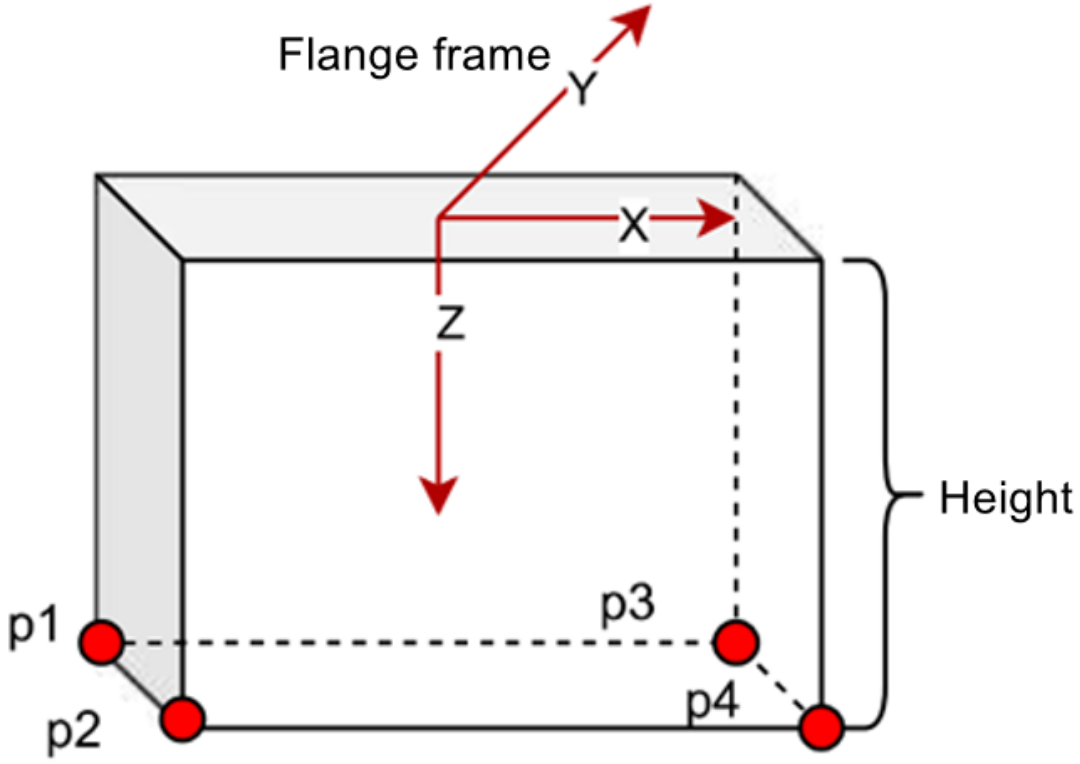
active only when the robot is in ECP mode. The points are taken in the flange frame. The range of the point value is [-10000,10000], in mm.



When the point acquisition method is set to "Datum point + offset", you can enter the datum point and the offset manually, or click the "Get datum point" button to get the point automatically and then manually enter the offset. Note that the "Get datum point" button takes effect only when the robot is in ECP mode. The point and offset are taken in the flange frame. The range of the point value is [-10000,10000], and the range of the offset is [-10000,0), (0,10000], in mm.



When the point acquisition method is set to "Get point", you can enter the point manually, or click the "Get current point" button to get the point automatically. Note that the "Get current point" button is active only when the robot is in ECP mode. The points are taken in the flange frame. Note that the points 1-4 are the four points on the bottom face of the cuboid. The height is the distance in the Z direction under the flange frame. The range of the point value is [-10000,10000] and the range of height is (-0.10000], in mm, as shown in the figure below.



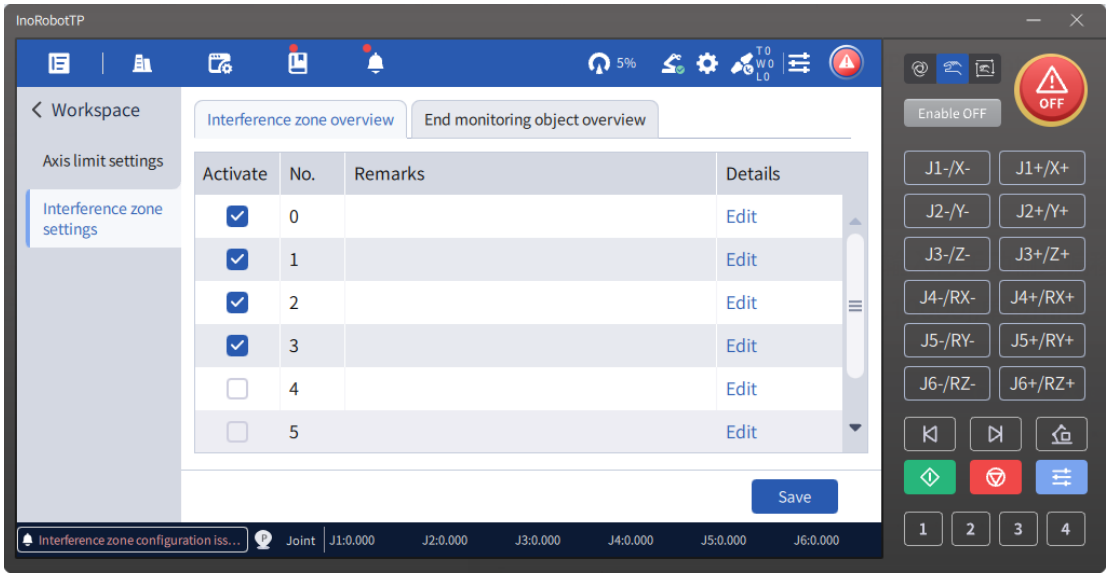
CAUTION

Notes of the cuboid bounding box:

- The orientation of the cuboid bounding box is the same as that of the flange frame. That is, a tilted cuboid bounding box cannot be defined under the flange frame.
- Before getting a point, you must calibrate an external tool and then move the robot to the point on the external tool.
- Regarding the setting of the four points + height, for the 6-axis robots, you need to rotate the J5 axis so that the Z axis of the flange frame points downwards before setting the points and height; for the SCARA robots, just set the points and height normally.

After configuring the monitoring object, click the "Done" button.

Check the interference zone and monitoring object to be used:



Click the "Save" button to complete the settings.

10.7.2.3 Notes

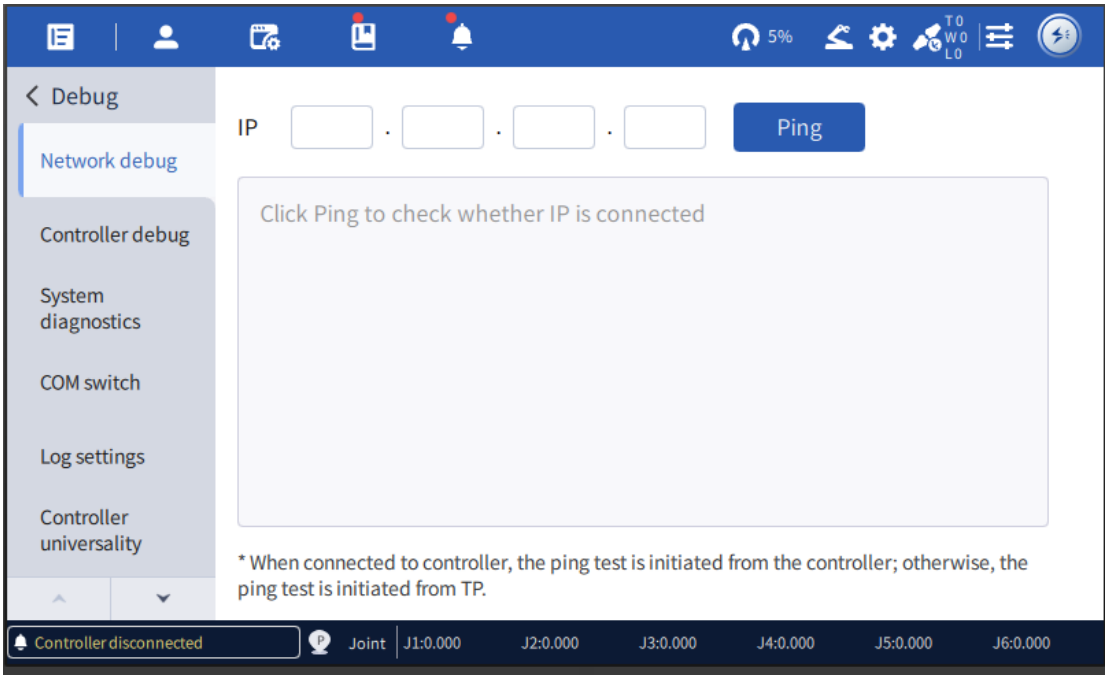
When using the interference zone function, the following precautions or restrictions need to be taken.

1. Once determined, the position of the interference zone under the world frame will not change even if the corresponding tool/workobject parameters are modified. If you need to modify the position of the interference zone, you need to modify the points of the interference zone and save the changes.
2. After the monitoring object at the end of robot enters the interference zone, you need to disable the interference zone function or switch the input signal to ON to clear the alarm and continue motion.
3. If the "Trigger alarm and stop" parameter is set to "NO", when the robot enters the interference zone, it only triggers the output signal, but does not alert and stop. Be aware of safety!
4. The larger the robot speed, the greater the distance the robot enters the interference zone. Therefore, you need to set the interference zone and safety distance as large as possible according to the actual working conditions.
5. When the robot grips the workobject, if you set the monitoring object type to "TCP", the flange center is used for detection, which may result in collision between the workobject and external devices or obstacles. In this case, it is recommended to set the monitoring object type to sphere or cuboid bounding box.
6. When the interference zone is activated, it is detected in any motion mode.
7. When the cuboid bounding box is defined by the four points + height,for the 6-axis robots, you need to rotate the J5 axis so that the Z axis of the flange frame points downwards before setting the points and height. Otherwise, the cuboid cannot be formed properly.

10.8 Debug

10.8.1 Network Debug

This function is used to debug the communication of InoTeachPad and controller with other devices, which is equal to the Ping function. Enter the IP address, then click the Ping button to debug.



CAUTION

- When the teach pendant is connected to the controller, it is the controller to Ping other devices.
- When the teach pendant is not connected to the controller, it is the teach pendant to Ping other devices.

10.8.2 Controller Debug

This function is used to output and record running process information of the controller, and monitor the controller status and flow for online check and subsequent analyze. Debug the controller under the guidance of the manufacturer.

Debugging object:

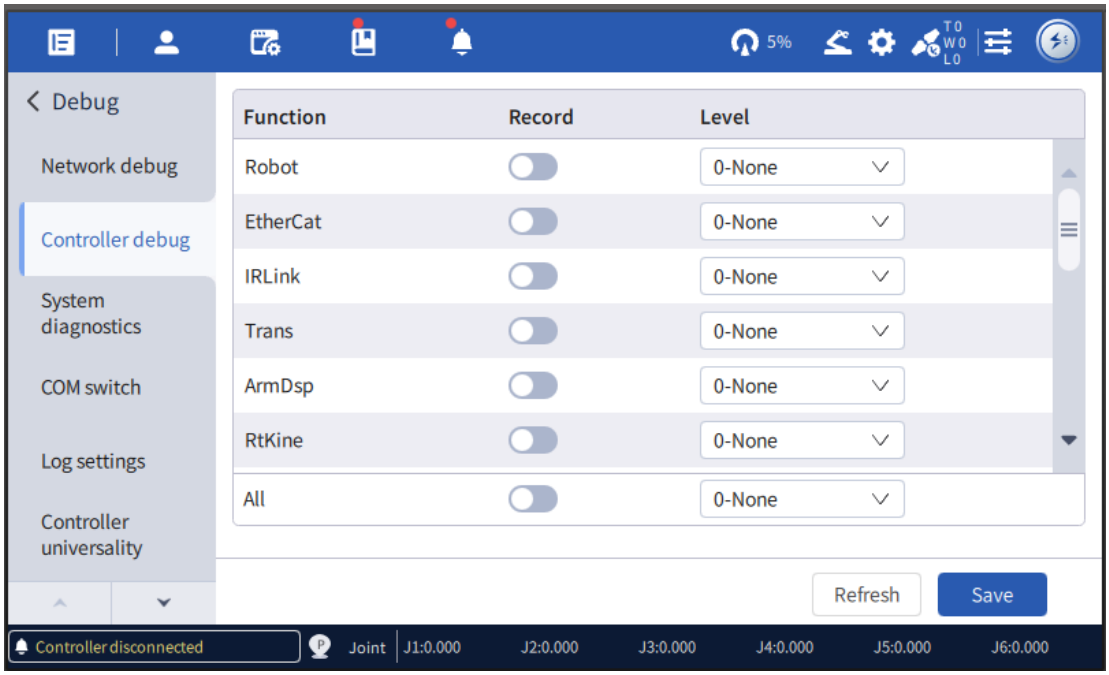
Name	Description
Robot	Core scheduling module
EtherCat	EtherCAT communication slave module
IRLink	IR-Link communication module
Trans	Language interpreter module
ArmDsp	ARM and DSP interaction module
RtKine	Kinematics module
SHM	Shared memory module
GD	Configuration information module

Debugging level:

You can select the recording level for each debugging object. The higher the level, the more detailed the recording.

Log level	Description
0-None	No events recorded
1-Alert	Only the most serious errors are recorded.
2-Crit	Critical errors are recorded.
3-Error	Error-level events are recorded.
4-Warning	Warning-level events are recorded.
5-Notice	Notice-level events are recorded.
6-Info	General events are recorded.
7-Debug	All detailed information are recorded.

Use of debugging function:



Select "Debug" > "Controller debug", enable the record of object as needed, and select the corresponding level. Changes take effect immediately upon saving.

(1) Online debugging: Prints information through the serial or TCP/IP port of the controller.

Serial port: Connect the controller through serial port. Note that the serial port on the controller is RS485. An RS232 to RS485 adapter is generally required.

TCP/IP: Connect the controller via another device (such as a PC) over TCP/IP protocol, port number 5555.

(2) Saving and exporting debugging information:

The system automatically records the recent debugging information. On the system diagnostics interface, check "Trajectory" and click "Start" to start the diagnosis. After the diagnosis is completed, click "Close" to close the success dialog, and click "Export report" to save the debug information to the USB drive on the controller.

10.8.3 System Diagnostics

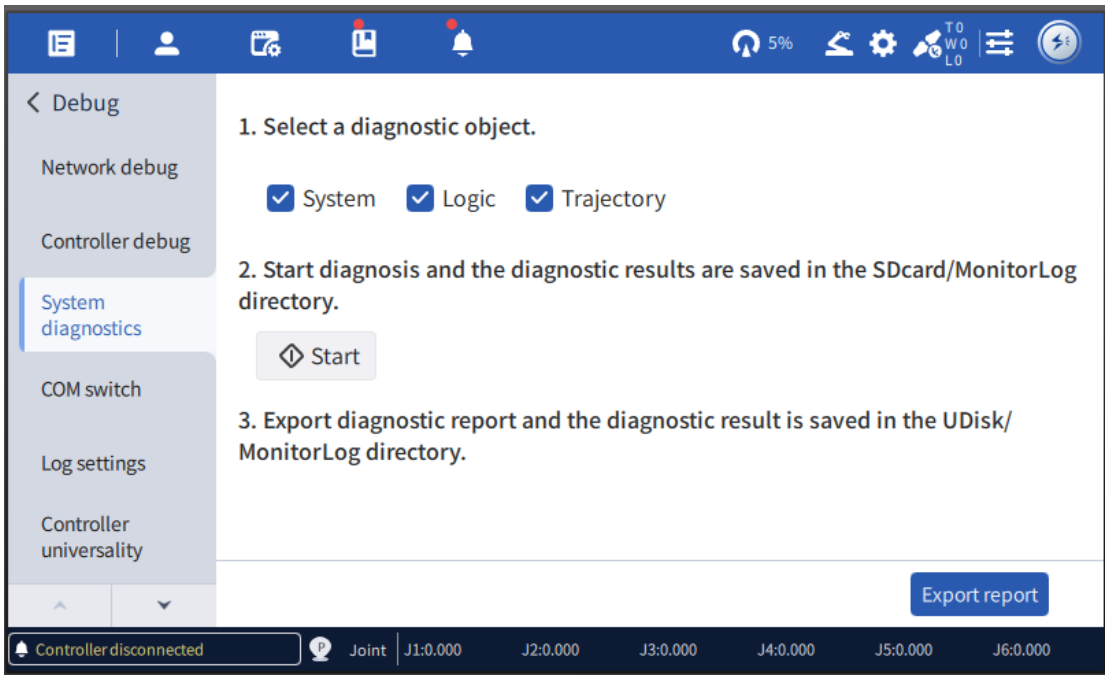
Steps:

1. Check the diagnostic object.
   The objects include System, Logic, and Trajectory. You can choose one or more of these options for diagnosis.

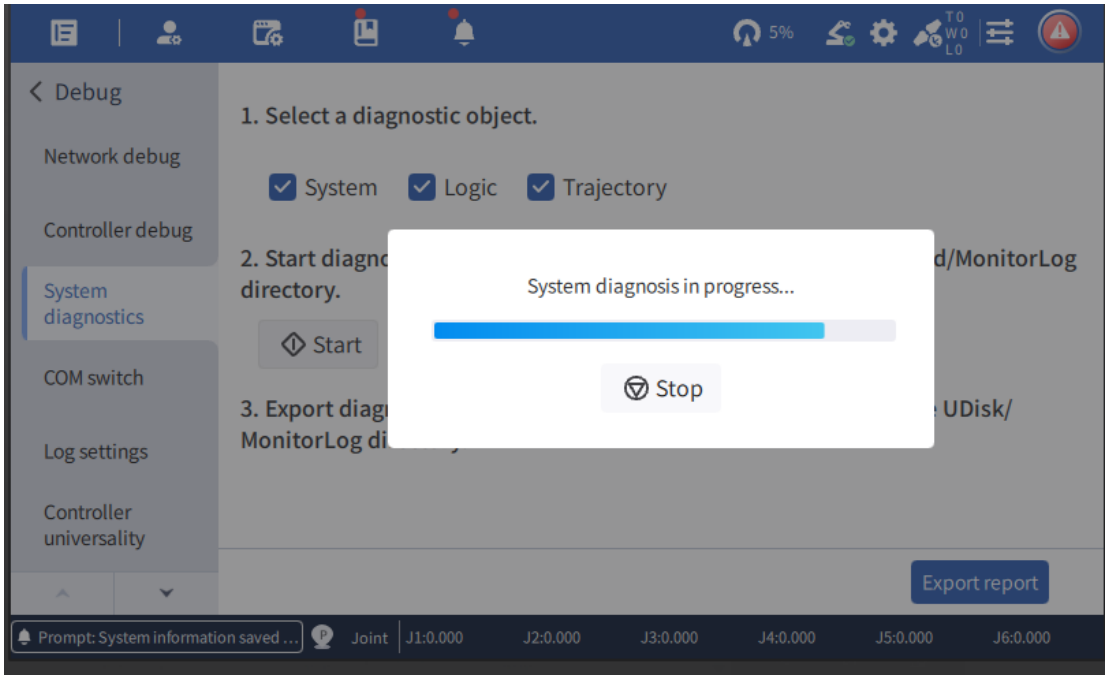
   System: Contains internal configuration parameters, etc. of the system.

   Logic: Contains the variable state during system operation.

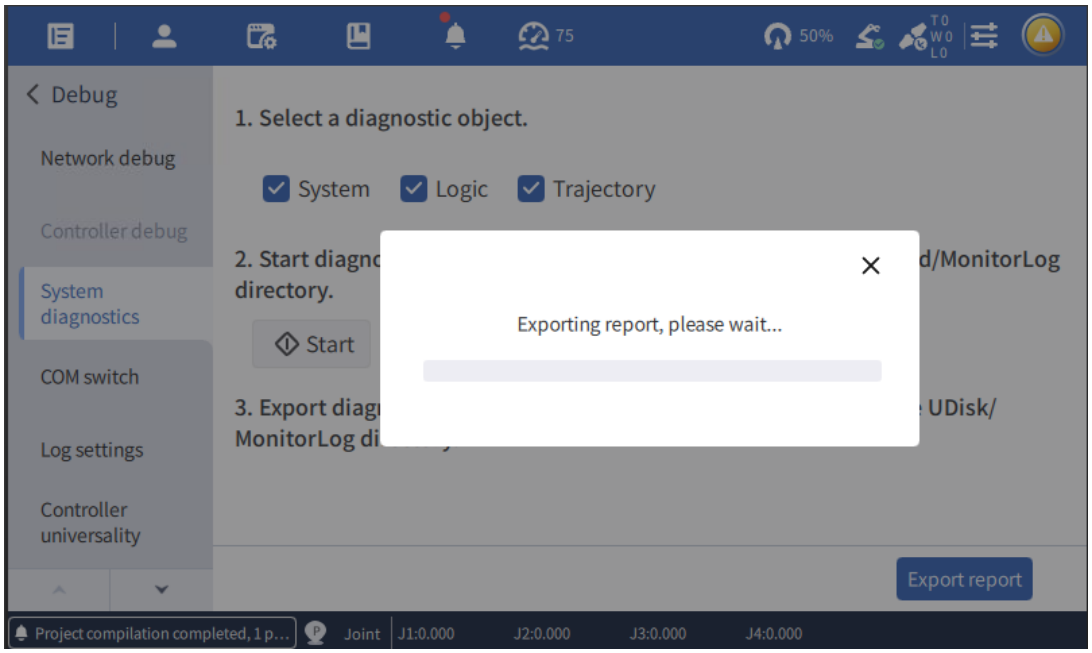
   Trajectory: The trajectory of the robot motion.



2. Click "Start" to start the diagnosis. The system will save the files for the checked items. If you click "Stop" during the diagnosis, the current save operation will stop and the internal file will still be the last saved file.



3. Export the diagnosis report. You can monitor the export process of the report through the progress bar. The success or failure status is displayed as text above the progress bar.

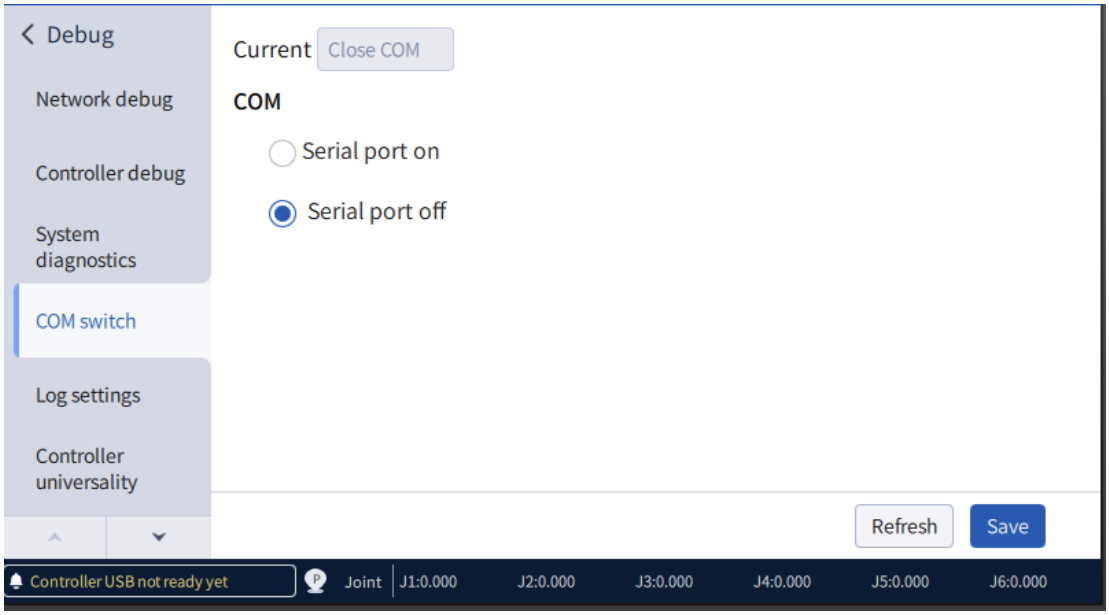


Note

You can choose to export all reports or the latest report.

10.8.4 COM Switch

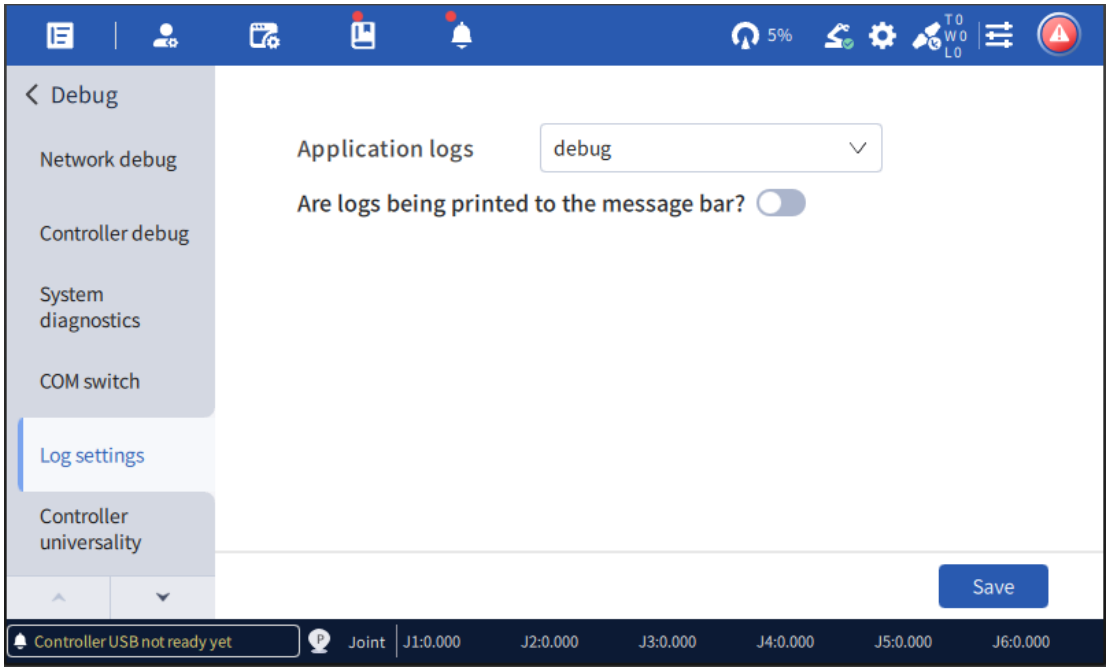
Open the COM switch before you can use the instruction Open Com. Restart the controller to make the setting take effect.



10.8.5 Log Settings

This function is used to set the log level and whether to print logs to the message bar.

You can set four log levels: trace, debug, info, and warn.



10.8.6 Controller Universality

Unordered matching (hereinafter referred to as "universality") means that the robot model parameters are stored at the robot controller and at the robot gyroscope 2.0 (hereinafter referred to as "manipulator"). When the controller is powered on, the robot model parameters are compared between the controller and the manipulator. When mismatch occurs, an alarm occurs (see section "Robot Alarms and Handling Method"). You can synchronize the robot model parameters between the controller and the manipulator using the teach pendant software.

Use scenario: When the robot controller or manipulator is replaced, you can automatically import the robot model parameters using this function, without the need to calibrate and set the robot model parameters again.

10.8.6.1 Functions and Operating Steps

Function 1: Universality

This function checks the difference in the robot model parameters between the robot controller and the manipulator and achieves the mutual transmission of parameters between the controller and the manipulator. The following scenarios may occur.

Scenario 1: The robot model stored on the controller is the same with that stored on the manipulator, but some parameters (for example, zero point and link length) are different.

After the teach pendant is connected, a pop-up box indicates "The robot model parameters are inconsistent between the manipulator and the controller. Do you want to sync robot model parameters from manipulator to controller?" and alarm 0xE10A occurs (see section "Robot Alarms and Handling Method"), as shown in Figure 1. If you select "No", the window closes without synchronization of robot model parameters, and the alarm cannot be cleared. If you select "Yes", the robot model parameters will be synchronized between the controller and the manipulator, as shown in Figure 2. After the synchronization is complete, a prompt "Robot model parameter synchronization complete, please restart the controller!" appears, as shown in Figure 3.

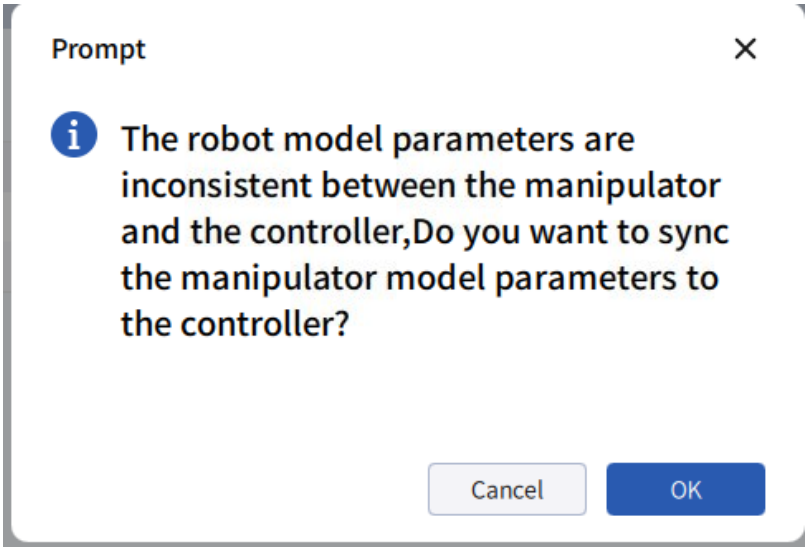


Figure 1

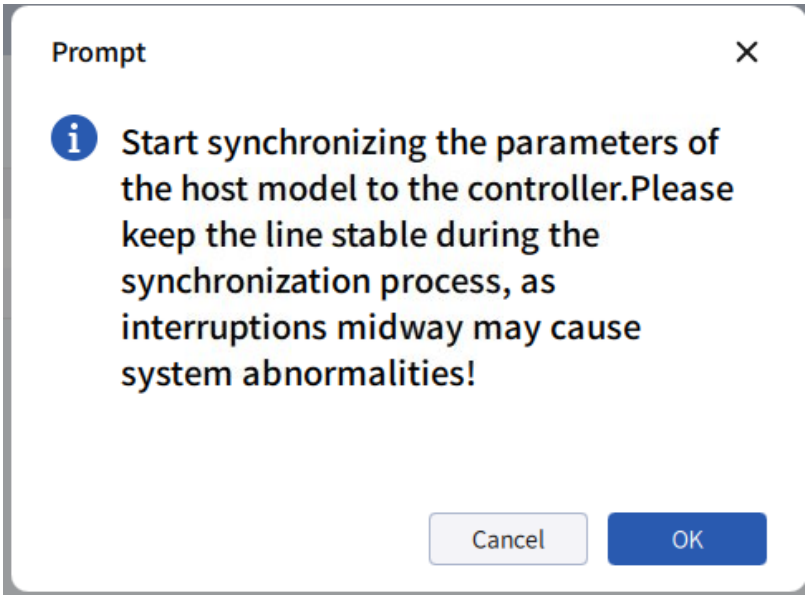


Figure 2

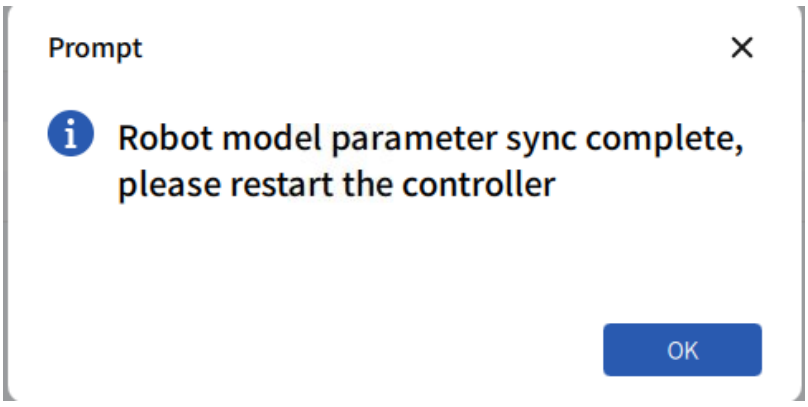


Figure 3

Scenario 2: The robot model stored on the controller is different from that stored on the manipulator.

After the teach pendant is connected, a pop-up box indicates "The robot model parameters are inconsistent between the manipulator and the controller. Do you want to sync robot model parameters from manipulator to controller?" and alarm 0xE10A occurs (see section "Robot Alarms and Handling Method"), as shown in Figure 4. If you select "No", the window closes without synchronization of robot model parameters, and the alarm cannot be cleared. If you select "Yes", the robot model parameters will be synchronized between the controller and the

manipulator, as shown in Figure 5. After the synchronization is complete, a prompt "Robot model parameter synchronization complete, please restart the controller!" appears, as shown in Figure 6.

Figure 4

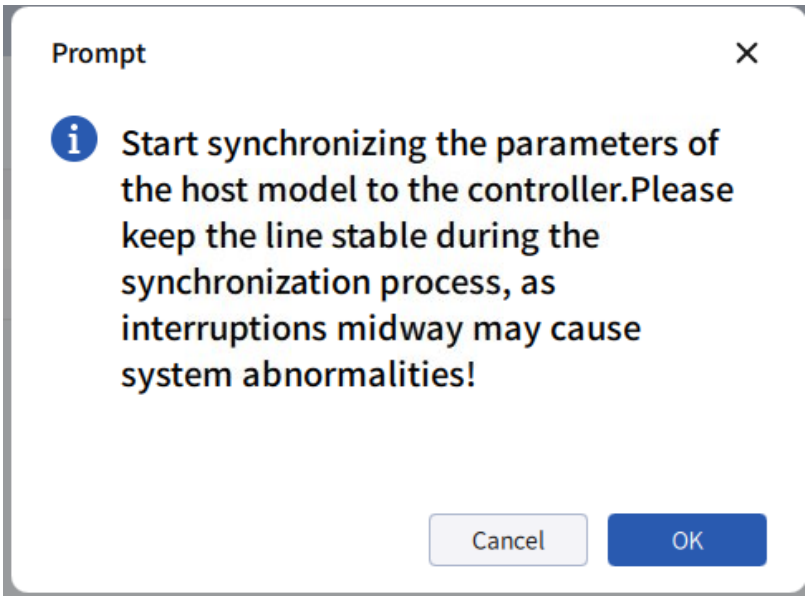


Figure 5

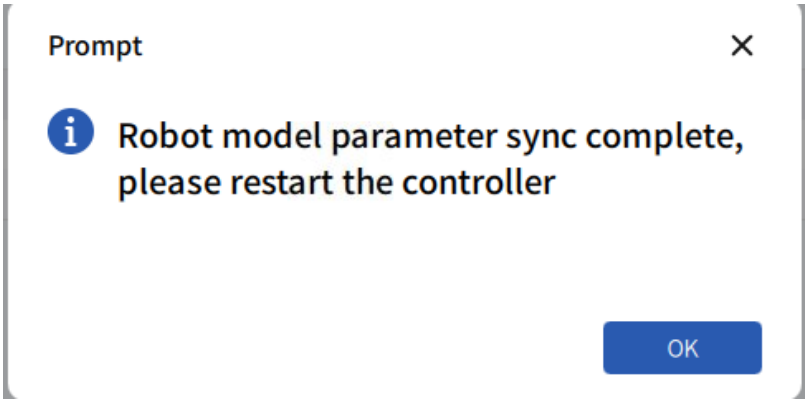


Figure 6

Scenario 3: No robot model parameters are stored in the manipulator.

After the teach pendant is connected, a pop-up box indicates "The robot model parameters are inconsistent between the manipulator and the controller. Do you want to sync controller model parameters from controller to manipulator?" and alarm 0xE10A occurs (see section "Robot Alarms and Handling Method"), as shown in Figure 7. If you select "No", the window closes without synchronization of robot model parameters, and the alarm can be cleared. If you select "Yes", the robot model parameters will be synchronized between the controller and the manipulator, as shown in Figure 8. After the synchronization is complete, a prompt "Robot model parameter synchronization complete!" appears, as shown in Figure 9.

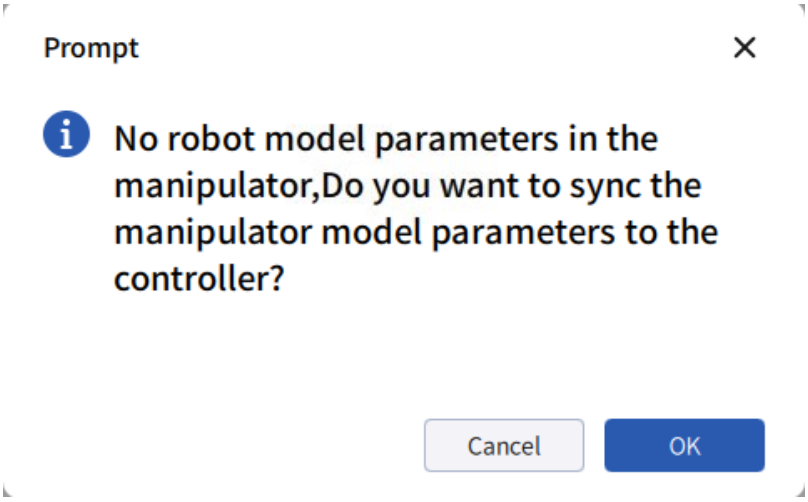


Figure 7

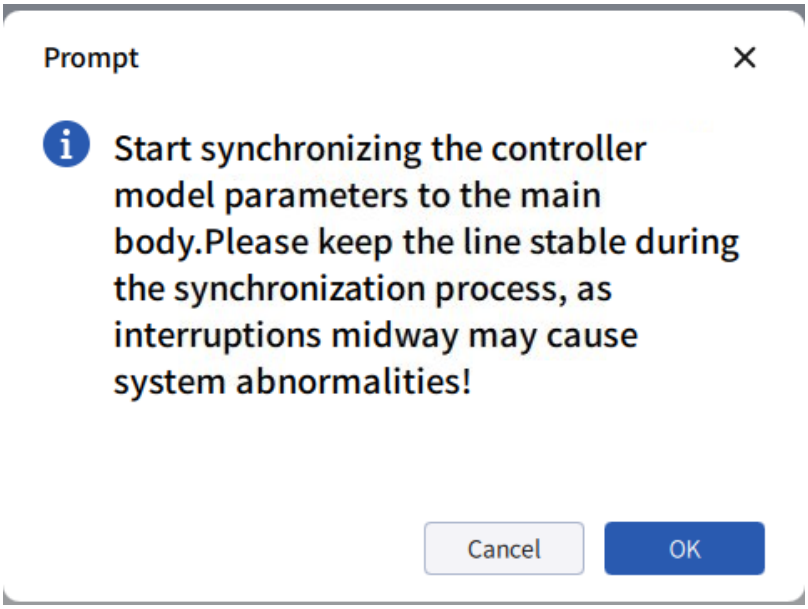


Figure 8

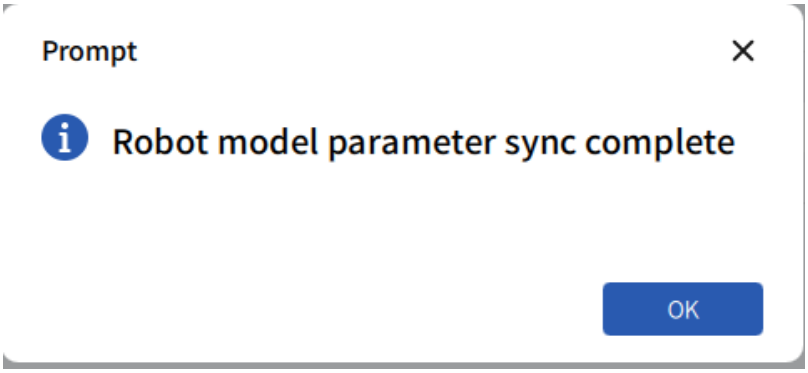


Figure 9

Scenario 4: The power of the manipulator is inconsistent with the power of the controller. For example, the drive power is smaller than the servo power, the servo DB resistance is not between the upper and lower limits stored in the servo drive, and the brake configuration of the servo is inconsistent with the brake configuration stored in the manipulator.

After the teach pendant is connected, the following information will be displayed in a pop-up box (as shown in Figures 10, 11, 12), and alarm 0xE10B occurs (see section "Robot Alarms and Handling Method").

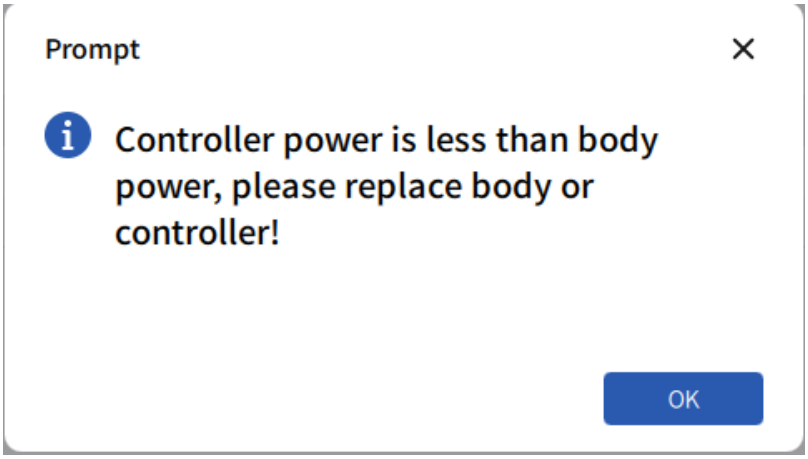


Figure 10

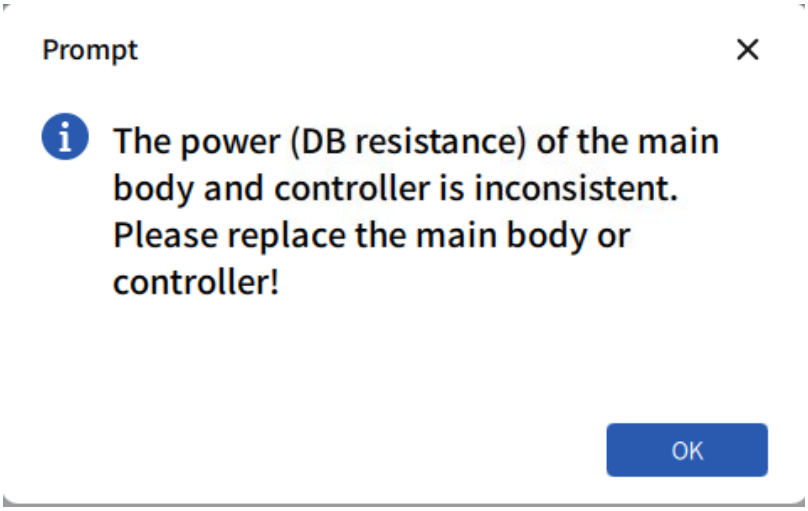


Figure 11

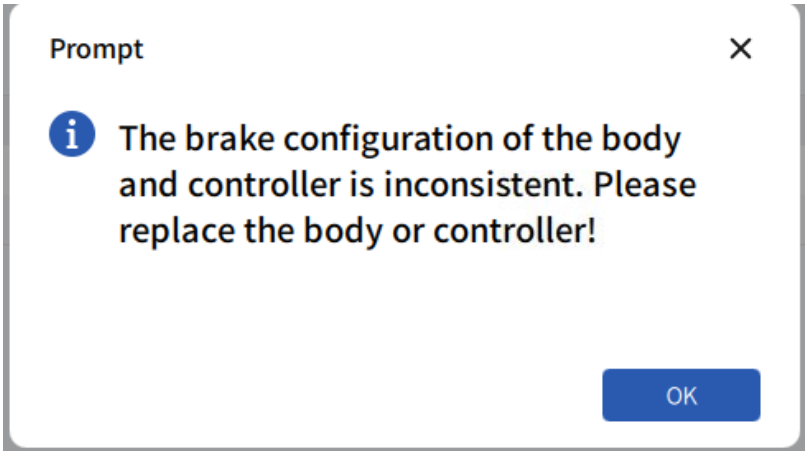


Figure 12

Scenario 5: The difference in the parameter version between the manipulator and the controller is too large (including parameter addition, parameter deletion, parameter name change, and parameter structure change).

After the teach pendant is connected, a pop-up dialog indicates "The controller software is not compatible with the manipulator parameters. Please disable the universality or upgrade the software.", as shown in Figure 13, and alarm 0xE109 occurs (see section "Robot Alarms and Handling Method").

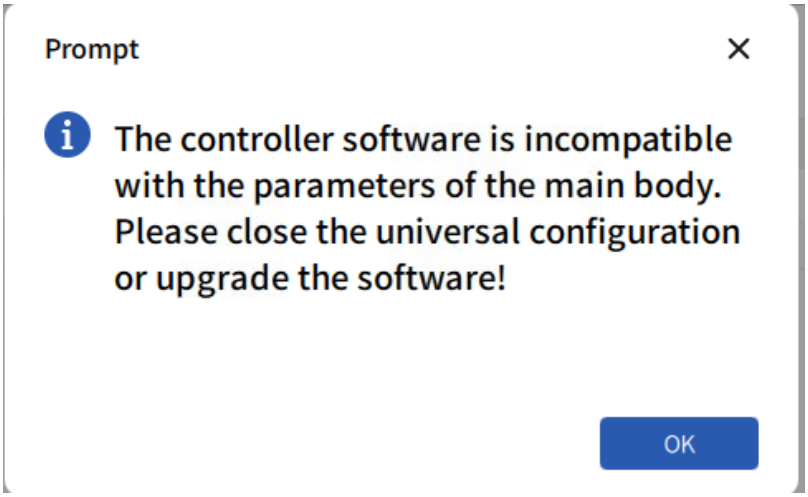


Figure 13

Scenario 6: For some older models, the hardware conditions do not meet the universality requirements (e.g. the robot does not include a gyroscope, the gyroscope version is 1.0, the firmware version of the gyroscope 2.0 does not support universality, the controller FPGA brand is not ANLOGIC).

After the teach pendant is connected, a pop-up dialog indicates that "The controller universality function requires the hardware version of the manipulator memory to be at least 2.0 and the software version to be at least 2.1.", as shown in Figure 14. It only indicates that the hardware conditions do not meet the requirements for universality configuration. The robot can still be used normally.

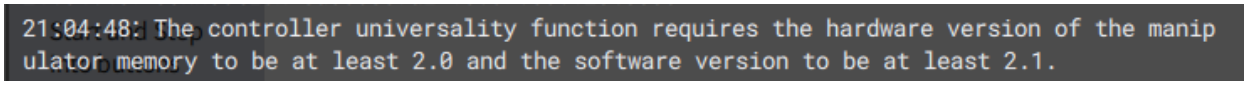
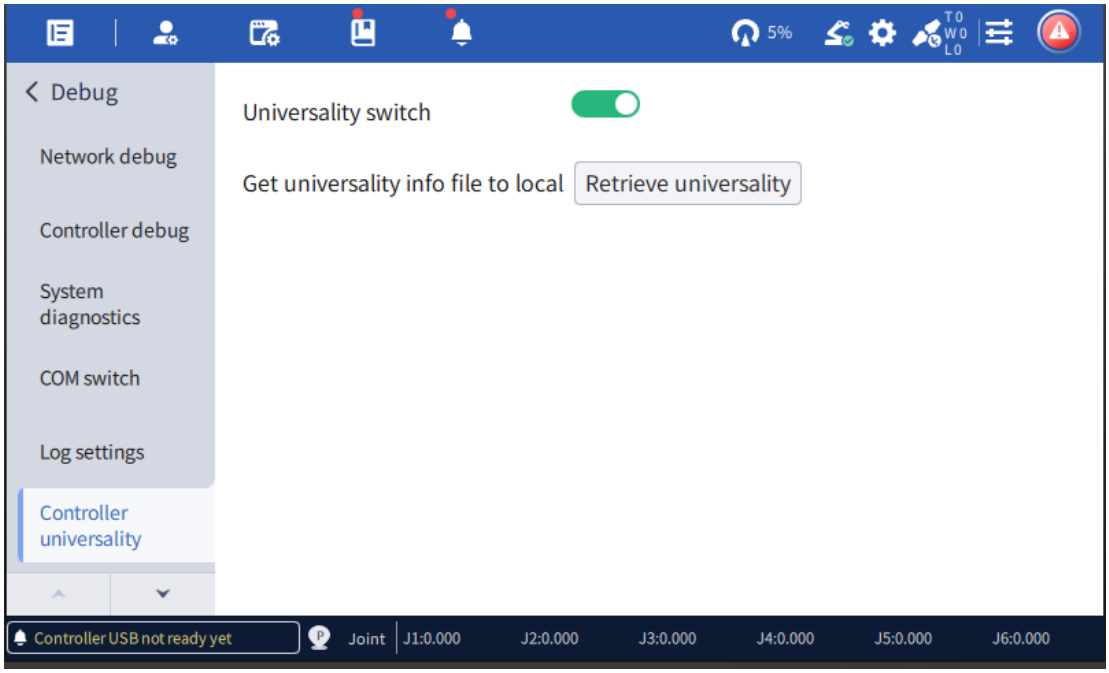


Figure 14

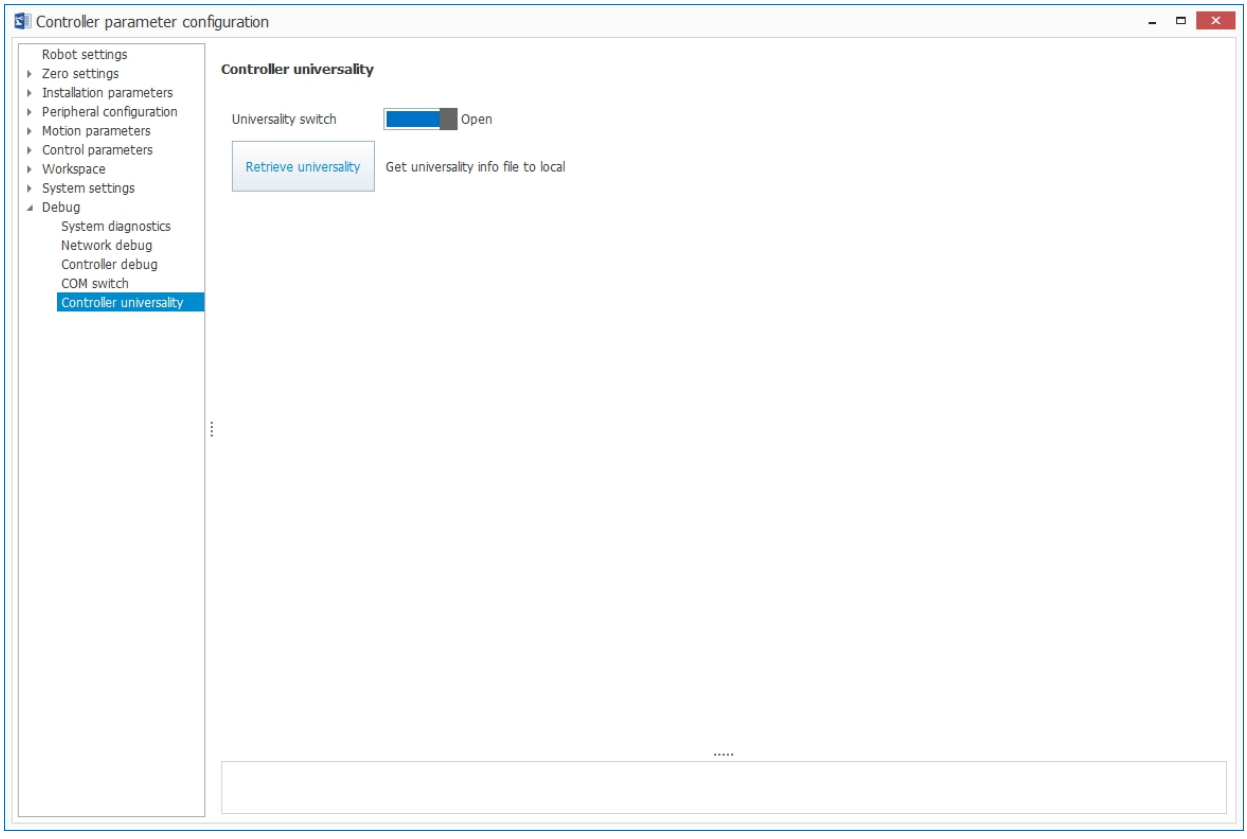
Function point 2: Universality switch

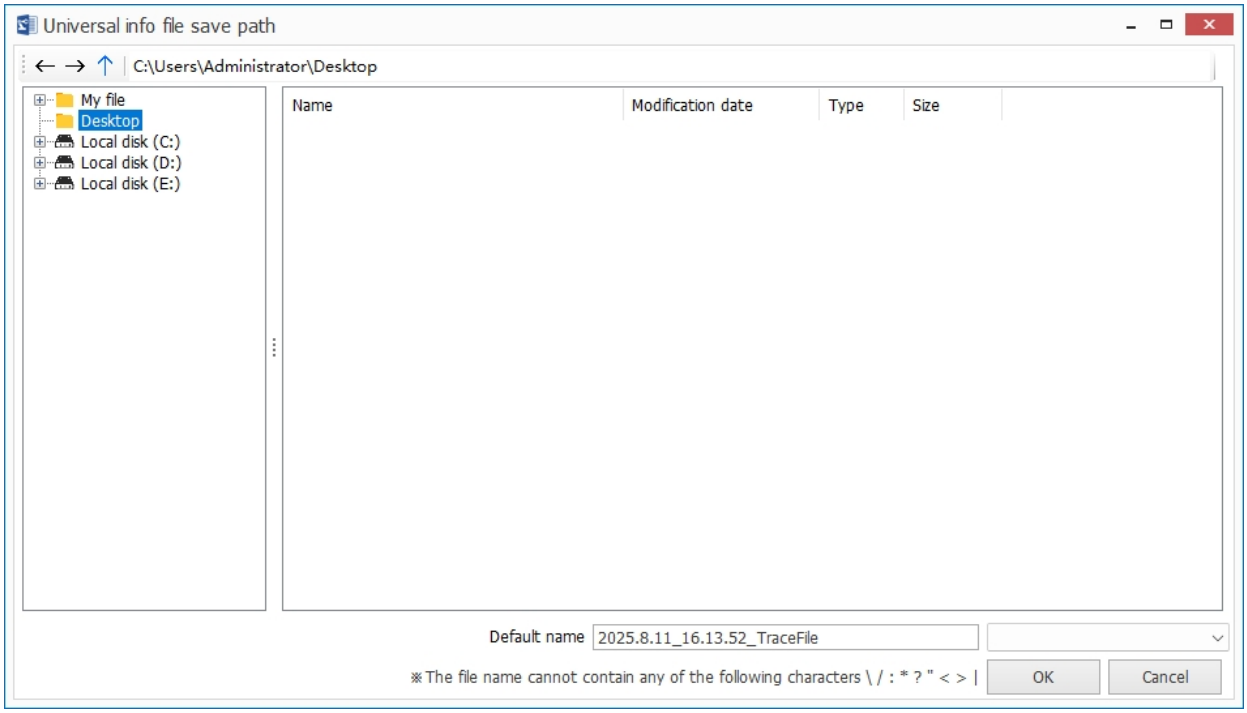
When the controller is inconsistent with the manipulator in parameters or in robot model, or the controller software is not compatible with the manipulator parameters, you can close the pop-up dialog, but the alarms cannot be cleared. In this case, you can log in to the teach pendant as the manufacturer and go to "Debug" > "Controller universality", as shown in the following figure, and turn off the universality switch to clear the alarm message. After the universality switch is turned off, the parameters modified in the controller parameter configuration page are not written to the robot manipulator. The parameters in the robot manipulator will still be modified by the functions of flashing, upgrade, and importing robot model parameters. After the controller is restarted, the universality switch is turned on by default.



Function point 3: Retrieve universality

Log in to the teach pendant as the manufacturer and go to "Debug" > "Controller universality" > "Retrieve universality", as shown in the following figure. You can export the universality information of the controller and the manipulator. The exported information is for internal troubleshooting only.





10.8.6.2 Notes

When performing the parameter synchronization, if the manipulator does not store any parameters, or the manipulator stores parameters but the parameters are not synchronized for the first time, you need to enter the password before you can continue, as shown in the following figure. If the password is entered incorrectly more than 3 times, or the password dialog is closed more than three times, the pop-up dialog will not appear anymore and you will not be able to operate the robot and write parameters into the robot.



When the controller and the manipulator are inconsistent in power or brake configuration, the universality switch cannot be turned off. You will be prompted that the operation is invalid and the alarm cannot be cleared The prompt includes "Not allowed to disable the universality as the controller power is smaller than the manipulator power.", or "Not allowed to disable the universality as the manipulator differs from the controller in brake configuration.", or "Not allowed to disable the universality as the manipulator differs from the controller in power (DB resistance)."

10.8.7 Release Brake

This function allows the unlocking and locking of one of the J1-J6 axes.

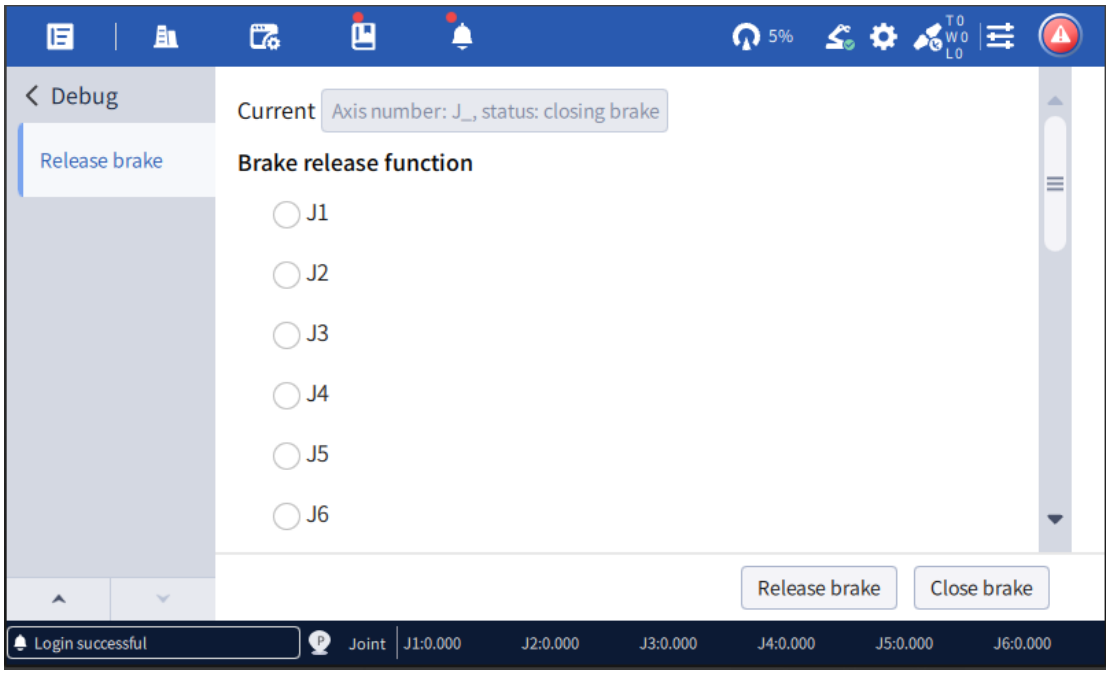
This function is available only when the following conditions are met:

1. Control is assigned to the teach pendant.
2. The mode is Admin or Manufacturer.

3. The robot is in emergency stop state.

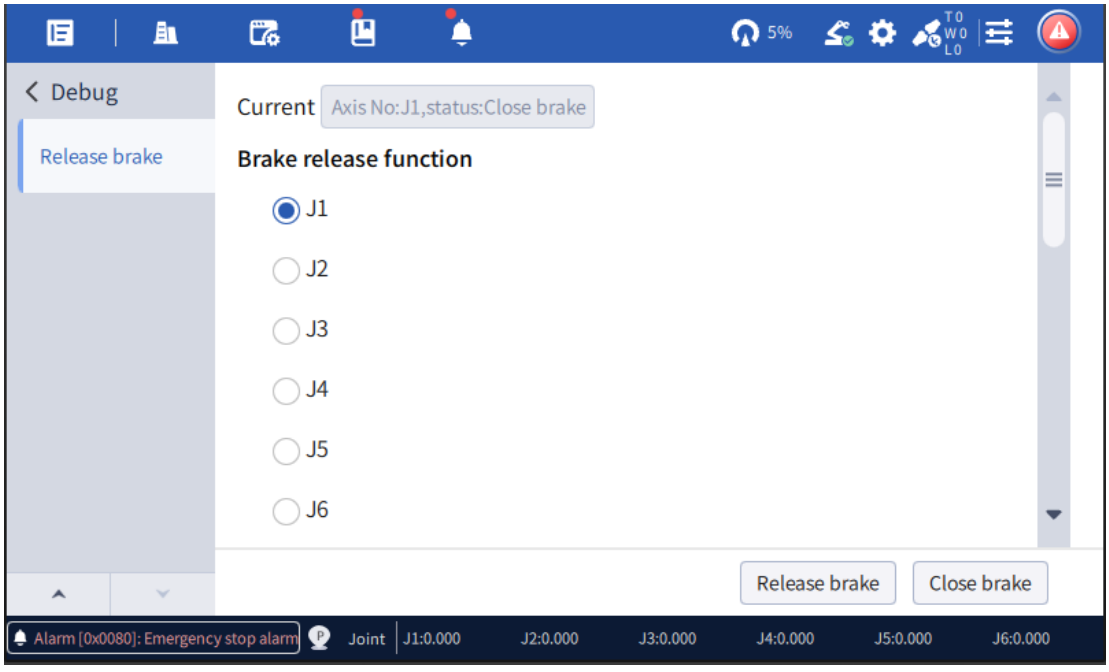
Steps:

1) Click "Release Brake" in the menu bar, and the interface will display as shown below:



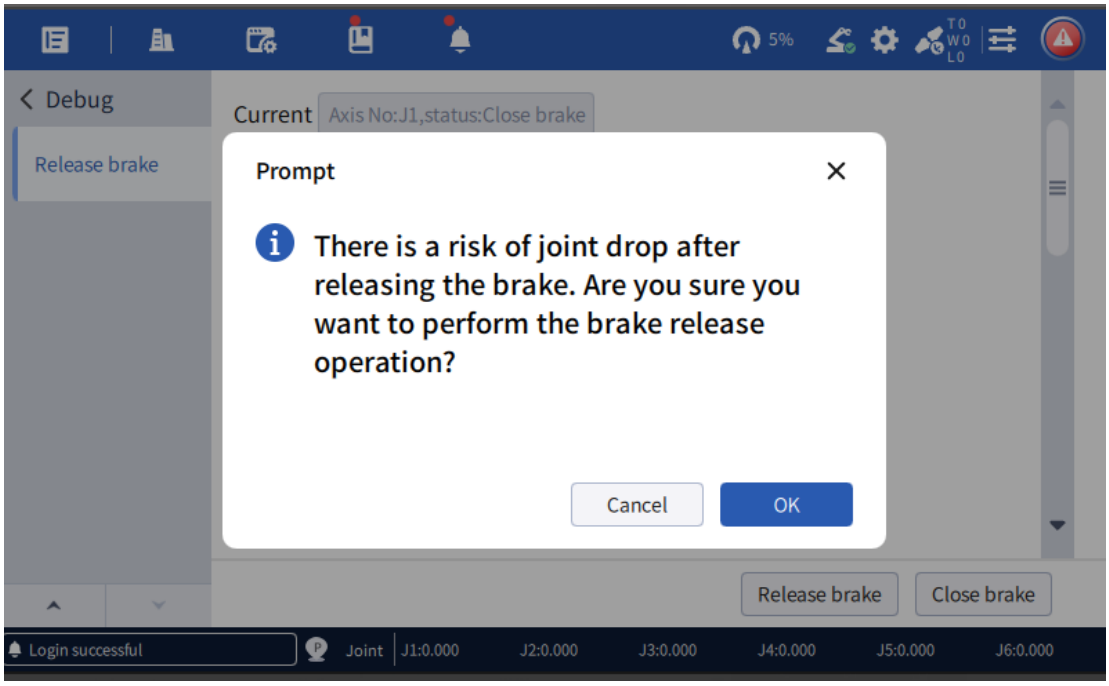
2) Select the axis.

Select one of the J1~J6 axes. For example, when you select J1, you can see the current state of J1, as shown below.

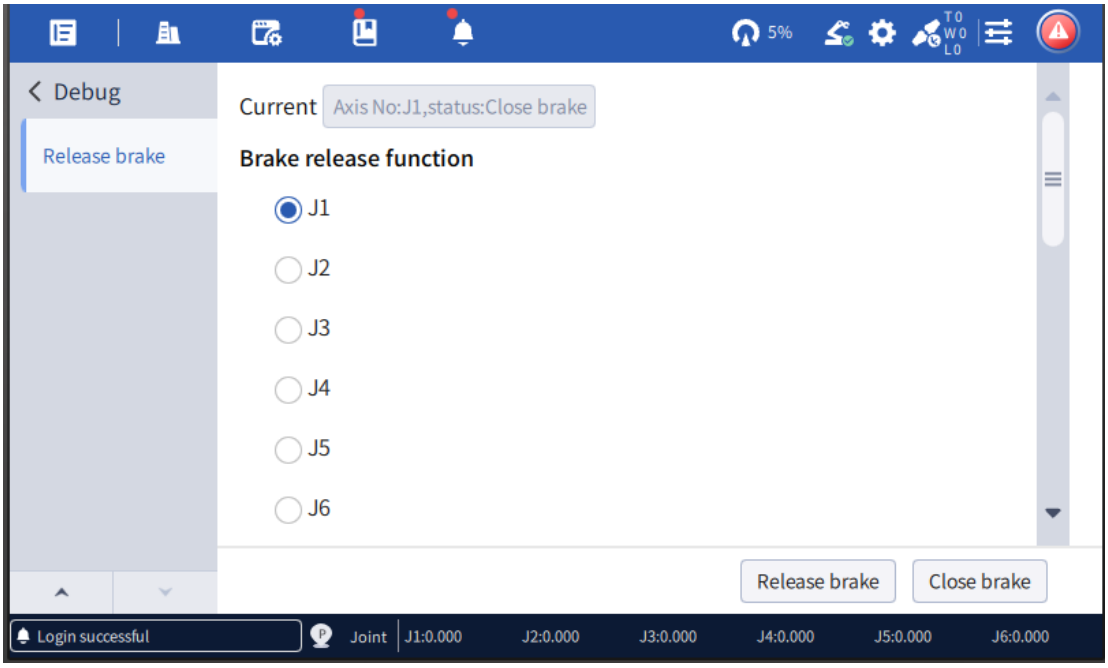


3) Release the brake.

① After you click the "Release brake" button, a prompt pops up. Click "OK" to release the brake of the selected axis.

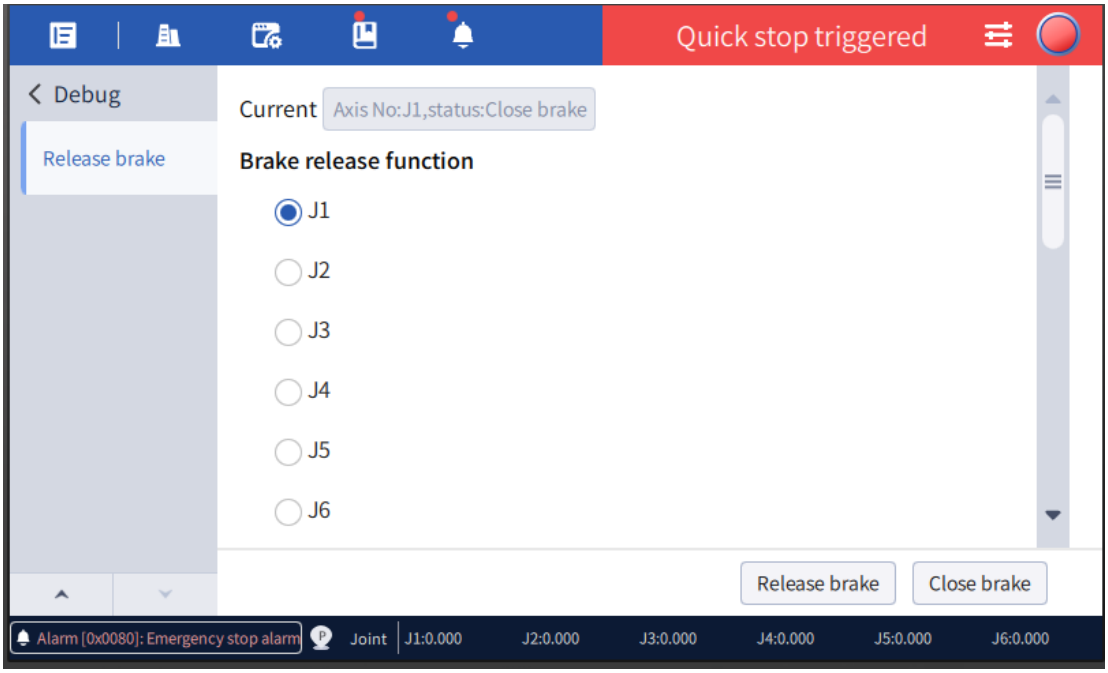


② After clicking "OK", the interface will display as shown below:



4) Close the brake.

After clicking the "Close brake" button, the interface will display as shown below:

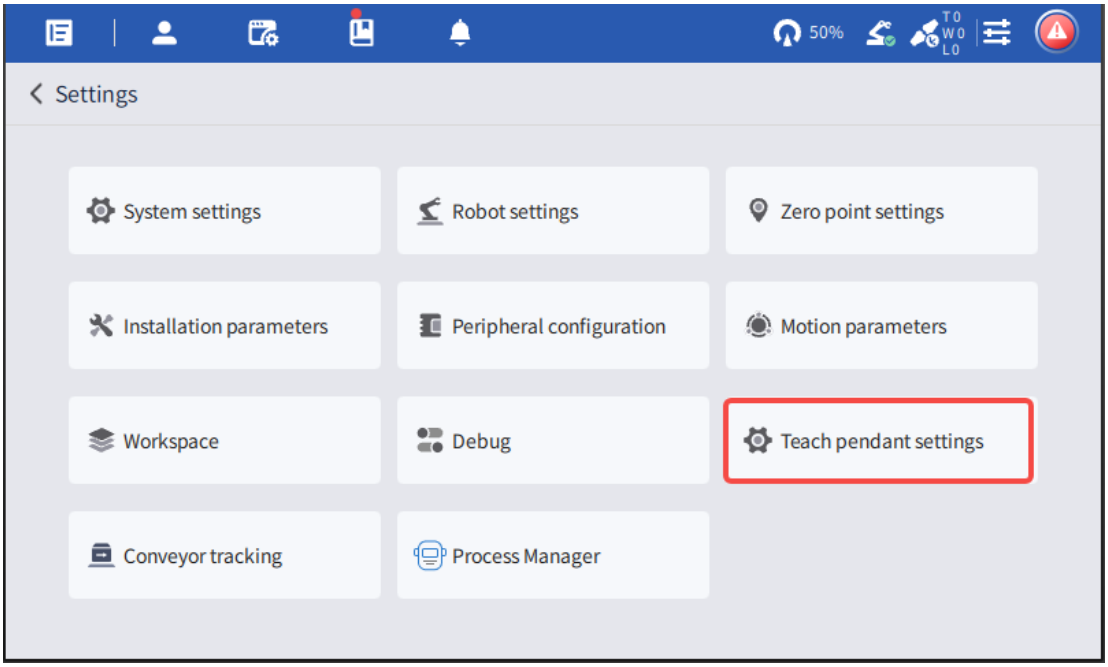


CAUTION

- When the brake of a certain axis is released, if the emergency stop button on the hand-held teach pendant is bounced, a brake engagement operation will be performed on the current axis. Only when the emergency stop button has been pressed again can you click the button to release the brake.
- When the axis number has been selected and the brake release is not applied, it is allowed to close the brake as this is a safe operation.

10.9 Teach Pendant Settings

The teach pendant settings function is only displayed when using the hand-held teach pendant and is not displayed on the PC-based teach pendant.

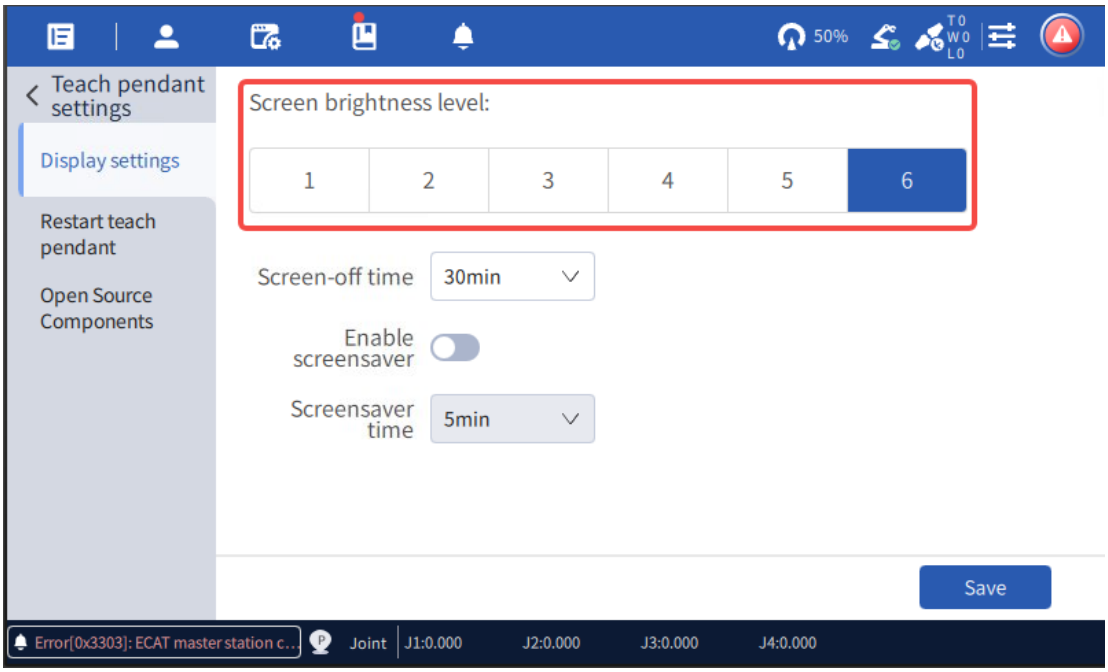


10.9.1 Display Settings

The display settings mainly include screen brightness settings, screen off function, screen saver function, and screen calibration function.

10.9.1.1 Screen Brightness Settings

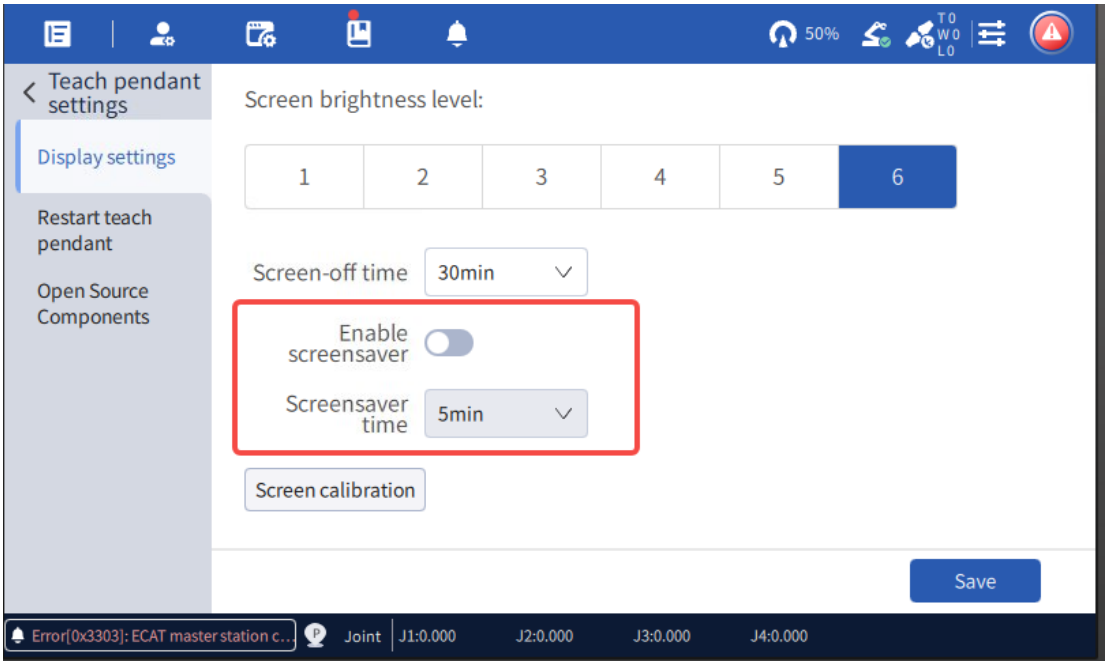
The hand-held teach pendant has six brightness levels from 1 to 6, with level 1 being the lowest brightness and level 6 being the highest brightness.



You can freely select the brightness level, then click the "Save" button to apply the setting.

10.9.1.2 Screen Saver Function

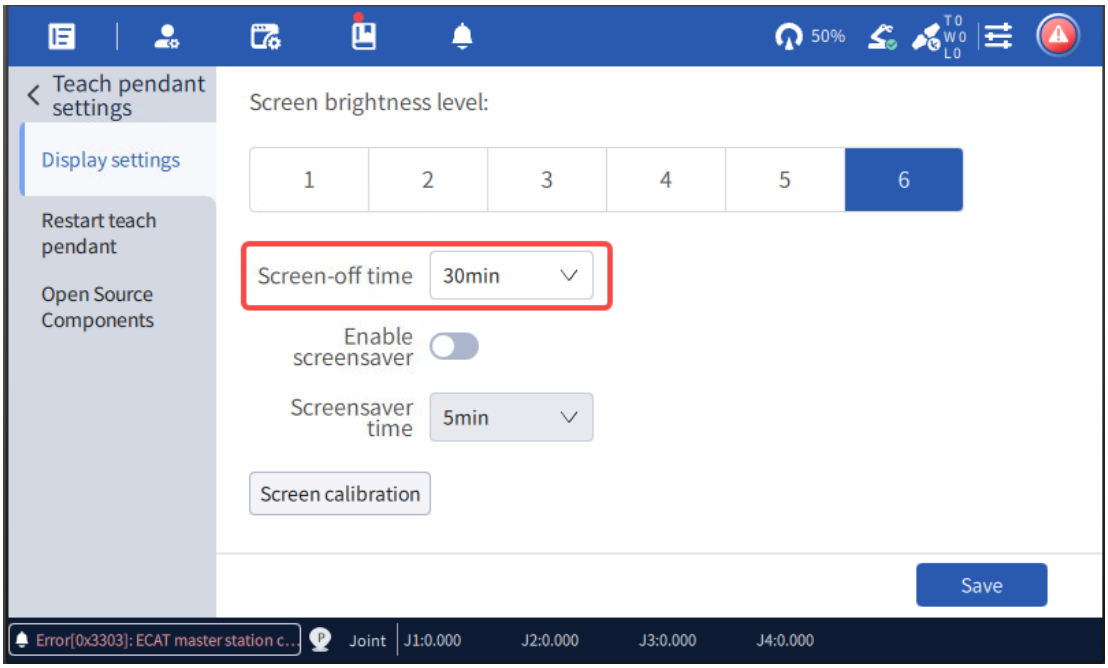
You can selectively activate the screen saver function and set screen saver time.



10.9.1.3 Screen Off Function

The hand-held teach pendant has a screen off function, which automatically turns off the screen sets the brightness to 0 when there has been no operation for the set time.

There are five levels of screen off time: 1 min, 5 min, 10 min, 30 min, and 60 min.



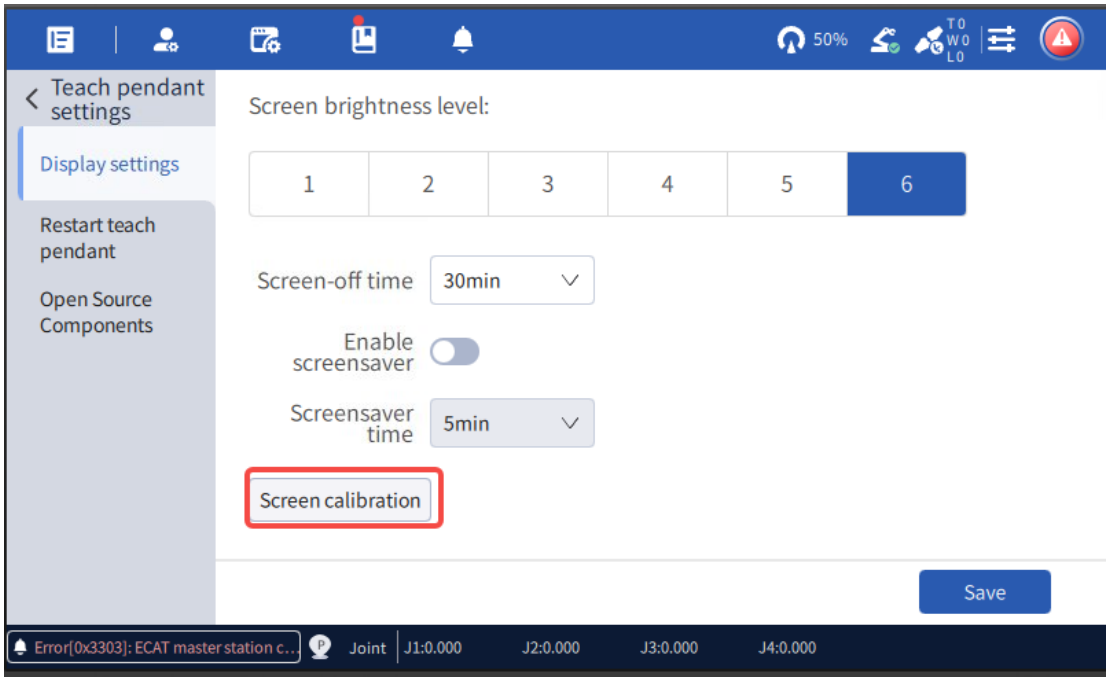
When the hand-held teach pendant is in screen-off state, operations such as clicking the screen, pressing a physical button, or scrolling the wheel can wake up the screen.

10.9.1.4 Screen Calibration

The screen calibration function solves the problem of inaccurate touch on the touch screen of the hand-held teach pendant.

Log in as Admin. The "Screen calibration" button will be displayed on the interface, as shown in the figure below. Click the button to start screen calibration.

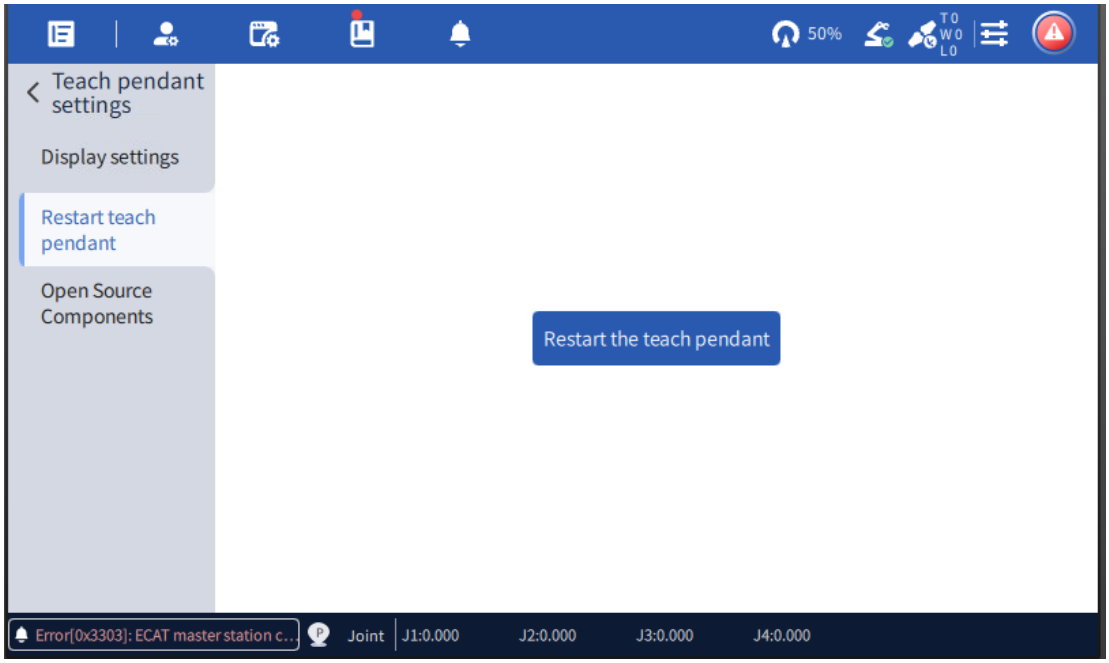
> **CAUTION**
>
> Holding the "Control Panel" physical button for more than 10 seconds also triggers the screen calibration function.



Use the stylus to tap the "+" cursors that appear at the center and four corners of the screen in sequence. If any of the five taps are inaccurate, screen calibration will be retriggered until 5 taps are accurately on the "+" cursors. When the screen calibration is successful, a pop-up window and printed message will indicate "Screen calibration complete, reboot teach pendant to take effect". Reboot the hand-held teach pendant for this calibration to take effect.

10.9.2 Teach Pendant Reboot

Click the restart button on the teach pendant to restart the teach pendant software.



11 Process Application

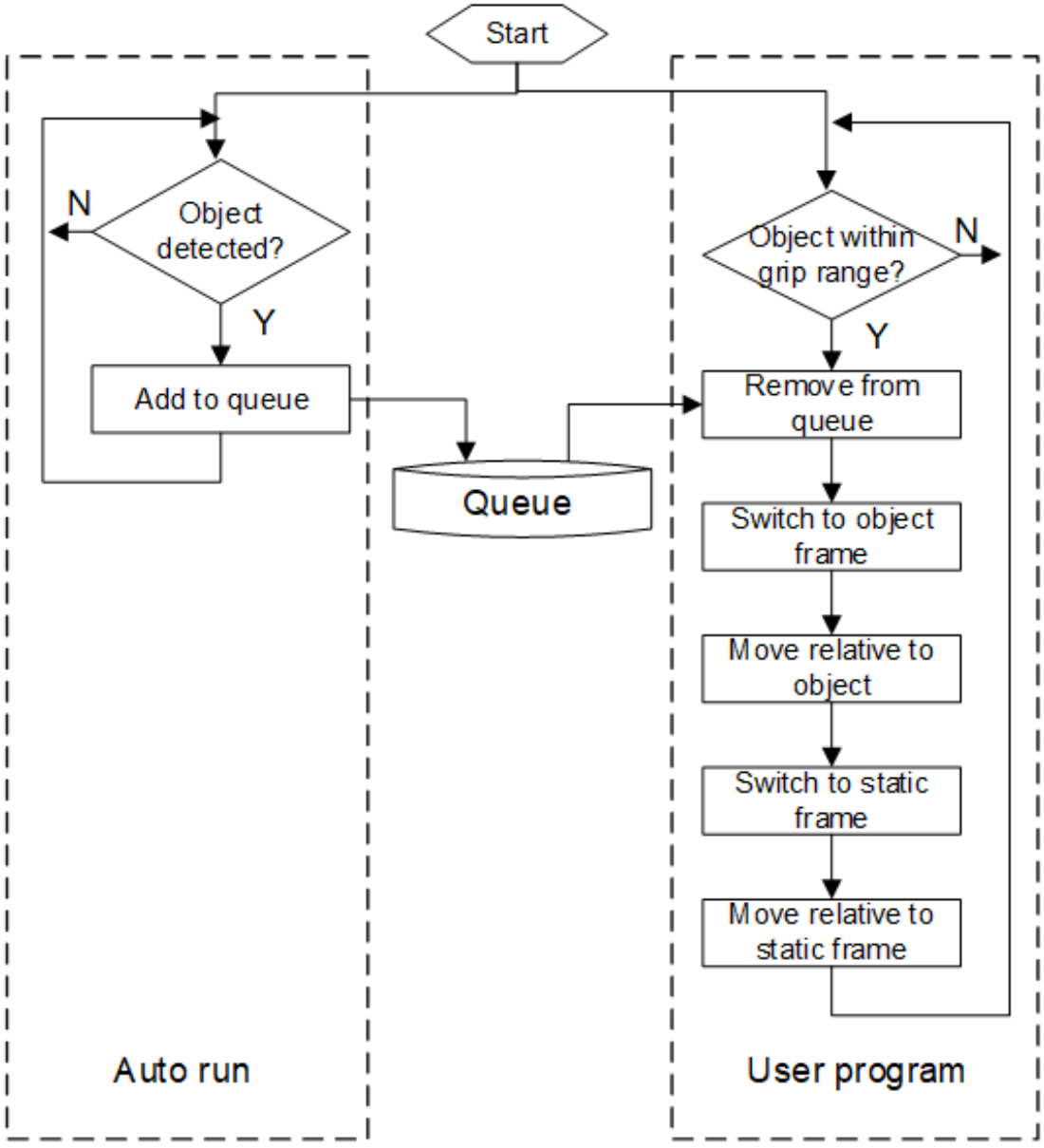
11.1 Conveyor Tracking

11.1.1 Overview

The tracking process allows you to track moving objects and plan robot movements with reference to the moving objects. Conveyor tracking is a typical application of the tracking process. Conveyor tracking detects objects on the conveyor through vision device or photoelectric sensors to enable the robot to accurately grasp moving objects.

11.1.1.1 Workflow

1. The position of an object on a conveyor is acquired through vision device or photoelectric sensors. The acquired position information is placed into a conveyor object queue, and the changes in the position of tracked object is fed back through the encoder.
2. The robot moves with the moving object in the object queue as the reference frame. The position detection and robot movement are processed in parallel. The following figure shows the detailed flowchart.



The conveyor application is also known as dynamic grasping application. The position of the material changes with the movement of the conveyor. The vision device sends the position data of material to the robot at the time of taking a photo of the material. As the material moves in real time during the photo taking period, if the robot grasps the material according to the original position data, it will definitely be inaccurate. Therefore, the real-time offset value is calculated from the data of the encoder on the conveyor to achieve accurate dynamic grasping.

Dynamic grasping can be divided into two types: parallel grasping and predictive grasping.

- In parallel grasping, the robot calculates the position of the material in real-time through the encoder data while maintaining a relatively static state with the conveyor, thereby achieving grasping.
- In predictive grasping, the robot calculates the position of the point where the robot meets the material in advance based on the movement time after obtaining the position of the material, thereby achieving grasping.

11.1.1.2 Position Description System

The tracking motion takes the object frame as the reference frame. The description of the trajectory and point position during motion is relative to the dynamic frame. When no motion instruction is applied, the robot and the object remain relatively static (i.e., the robot moves in synchronization with the object). When a motion instruction is applied, the motion trajectory is a trajectory under the object frame, and the target point is a coordinate point under the object frame.

Conveyor frame (O_{cny}): Indicates the position and orientation of the conveyor under the base frame. It is used to describe the relative relationship between the conveyor and the robot. The conveyor frame is static.

Object frame (O_{obj}): Indicates a frame that is fixedly attached to the object and moves with the object. It is a dynamic frame. The object frame describes the position and orientation of the object on the conveyor. It is the coordinate of the datum point of the object under the conveyor frame.

Vision frame (O_{vis}): Describes the position conversion relationship between the camera and the conveyor. The instantaneous position of the object on the conveyor is obtained through the camera, and the amount of movement of the object on the conveyor is obtained in real time through the encoder, enabling the robot to track the position of the object in real time.

Frame	Description	Conveyor frame
Conveyor frame (O_{cny})	The position and orientation of the conveyor under the base frame.It is used to describe the relative relationship between the conveyor and the robot. The conveyor frame is static.	Static
Object frame (O_{cbj})	The frame that is fixedly attached to the object and moves with the object. The object frame describes the position and orientation of the object on the conveyor. It is the coordinate of the datum point of the object under the conveyor frame.	Dynamic
Vision frame (O_{vis})	The position conversion relationship between the camera and the conveyor. The instantaneous position of the object on the conveyor is obtained through the camera, and the amount of movement of the	-

Frame	Description	Conveyor frame
	object on the conveyor is obtained in real time through the encoder, enabling the robot to track the position of the object in real time.	

The relationship between frames in the tracking process is shown below.

Specification	Description
Conveyor type	Linear, circular
Number of conveyors	4 can be configured, and up to 2 can be used simultaneously.
Detection method	Vision device or photoelectric sensor, with a maximum of one vision device used.
Tracking motion instructions	Movl, Movc, Movs, JumpL
Number of Workobject types	16 different types of workobjects can be set on the same conveyor.
Vision data type	Robot coordinates or pixel coordinates
Vision communication format	Fixed format (For details, see the CnvVison instruction in the Instruction Guide.)
Number of objects in a single picture	0-50
Object queue length	1000

11.1.1.3 Function Specifications

Specification	Description
Conveyor type	Linear, circular
Number of conveyors	4 can be configured, and up to 2 can be used simultaneously.
Detection method	Vision device or photoelectric sensor, with a maximum of one vision device used.
Tracking motion instructions	Movl, Movc, Movs, JumpL
Number of Workobject types	16 different types of workobjects can be set on the same conveyor.

Specification	Description
Vision data type	Robot coordinates or pixel coordinates
Vision communication format	Fixed format (For details, see the CnvVison instruction in the Instruction Guide.)
Number of objects in a single picture	0-50
Object queue length	1000

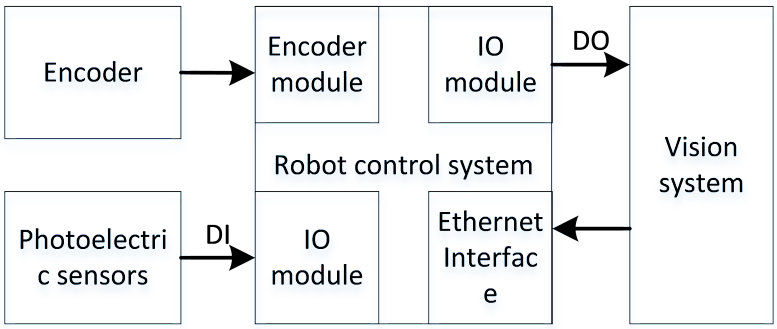
11.1.1.4 Configuration Flowchart

The following are required to use the tracking process. For details, see the relevant configuration sections.

- 11.1.2 Hardware Configuration
- 11.1.3 Frame Settings
- 11.1.4 Parameter Settings

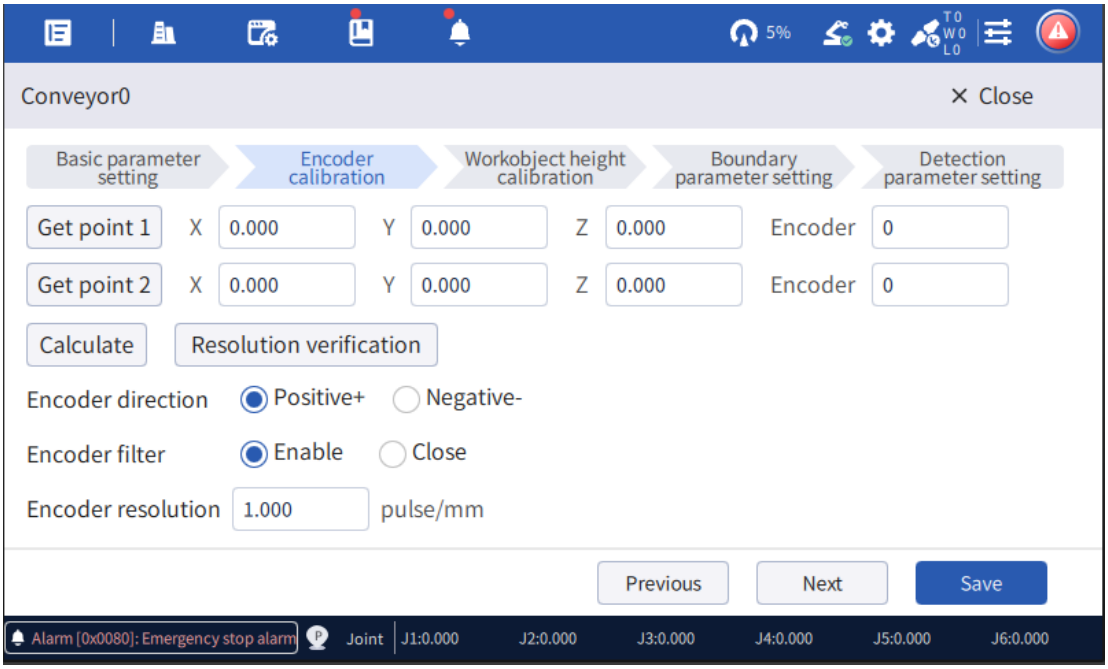
11.1.2 Hardware Configuration

The following figure shows the configuration of the following process hardware. The photoelectric sensor and vision system can be configured according to the detection method. If vision system is used, the camera must be triggered by hardware.



11.1.2.1 Connecting the Encoder

Connect the signal and power lines of the pulse encoder to the encoder interface of the robot controller. See the robot controller user guide for specific wiring logic. After the physical connection is completed, rotate the encoder and read the value of the encoder through the following interface. Observe the changes in the encoder value to determine whether the physical connection is correct.



11.1.2.2 Connecting the Photoelectric Sensor

The photoelectric sensor outputs different level signals when triggered by an object. The robot controller detects the object through the signal edge. Connect the signal wire of the sensor to a general DI interface of the I/O module of the controller. For the wiring requirements, see the robot controller user guide. Once the wiring is complete, observe the change of corresponding DI value on the I/O monitoring interface to determine whether the sensor works normally.

11.1.2.3 Vision Device

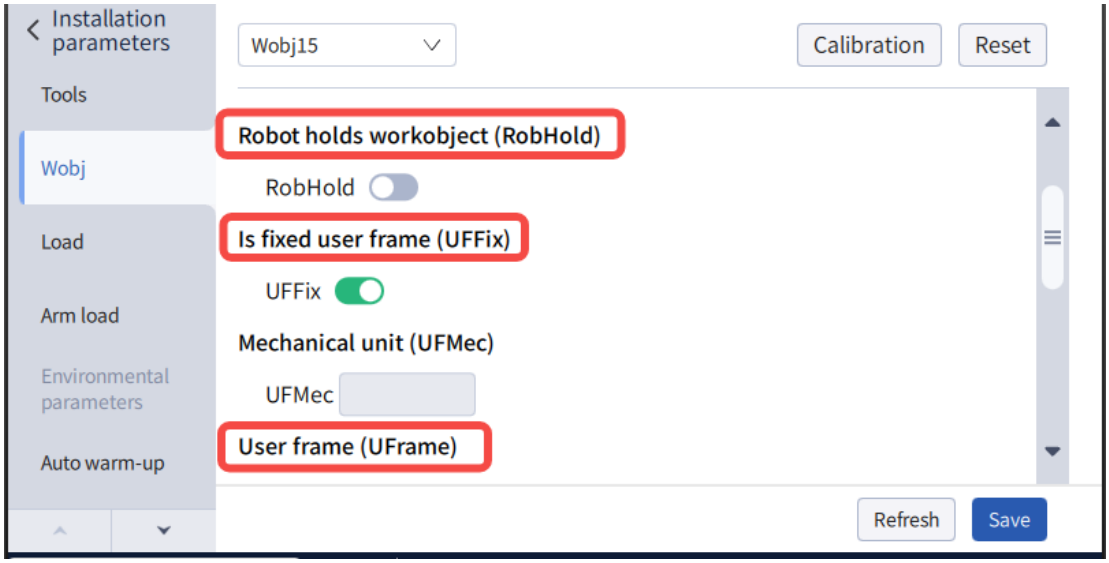
The interaction between vision device and the robot includes DO triggering and Ethernet communication. The DO triggering requires a signal line connecting the DO interface of the robot controller and the I/O trigger interface of the camera. After the physical connection is completed, manually operate the DO to see if the camera can be triggered properly.

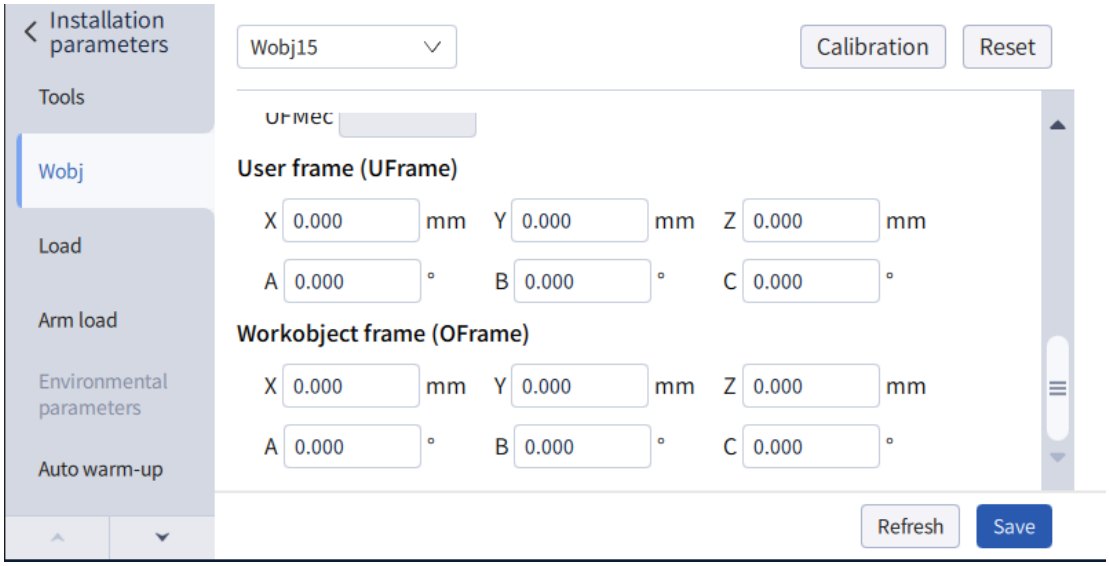
11.1.3 Frame Settings

The conveyor frame is the workobject frame associated with the tracking process. You need to set or calibrate the frame parameters in "Settings" > "Installation parameters" > "Wobj". The conveyor frame describes the position and orientation of the conveyor. The positive X-axis direction coincides with the direction of conveyor movement. The setting method is described as follows.

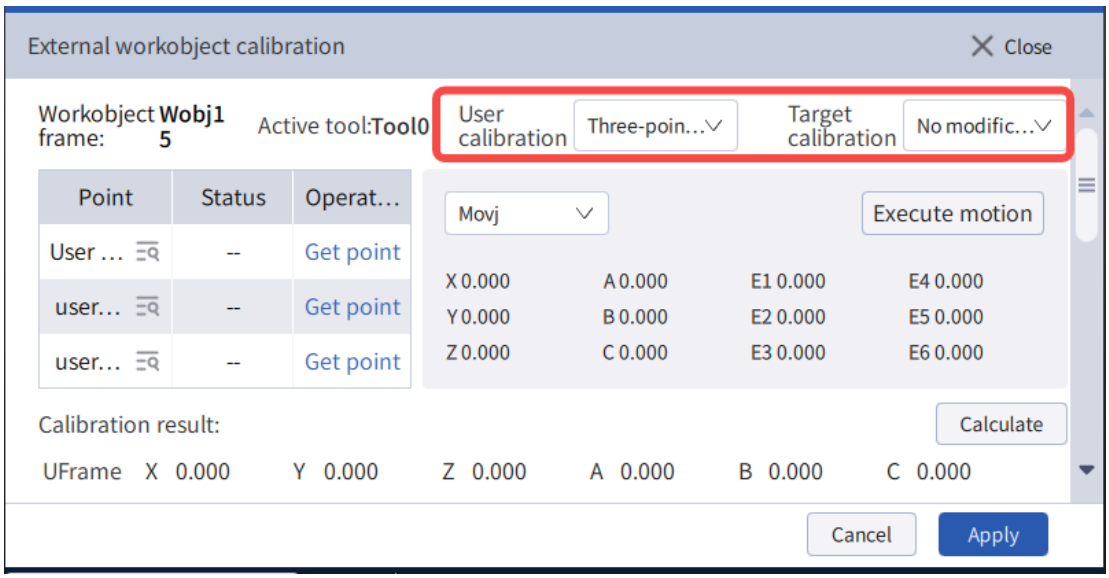
CAUTION

If the workobject frame is used as the conveyor frame, you only need to calibrate the user frame parameters (UFrame) without the need to calibrate the workobject frame parameters (Oframe). For the workobject frame, the RobHold parameter must be set to "False" and UFFix parameter to "True".





1) For a linear conveyor, use the 3-point method, as shown below.

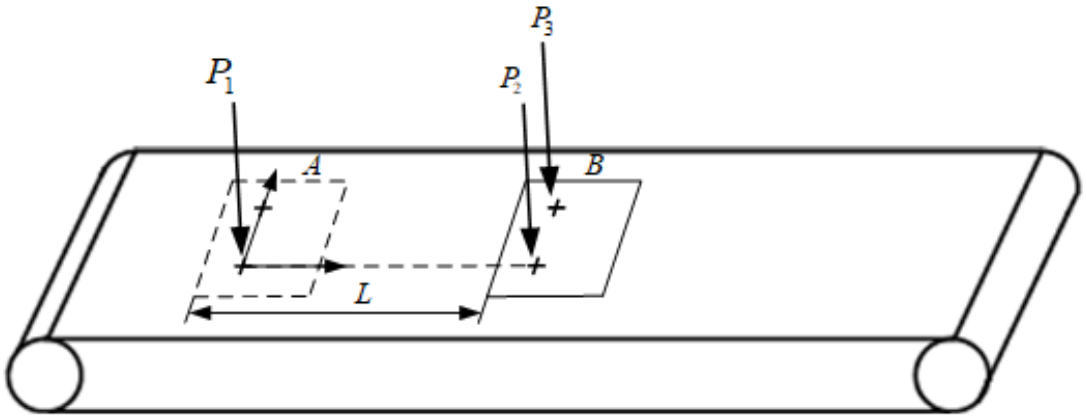


Select three points as follows:

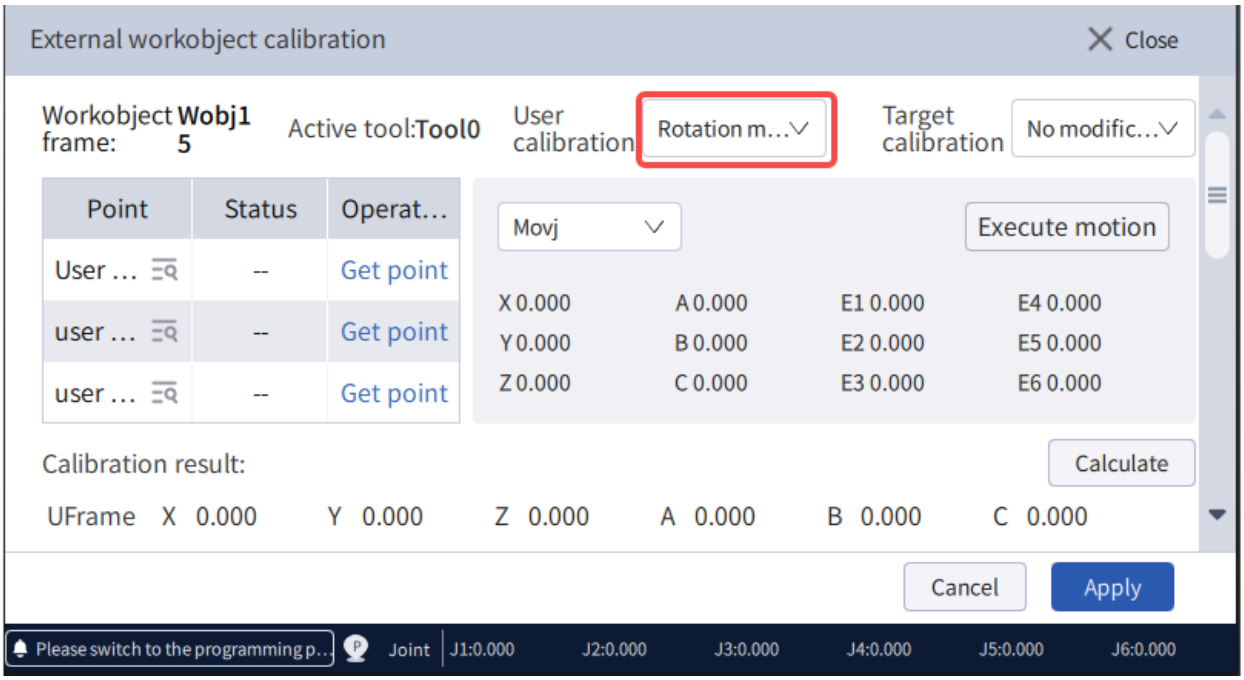
(1) Set the origin of the conveyor frame: Place the calibration board or another calibration reference on the conveyor. Align the end of the robot tool with the datum point to get user point P1, which is the origin of the conveyor frame.

(2) Set a point in the X direction of the conveyor frame: Keep the position of the calibration board relative to the conveyor unchanged during movement. Turn on the conveyor to move from P1 to P2, and then stop the conveyor. Align the end of the robot tool with the datum point to get user point X+. The direction from P1 to P2 is the positive X direction.

(3) Set a point in the Y direction of the conveyor frame: Move the end of the robot tool more than 10 mm to the left in the direction of conveyor movement to reach P3, user point Y+. Getting a point in the first quadrant XY as user point Y+ according to the right hand rule ensures that the Z axis is perpendicular to the conveyor direction.



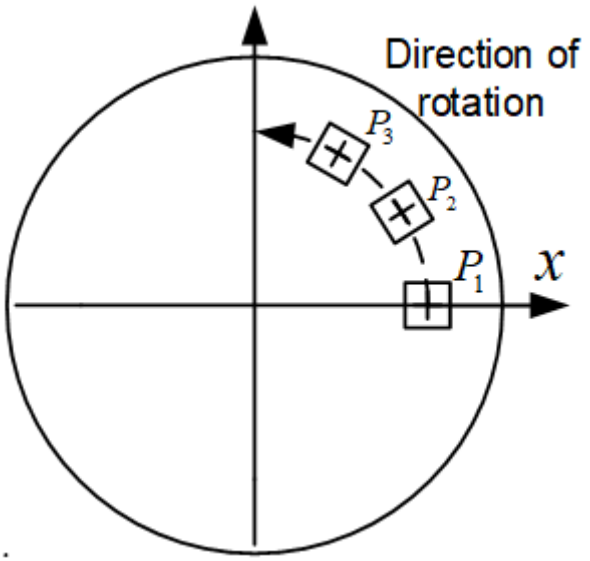
2) For a circular conveyor, use the rotation method. The calibration interface is shown below.



The rotation method takes three points, as shown below.

(1) Fix a calibration datum point on the conveyor. After rotating the datum point to a proper position, align the end of the robot tool with the datum point to get point P1. The direction from the center of rotation to P1 is the positive X direction of the frame.

(2) Rotate the conveyor counterclockwise, align the end of the robot tool with the datum point to get points P2 and P3 in sequence. Three points determine an arc. The center of the arc is the origin of the frame. Since the conveyor is rotated counterclockwise, it is ensured that the Z axis is perpendicular to the conveyor direction. The Y axis direction can be determined according to the right hand rule.

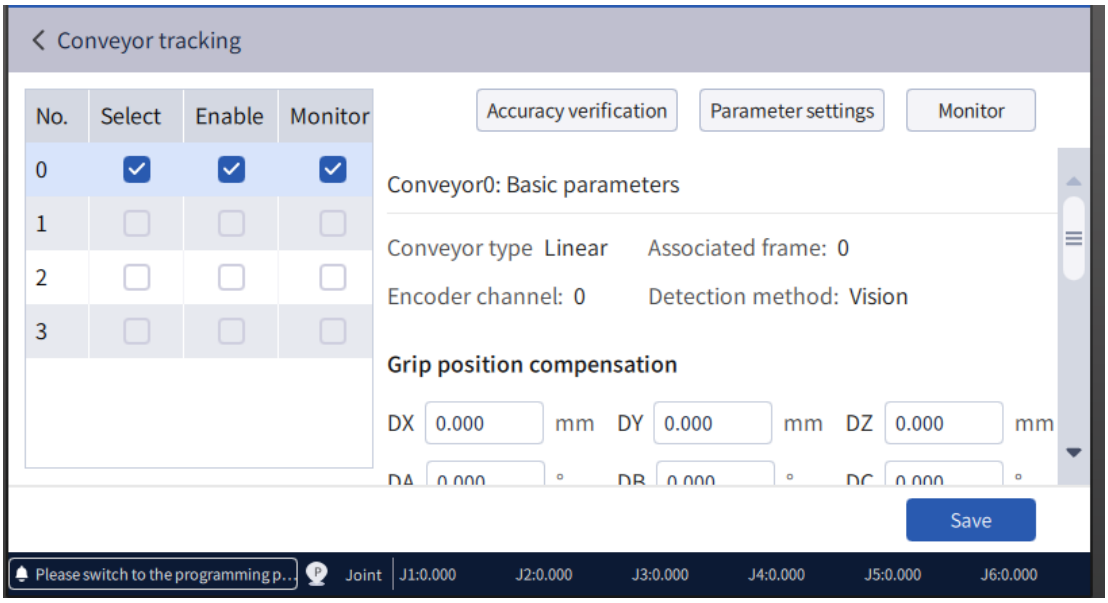


CAUTION

- To improve accuracy, it is recommended that the three points are spaced as far away as possible.
- If a tool is installed at the end of the robot, it is required to first calibrate the tool frame and activate the corresponding tool frame number.

11.1.4 Parameter Settings

The conveyor parameters include basic parameter setting, encoder calibration, workobject height calibration, boundary parameter setting, and detection parameter setting. Depending on the detection method, the , detection parameters are divided into vision parameters or sensor parameters. You can set the conveyor parameters in "Settings" > Conveyor tracking". The main interface is shown below..



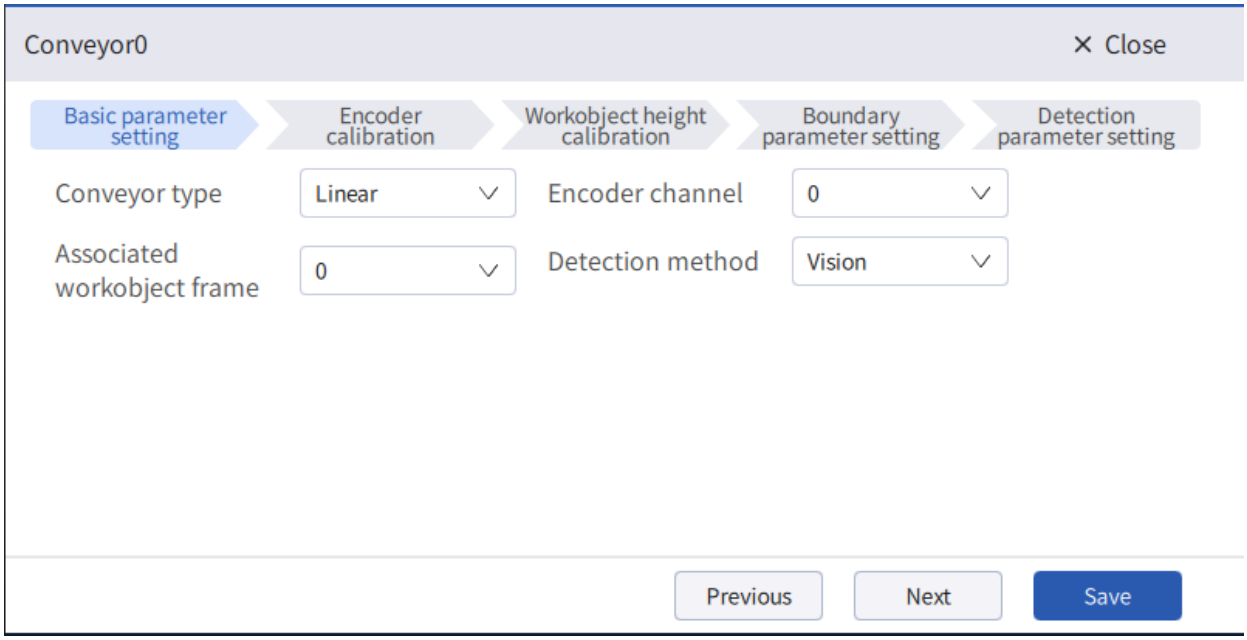
The following describes the options and buttons on the conveyor tracking interface.

Name	Description
Select	When checked, you can view or edit the parameters for that conveyor.
Enable	When checked, the conveyor can be used in the user program.

Name	Description
Monitor	When checked, you can monitor the conveyor tracking information.
Basic parameters	Displays the basic parameters of the selected conveyor. The parameters are for view only and cannot be modified
Grip position compensation	You can fine-tune the grip position. This is for position compensation of the origin of the object frame in the conveyor frame.
Parameter settings	Click to enter the parameter setting page.
Accuracy verification	Click to enter the accuracy verification page.

11.1.4.1 Basic Parameter Settings

Click the "Parameter settings" button to access the parameter setting interface. The parameter settings are wizard-based. Click "Previous" or "Next" button in the lower right corner to switch the interface. After setting the parameters, click "Next" or "Save" button to save the parameters to the controller.



The first step is to set the basic parameters, including:

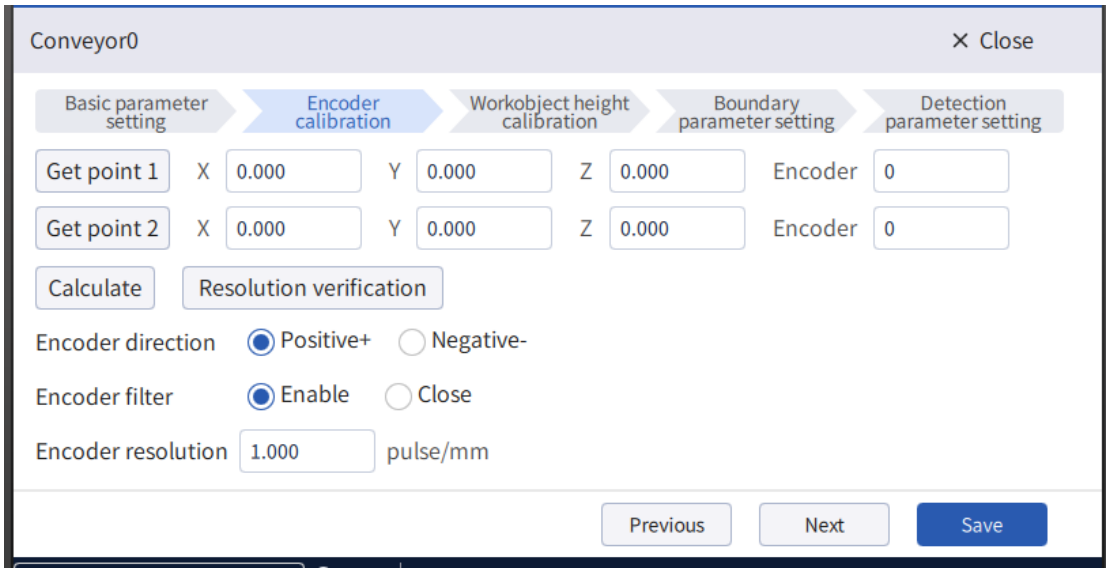
Name	Description
Conveyor type	Linear or circular.
Encoder channel	The signal input channel of the conveyor encoder on the robot controller.
Associated workobject frame	The workobject frame number obtained after calibration and to be associated with the conveyor.
Detection method	Vision, sensor, vision + sensor, and instructions + vision.

> **CAUTION**
>
> As the workobject frame 0 is fixed in the system and is coincident with the base frame, it cannot be modified. When calibrating the conveyor frame, use workobject frames 1-15.

11.1.4.2 Encoder Calibration

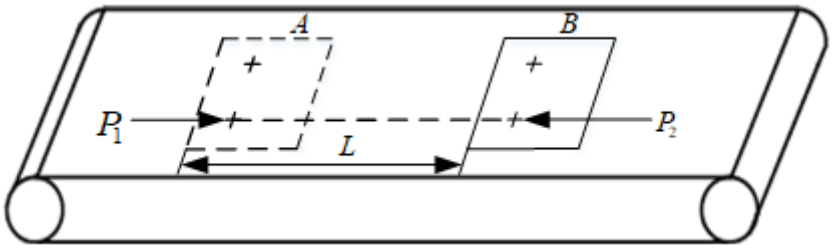
The second step is to calibrate the encoder. You can set the following parameters.

Name	Description
Encoder resolution	Indicates the pulse increment of the encoder when conveyor moves by a unit length (mm or °).
Encoder direction	Indicates whether the encoder pulse value increases or decreases when the conveyor moves forward.
Encoder resolution	By default, the encoder filter is enabled. Disable the encoder filter only when the conveyor speed is stable and external interference is low, to improve the grip accuracy.
Resolution verification	Allows you to re-calibrate the encoder resolution to calculate the encoder resolution error and conveyor frame calibration error. The resolution verification is required only for checking for errors in encoder resolution or conveyor frame calibration when gripping accuracy is low.



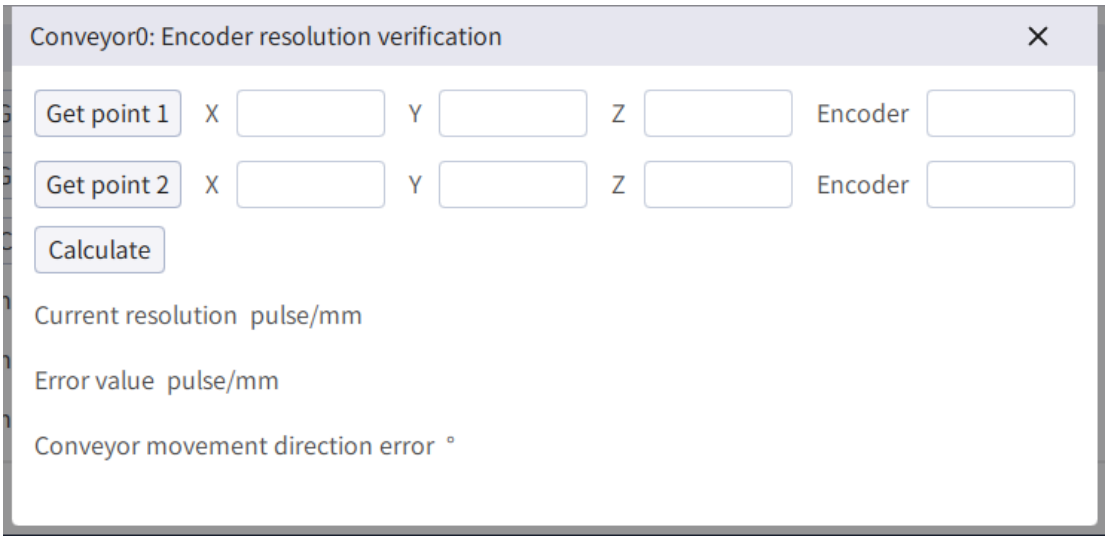
The calibration process is described as follows.

1. Place a marker point P1 on the conveyor. Align the end of the robot tool with P1. Click "Get point 1".
2. Keep the position of the marker point relative to the conveyor unchanged. Move the conveyor to P2. Align the end of the robot tool with P2, and click "Get point 2".
3. Click "Calculate" to complete automatic calculation of the resolution and direction of the encoder.



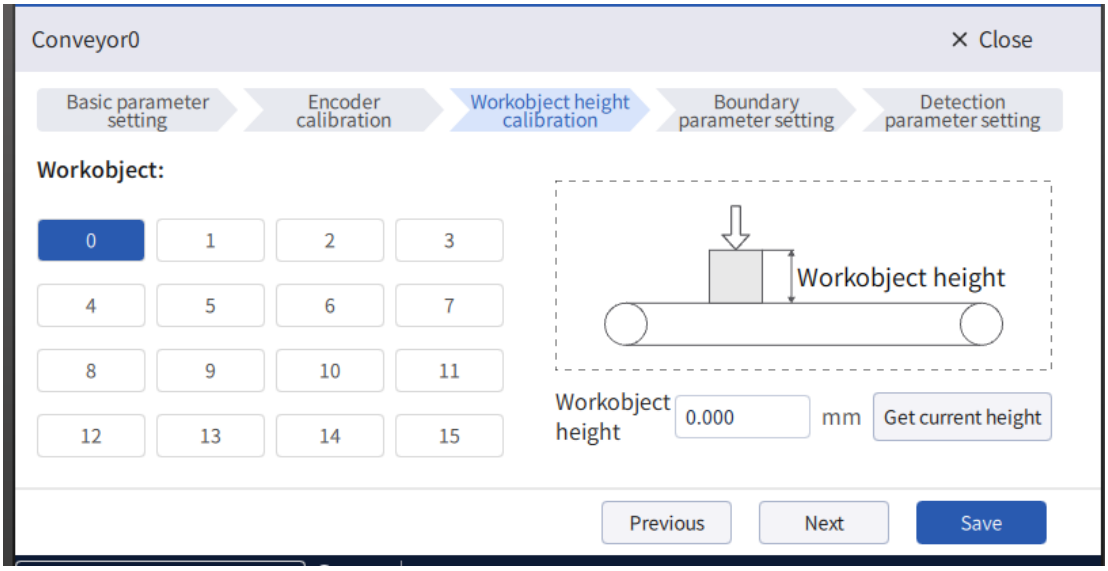
The encoder resolution verification is described as follows.

Click "Resolution verification" to enter the encoder resolution verification interface. Repeat the preceding encoder resolution calibration process once. The current resolution, resolution error value, and conveyor movement direction error are calculated automatically.



11.1.4.3 Workobject Height Calibration

The third step is to calibrate the height of the workobject, as shown below. The height of the workobject cannot be detected by the vision device or sensor. Therefore, you need to specify the height of each workobject type through parameter setting. The workobject height value is the Z coordinate value of the workobject datum point (i.e., origin of the object frame) under the conveyor frame.



Follow the steps below.

1. Select the workobject number.
2. Move the end of the robot tool to the workobject datum point and click "Get current height" to read the height automatically.

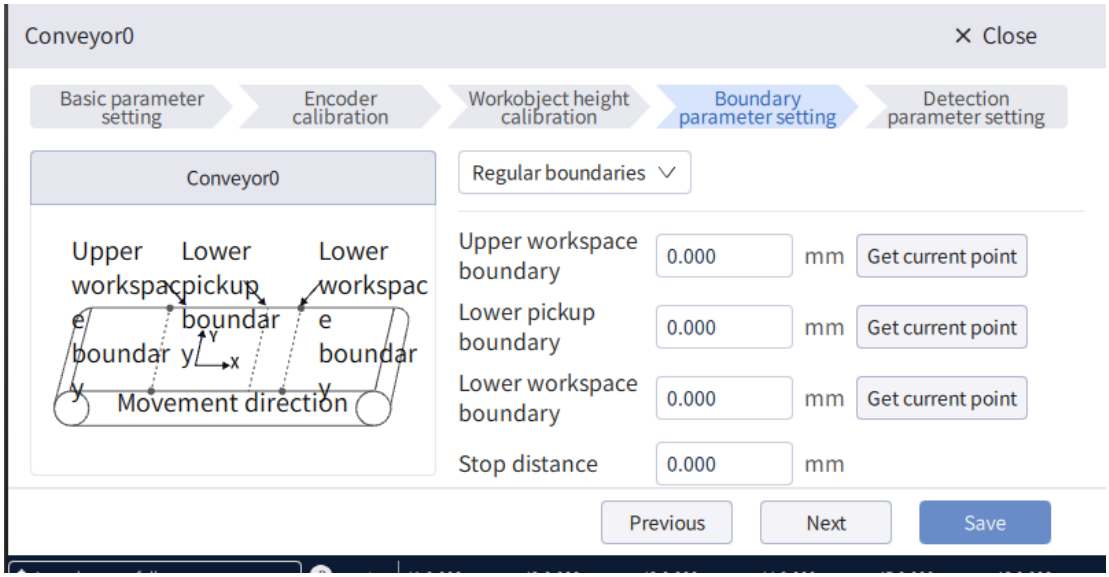
CAUTION

If a tool is installed at the end of the robot, it is required to first activate the corresponding tool frame number.

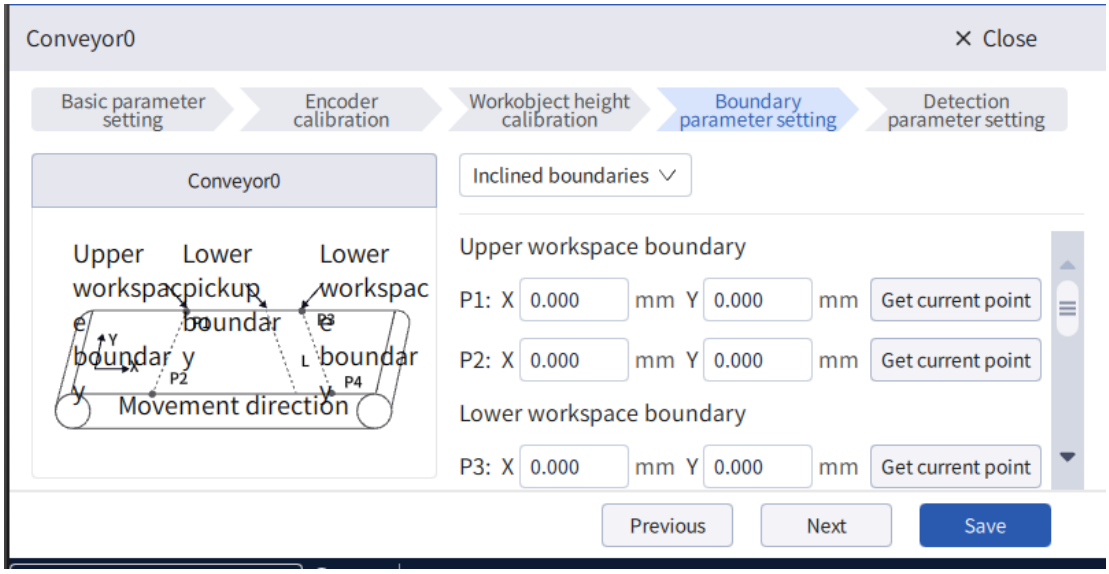
11.1.4.4 Boundary Parameter Settings

The fourth step is to set the boundary parameters. The interfaces for setting linear and circular conveyor are shown in the following figures (a and b). The linear conveyor includes regular boundaries and inclined boundaries. You can set the following parameters on the boundary parameter setting interface.

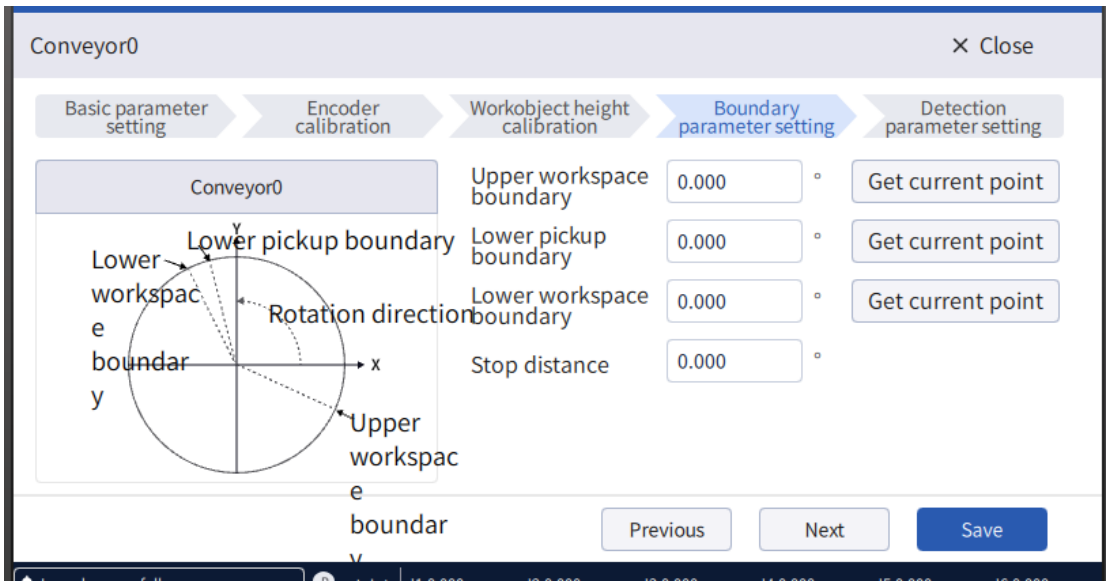
1. Upper workspace boundary: Indicates the highest boundary the robot can reach, as well as the upper boundary of object search area. When the object exceeds this boundary, it can be queried by the query instruction GetCnvObject. The upper workspace boundary must be within the range of the robot's right-angle motion and away from the singular position.
2. Lower workspace boundary: Indicates the lowest boundary the robot can reach. When the distance between the robot distance and this boundary is smaller than the stop distance, an alarm occurs. The lower workspace boundary must be within the range of the robot's right-angle motion and away from the singular position.
3. Lower pickup boundary: Indicates the lower boundary of the object search area. When the object exceeds this limit and is not picked up, the object will be removed from the queue without being picked up. Dynamic grasping takes a certain time. If an object has exceeded the lower workspace boundary before the grasping is complete, an alarm occurs. You can set the lower workspace boundary properly to prevent this situation. When setting the lower workspace boundary, ensure that the time for the object to move from the lower pickup boundary to the lower workspace boundary is greater than the time for completing grasping.
4. Stop distance: Indicates the smooth stop distance when the object approaches the lower workspace boundary. The smooth stop starts when the distance to the lower workspace boundary is smaller than this parameter.



a1. Boundary parameters for linear conveyor: Regular boundaries



a2. Boundary parameters for linear conveyor: Inclined boundaries



b. Boundary parameters for circular conveyor

Description of boundary parameters:

1. When the boundary type of the linear conveyor is set to regular boundaries, the upper workspace boundary, the lower workspace boundary and the lower pickup boundary are three lines perpendicular to the X-axis direction of the conveyor frame, represented by the x coordinate value under the conveyor frame.
2. When the boundary type of the linear conveyor is set to inclined boundaries, the upper workspace boundary is a straight line defined by two points P1 and P2, and the lower workspace boundary is a straight line defined by two points P3 and P4, and the lower pickup boundary is a straight line obtained by moving the lower workspace boundary by a lower pickup boundary offset value in parallel to the opposite direction of the conveyor.
3. The boundary type of the circular conveyor can only be set to regular boundaries. The upper workspace boundary, the lower workspace boundary and the lower pickup boundary are three straight lines corresponding to different angles in the conveyor frame, with the angle being positive in a counterclockwise direction.
4. The above boundary parameters can be entered directly. Alternatively, you can obtain these parameters automatically by moving the robot to the target position and click the "Get current point" button. The stop distance is generally set to 5 mm or 5°.

(1) After the object is visually recognized or sensed by the sensor, the object will be placed in a queue. When the object exceeds the lower pickup boundary, it will be moved out of the queue.

(2) The robot starts the pick-up operation only when the workobject exceeds the upper workspace boundary. You can set the waiting point close to the upper workspace boundary to reduce the robot grasping time.

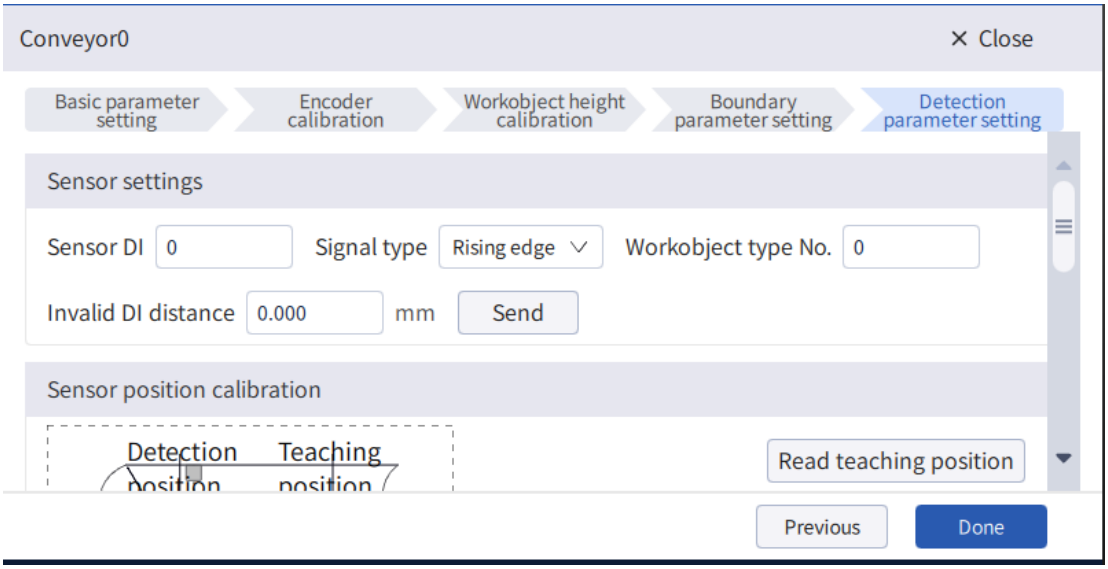
(3) During the tracking process, the robot moves to the upstream offset point relative to the object frame. There are also cases where the offset point exceeds the working range.

(4) Set the lower workspace boundary properly. Too large lower workspace boundary may cause the robot to straighten and damage the reducer.

11.1.4.5 Detection Parameter Setting

The fifth step is to set the detection parameters. The detection method includes sensor, vision, vision + sensor, and instructions + vision.

1. If you set the detection method to "Sensor", you need to configure the parameters as follows.



Sensor detection parameter settings include sensor settings and sensor position calibration.

a) The sensor settings include the following four parameters.

(1) Sensor DI: The input port number of the photoelectric sensor on the IR-Link module.

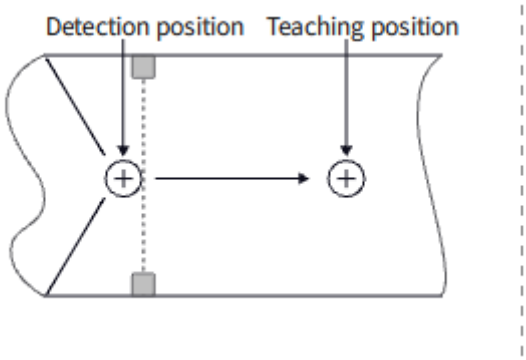
(2) Signal type: Indicates the signal edge type to output when the sensor is triggered by the workobject.

(3) Workobject type No.: One conveyor supports up to 16 types of workobjects. The workobject type cannot be identified when the sensor is used. You need to specify the workobject type.

(4) Invalid DI distance: After a valid signal is detected, if a signal change is detected again within a certain distance, it is considered that the signal is triggered by the same workobject and automatically removed as an invalid signal. This distance is called the invalid DI distance.

After setting the above parameters, click "Send" before performing sensor position calibration.

b) The purpose of sensor position calibration is to obtain the pose of the datum point of the object in the conveyor frame at the moment the sensor is triggered. That is, the detecting position on the left in the following figure. The pose of the object when the sensor is triggered is considered to be the value of "Detect position calculation".



The detailed operations are as follows:

1) Adjust the conveyor to the normal operating speed. Place an object upstream of the sensor and move the object together with the conveyor. The sensor is triggered when the object passes the sensor. Stop the conveyor after the object moves to the robot motion range, ensuring that the sensor is triggered only once during this process. If the sensor is not triggered or is triggered more than once during this process, a warning will be displayed when you click "Detect position calculation".

2) Align the end of the tool with the datum point of the object and click "Read teaching position". In this case, the position and orientation of the robot in the conveyor frame is the pose of the object frame established on the object relative to the conveyor frame when the object passes through the sensor.

Click "Detect position calculation". The controller automatically calculates the pose of the object at the moment the sensor is triggered by the object.

(1) Ensure that the speed at which the workobject passes the sensor during calibration is the same as during normal operation.

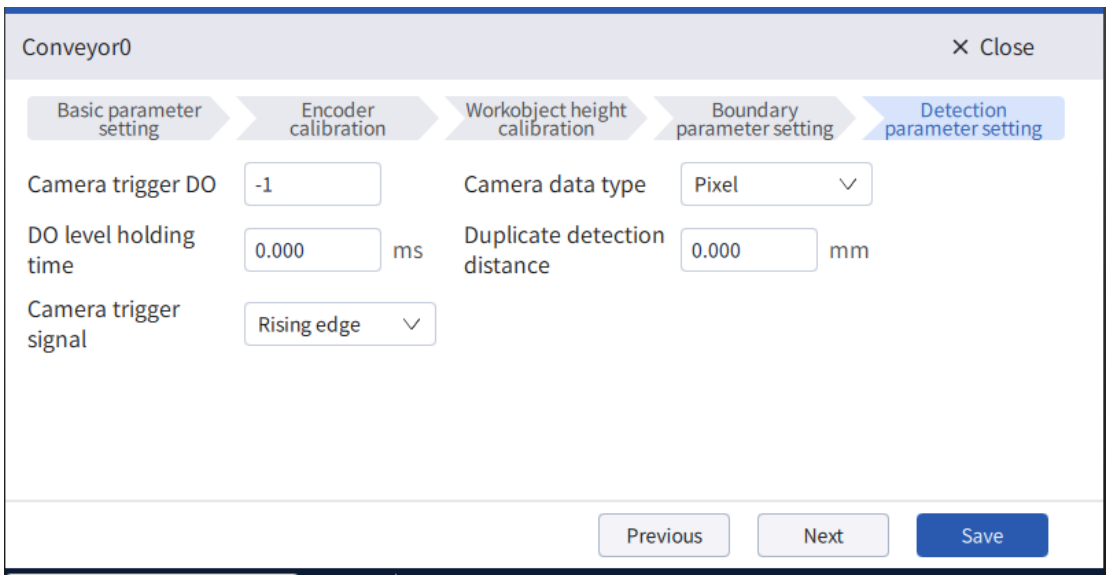
(2) Do not use hands or other objects to trigger the sensor during calibration.

(3) If the robot is equipped with a tool at the end, select the corresponding tool number when reading the teaching position.

(4) When sensor is used for detection, the orientation of the fed object is not limited. Therefore, in general, you can directly set the value A for "Detection position calculation" to 0°, and then click "Save".

After the setting is done, click "Done".

2. If you set the detection method to "Vision", you need to set the vision-related parameters. The vision settings include basic parameter settings and vision calibration. The basic parameter setting interface is as follows.



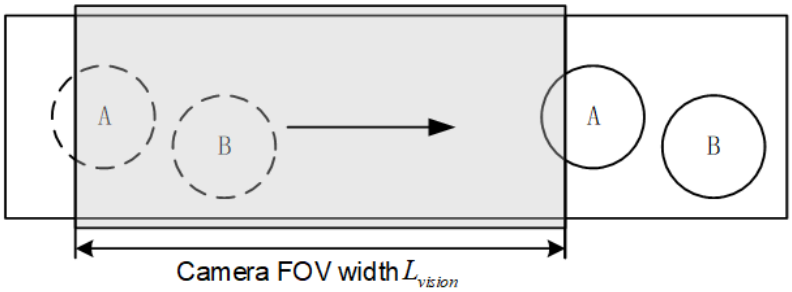
(1) Camera trigger DO: The output port number of the I/O signal triggering the camera hardware to take photo on the IR-Link module.

(2) Camera trigger signal: Indicates the signal edge type that triggers the camera to take photos via the I/O module.

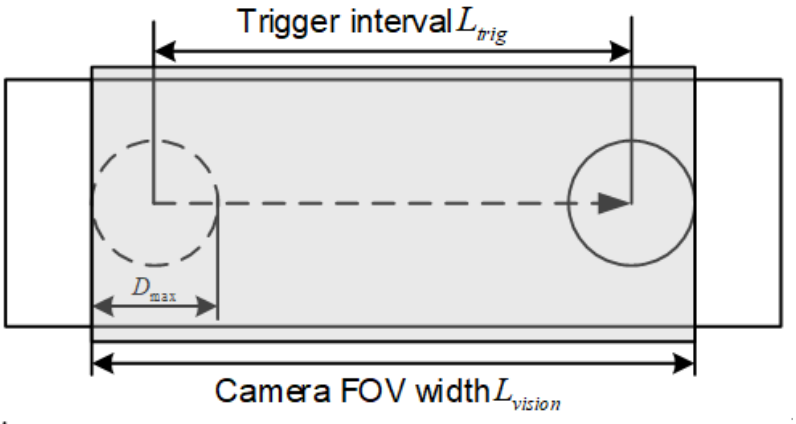
(3) Shooting spacing: Indicates the distance (mm) or degree (°) the conveyor moves forward to trigger the camera to take photos. Each time the conveyor moves a "Shooting spacing", the controller sets the level of the DO port corresponding to the "Camera trigger DO" to the signal type selected by the "Camera trigger signal", triggering the visual camera to take photos.

The principle for setting the photo shooting spacing is to ensure that the identification of each object on the conveyor can be captured without missing any shots. If the set photo shooting spacing is equal to the width of camera's field of view, the camera's previous and subsequent shots are seamless, so that each object on the conveyor can be captured. If an object happens to be located at the junction of the two shots, then half of the object will be captured in each shot, and the object cannot be identified.

As shown below, the workobject was located at the dashed line position during the first photo taking, and the workobject moved to the solid line position on the right during the second photo taking. Both previous and subsequent photos did not recognize the workobject A.



To avoid this situation, the previous and subsequent shots should overlap slightly, with an overlap width greater than the maximum width of the object identification, achieving at least one complete photo, as shown below.



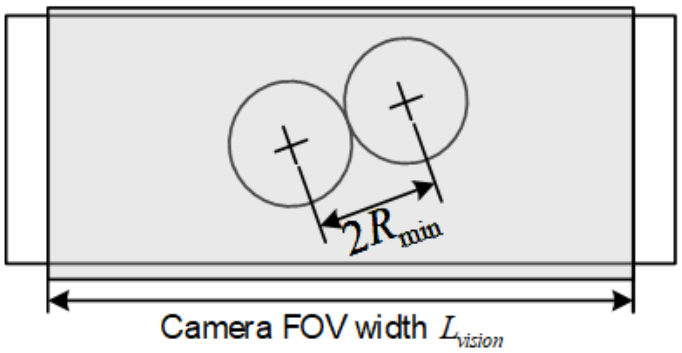
The vision system must complete image recognition within a photo shooting cycle, which is equal to photo shooting spacing/conveyor speed. Setting the photo shooting spacing too small can lead to a shorter photo shooting cycle, requiring faster vision processing speed. Therefore, the photo shooting spacing should be as large as possible without missing shots. In general, the photo cycle must be at least > 0.6s. Based on the requirements of various aspects, the photo shooting spacing must be appropriate. You can set the photo shooting spacing according to following formula. L_{trig} is the photo shooting spacing, L_{vision} is the field of view width, Dmax is the maximum width of object identification, and δ_{vision} is the margin setting, which is generally 5 to 10 mm or degrees.

$$\begin{cases} L_{trig} = L_{vision} - D_{max} - \delta_{vision} \\ \delta_{vision} < 10mm \end{cases}$$

(4) Duplicate detection distance: Based on the above-mentioned photo shooting spacing setting principle, there is overlap between the previous and subsequent photos, which may cause the same object to be repeatedly recognized in the two photos. The distance between the work objects at the time of the two photographs is called duplicate detection distance.

The controller compares the two positions of the object. If the distance between the two positions is less than the distance determined by the duplicate detection distance, it is considered a duplicate and the object obtained from the subsequent shot is removed. The principle for setting the duplicate detection distance is to correctly identify one same object that is overlapped and two objects that are normally close. As shown below, two objects can be considered as two different objects when the distance is greater than $2R_{min}$, otherwise as the same object.

$L_{remove}<2R_{min}=D_{min}$

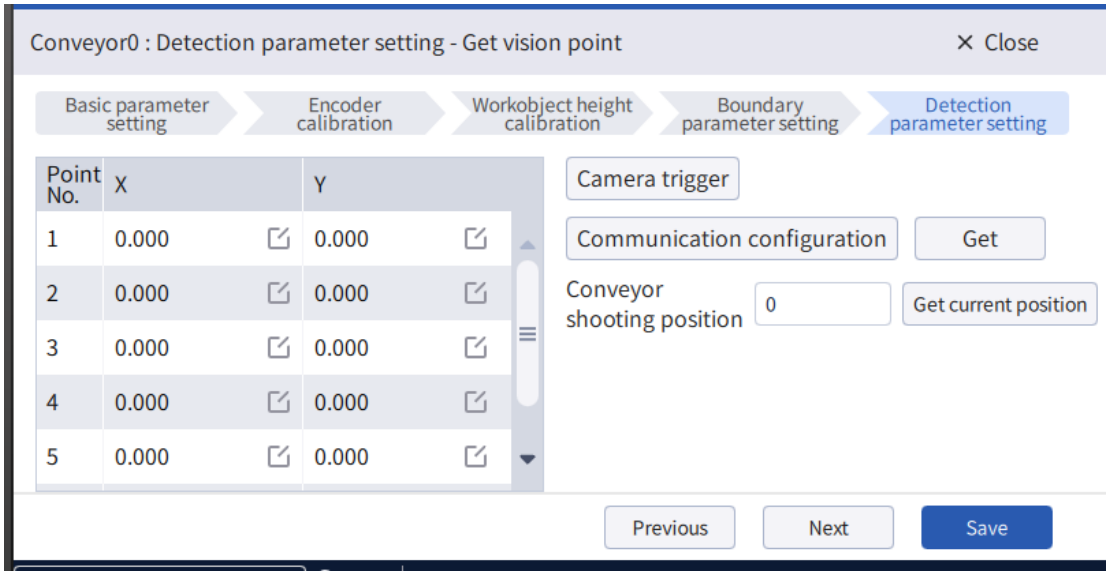


(5) Camera data type: Pixel or Robot. Select "Pixel" when the data sent by the vision system to the robot is pixels. In this case, vision calibration is performed at the robot side. Otherwise, select "Robot". (When camera data type is set to "robot", coordinate conversion is performed in the vision system. In this case, the robot controller does not need to perform vision calibration. When vision calibration is performed in the vision software, you can still complete the acquisition of nine points using the conveyor vision calibration interface.)

(1) Set the photo shooting spacing and duplicate detection distance properly to avoid repeated grasping. Otherwise, repeated grasping will occur when the same object is repeatedly identified three times or more.

Visual calibration:

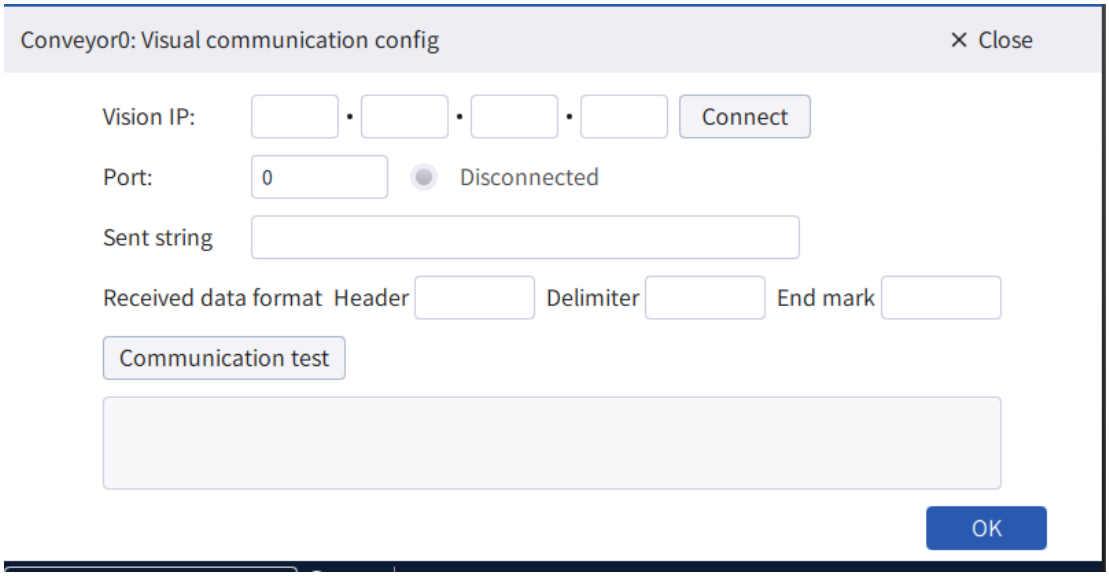
If the position information sent by the vision system to the robot is pixel coordinates, it is needed to perform visual calibration in the robot controller. Click "Next" to enter the vision calibration interface after setting the basic parameters.



Place the calibration board on the conveyor below the camera. Take a photo to obtain the pixel coordinates of the nine points on the calibration board. Fill in the corresponding coordinates in points on the "Get vision point" interface in sequence. Click "Get current position" to read the position information of the conveyor at the time of photo taking.

The "Communication" button allows the vision system to send the pixel coordinates of the nine points at one time to the robot. The "Get" button allows the received data to be parsed and automatically filled in the points on the "Get vision point" interface in sequence.

Click "Communication configuration" to open the vision communication configuration page.



1) Enter the vision IP address and port, and then click "Connect" to establish communication.

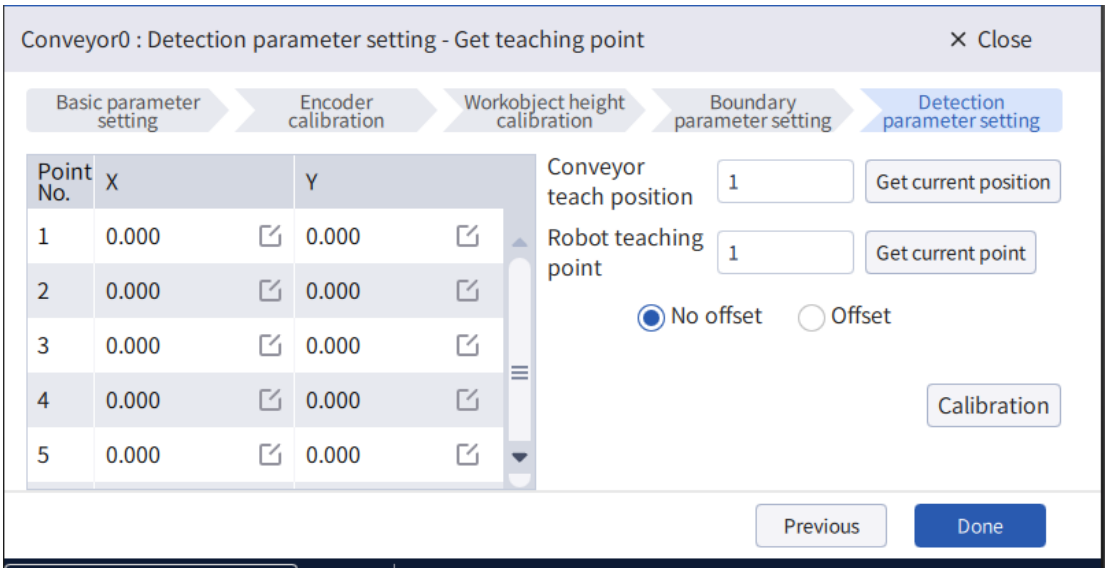
2) Sent string: When you select Ethernet trigger, you need to set the string that triggers camera to take photos.

3) The format of the data received by the vision device includes header, delimiter and end mark.

After you have completed the above settings, click "Communication test" to verify whether the robot and vision device can send and receive data properly. If data sent by the vision device has not been received in the receiving area, check the network cable and the connection between the vision device and the robot controller. The format of data sent by the vision device includes header "TA", delimiter ",", and end mark ";". The coordinates of each point are separated by ";". For example, the data sent is "TA, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800;".

After confirming that the communication test is successful, that is, the data receiving area displays the pixel coordinates of the nine points sent by the vision device, click "OK" to close the vision communication configuration page. Finally, click "Get" to complete the automatic filling of pixel coordinates in the points on the "Get vision points" interface.

After entering the pixel coordinates and reading the photo taking position, click "Next" to proceed to get the teaching points.



Keep the relative position between the calibration board and the conveyor unchanged. Move the conveyor and stop it when the calibration board enters the robot's motion range. Align the robot tool end to the nine points in sequence. Click "Get current point" to obtain the coordinates of the nine points.

(1) Click "Get current position" to read the position information of the conveyor at the time of teaching.

(2) After reading the current position of the conveyor and the coordinates of the nine points, click "Offset" to calculate the coordinates of the nine points in the photo-taking position.

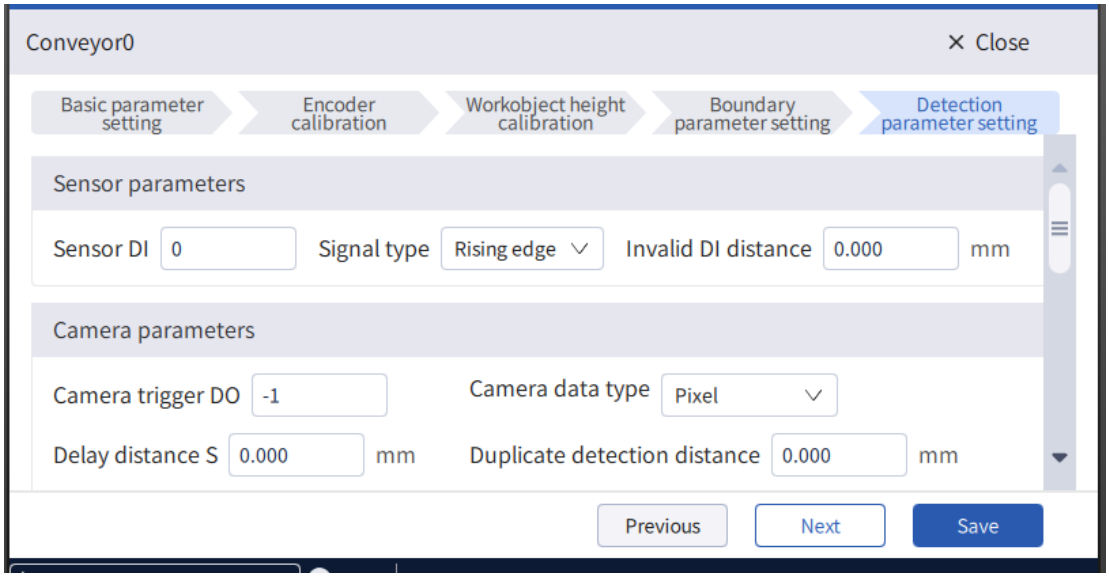
(3) Click "Calibration" to calculate the calibration results.

(4) After completion, click "Save" to end all settings and save the results.

CAUTION

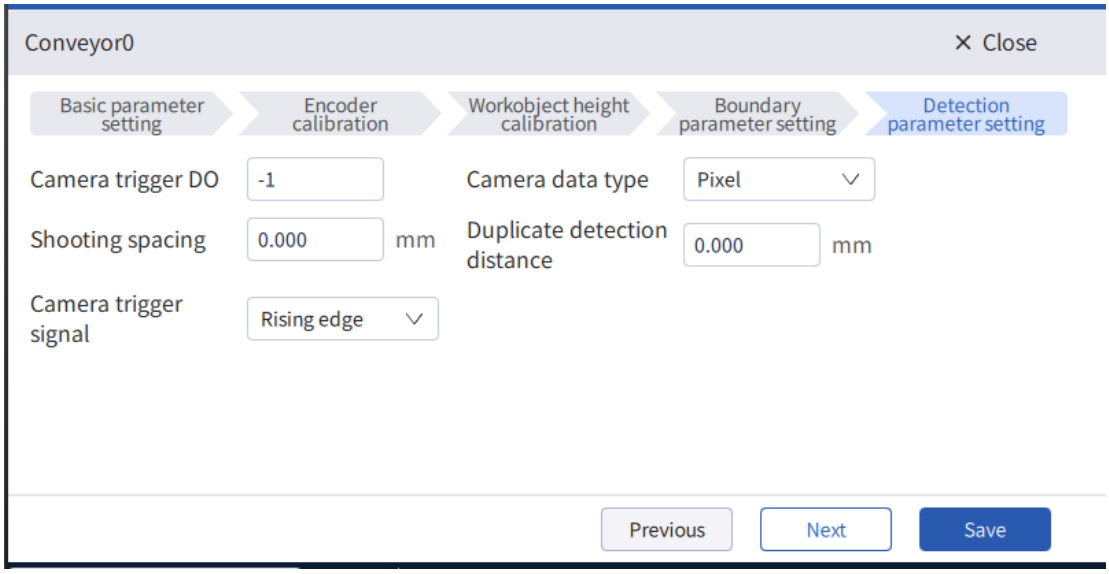
- During vision calibration, you need to activate the corresponding tool. Ensure that the activated tool is correct.
- If the camera data type is set to "Robot", you need to fill in the offset coordinate values obtained in the "Get teaching point" interface for vision calibration.

3. If you set the detection method to "Vision + Sensor", you need to set the basic parameters and perform vision calibration. The vision calibration process for the "Vision + Sensor" detection method is the same as that for the "Vision" detection method and will not be described again. The following describes the configuration of basic parameters.



Name	Description
Sensor DI	The input port number of the photoelectric sensor on the IR-Link module.
Signal type	Indicates the signal edge type to output when the sensor is triggered by the workobject.
Invalid DI distance	After a valid signal is detected, if a signal change is detected again within a certain distance, it is considered that the signal is triggered by the same workobject and automatically removed as an invalid signal. This distance is called the invalid DI distance.
Camera trigger DO	The output port number of the I/O signal triggering the camera hardware to take photo on the IR-Link module.
Camera data type	Pixel or Robot. For details, see the definition of "Camera data type" described for the "Vision" detection parameter settings.
Delay distance S	When the sensor detects an object, it triggers photo taking after the conveyor moves a certain distance. This distance is called the delay distance. When the delay distance S = 0, the sensor trigger photo taking immediately when detecting the object.
Duplicate detection distance	See the "Duplicate detection distance" description.
Camera trigger signal	Indicates the signal edge type that triggers the camera photos via the I/O module.
DO level holding time	When the level of the DO corresponding to "Camera trigger DO" is set to the signal type selected by "Camera trigger signal", the DO for a certain period of time before the level is reversed. This period of time is called the DO level holding time. The minimum value is 20 ms.

4. If you set the detection method to "Instructions + Vision", you need to set the basic vision parameters and perform vision calibration. The vision calibration process for the "Instructions + Vision" detection method is the same as that for the "Vision" detection method and will not be described again. The following describes the configuration of basic vision parameters.



Name	Description
Camera trigger DO	The output port number of the I/O signal triggering the camera hardware to take photo on the IR-Link module.
Camera data type	Pixel or Robot. For details, see the definition of "Camera data type" described for the "Vision" detection method.
DO level holding time	When the level of the DO corresponding to "Camera trigger DO" is set to the signal type selected by "Camera trigger signal", the DO for a certain period of time before the level is reversed. This period of time is called the DO level holding time. The minimum value is 20 ms.
Duplicate detection distance	For details, see the definition of "Duplicate detection distance" described for the "Vision" detection method.
Camera trigger signal	Indicates the signal edge type that triggers the camera photos via the I/O module.

11.1.5 Notes

1. After the RefSys Conveyor instruction is executed, the robot keeps moving with the conveyor until the RefSys Base instruction is executed. If the RefSys Base instruction fails to be executed in time, the robot will follow the conveyor to move out of boundary. Therefore, it is necessary to ensure that RefSys Conveyor and RefSys Base instructions exist in pairs logically. If you use Goto instruction or run subprograms, return to the program in time to ensure that the RefSys Base instruction can be executed. The time of the program segment between the two instructions cannot be greater than the time the conveyor takes to move to the boundary. (The same applies to the CnvFastCatch instruction.)
2. The instructions for switching frames should be used in pairs. At the end of a dynamic tracking, it is needed to switch to the base frame first. It is not allowed to directly switch between different dynamic reference frames. For example, RefSys Conveyor and CnvFastCatch instructions cannot be used continuously and must include a RefSys Base instruction between them. That is, the RefSys Conveyor instruction is used in pairs with the RefSys Base instruction, and the CnvFastCatch instruction is used in pairs with the RefSys Base instruction.

3. The robot motion in the tracking mode follows the Cartesian trajectory. Joint motion is prohibited. After entering the synchronization mode with the conveyor, the robot remains in motion and the instruction to stop the robot will be invalid.
   If such instruction is used, running error occurs.
   (1) Only Movl/Movc/JumpL instructions are allowed, and other motion instructions are prohibited.
   (2) Do not use Until and PE parameters in motion instructions.
   3) Do not use non-motion instructions WaitInPos(Fine/Corner), but WaitInPos(Value) instruction is supported.

4. During the conveyor tracking process, if both the robot and conveyor run at a high speed, it is normal that a robot joint speed planning error occurs. In this case, reduce the robot speed or conveyor speed.

5. If parameter Offset is used in the CP motion instruction in the tracking process, it indicates offset of the TCP under the object frame on the conveyor. In this case, only the offset in the X/Y/Z directions can be performed. The offset in the A/B/C directions is not superimposed.
   (1) P[30]=(0,0,10,0,0,0),(0,0,0,0),(0,0,0,0,0,0); ##Defines P[30] as a point in the object frame, with coordinates (0,0,0,0,0,0,0)
   (2) PR[0]=(10,20,30,10,20,30); ##Defines the offset variable as (10,20,30,10,20,30)RefSys Conveyor(1,Tool[2])
   (3) Movl Offset (P[30],PR[0],V[100],Z[1],Tool[2],Cnv; ##Uses tool 2 to move to the offset point under the object frame
   (4) RefSys Base; ##Switches the motion reference system to the robot
   The above point Offset(P[30],PR[0]) is actually equal to (10,20,40,0,0,0). P[30] superimposes only the XYZ of PR[0] and not the ABC of PR[0]. If you want to superposition the ABC of PR[0] at the same time, you can perform the offset first, and then execute the motion instruction, for example: P[30]=(0,0,10,0,0,0),(0,0,0,0),(0,0,0,0,0,0); ##Defines P[30] as a point in the object frame, with coordinates (0,0,10,0,0,0)
   (1) PR[0]=(10,20,30,10,20,30); ##Defines the offset variable as (10,20,30,10,20,30)RefSys Conveyor(1,Tool[2])
   (2) P[31]= Offset(P[30],PR[0]); ####The point obtained after the offset is (10,20,40,10,20,30).
   (3) Movl P[31],V[100],Z[1],Tool[2],Cnv; ##Uses tool 2 to move to the point P[31] under the object frame
   (4) RefSys Base; ##Switches the motion reference system to the robot
   The value of P[31] is equal to (10,20,40,10,20,30).

6. After version 18, the initial orientation of the Z axis of the dynamic point coordinate is consistent with the Z orientation of the object frame. It is necessary to assign values to the orientation according to actual situation. Otherwise, a limit alarm will be triggered.
   For example, when a 6-axis robot is used to grasp materials, the flange face at the end of the robot is normally required to be vertically downwards and perpendicular to the horizontal plane of the conveyor. However, the Z-axis for establishing the conveyor frame is vertical upwards, resulting in the Z-axis of the object frame also being vertical upwards. Therefore, when defining the C value of point in the object frame, the C value needs to be ± 180 ° to ensure that the robot's orientation is vertical downwards when grasping materials, that is:
   P[30]=(0,0,10,0,0,-180),(0,0,0,0),(0,0,0,0,0,0); ##Defines P[30] as a point in the object frame, with coordinates (0,0,10,0,0,-180)RefSys Conveyor(1,Tool[2])
   Movl P[30],V[100],Z[1],Tool[2],Cnv; ##Uses tool 2 to move to the P[30] point under the object frame
   RefSys Base; ##Switches the motion reference system to the robot

7. The RefSys Base instruction cannot be directly followed by a motion instruction with PE parameter. If necessary, use motion instructions with a fixed position before using motion instructions with PE parameter. For example: RefSys Base;Movj P[0],V[100],Z[0];Movl Offset(PE,PR0),V[100],Z[0];

8. During the process that the robot tracks the conveyor using RefSys Conveyor or CnvFastCatch instruction, if the user manually stops the robot or the robot stops due to errors, the tracking motion cannot be completed by directly starting the program again. In this case, return to the start line of the program.
9. When the robot is not in the tracking state, it is allowed to stop the robot. In this case, data in the object queue will not be cleared and the queue will still be updated in real time (the object will be added to the queue after entering the upper workspace boundary, and removed from the queue when exceeding the lower pickup boundary.)
10. CP motion instructions (Movl, Movc, and JumpL) should use the parameter Cnv in the tracking state, and the parameter Wobj in the non-tracking state. Incorrect use of the parameters will trigger alarms.
11. When the timing instruction (Timeout) is used in the tracking state, the output time is incorrect. Therefore, do not use the timing instruction in the tracking state. However, it can be used in the non-tracking state.
12. The parameter file of the tracking process is "FollowCraftCaliCfg.dat". If the parameter file of robot B is replaced by the parameter file of robot B, you need to restart the controller.
13. The "RobHold" property of the tool used in the tracking process must be set to "True", the "RobHold" property of workobject frame must be set to "False" and "UFFix" property set to "True". Therefore, the tracking process does not support ECP mode.
14. The maximum supported speed is 500 mm/s for the linear conveyor, and 30 for the circular conveyor.
15. The tracking process supports no-model external axis only.
16. Independent axis instructions are not supported when the robot is tracking the conveyor, and can only be used in non-tracking state.

11.1.6 Application Cases

11.1.6.1 Dynamic Grasping

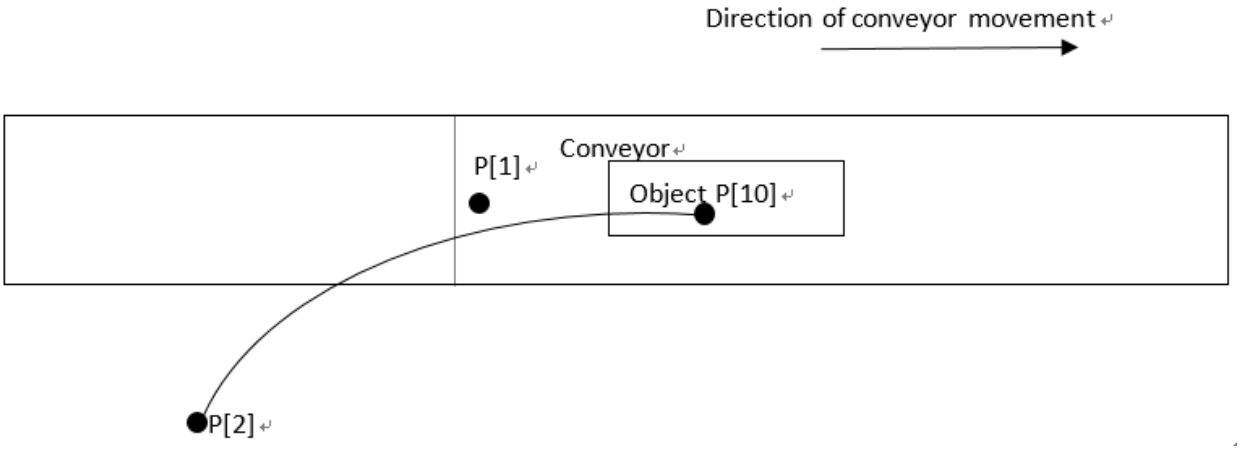
Point Diagram

As shown in the following figure, P[10] is a point on an object. A dynamic object frame is used. P[1] is a waiting point and P[2] is a placement point.

1. The robot waits from point P[1]. When the object passes the upper workspace boundary, it is quired through the GetCnvObject instruction.

2. The motion reference frame switches to the object frame, and the robot moves to point P[10] under the object frame to complete the grasping of the object.

3. After grasping the object, the robot lifts the object 10 mm off the conveyor surface, switches to the static frame, and moves to the placement point P[2] where the object is placed down.

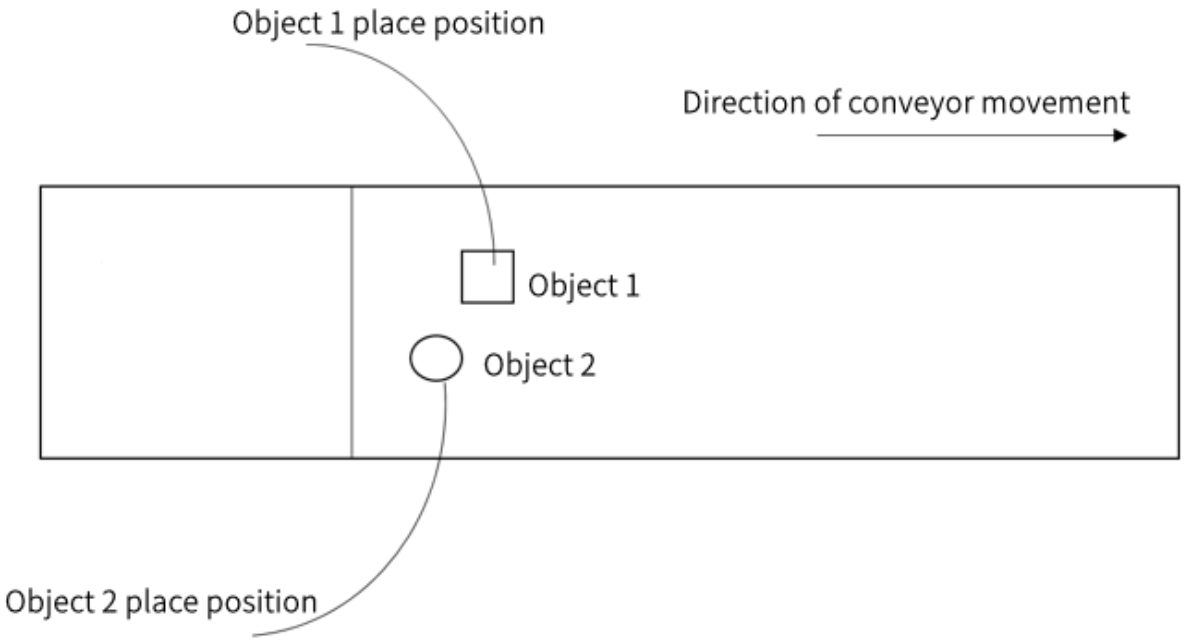


2) Program

```
Start;                                  ## Program start flag
##Open the port. The external device acts as the server, with an IP 192.168.24.55 and a port 1025.
##The robot controller is acts as a client, with a port number 1026.
R[0]=1026;
B[0]=0;                                 ##B[0] variable initialization
P[10]=(0,0,0,0,0,0),(0,0,0,0),(0,0,0,0,0,0); ## Defines a point under the object frame: Object Origin
P[11]=(0,0,10,0,0,0),(0,0,0,0),(0,0,0,0,0,0); ##Defines a point under the object frame: 10 mm directly above the object
While B[0]<>1
Open Socket("192.168.24.55",1025,R[0],Single,B[0]);     ## Establishes a connection between the robot side and the vision device
EndWhile;
CnvVision(Conveyor[0],OFF,R[0]);            ## Turns off vision of the conveyor
CnvVision(Conveyor[0],ON,R[0]);             ## Turns on vision of the conveyor
L[0]:                                   ##Flag L[0]
Jump P[1],V[100],Z[0],Tool[0],Wobj[0],LH[10],MH[-50],RH[10]; ##Robot wait point, which is normally set near the upper workspace boundary
L[1]:                                   ##Program jump flag L[1]
GetCnvObject(0,1),Goto L[1];            ## Queries for the object. If the object is queried, continue to execute the following instructions; otherwise, jump to L[1]
RefSys Conveyor(0,Tool[1]);                 ## Switches motion reference system to the object frame on the conveyor
JumpL P[10],V[100],Z[0],Tool[1],Cnv,LH[10],MH[-50],RH[10];  ##Moves to P[10] under the object frame
Delay T[1];                                 ##Keeps the robot moving with the conveyor for 1s
Set Out[8],ON;                              ##Turns on the switch to suck the object
Movl P[11] ,V[100],Z[0],Tool[1],Cnv;        ## Lifts the object 10 mm off the conveyor surface
RefSys Base;                            ##Makes the robot out of synchronization with the conveyor and switches the motion reference system to the robot
Jump P[2],V[100],Z[0],Tool[0],Wobj[0],LH[10],MH[-50],RH[10]; ##Runs the robot to the placement point P[2]
Set Out[8],OFF;                             ##Turns off the switch and places the object
Goto L[0];                              ##Program loop
End;                                    ##Program end flag
```

11.1.6.2 Dynamic Sorting

1) Point diagram



When there are two or more objects on the conveyor, the vision system recognizes the attributes of the objects and sends them to the robot. The robot can sort the different objects according to the object attributes in the sent data.

2) Program

```
Start;
R[0]=1026;
B[0]=0;
P[10]=(0,0,0,0,0,0),(0,0,0,0),(0,0,0,0,0,0);
P[11]=(0,0,10,0,0,0),(0,0,0,0),(0,0,0,0,0,0);
While B[0]<>1
Open Socket("192.168.24.55",1025,R[0],Single,B[0]);
EndWhile;
CnvVision(Conveyor[0],OFF,R[0]);
CnvVision(Conveyor[0],ON,R[0]);
L[0]:
Jump P[1],V[100],Z[0],Tool[0],Wobj[0],LH[10],MH[-50],RH[10]; ##Robot wait point
L[1]:
GetCnvObject(0,1),Goto L[1];                    ##Queries for object #1
RefSys Conveyor(0,Tool[1]);
JumpL P[10],V[100],Z[0],Tool[1],Cnv,LH[10],MH[-50],RH[10];  ##Grasps object #1
RefSys Base;
Jump P[2],V[100],Z[0],Tool[0],Wobj[0],LH[10],MH[-50],RH[10]; ##Places the object in discharge zone #1
L[2]:
GetCnvObject(0,2),Goto L[2];                    ##Queries for object #2
```

```
RefSys Conveyor(0,Tool[1]);
JumpL P[10],V[100],Z[0],Tool[1],Cnv,LH[10],MH[-50],RH[10];  ##Grasps object #2
RefSys Base;
Jump P[3],V[100],Z[0],Tool[0],Wobj[0],LH[10],MH[-50],RH[10]; ##Places the object in discharge zone #2
Goto L[0];
End;
```

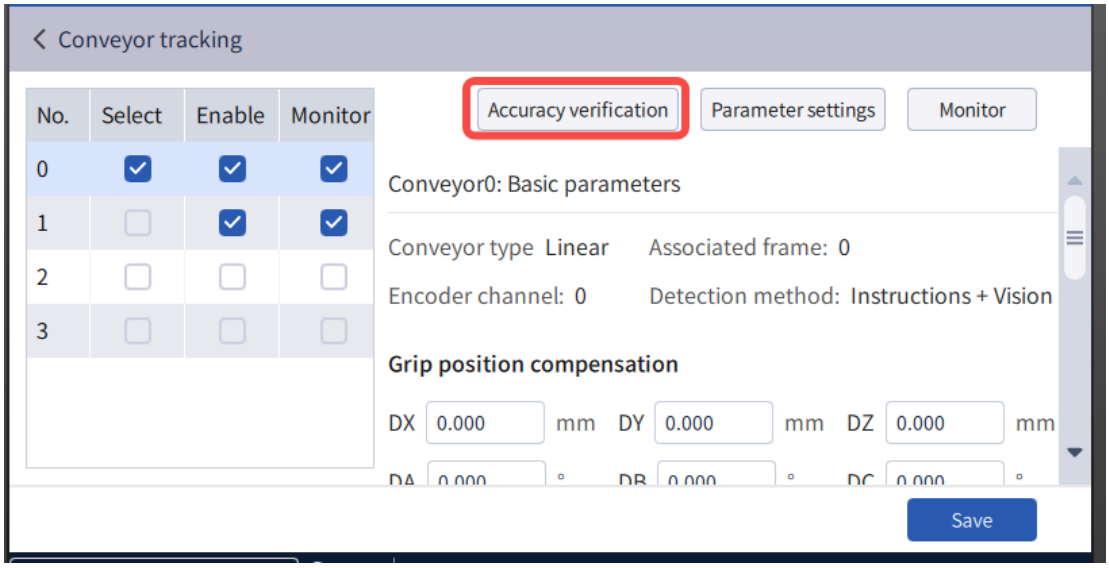
CAUTION

- Dynamic sorting supports 16 different types of objects, and the data of up to 10 objects can be sent during photo taking.
- The objects for sorting need to be of similar size.

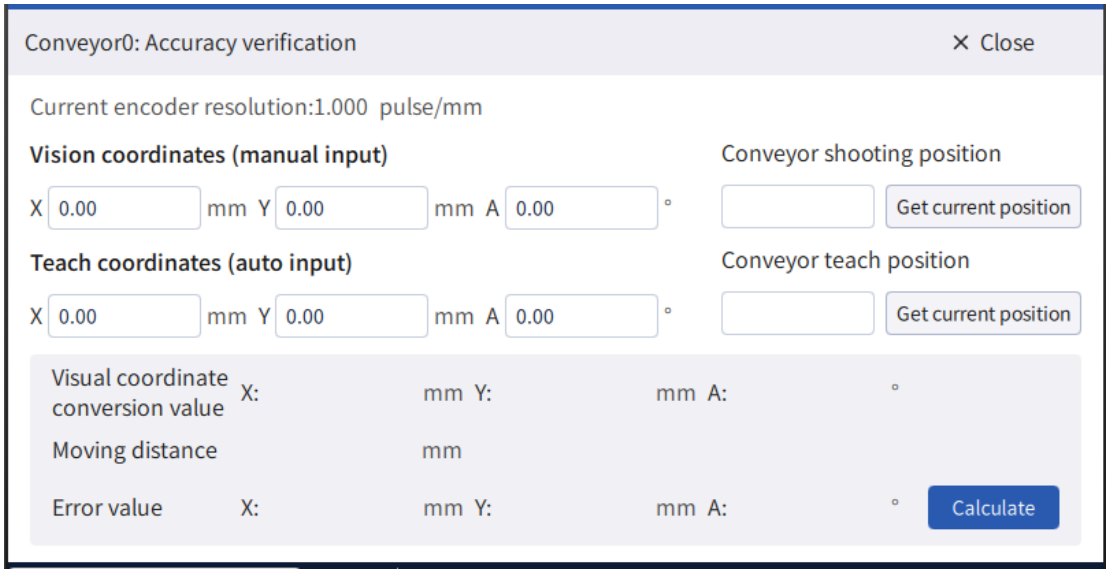
11.1.7 Auxiliary Functions

11.1.7.1 Accuracy Verification

After setting all parameters of the tracking process, you can perform error calculation on the calibration accuracy of the whole tracking process through the accuracy verification function. The error calculation covers the encoder resolution calibration, conveyor frame calibration, and vision calibration. You can access the accuracy verification function as shown below.



Click the "Accuracy verification" button to access the accuracy verification function.



The verification process is as follows.

1. Stop the conveyor. Place a marker point that can be recognized by the vision device on the conveyor below the camera. Take a photo to obtain the pixel coordinates (X,Y, A) of the marker point and fill in the "Vision coordinates (manual input)" box, and click "Get current position" under "Conveyor shooting position" to record the encoder value.
2. Move the conveyor with the position of the marker point relative to the conveyor unchanged. After the marker point enters the robot's motion range, stop the conveyor. Align the robot tool end to with the marker point and click "Get current position" under "Conveyor teach position". The coordinates of this marker point under the conveyor frame and the encoder value are obtained automatically.
3. Click "Calculate" to automatically calculate the vision coordinate conversion values, moving distance, and overall accuracy error. (Error Value = Teaching Coordinate - Offset Vision Coordinate).

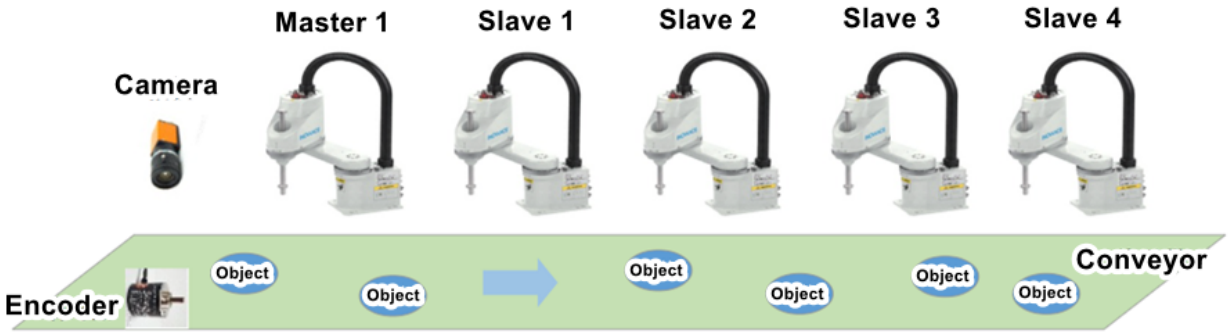


If a tool is installed at the end of the robot, you need to activate the corresponding tool frame number.

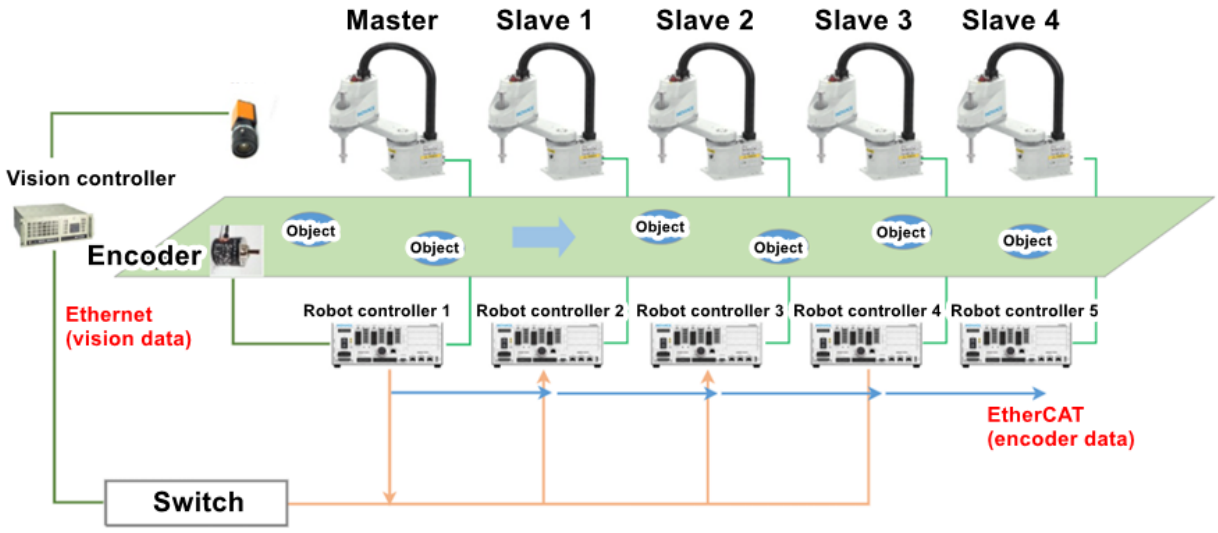
11.1.7.2 One-Drive-Many Vision Function

Overview

- In the normal conveyor tracking process, one robot requires one sensor plus one encoder to grasp the objects on the conveyor.
- With the one-drive-many vision function, at most five robots only require one camera plus one encoder to grasp the objects on the conveyor. The object missed by one robot will be grasped by the next robot.
- Currently, the one-drive-many vision function is only applicable to the linear conveyor, and to the detection methods including Vision, Instructions + Vision, and Vision + Sensor.



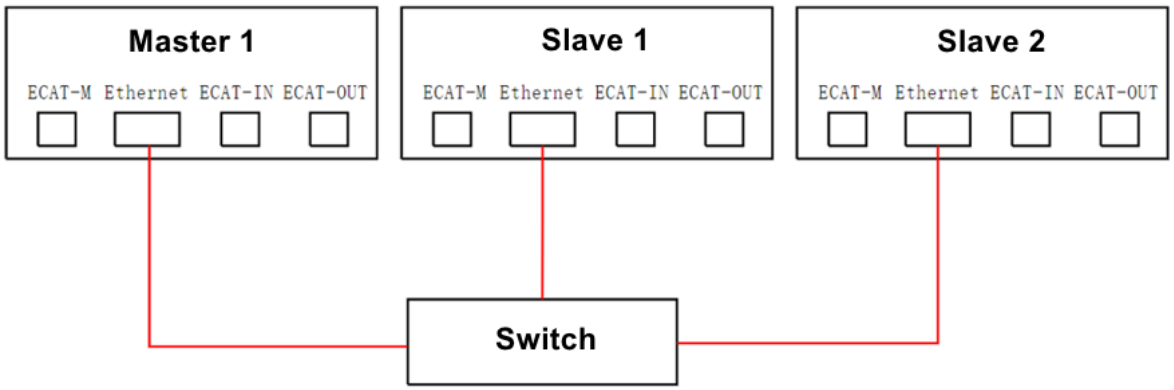
Hardware configuration:



1. Connect the encoder: Connect the encoder to the master robot controller. For details, see section 11.1.2.1 Connecting the Encoder.

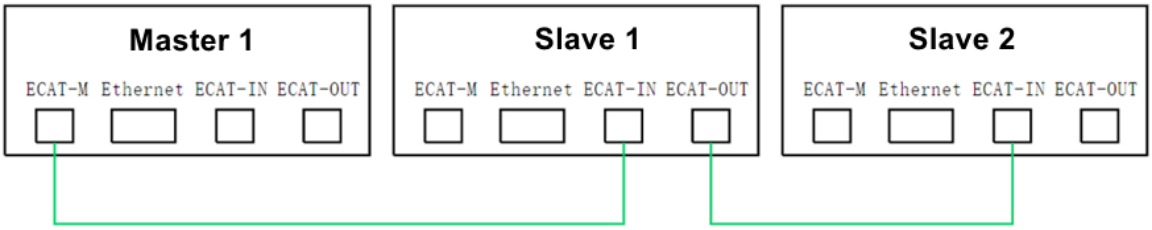
2. Install the camera and I/Os: Connect the I/O trigger cable of the camera to the I/O terminal of the master robot controller.

3. Configure the TCP protocol:
   The sharing of camera data is based on the TCP/IP protocol. To ensure normal communication between the master and slave robot controllers, it is needed to configure the IP addresses of all controllers to be on the same network segment.



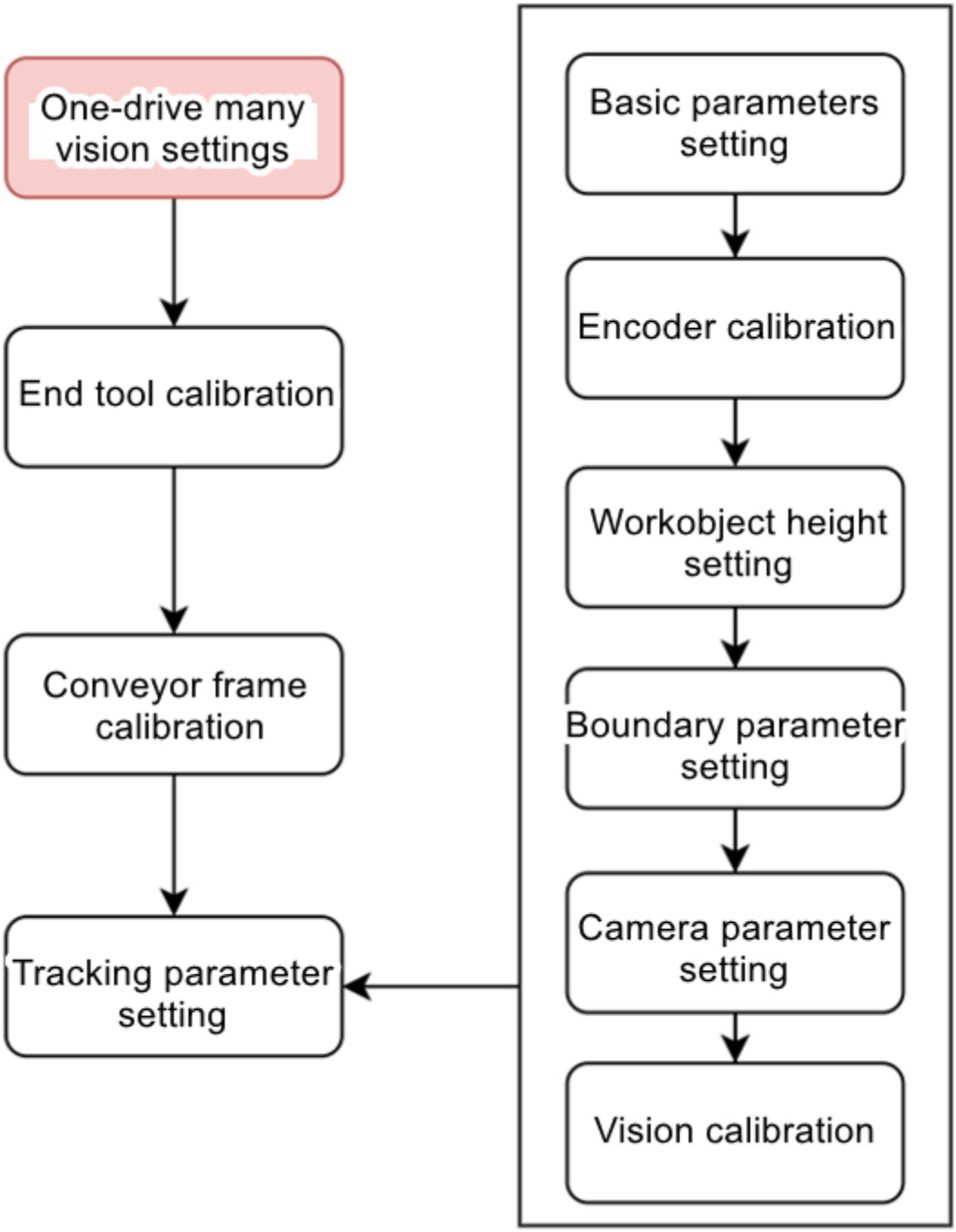
4. EtherCAT:

   The sharing of encoder data is based on the EtherCAT protocol. To ensure sharing of encoder data, make sure all devices are connected according to the figure shown below.



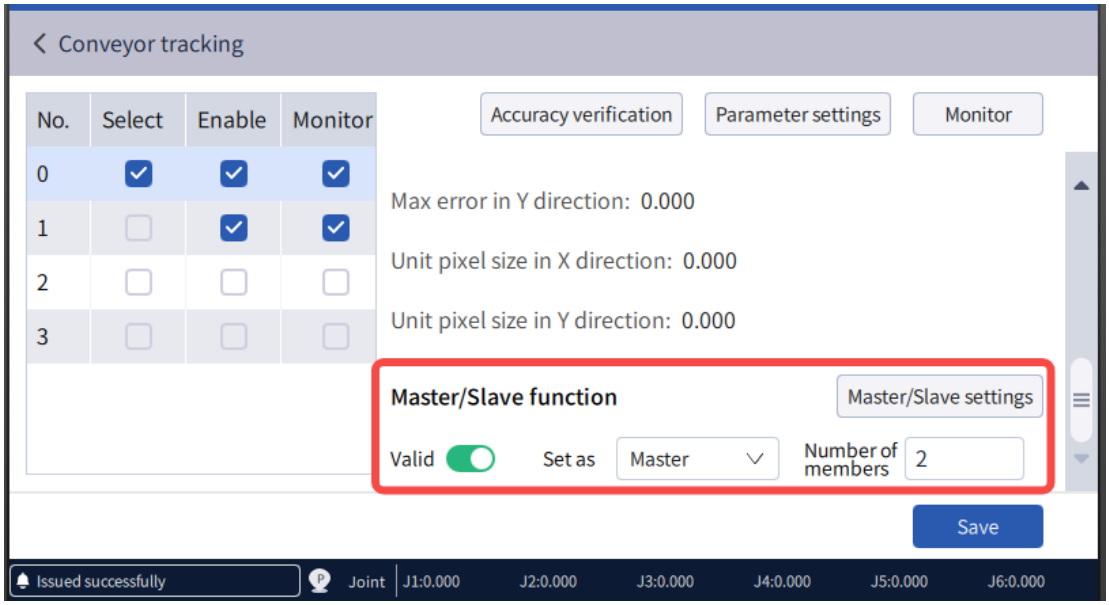
▪ Master robot configuration:

The end tool calibration, conveyor coordinate calibration, and the tracking process parameters for the one-drive-many vision function are the same as those for the regular tracking process.

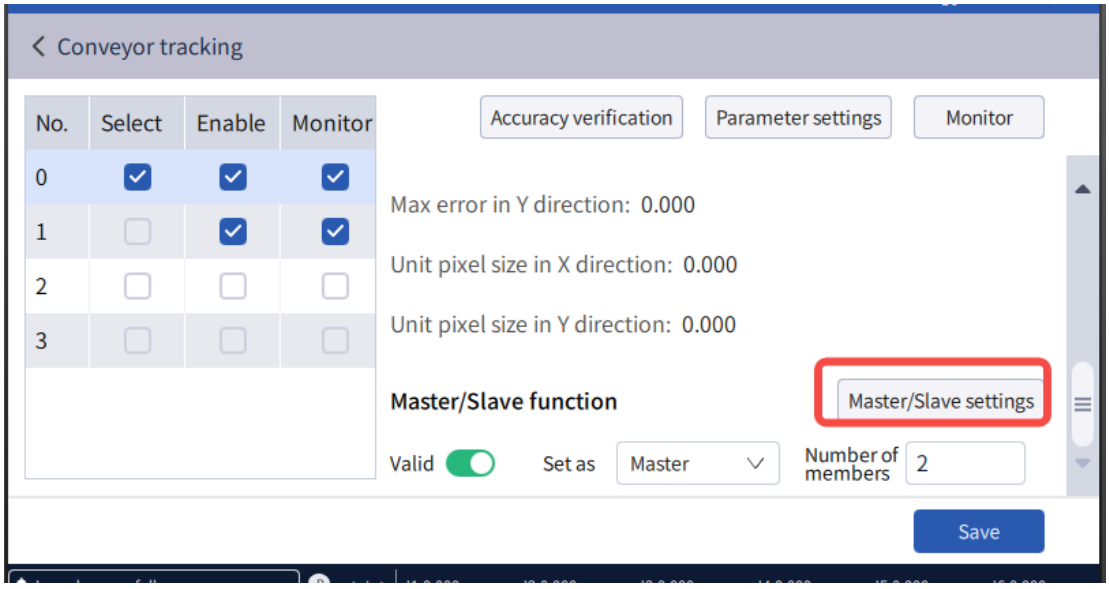


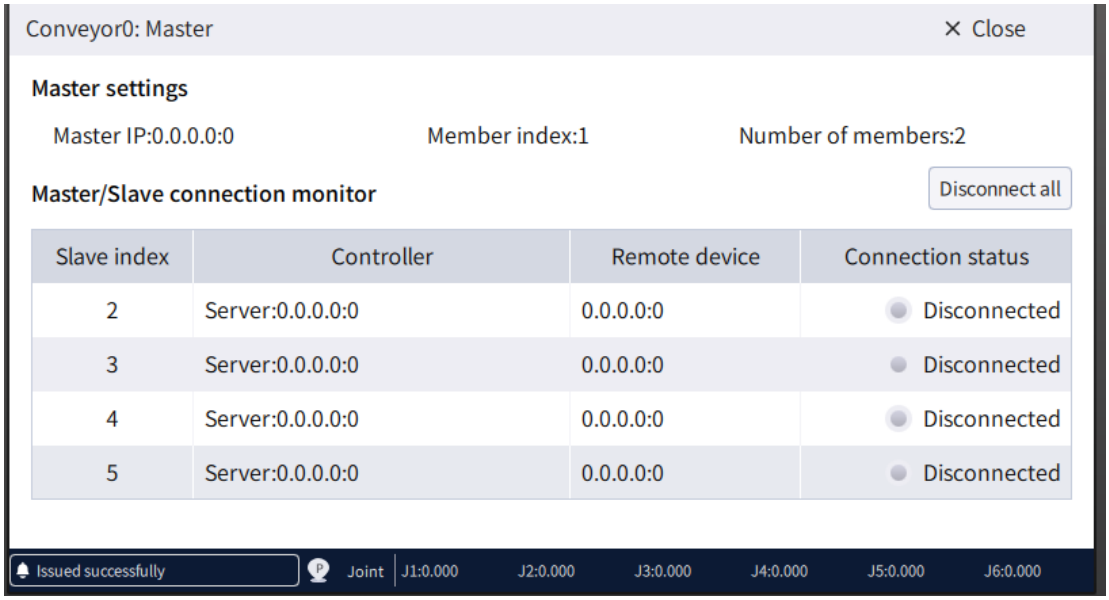
▪ One-drive-many vision function configuration

Switch the "Master/Slave function" to "Valid", set the robot as "Master", set "number of members", and click "Save". Then restart the controller.



You can click "Master/Slave settings" to view the TCP connection status of the slaves.





CAUTION

The number of members refers to the sum of master and slave robots.

After setting a robot as the master, you must restart the controller of that robot.

Currently, you can enable the master/slave function for only one conveyor.

It is not allowed to modify the IP address of the controller after the one-drive-many vision function is enabled. It is recommended to use a fixed IP address.

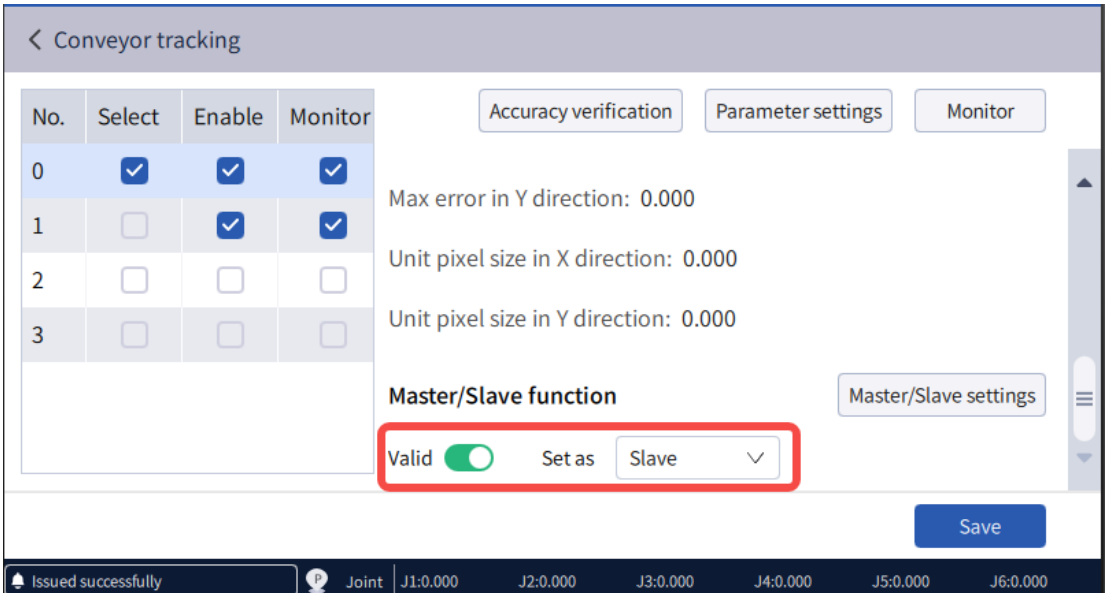
5. Tracking process configuration:

The end tool calibration, conveyor coordinate calibration, and the tracking process parameters for the one-drive-many vision function are the same as those for the regular tracking process.

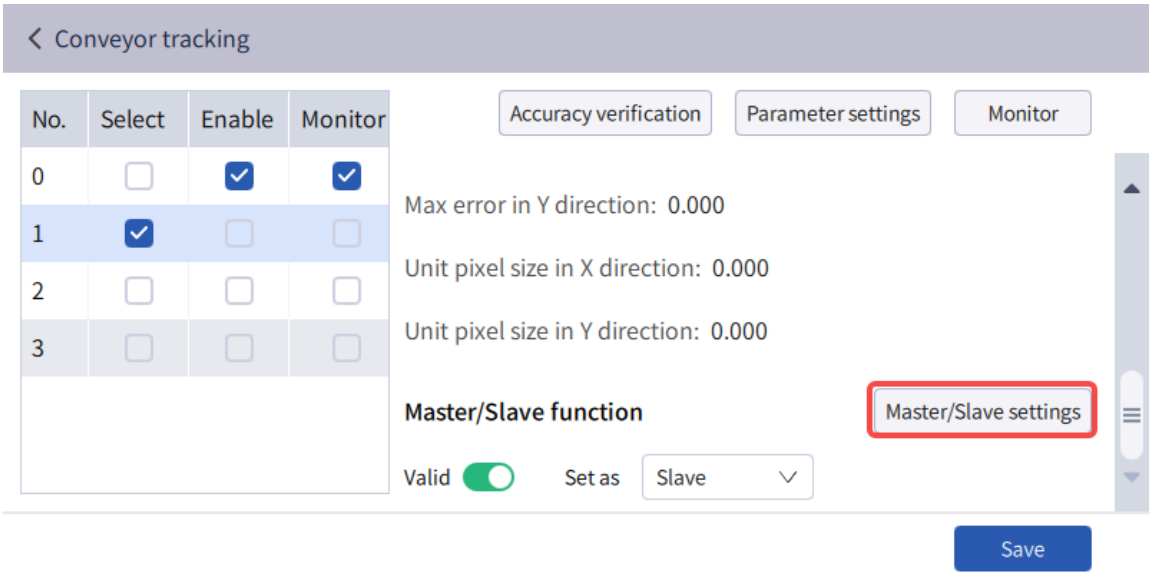
▪ Slave robot configuration:

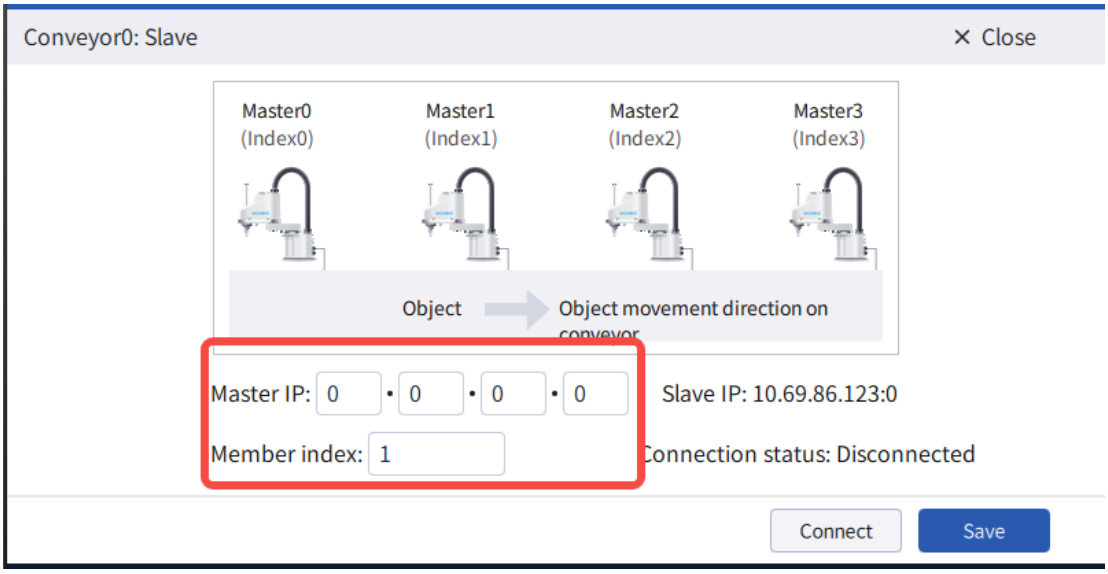
1) One-drive-many vision function configuration

Switch the "Master/Slave function" to "Valid", set the robot as "Slave", and click "Save". You do not need to restart the controller.



Click "Master/Slave settings", set the "master IP" and "Member index" and click "Connect".





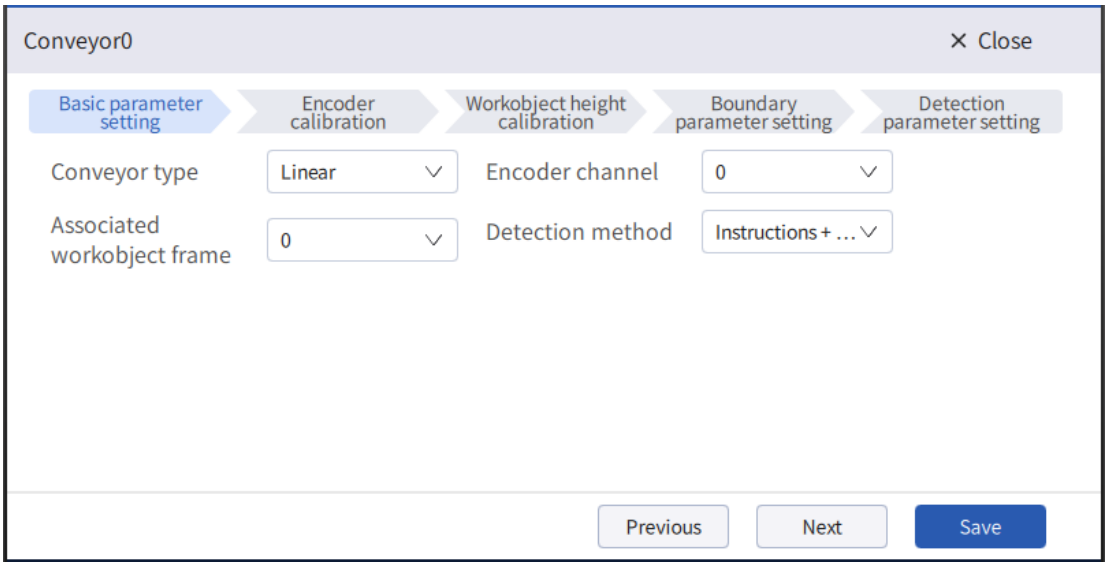
CAUTION

- After setting a robot as the slave, you do not need to restart the controller of that robot.
- Currently, you can enable the master/slave function for only one conveyor.
- It is not allowed to modify the IP address of the controller after the one-drive-many vision function is enabled. It is recommended to use a fixed IP address.
- The member index must be set from small to large according to the conveyor direction. It is not allowed to set different robots to the same index.

2) Tracking process configuration

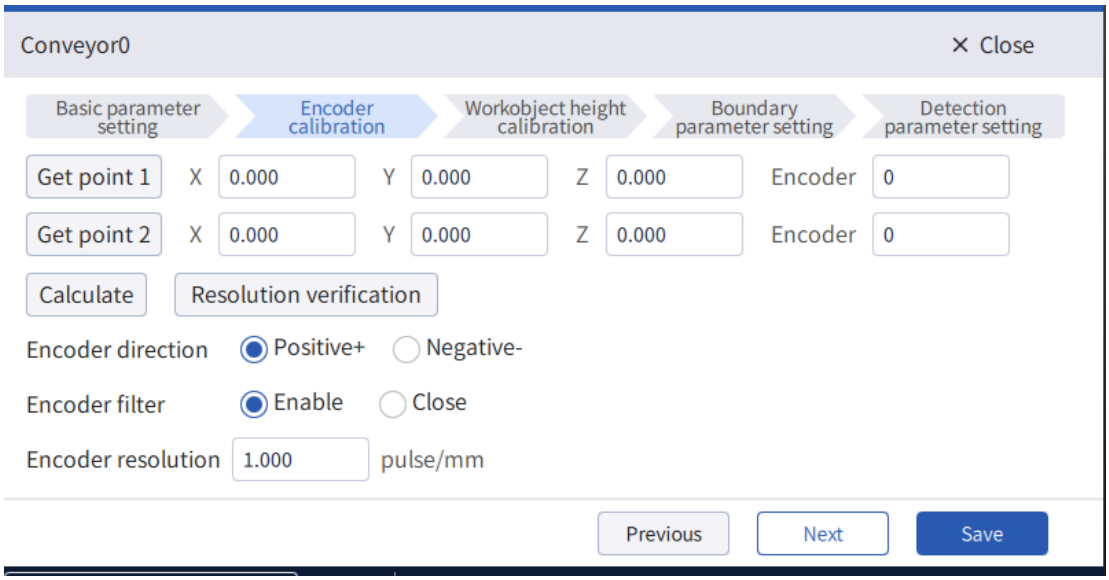
The end tool calibration, conveyor coordinate calibration, and the tracking process parameters for the one-drive-many vision function are basically the same as those for the regular tracking process, with certain slight differences.

When a robot is set as a slave, the "Conveyor type" is fixed to "Linear", "Encoder channel" parameter is fixed to "Ethernet" and the "Detection method" is fixed to "Vision".

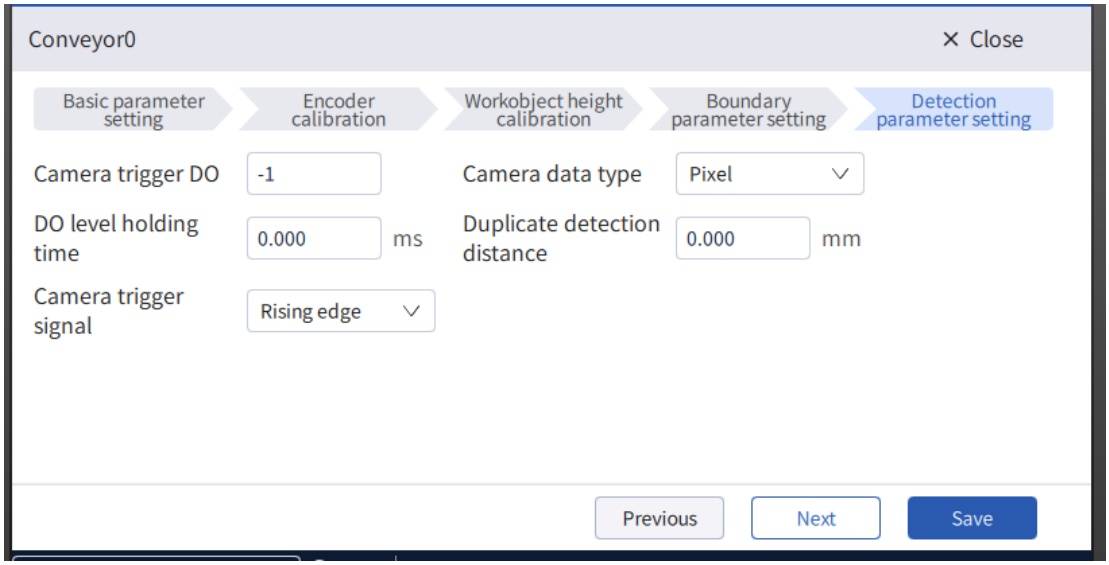


The tracking process needs to use the encoder value. Before configuring the one-drive-many vision function of the slave robots, it is recommended that you connect the master and slave robots via

EtherCAT and configure the one-drive-many vision function of the master robot, so that all slave robots can acquire the encoder value.



When a robot is set to a slave, its detection parameter settings cannot be modified except for "Camera data type".



- Vision software configuration:

Only the master robot receives data sent from the vision controller. Connect the trigger I/O of the vision controller to I/O terminal of the master robot controller. The vision controller acts as a server and the master robot acts as a client.

Example program:

The robot starts from wait point P[0], picks up an object from the conveyor (P[30] fixed to the object), and then moves to P[1] to complete the task. The task flow is repeated. The object missed by one robot will be picked up by the next robot.

1. Master robot program:

Start;

##Open the port. The external device acts as the server, with an IP 10.45.151.59 and a port 2000.

##The local controller acts as a client and the port number is 1234.

B[0] =0;

```
While B[0] <> 1
Open Socket("10.45.151.59",2000,1234,Single,B[0]);
EndWhile;
CnvVision(Conveyor[1],OFF,1234);
CnvVision(Conveyor[1],ON,1234);          ###Opens the vision port of conveyor #1, with a client port number 1234
P[30]= (0,0,10,0,0,0),(0,0,0,0),(7,0,0);          ##Defines P[30] as a point under the object frame, with coordinates (0,0,10,0,0,0)
L[0]:
Movj P[0],V[100],Z[0],Tool[0];                ##Moves to the wait position
L[1]:
GetCnvObject(1,0), Goto L[1];                ##Queries the queue for object of type 0 on conveyor #1
RefSys Conveyor(1,Tool[2]);                    ##Switches the motion reference frame to the object that has just been found
Movl P[30],V[100],Z[1],Tool[2];              ##Uses tool 2 to move to the point P[30] under the object frame
Delay T[1];                                    ##Keeps the robot moving with the conveyor for 1s
Set Out[1],ON;                                 ##Turns on the switch to suck the object
RefSys Base;                                   ##Switches the motion reference system to the robot
Jump P[1],V[100],Z[0],Tool[0],LH[10],MH[-750],RH[10];    ##Moves the object to P[1]
Set Out[1],OFF;                                ##Places the object
Goto L[0];
End;
```

2. Slave robot program:

```
Start;
##Open the port. The external device acts as the server, with an IP 10.45.151.59 and a port 2000.
##The local controller acts as a client and the port number is 1234.
B[0] =0;
CnvVision(Conveyor[1],OFF,1234);    ##Turns off vision of the conveyor #1
P[30]= (0,0,10,0,0,0),(0,0,0,0),(7,0,0);  ##Defines P[30] as a point under the object frame, with coordinates (0,0,10,0,0,0)
L[0]:
Movj P[0],V[100],Z[0],Tool[0];                ##Moves to the wait position
L[1]:
GetCnvObject(1,0), Goto L[1];                ##Queries the queue for object of type 0 on conveyor #1
RefSys Conveyor(1,Tool[2]);                ##Switches the motion reference frame to the object that has just been found
Movl P[30],V[100],Z[1],Tool[2];          ##Uses tool 2 to move to the point P[30] under the object frame
Delay T[1];                                    ##Keeps the robot moving with the conveyor for 1s
```

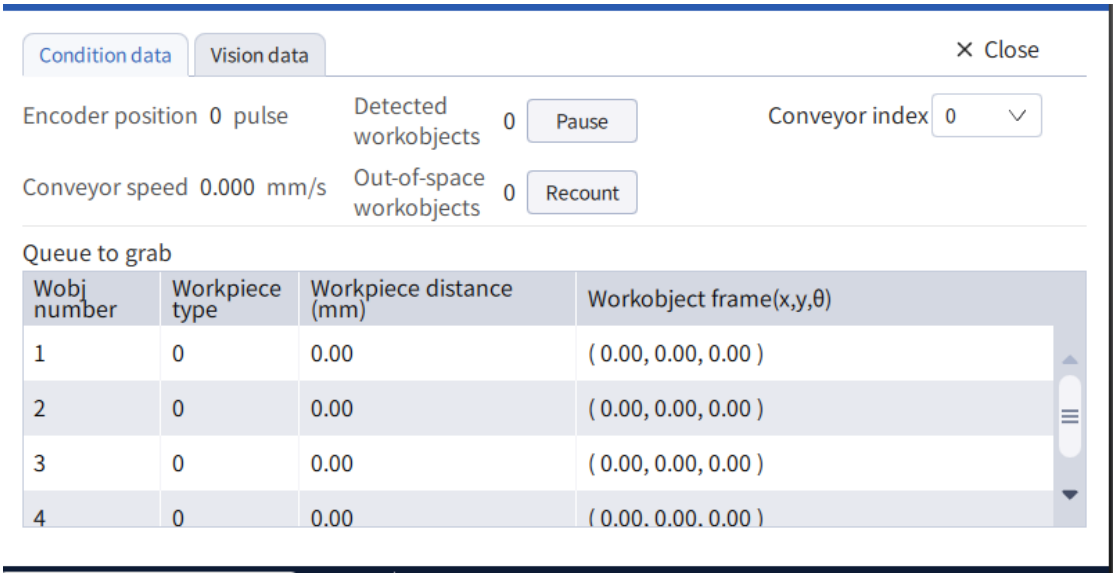
```
Set Out[1],ON;                    ##Turns on the switch to suck the object
RefSys Base;                      ##Switches the motion reference system to the robot
Jump P[1],V[100],Z[0],Tool[0],LH[10],MH[-750],RH[10]; ##Moves the object to P[1]
Set Out[1],OFF;                   ##Places the object
Goto L[0];
End;
```

CAUTION

Before running the one-drive-many vision program on the master robot, check that the TCP connections of all the slave robots are normal. If a slave robot is not connected, an error occurs when running the one-drive-many vision program on the master robot.

11.1.7.3 Monitoring Interface

If you click the "Monitor" button for a conveyor on the "Conveyor tracking" setting page, you can view the real time monitoring information of the selected conveyor in "Monitor" > "Condition monitor". The monitor displays various monitoring information such as conveyor speed, the number of detected workobjects etc. You can switch monitoring of different conveyors.



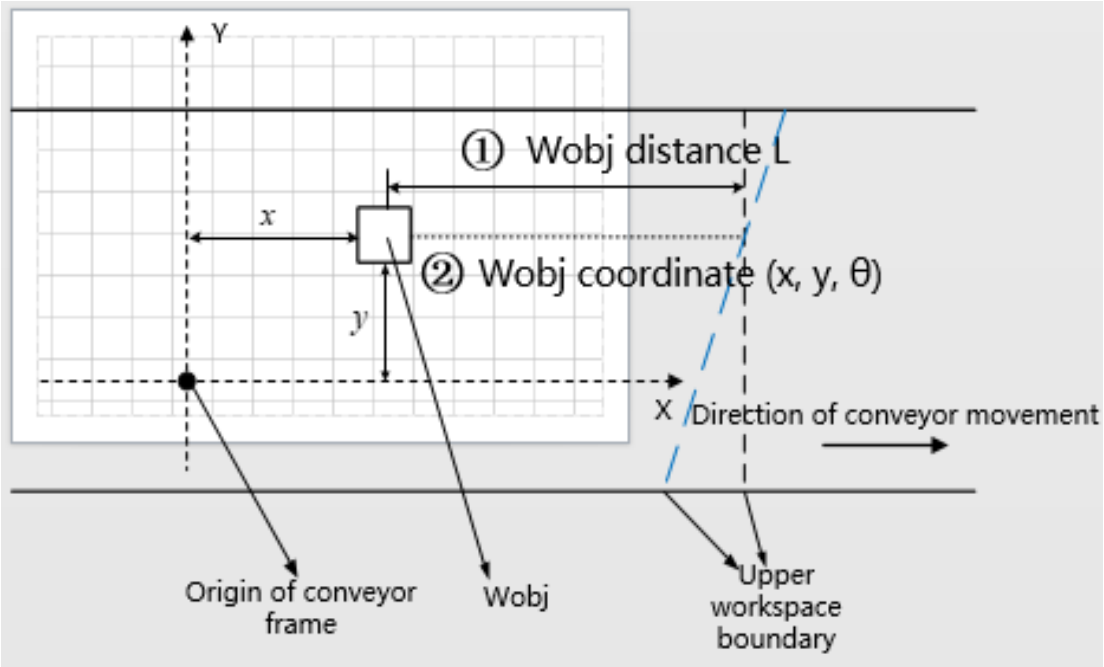
The following information is displayed on the monitoring interface of the conveyor tracking process.

1. Encoder position: The encoder value associated with the conveyor, in pulse
2. Conveyor speed: The moving speed of the conveyor, in mm/s or °/s
3. Detected workobjects: The number of workobjects in the workobject queue, that is, the total number of workobjects between the sensor or camera's field of view and the lower pickup boundary
4. Out-of space workobjects: The total number of workobjects that have been detected by the sensor or camera, but failed to be picked up and thus exceeding the lower pickup boundary, from the start of the program to the current time

> **CAUTION**
>
> You can click the "Recount" button on the right to clear the current count and start counting again.

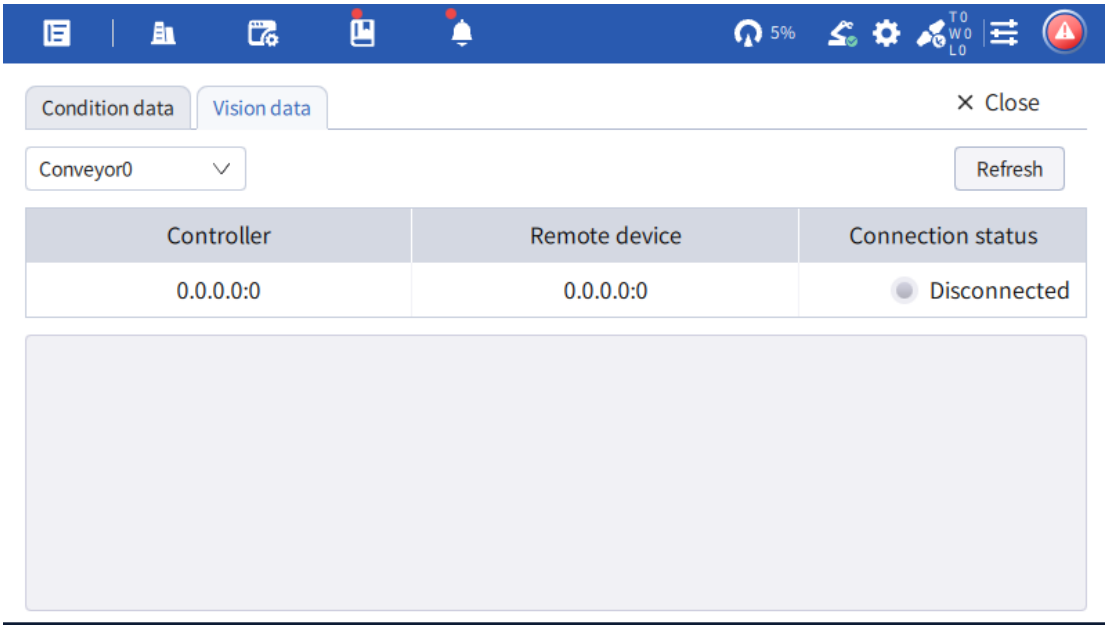
5. Queue to grab (Up to the first 10 workobjects can be displayed)

- Wobj number: The workobjects are ordered in the queue according to their positions on the X axis of the conveyor frame. The workobject furthest downstream of the conveyor is displayed first. Workobject #1 represents the next workobject to be picked up by the robot. It is the workobject furtherest downstream between the sensor or camera's field of view and the lower pickup boundary. When a workobject is retrieved by GetCnvObject or CopyCnvObject instruction or it exceeds the lower pickup boundary, the workobject is automatically removed from the workobject queue. Range: 0 to 10
- Workobject type: The type of workobject. Range: 0 to 15
- Workobject distance: The distance L (① as shown below) between the workobject on the conveyor and the upper workspace boundary. This distance is negative when the workobject is located upstream of the upper workspace boundary, and positive when it exceeds the upper workspace boundary. When the upper workspace boundary is diagonal, the workobject distance is the distance between the current position of the workobject and the intersection point of the horizontal line in the X direction of the conveyor frame and the upper workspace boundary. Unit: mm or °.
- Workobject frame (x, y, θ): The coordinate values of the workobject in the conveyor frame (② as shown below).



Pause/Refresh button: By default, the button displays "Pause". After you click the "Pause" button, the data on the monitoring interface remains unchanged. The button name changes from "Pause" to "Refresh". When you click the "Refresh" button, the monitoring data is refreshed at a rate of 1s.

Click "Vision data" tab to switch to the vision data monitoring interface:



The vision data monitoring interface displays the following information.

- Controller: The IP address of the current controller.
- Remote device: The IP address of the remote device.
- Connection status: The Connected/Disconnected status with remote device.
- Conveyor coordinates: The spatial coordinate values of the workobject in the conveyor frame.
- Pixel coordinates: The pixel coordinate values of the workobject in the camera frame.
- Pause/Refresh button: By default, the button displays "Pause". After you click the "Pause" button, the data on the monitoring interface remains unchanged. The button name changes from "Pause" to "Refresh". When you click the "Refresh" button, the monitoring data is refreshed.

11.2 Vision Calibration

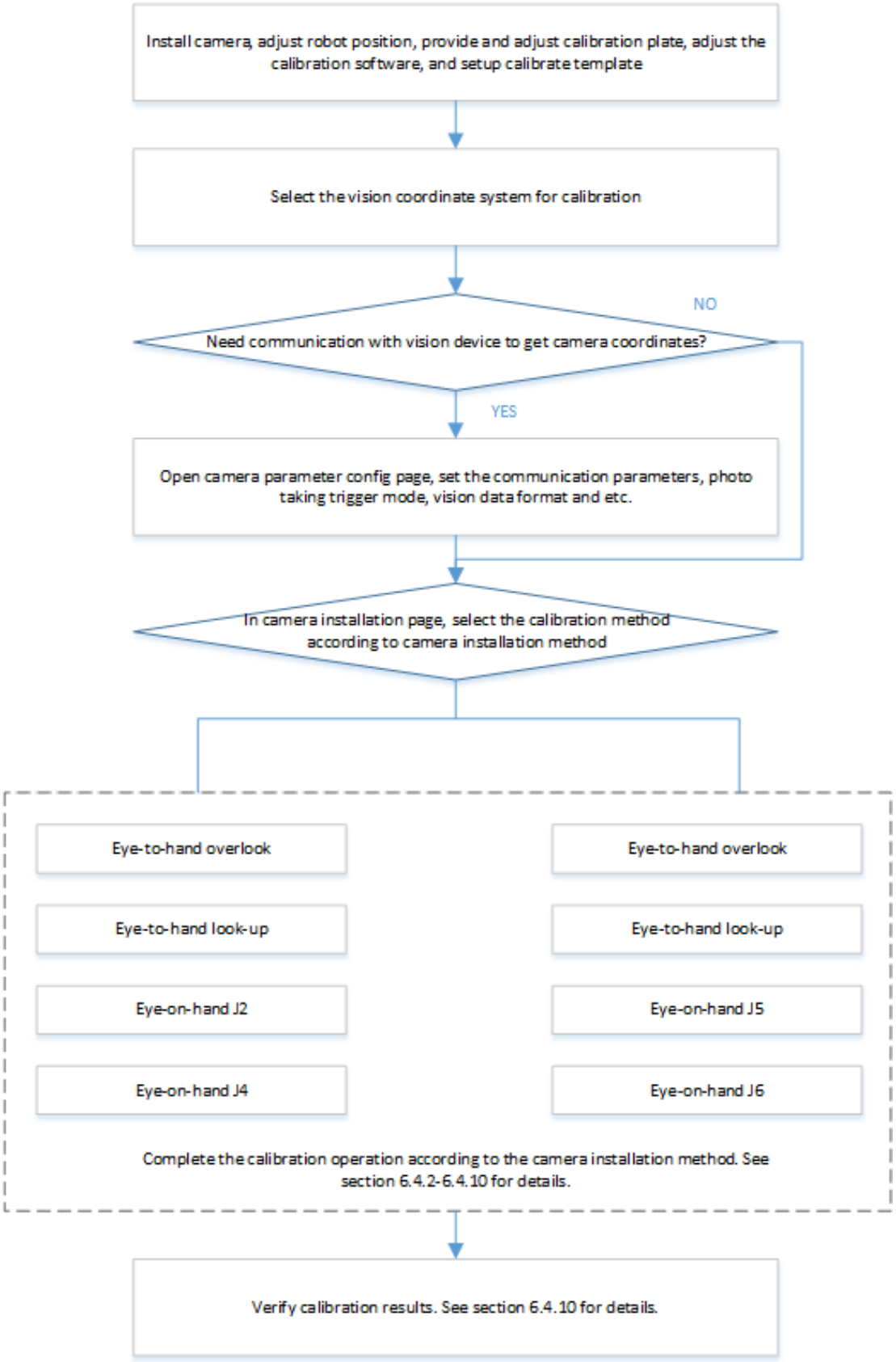
11.2.1 Overview

Vision calibration is the prerequisite to use the vision function of the robot system. The purpose of calibration is to obtain the relative position relationship between the camera and the robot, so that the pixel coordinates can be converted to the robot coordinates in subsequent operations. Inovance provides SCARA robots and 6-axis robots. These two types of robots have the following differences in the vision calibration operations.

Calibration steps	Operations for SCARA robots	Operations for 6-Axis robots
Calibrate the end fixture	-	Calibrate the end fixture
Calibrate the workobject frame	-	Calibrate the workobject frame (using calibrated end fixture)
Set the calibration parameters	Select parameters such as the calibration mode and camera installation mode	Select parameters such as the calibration mode and camera installation mode
Select datum points	Select two datum points	Select three datum points
9-point teaching	Perform 9-point teaching	Perform 9-point teaching

Calibration steps	Operations for SCARA robots	Operations for 6-Axis robots
Finish	Finish	Finish

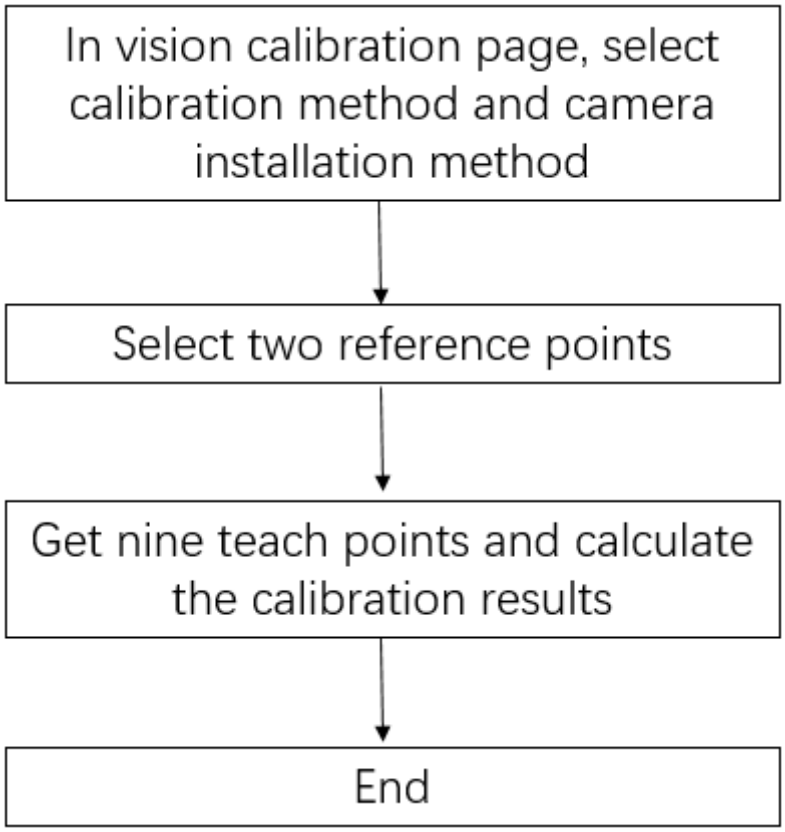
The following figure shows the vision calibration flowchart.



11.2.2 Vision Calibration of SCARA Robots

The vision calibration of SCARA robots includes Eye-to-Hand overlook calibration, Eye-to-Hand look up calibration, Eye-in-Hand J2 calibration, and Eye-in-Hand J4 calibration. All controller versions support vision calibration of SCARA robots.

Due to its structural limitations, SCARA robots generally work on user plane parallel to the base plane. The calibration process of SCARA robots does not require an associated workobject frame, and only two datum points are need for the datum point teaching. The vision calibration process of SCARA robots is shown below.



11.2.3 Vision Calibration of 6-Axis Robots

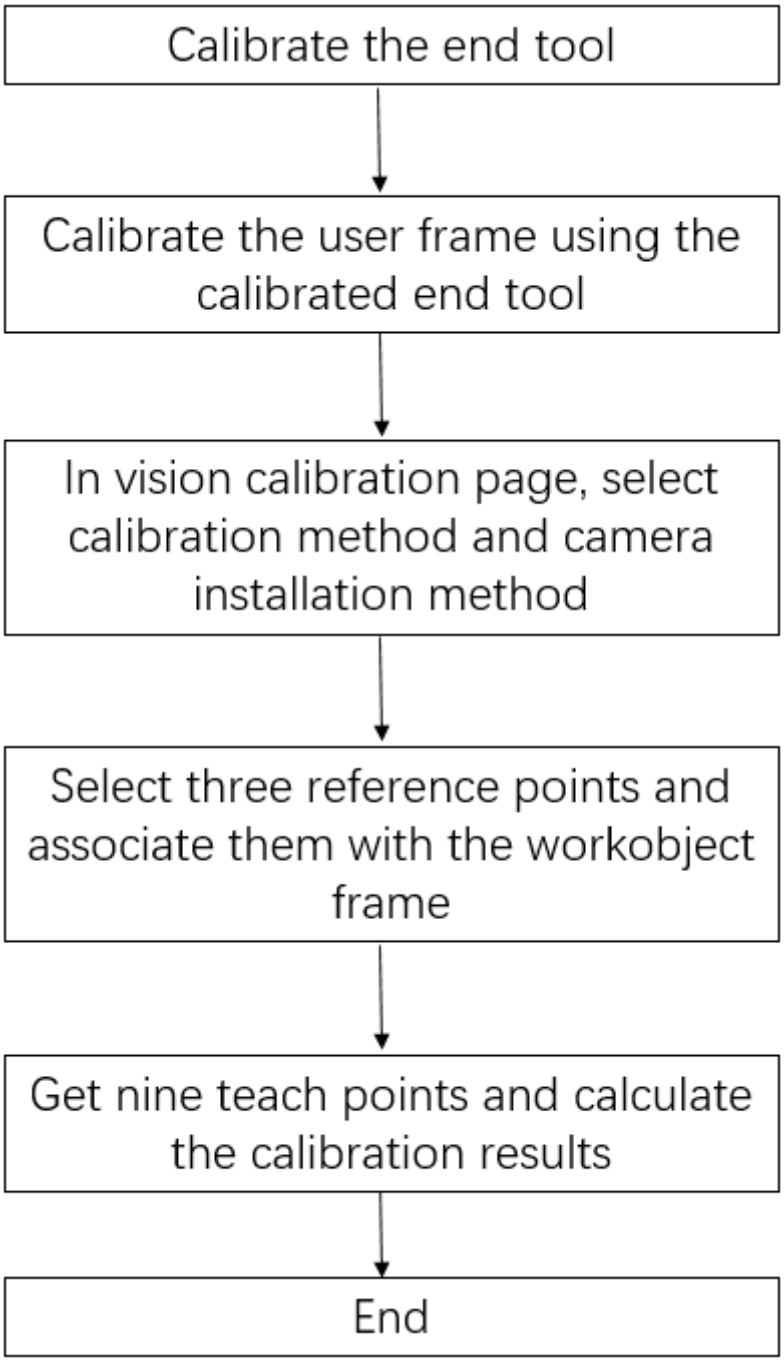
The vision calibration of 6-axis robots includes Eye-to-Hand overlook calibration, Eye-to-Hand look up calibration, Eye-in-Hand J5 calibration, and Eye-in-Hand J6 calibration. The vision calibration of 6-axis robots is only supported by controller version 17 and above.

The 6-axis robots can work on the user plane parallel to the base plane, as well as on the user plane not parallel to the base plane (but the Z direction must be upwards). During calibration, you need to select the associated workobject frame. When you select the associated workobject frame, ensure that the tool frame and workobject frame have been calibrated. In the datum point teaching, you need to select three datum points to determine the calibration tool.



When performing datum point teaching, keep the camera and calibration board in relative parallel relationship. The orientation change between each two datum points must be larger than 30°.

The vision calibration process of 6-axis robots is shown below.



CAUTION

During calibration, pay attention to the introduction of vision calibration errors. Factors that affect the calibration accuracy include manual operation accuracy, tooling precision, vision detection accuracy, absolute accuracy of the manipulator, and calibration algorithm accuracy.

11.2.3.1 Steps

Depending on the installation mode of the camera, different calibration methods can be used. For details, see the relevant sections.

Process	Reference section
Eye-to-Hand overlook calibration	11.2.4 Eye-to-Hand Overlook Calibration

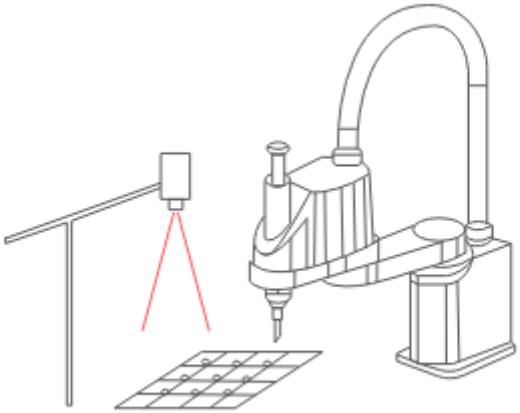
Process	Reference section
Eye-to-Hand look up calibration	11.2.5 Eye-to-Hand Look Up Calibration
Eye-in-Hand J2 calibration	11.2.6 Eye-in-Hand J2 Calibration
Eye-in-Hand J4 calibration	11.2.7 Eye-in-Hand J4 Calibration
Eye-in-Hand J5 calibration	11.2.8 Eye-in-Hand J5 Calibration
Eye-in-Hand J6 calibration	11.2.9 Eye-in-Hand J6 Calibration

11.2.3.2 Result Verification

The calibration results obtained by various calibration methods can be verified through programming. For details, see 11.2.10 Vision Process Calibration Examples and Result Verification.

11.2.4 Eye-to-Hand Overlook Calibration

The camera is installed above the calibration board, as shown below.



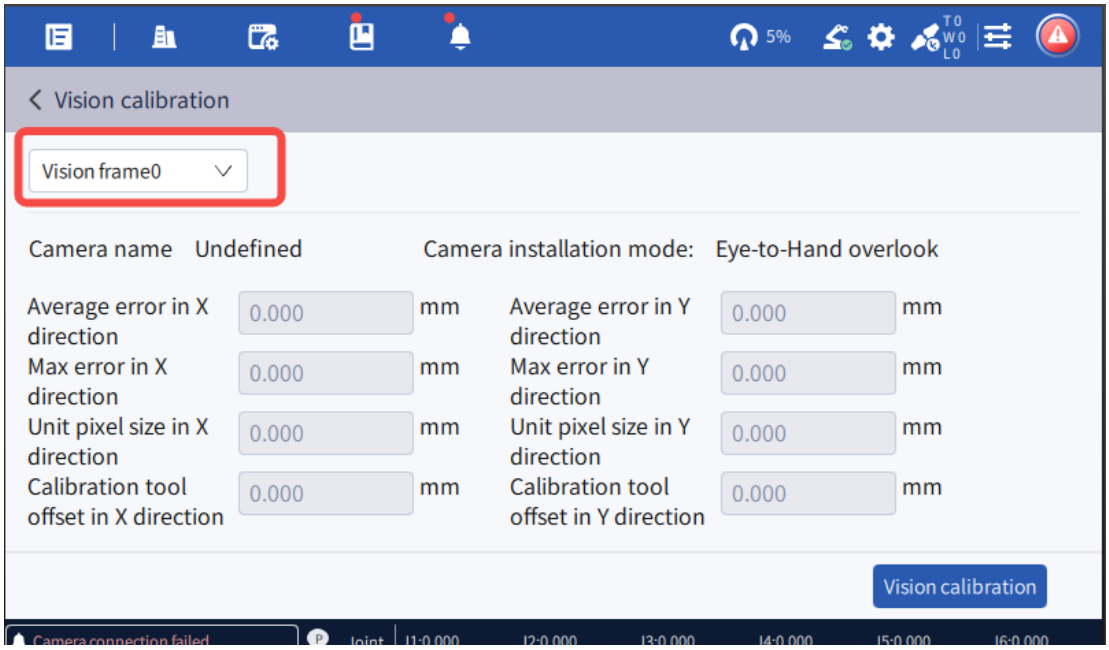
11.2.4.1 Installation Condition

- In the figure, a nine-square calibration board is placed directly below the camera. Keep the camera, robot, and calibration board on the same level. The calibration board contains nine marker points that need to be calibrated by the robot.
- Ensure that the nine marker points on the calibration board can be clearly imaged in the camera lens.
- Install a fixture at the end of the robot, which can be a tip fixture or a visually recognizable fixture.
- In case of the tip fixture, an additional 9-point calibration board is required; in case of the visually recognizable fixture, no additional device is required.

11.2.4.2 Calibration Steps

Step 1: Install the camera, adjust the robot position, place and adjust the calibration board, adjust the vision software, and create calibration templates, etc.

Step 2: Select the frame to be calibrated, as shown below.



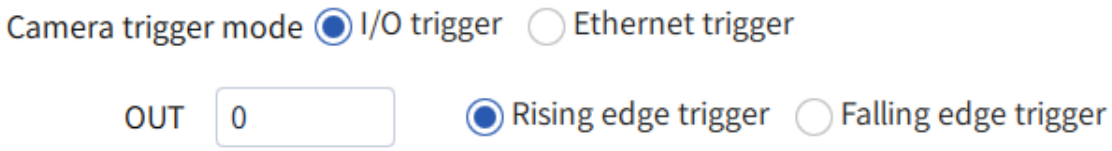
Step 3: Click the "Vision calibration" button to access the basic camera parameters setting page.

Set the vision (camera) IP address, port, and camera name (optional). After setting is complete, click "Connect to camera" to establish communication.

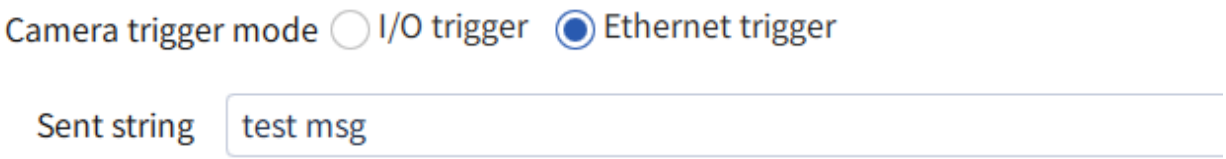
Camera trigger mode includes "I/O trigger" and "Ethernet trigger".

- If you choose "I/O trigger", the camera is to be triggered to take photo by a level signal sent from a DO of the robot. In this case, the camera's trigger method should be set to hardware trigger.
- If you choose "Ethernet trigger", the camera (namely, server) is triggered to take photo by a string sent from the robot (namely, client) through the Ethernet network. In this case, the camera trigger method should be set to software trigger.

When you select I/O trigger, you need to configure the following parameters:



When you select Ethernet trigger, you need to set the string that triggers camera to take photos:



The format of the data received by the vision device includes header, delimiter and terminator.

If you do not need to communicate with vision device to obtain the camera coordinates, click "Next".

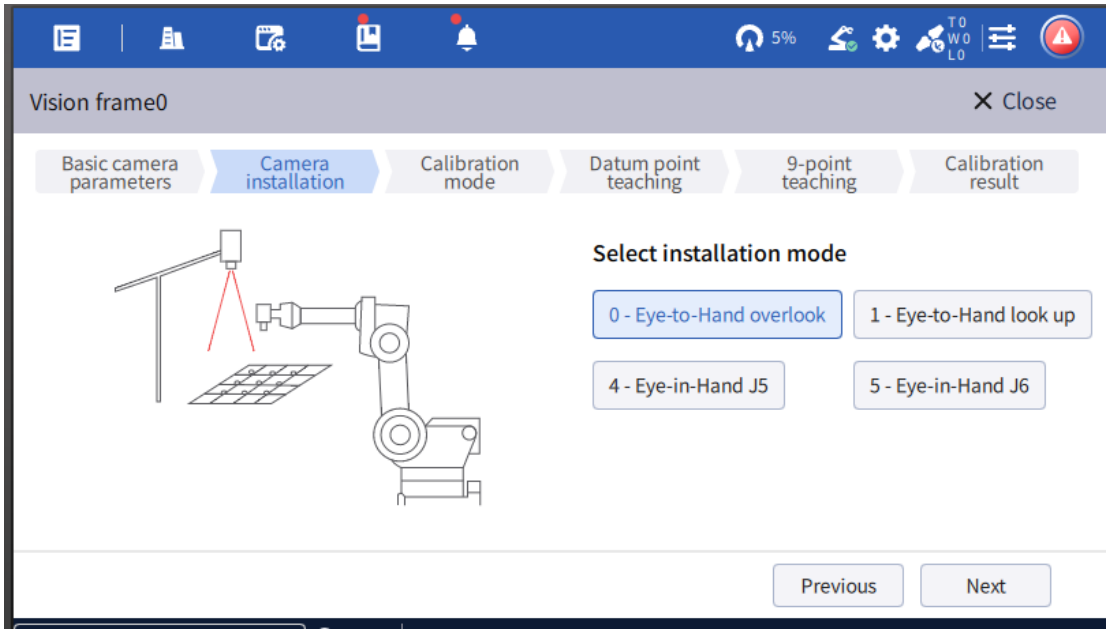
CAUTION

When the camera trigger mode is set to "Ethernet trigger", click "Communication test" to test the communication. If data sent by the peer has not been received in the receiving area, check the network cable and the connection between the peer and the robot controller.

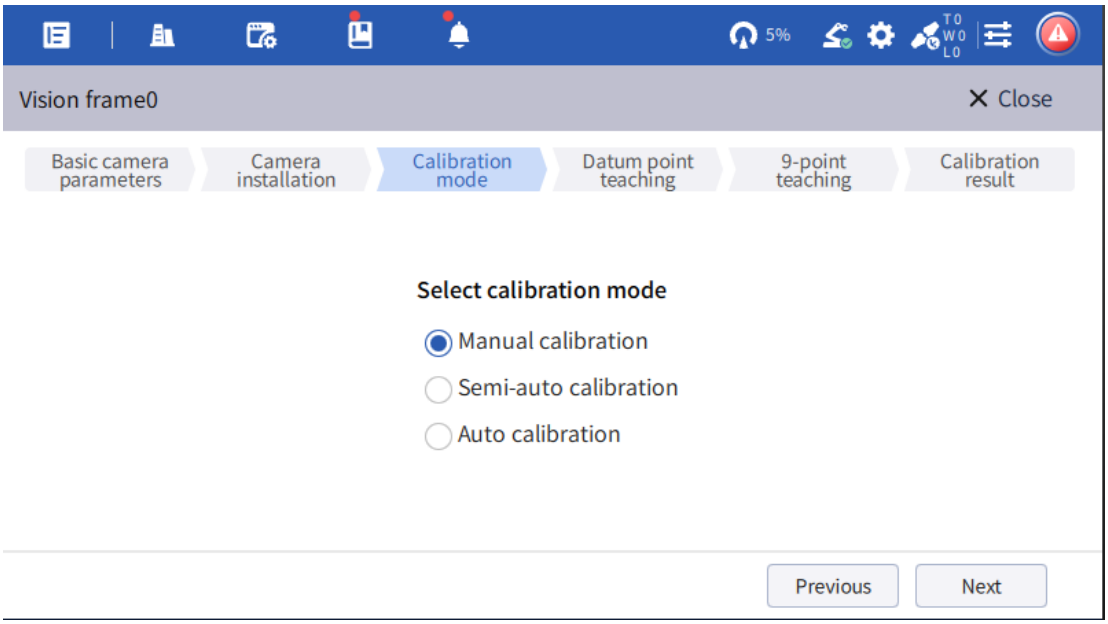
11.2.4.3 Camera Communication Test

It allows you to test communication between the robot controller and the vision software. The robot controller triggers a signal (I/O signal or a string) to the vision device. The string sent by the vision device is displayed in the data receiving area. Check whether the format of data sent is consistent with the specified format.

Step 1: Go to the camera installation mode selection page, select "0 - Eye-to-Hand overlook", and click "Next".



Step 2: Select the calibration mode and click "Next".



Three calibration modes are provided.

- Manual calibration: Manually teach the robot to calibrate the nine marker points in the calibration board and obtain the corresponding camera coordinates.
- Semi-auto calibration: Set three marker points on the pallet, from which nine marker points are generated. The robot automatically runs to the nine marker points and obtains the corresponding camera coordinates.
- Auto calibration: Generate nine marker points by teaching the robot with the center of the camera's field of view and setting the distance between nine points. The robot automatically runs to the nine marker points and obtains the corresponding camera coordinates.

Step 3: Go to the datum point acquisition page. Figure 1 shows the datum point teaching of SCARA robots, and Figure 2 shows the datum point teaching of 6-axis robots. After getting the points, click "Next".

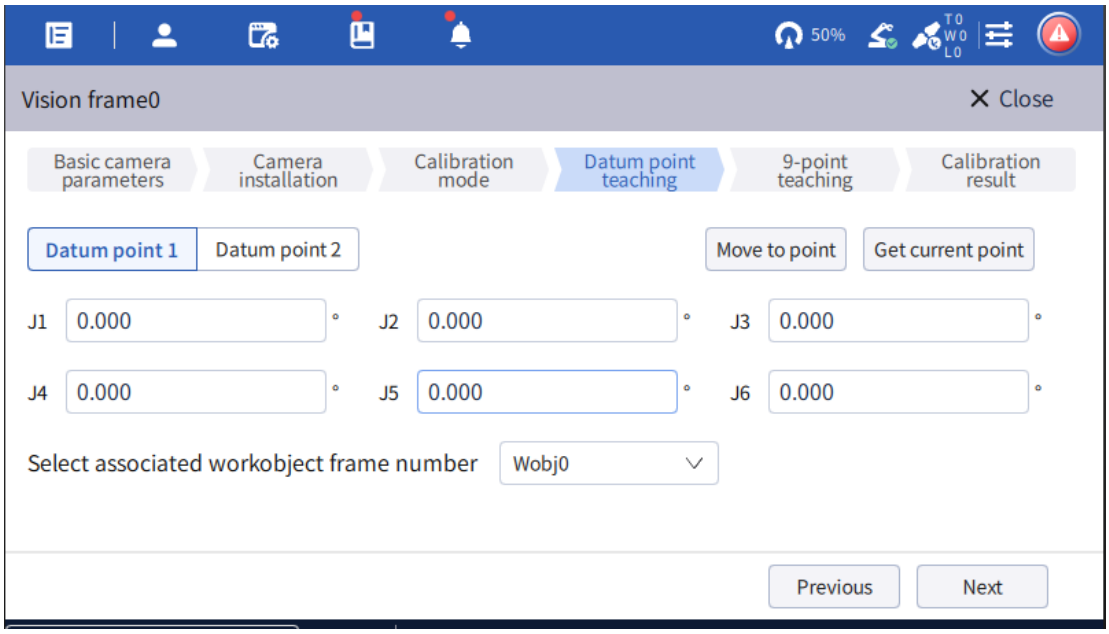


Figure 1

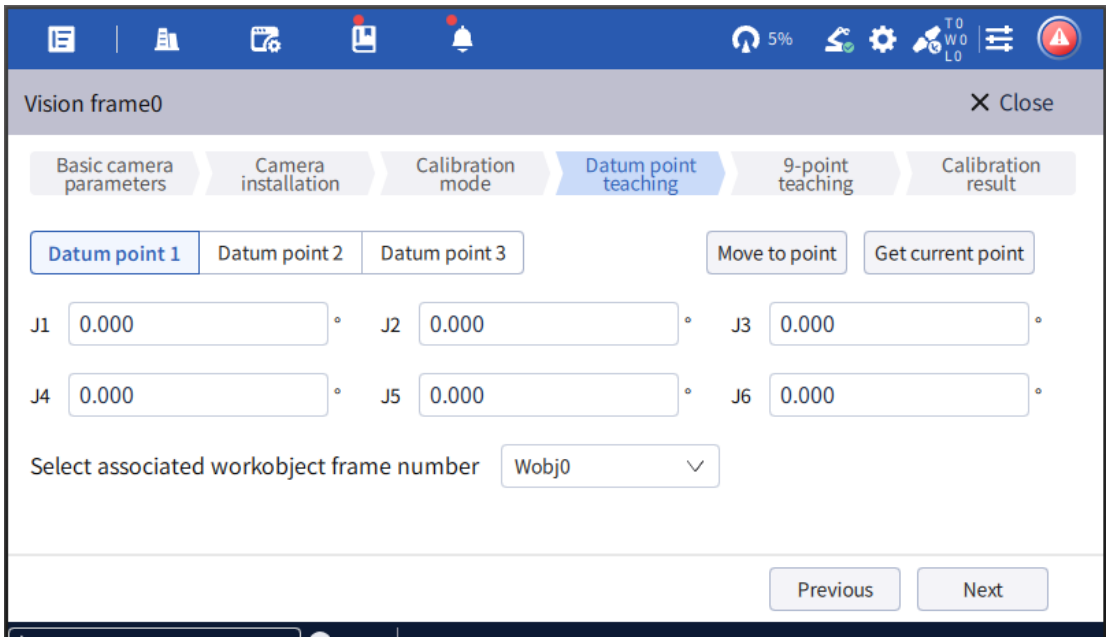


Figure 2

CAUTION

Two datum points are required for calibration of SCARA robots, and three for 6-axis robots. Set the datum point according to the calibration mode selected.

If the calibration fixture at the end of the robot is a tip fixture, teach the robot to align the tip of the fixture with the marker point at the center of the calibration board:

(1) The calibration of the SCARA robots requires two datum points. First, teach the robot to align the tip of the fixture with the marker point on the calibration board, and click "Get current point" to obtain the position of the robot as datum point 1. Then rotate the J4 axis of the robot to a certain angle and re-align the tip of fixture with the marker point, and click "Get current point" to obtain the position of the robot as datum point 2.

CAUTION

Do not select the two datum points by left and right hand rules.

(2) The calibration of 6-axis robots requires three datum points. For the calibration of tip tool of 6-axis robots, see 10.3.1 Setting the Tools. Align the tip of the fixture with the marker point at the center of the calibration board in three different orientations.

CAUTION

1. If the user plane is not parallel to the robot's base plane, before performing vision calibration, first calibrate the tool frame of the fixture's tip at the end of the robot, and then use the tool frame to calibrate the user plane, that is, the user frame (UFrame) in the workobject frame. Use "Select associated workobject frame number" to select the number of the workobject frame calibrated by the user plane.
2. Place the calibration board on the user plane. Keep the orientation difference between every two datum points as large as possible. For details, see the calibration method of the tool frame.

If the calibration fixture at the end of the robot is a visually recognizable template tool:

(1) For a SCARA robot, teach it with two datum points in either of the following two ways:

1. Align the center of the camera's field of view with a visually recognizable template tool, and click "Get current point" to obtain the position of the robot as datum point 1. Then rotate the J4 axis of the robot to a certain angle and re-align the template tool with the center of the camera's field of view, and click "Get current point" to obtain the position of the robot as datum point 2.

2. These two points are obtained according to the tip calibration method of the SCARA robot. For the tip calibration method, see 10.3.1 Setting the Tools. Align the template tool with a certain pointed device in three different orientations. For details, see the calibration method of the tool frame of the SCARA robot.

CAUTION

Do not select the two datum points by left and right hand rules.

(2) The calibration of 6-axis robots requires three datum points. For the calibration of tip tool of 6-axis robots, see 10.3.1 Setting the Tools. Align the template tool with a certain pointed device in three different orientations. Keep the orientation difference between every two datum points as large as possible. For details, see the calibration method of the tool frame of the 6-axis robot.

Step 4: In the 9-point teaching page, get the nine points and click "Next".

(1) Manual calibration:

If the calibration fixture at the end of the robot is a tip fixture:

Place the calibration board on the user plane, trigger the camera to take a photo to obtain the pixel coordinates of the nine points on the calibration board at once. Teach the robot to align the tip of the fixture with one of the points on the calibration board. Turn off "Get camera coordinates" and manually enter the pixel coordinates of the point, and then click "Get current point" to get the current joint coordinates of the robot. In the similar way, enter the pixel coordinates of all nine points in sequence to get the joint coordinates of the robot for the nine points on the calibration board.

If the calibration fixture at the end of the robot is a visually recognizable template tool:

Teach the robot to move the template tool into the camera's field of view. The camera is triggered to take a photo to get the pixel coordinates of a point on the template tool. You can get the coordinates via communication, or manually enter the coordinates. Then click "Get current point" to get the current joint coordinates of the robot. In the similar way, get pixel coordinates of nine different points on the template tool in the camera's field of view, and the corresponding robot joint values.

CAUTION

The visually recognizable template tool should be kept relatively horizontal with the camera as much as possible, while the vertical distance between the two should remain unchanged.

When the visually recognizable template tool is used as the end calibration fixture of the robot, the points on the calibration fixture should cover 2/3 of the camera's field of view as much as possible to ensure visual calibration accuracy.

(2) Semi-auto calibration:

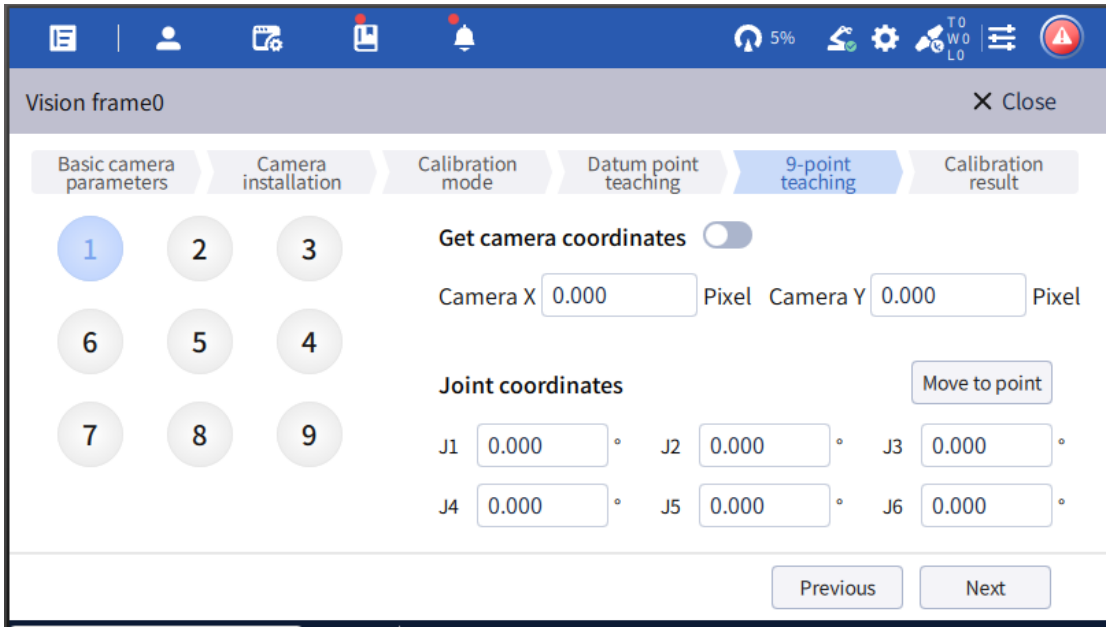
If the calibration fixture at the end of the robot is a tip fixture:

The calibration function is not available.

If the calibration fixture at the end of the robot is a visually recognizable template tool:

1. After establishing communication between the robot and the camera, select three points in the camera's field of view and click "Get current point" to obtain P[0], P[1], and P[2], as shown below. Align the intersection points of the grid lines in the camera's field of view with the marker points on the calibration board in sequence, and complete the three-point pallet teaching.

2. Click "Calibrate". The robot calculates the corresponding nine points using P[0], P[1], and P[2] as boundary points. At the same time, the robot automatically moves to the nine points in sequence, saving the robot coordinates as well as the corresponding pixel coordinates until the movement is completed.



(3) Auto calibration:

If the calibration fixture at the end of the robot is a tip fixture:

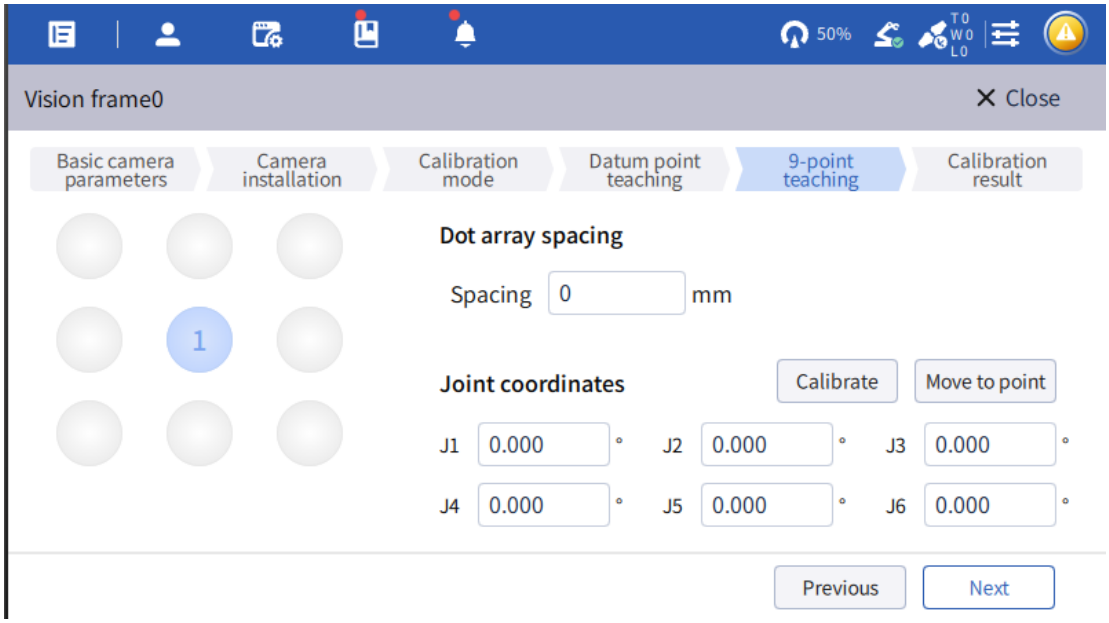
The calibration function is not available.

If the calibration fixture at the end of the robot is a visually recognizable template tool:

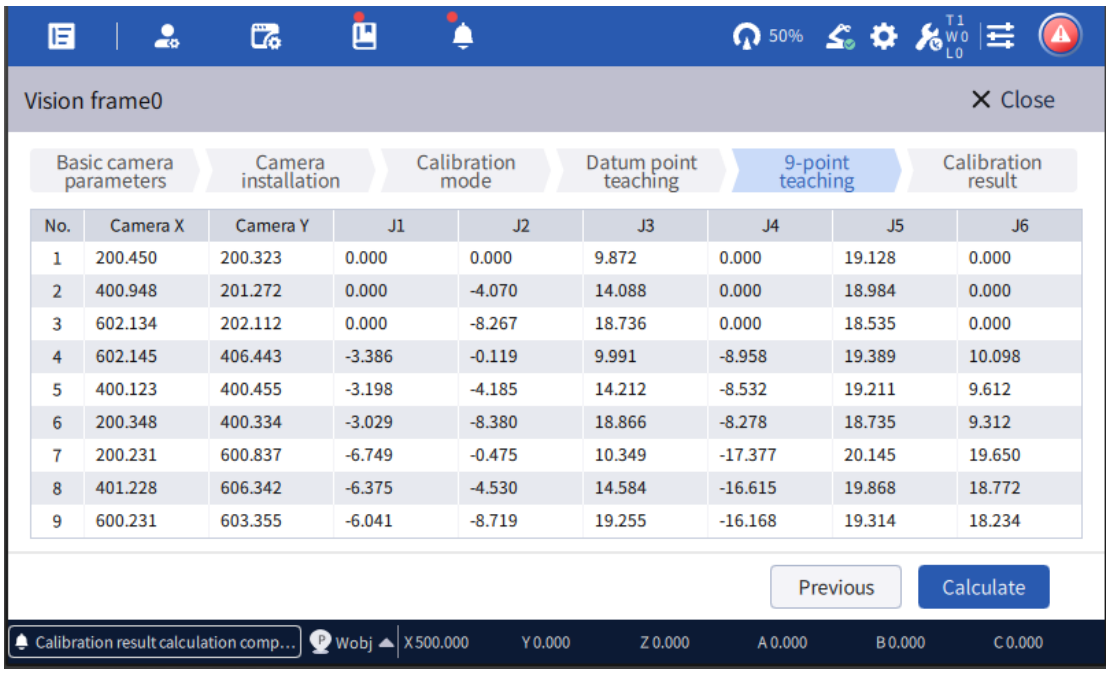
After establishing communication between the robot and the camera, teach the robot to move the template tool to the center of the camera's field of view and click "Get current point" to get the robot position P[0]. Set the "Spacing" (in mm) between points appropriately so that the nine points are all within the camera's field of view, then click "Calibrate". The robot automatically moves to the nine points in sequence, saving the robot coordinates as well as the corresponding pixel coordinates until the movement is completed.

CAUTION

The setting value of "Spacing" should be reasonably selected to ensure that the robot's motion range within the camera's field of view can cover about 2/3 of the camera's center field of view, while also ensuring that the robot's motion range does not exceed the camera's field of view.



Step 5: Enter the teaching point list page, check each robot position and pixel for any abnormalities, and click "Calculate" to perform calibration.



No.	Camera X	Camera Y	J1	J2	J3	J4	J5	J6
1	200.450	200.323	0.000	0.000	9.872	0.000	19.128	0.000
2	400.948	201.272	0.000	-4.070	14.088	0.000	18.984	0.000
3	602.134	202.112	0.000	-8.267	18.736	0.000	18.535	0.000
4	602.145	406.443	-3.386	-0.119	9.991	-8.958	19.389	10.098
5	400.123	400.455	-3.198	-4.185	14.212	-8.532	19.211	9.612
6	200.348	400.334	-3.029	-8.380	18.866	-8.278	18.735	9.312
7	200.231	600.837	-6.749	-0.475	10.349	-17.377	20.145	19.650
8	401.228	606.342	-6.375	-4.530	14.584	-16.615	19.868	18.772
9	600.231	603.355	-6.041	-8.719	19.255	-16.168	19.314	18.234

Step 6: The system calculates and generates the calibration results, as shown below.



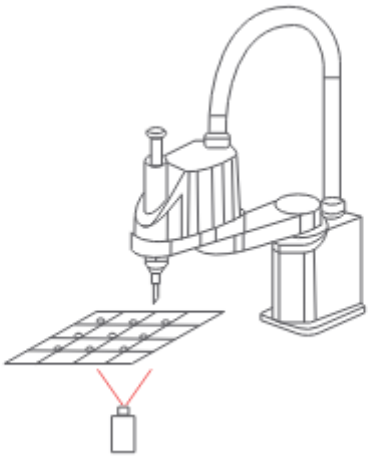
The results include average error in the X direction, average error in Y direction, maximum error in X direction, maximum error in Y direction, unit pixel size in X direction, unit pixel size in Y direction, calibration tool offset in X direction, and calibration tool offset in Y direction.

The calibration tool offset in X direction and calibration tool offset in Y direction indicate the tool parameters without rotation direction for the calibration tool.

Step 7: Click "Apply" to complete the vision calibration.

11.2.5 Eye-to-Hand Look Up Calibration

The camera is installed below the calibration board, as shown below.



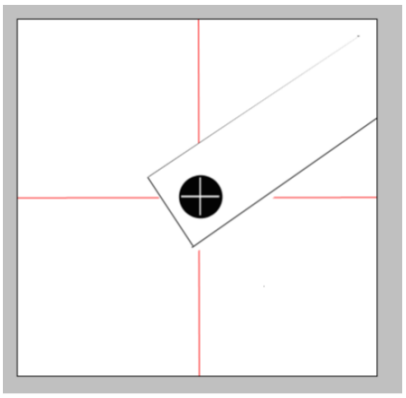
11.2.5.1 Installation Condition

Preparation

The camera is mounted directly below the robot, facing upwards. Keep the camera and robot on the same level. Install a fixture at the end of the robot. The fixture is generally a visually recognizable template tool.

Installation Condition

Adjust the camera focus and robot height to ensure that the marker points on the fixture can be clearly identified in the camera's field of view. If conditions permit, the process of eye-to-hand overlook calibration is the same with that of eye-to-hand look-up calibration.



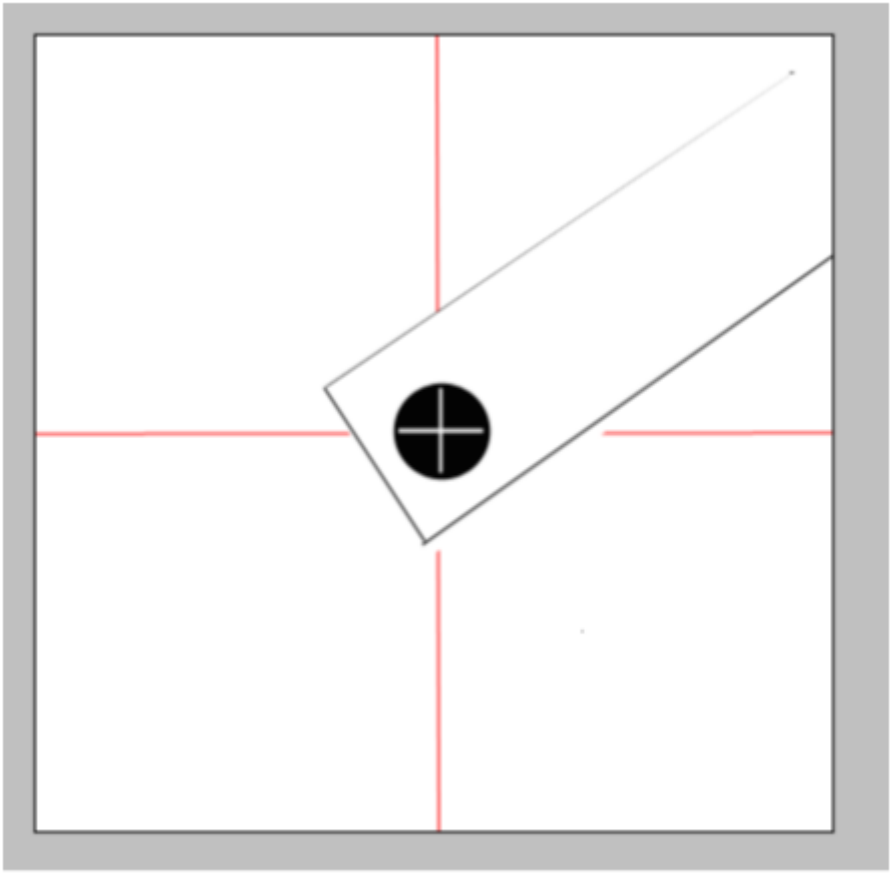
11.2.5.2 Calibration Steps

Steps 1 to 5: Same as steps 1 to 5 of 11.2.4 Eye-to-Hand Overlook Calibration.

Step 6: For SCARA robots, move the marker point on the fixture to the center of the camera's field of view to obtain datum point 1. Adjust the orientation of the robot and rotate direction of the fixture, and then move the marker point to the center of the camera's field of view to obtain datum point 2. Note that the calibration of 6-axis robots requires three datum points and the selection of associated workobject frame (When performing datum point teaching, keep the camera and calibration board in relative parallel relationship. The orientation change between each two datum points must be larger than 30°.)



Ensure that the plane of the selected datum points is consistent with the workobject frame associated with calibration.

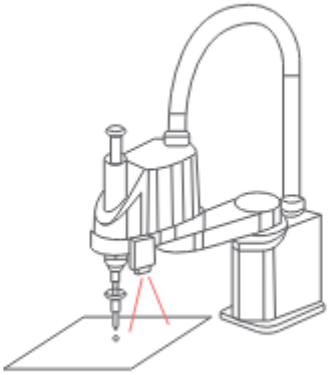


Step 7: Same as step 7 of 11.2.4 Eye-to-Hand Overlook Calibration. The process of manual point acquisition is same as step 6. Operate the robot and move the fixture to obtain nine points distributed in the camera's field of view evenly, and obtain corresponding vision coordinates at the same time. You can obtain the vision coordinates automatically or by manual input.

Step 8 to 10: Same as step 8 to 10 of 11.2.4 Eye-to-Hand Overlook Calibration.

11.2.6 Eye-in-Hand J2 Calibration

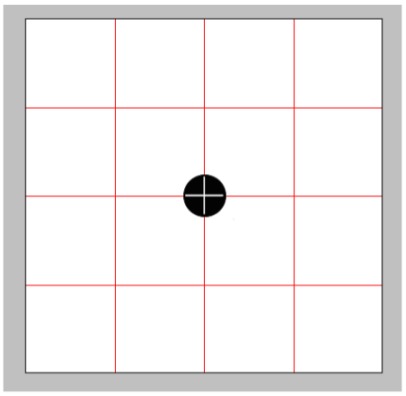
The camera is mounted looking downwards on the robot J2 axis, as shown below. This calibration mode is applicable to SCARA robots only.



11.2.6.1 Installation Condition

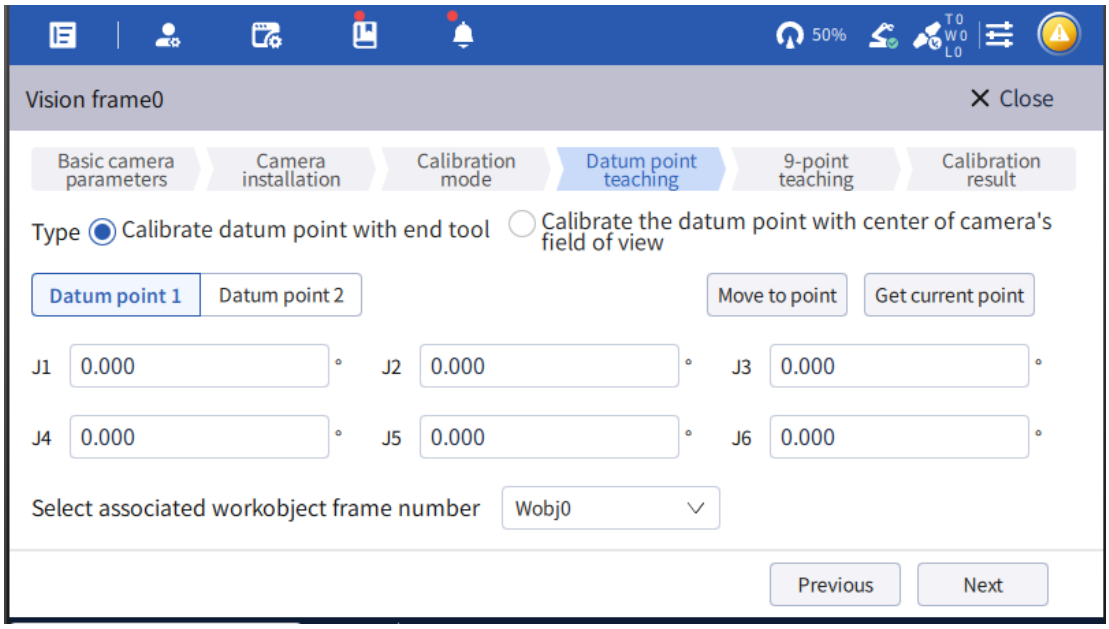
The camera is mounted looking downwards on the robot J2 axis. Keep the camera plane parallel to the horizontal plane. As shown below, the black marker point represents the marker point on the calibration board, the red lines represent the grid lines in the camera's field of view, and the intersection of the grid lines is the

required marker point. The calibration board used can contain only one visually recognizable marker point. The 9-point calibration board must not be used.



11.2.6.2 Calibration Steps

Steps 1 to 5: Same as steps 1 to 5 of 11.2.4 Eye-to-Hand Overlook Calibration.



If you choose to calibrate the datum point by "Calibrate datum point with end tool", you need to install a tip fixture at the end of the robot. It is needed to teach the robot with two datum points.

1. Teach the robot to align the tip of the fixture with the marker point on the calibration board, and click "Get current point" to obtain the position of the robot as datum point 1.

2. Rotate the J4 axis of the robot to a certain angle and re-align the tip of fixture with the marker point.

3. Click "Get current point" to obtain the position of the robot as datum point 2.

If you choose to calibrate the datum point by "Calibrate the datum point with center of camera's field of view", there is no need to install a tip fixture at the end of the robot. It is needed to teach the robot with two datum points.

1. Teach the robot to align the tip of the fixture with the center of the camera's field of view installed on the J2 axis with the marker point on the calibration board, and click "Get current point" to obtain the position of the robot as datum point 1.

2. Adjust the robot's arm type and re-align the center of the camera's field of view with the marker point, and click "Get current point" to obtain the position of the robot as datum point 2.

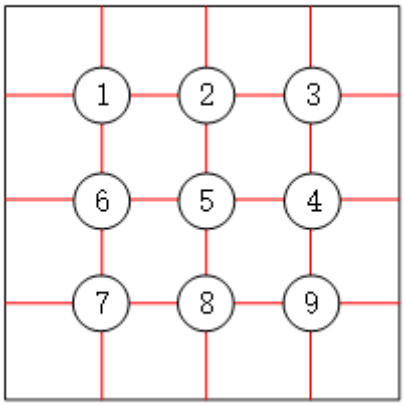
CAUTION

- If you use the center of the camera's field of view to calibrate the datum point, select the option "Calibrate the datum point with center of camera's field of view". The tool parameters displayed after calibration represent the deviation of the center of the camera's field of view from the end of the J2 axis.
- If you use the end tool of the robot to calibrate the datum point, select the option "Calibrate datum point with end tool". The tool parameters displayed after calibration are those of the tool installed at the end of the robot.
- If you choose to use the camera as a tool for manual calibration, then do not use the end tool.

3. Click "Next" to enter the 9-point calibration page.

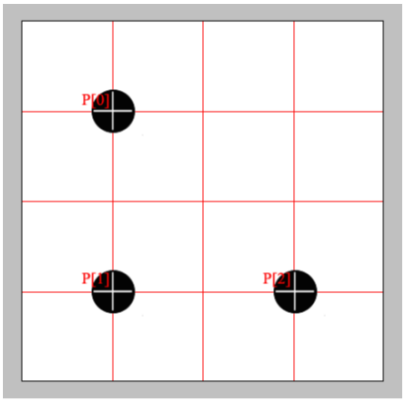
- Manual calibration:

Move the robot so that the marker point on the calibration board appear sequentially at different positions within the camera's field of view, as shown below. Make sure the motion range of the maker point covers 2/3 of the camera's field of view as much as possible to ensure visual calibration accuracy. Obtain the robot coordinates and pixel coordinates when the robot moves to each point. The camera coordinates can be automatically obtained or manually entered.



- Semi-auto calibration:

1. After establishing communication between the robot and the camera, select three points in the camera's field of view and click "Get current point" to obtain P[0], P[1], and P[2], as shown below. Align the intersection points of the grid lines in the camera's field of view with the marker points on the calibration board in sequence, and complete the three-point pallet teaching.



2. Click "Calibrate". The robot calculates the corresponding nine points using P[0], P[1], and P[2] as boundary points. At the same time, the robot automatically moves to the nine points in sequence, saving the robot coordinates as well as the corresponding pixel coordinates until the movement is completed.

CAUTION

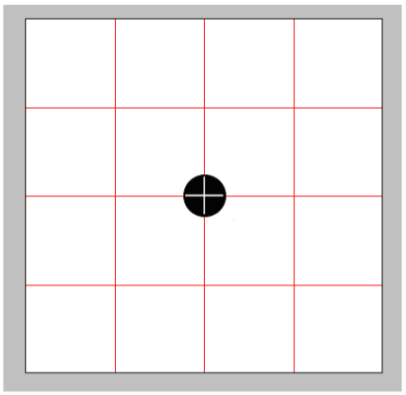
The robot calculates the 9 points on the pallet based on the end of the robot, while the camera is installed on the J2 axis of the robot. Therefore, if three datum points are calibrated according to the grid in the camera's field of view, the actual operation of the robot may not be based on the 9 points in the camera's field of view, but may be a parallelogram which may exceed the camera's field of view. Therefore, when calibrating the three datum points, calibrate them in the middle of the field of view.

- Auto calibration:

After establishing communication between the robot and the camera, teach the robot to align the center of the camera's field of view with the marker point on the calibration board and click "Get current point" to get the robot position P[0]. Set the "Spacing" (in mm) between points appropriately so that the nine points are all within the camera's field of view, then click "Calibrate". The robot automatically moves to the nine points in sequence, saving the robot coordinates as well as the corresponding pixel coordinates until the movement is completed.

CAUTION

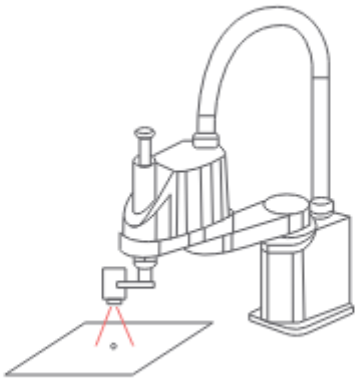
The setting value of "Spacing" should be reasonably selected to ensure that the robot's motion range within the camera's field of view can cover about 2/3 of the camera's center field of view, while also ensuring that the robot's motion range does not exceed the camera's field of view.



Step 8 to 10: Same as step 8 to 10 of 11.2.4 Eye-to-Hand Overlook Calibration.

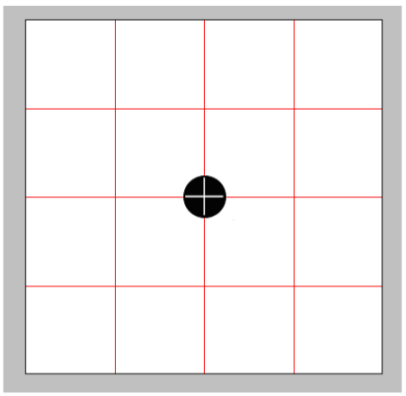
11.2.7 Eye-in-Hand J4 Calibration

The camera is mounted looking downwards on the robot J4 axis, as shown below.



11.2.7.1 Installation Condition

The camera is mounted looking downwards on the robot J4 axis. Keep the camera plane parallel to the horizontal plane. As shown below, the black marker point represents the marker point on the calibration board, the red lines represent the grid lines in the camera's field of view, and the intersection of the grid lines is the required marker point. The calibration board used can contain only one visually recognizable marker point. The 9-point calibration board must not be used.



11.2.7.2 Calibration Steps

Same steps as those of 11.2.6 Eye-in-Hand J2 Calibration.

CAUTION

When calibrating the datum points, there is no need to choose the calibration method on the interface. You can calibrate the datum points in either of the following two ways:

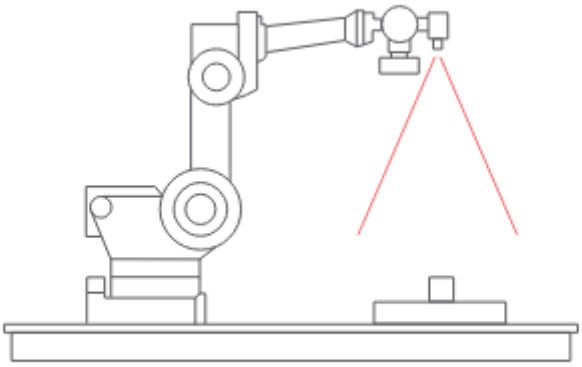
- Calibrate the datum points using the center of the camera's field of view.
- Install a tip fixture at the end of the robot and calibrate the datum points using such fixture.

Calibration method description:

- If you use the center of the camera's field of view to calibrate the datum point, the tool parameters displayed after calibration represent the deviation of the center of the camera's field of view from the end of the J4 axis.
- If you use the end tool of the robot to calibrate the datum point, the tool parameters displayed after calibration are those of the tool installed at the end of the robot.

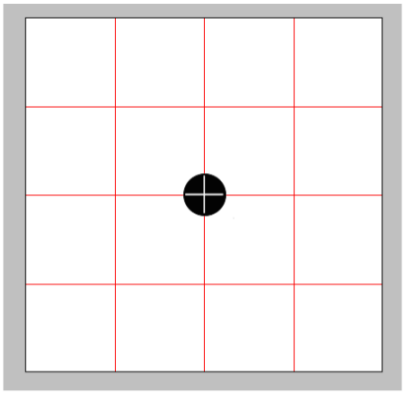
11.2.8 Eye-in-Hand J5 Calibration

The camera is mounted looking downwards on the robot J5 axis, as shown below.



11.2.8.1 Installation Condition

The camera is mounted looking downwards on the robot J5 axis. Keep the camera plane parallel to the horizontal plane. As shown below, the black marker point represents the marker point on the calibration board, the red lines represent the grid lines in the camera's field of view, and the intersection of the grid lines is the required marker point. The calibration board used can contain only one visually recognizable marker point. The 9-point calibration board must not be used.

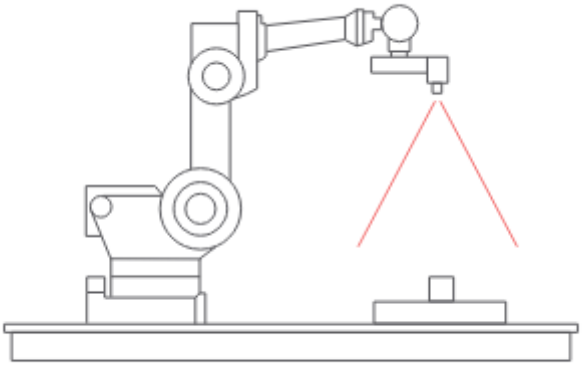


11.2.8.2 Calibration Steps

Same steps as those of 11.2.6 Eye-in-Hand J2 Calibration.

11.2.9 Eye-in-Hand J6 Calibration

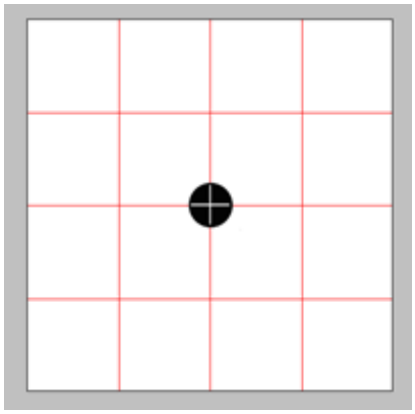
The camera is mounted looking downwards on the robot J6 axis, as shown below.



11.2.9.1 Installation Condition

The camera is mounted looking downwards on the robot J6 axis. Keep the camera plane parallel to the horizontal plane. As shown below, the black marker point represents the marker point on the calibration board, the red lines represent the grid lines in the camera's field of view, and the intersection of the grid lines is the required marker point. The calibration board used can contain only one visually recognizable marker point. The 9-point calibration board must not be used.

A tip fixture must be installed at the end of the robot.



11.2.9.2 Calibration Steps

Step 1: Install a tip tool at the end of the robot, and place a calibration board that contains only one visually recognizable marker point on the user plane.

Step 2:

1. If the user plane is not relatively parallel to the robot's base frame, it is necessary to calibrate the user plane using the calibrated tip tool. That is, calibration of both tip tool and user plane is required.
2. If the user plane is relatively parallel to the robot's base frame, calibration of tip tool and user plane is not required.

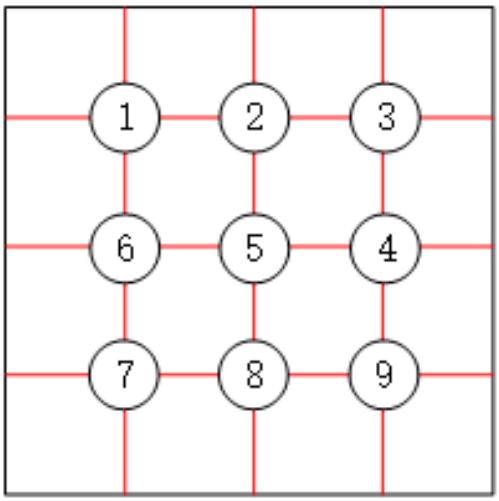
Steps 3 to 7: Same as steps 1 to 5 of 11.2.4 Eye-to-Hand Overlook Calibration.

Step 8: Calibrate the datum point by "Calibrate datum point with end tool" method. The calibration requires three datum points. For the calibration of tip tool of 6-axis robots, see 10.3.1 Setting the Tools. Align the tip of the fixture with the marker point at the center of the calibration board in three different orientations.

Step 9. Click "Next" to enter the 9-point calibration page.

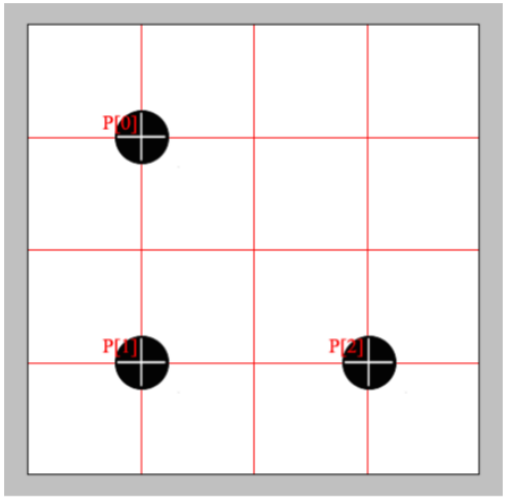
- Manual calibration:

Move the robot so that the marker point on the calibration board appear sequentially at different positions within the camera's field of view, as shown below. Make sure the motion range of the maker point covers 2/3 of the camera's field of view as much as possible to ensure visual calibration accuracy. Obtain the robot coordinates and pixel coordinates when the robot moves to each point. The camera coordinates can be automatically obtained or manually entered.



- Semi-auto calibration:

1. After establishing communication between the robot and the camera, select three points in the camera's field of view and click "Get current point" to obtain P[0], P[1], and P[2], as shown below. Align the intersection points of the grid lines in the camera's field of view with the marker points on the calibration board in sequence, and complete the three-point pallet teaching.



2. Click "Calibrate". The robot calculates the corresponding nine points using P[0], P[1], and P[2] as boundary points. At the same time, the robot automatically moves to the nine points in sequence, saving the robot coordinates as well as the corresponding pixel coordinates until the movement is completed.

- Auto calibration:

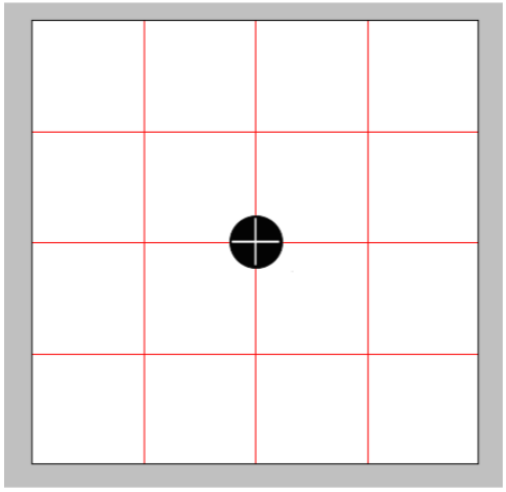
After establishing communication between the robot and the camera, teach the robot to align the center of the camera's field of view with the marker point on the calibration board.

1. Click "Get current point" to get the robot position P[0]. Set the "Spacing" (in mm) between points appropriately so that the nine points are all within the camera's field of view.

2. Click "Calibrate". The robot automatically moves to the nine points in sequence, saving the robot coordinates as well as the corresponding pixel coordinates until the movement is completed.

CAUTION

The setting value of "Spacing" should be reasonably selected to ensure that the robot's motion range within the camera's field of view can cover about 2/3 of the camera's center field of view, while also ensuring that the robot's motion range does not exceed the camera's field of view.

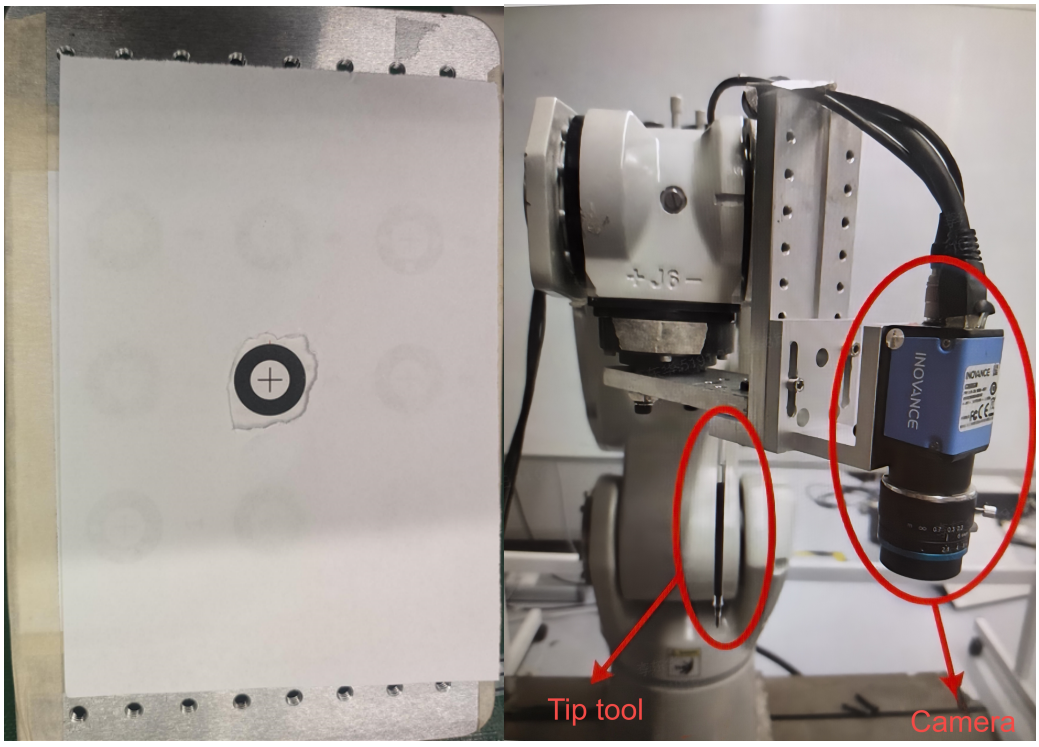


Steps 10 to 12: Same as step 8 to 10 of 11.2.4 Eye-to-Hand Overlook Calibration.

11.2.10 Vision Process Calibration Examples and Result Verification

The following is an example of the calibration process with the dynamic camera of a 6-axis robot in the condition that the user plane is not level.

- Robot model: 3-600 6-axis robot.
- Camera mounting method: On J6 axis of the robot.
- Calibration method: Semi-auto calibration.
- Tools: Camera, tip tool, calibration board that contains only one visually recognizable marker point.
- User plane: The tilted calibration board is used as the user plane.

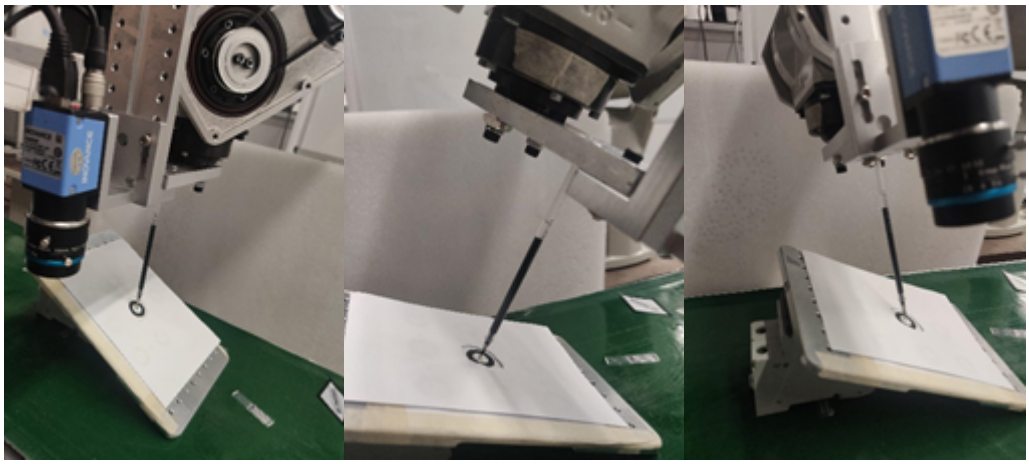


Step 1: Preparation

1. Install the camera and adjust the robot position.
2. Place and adjust the calibration board.
3. Adjust the vision software, and create a calibration template, etc.

Step 2: Calibrate the tool frame of the tip tool.

For the calibration of tip tool, see 10.3.1 Setting the Tools. Align the tip of the fixture with a fixed point in three different orientations. It is recommended to place the calibration board on the user plane that needs to be calibrated, and then use the marker point on the calibration board as a fixed point to calibrate the tip tool. Record the three positions of the robot for use in datum point calibration in the subsequent vision calibration process. The tool number of the tip tool used is Tool15.



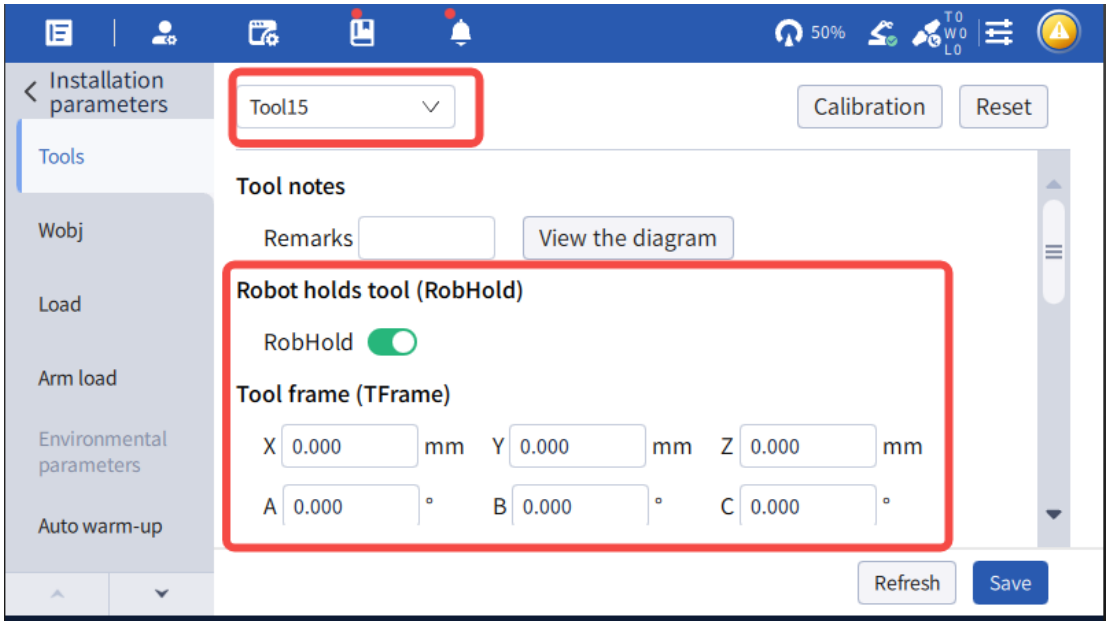


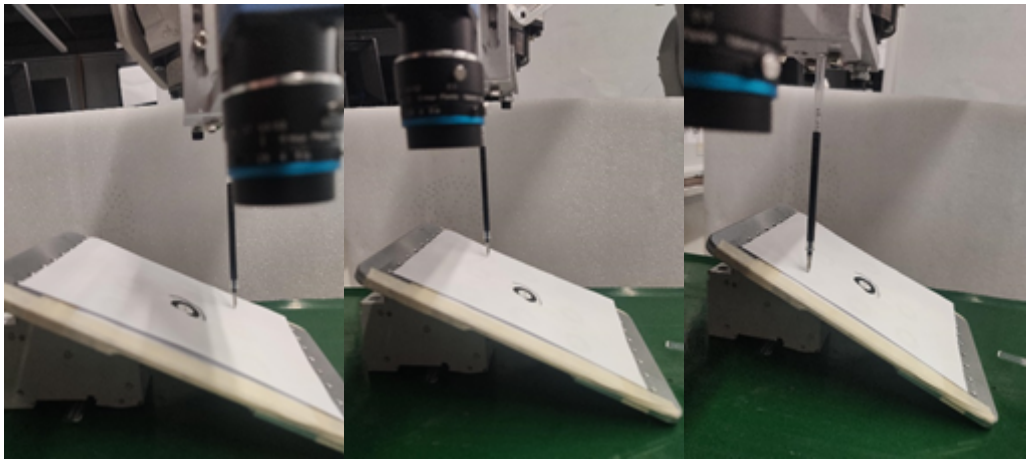
Figure 11-6 Example of tool frame

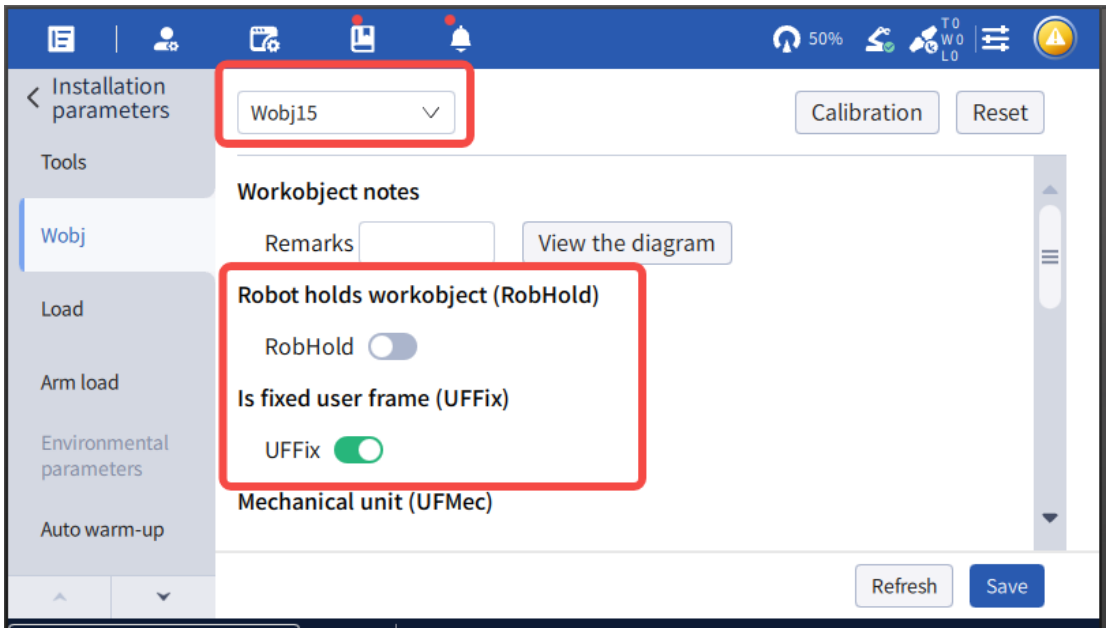
CAUTION

When calibrating the tip tool, you can also use a point other than the marker point on the calibration board as the fixed point. However, it is necessary to align the tip tool with the marker point on the calibration board as the fixed point in the subsequent datum point calibration process. Therefore, it is recommended to directly use the marker point on the calibration board as the fixed point for calibrating the pointed tool.

Step 3: Calibrate the workobject frame of the user plane.

For the calibration method of the workobject frame, see section 10.3.2 Setting the Workobject. Use the calibrated tip tool to calibrate the workobject frame of the user plane. When calibrating the workobject frame, you only need to calibrate the user frame (Uframe). In the example, the number of the workobject frame of the user plane is Wobj15.





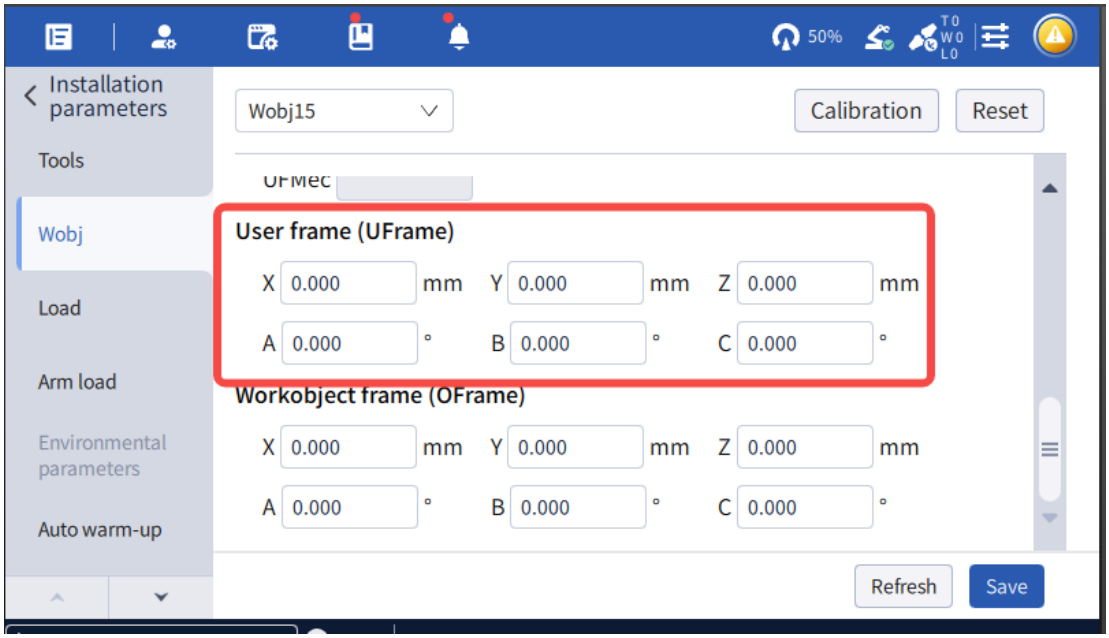


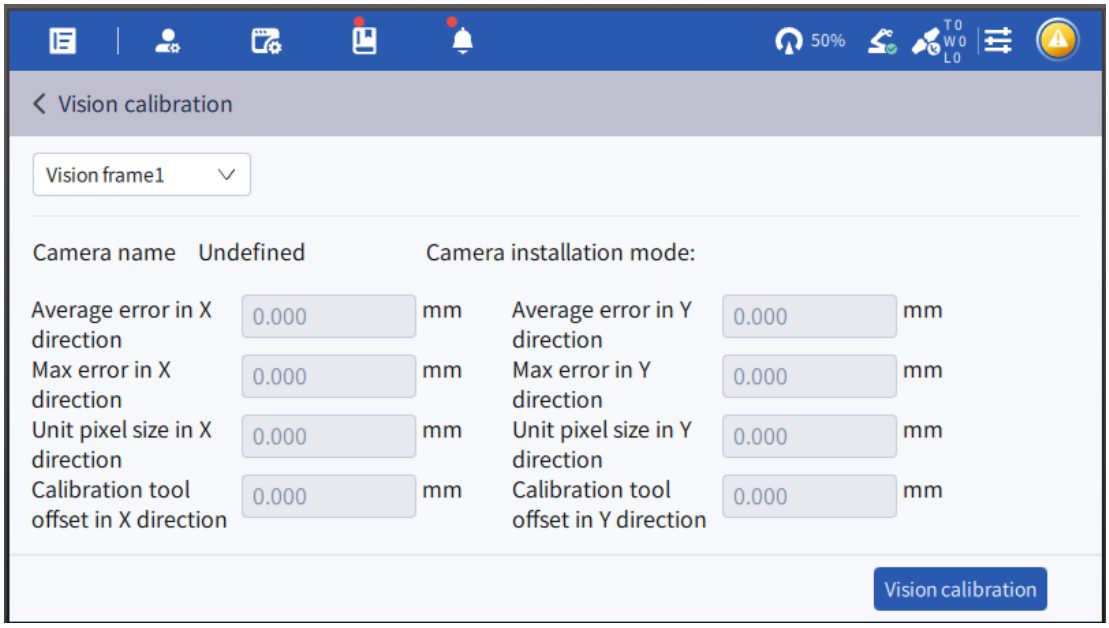
Figure 11-10 Example of workobject frame

CAUTION

When calibrating the workobject frame, switch the tool number to the number of the tip tool used. Otherwise, it will result in incorrect calibration results for the subsequent visual calibration process.

Step 4: Enter the vision calibration interface.

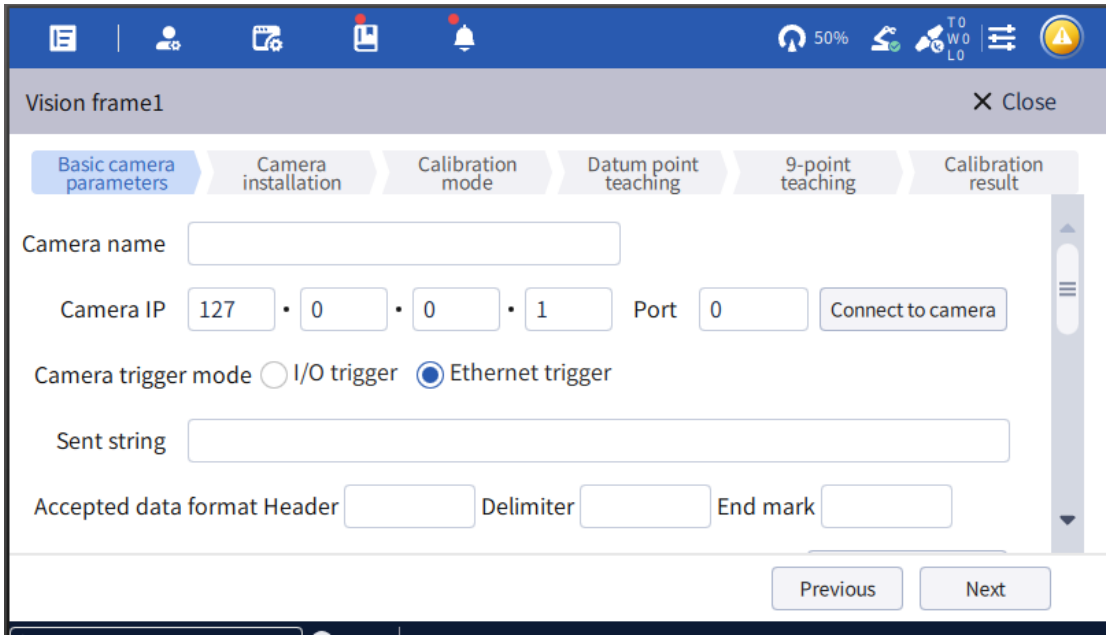
Select a vision frame, such as "Vision frame1", and click "Vision calibration" to enter the visual calibration process.



Step 5: Set the basic camera parameters.

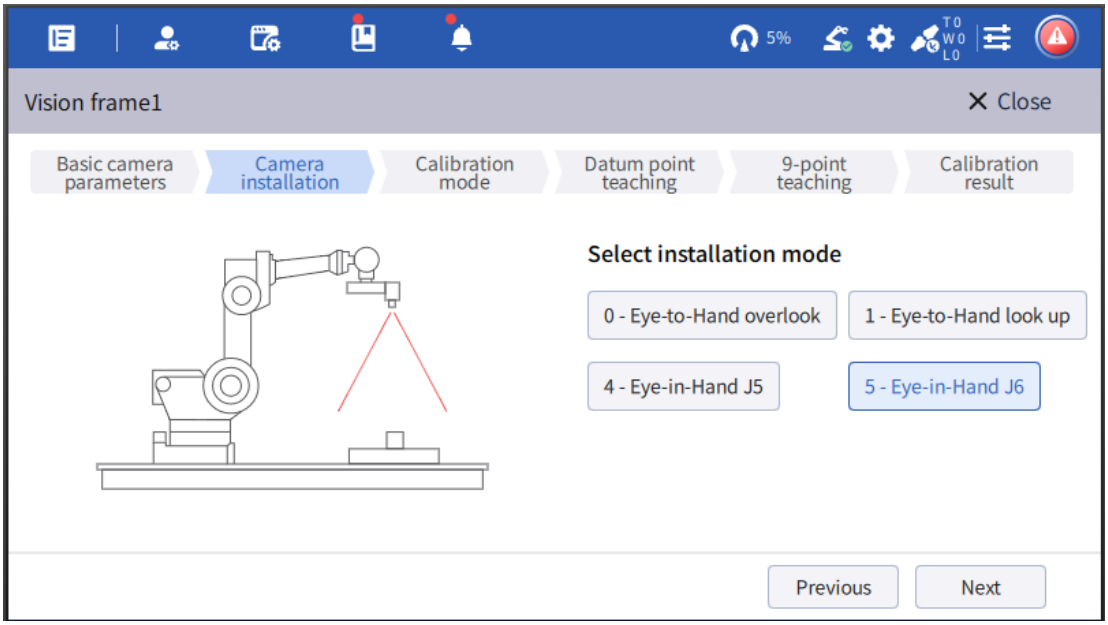
Set the basic camera parameters according to onsite conditions.

In this example, semi-auto calibration is adopted. Therefore, it is necessary to establish communication between the robot and the camera. Set the trigger mode to "Ethernet trigger".



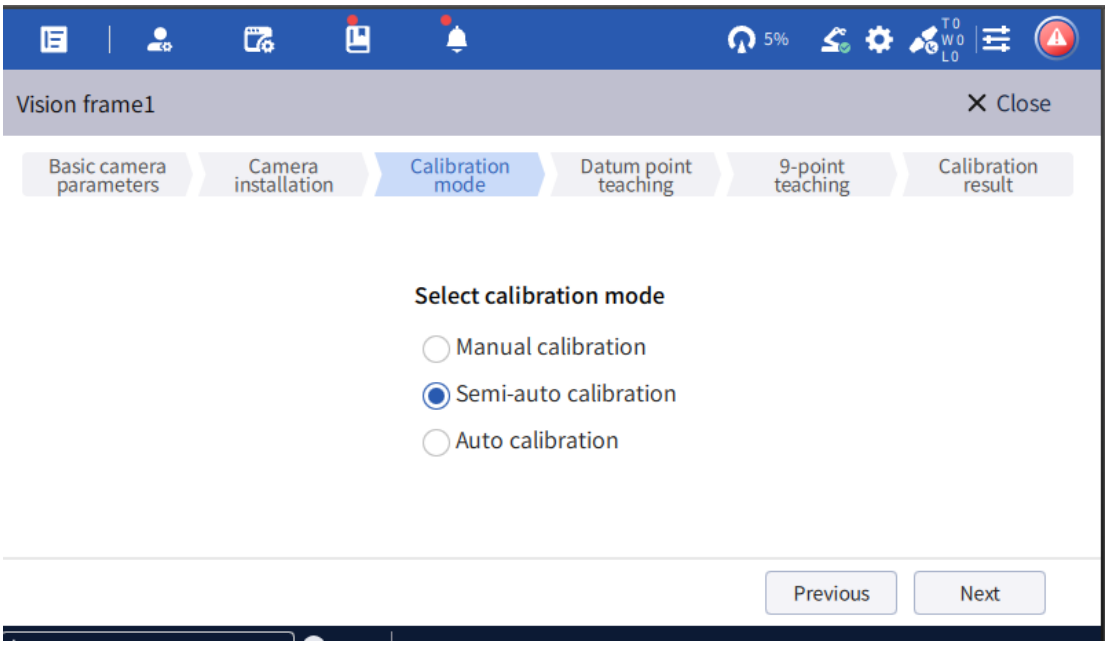
Step 6: Set the installation mode of the camera.

Select the installation mode according to onsite conditions. Here, as an example, select "5 - Eye-in-Hand J6".



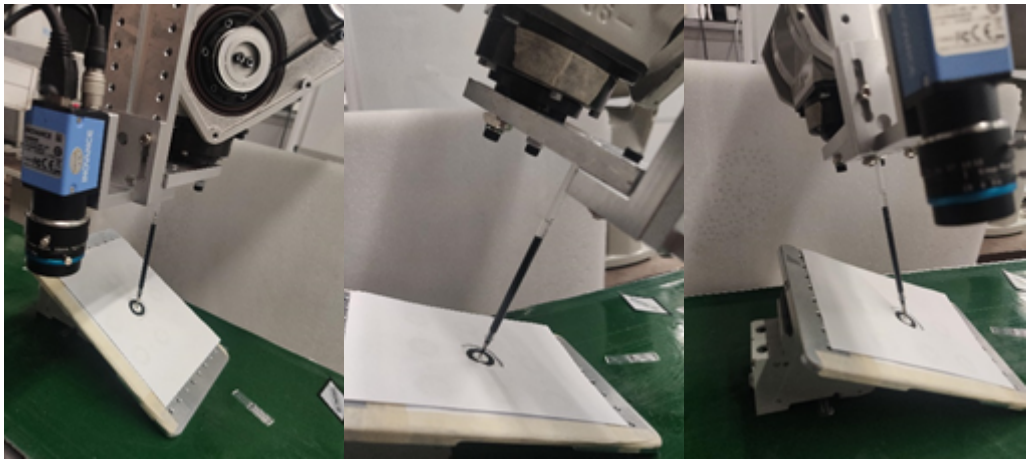
Step 7: Select the calibration mode.

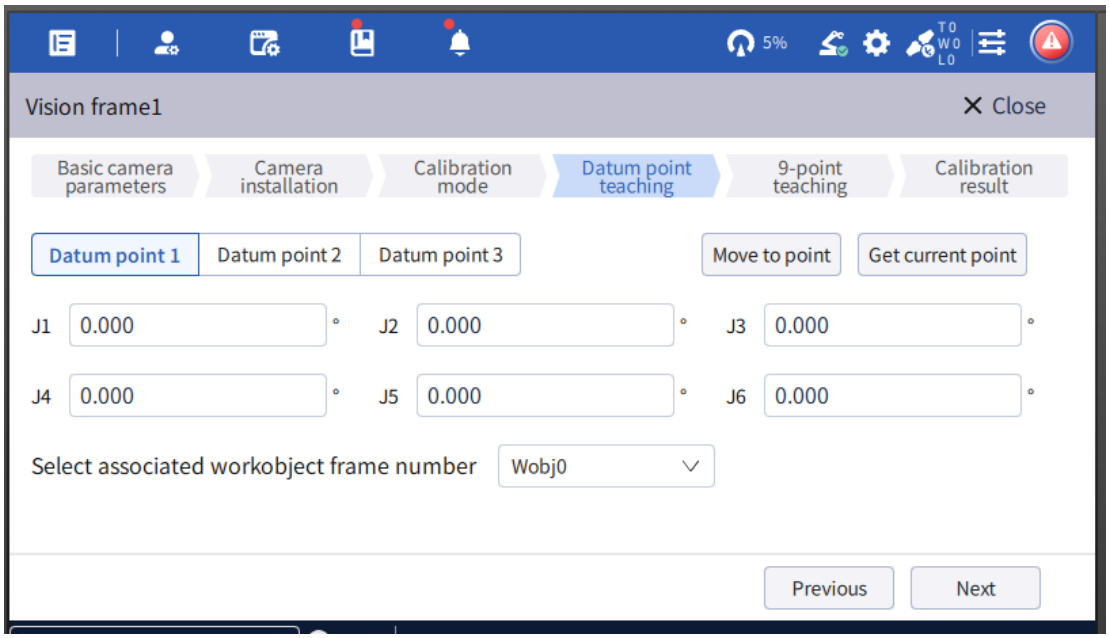
Select the calibration mode according to onsite conditions. Select "Semi-auto calibration" in this example.



Step 8: Calibrate the datum points.

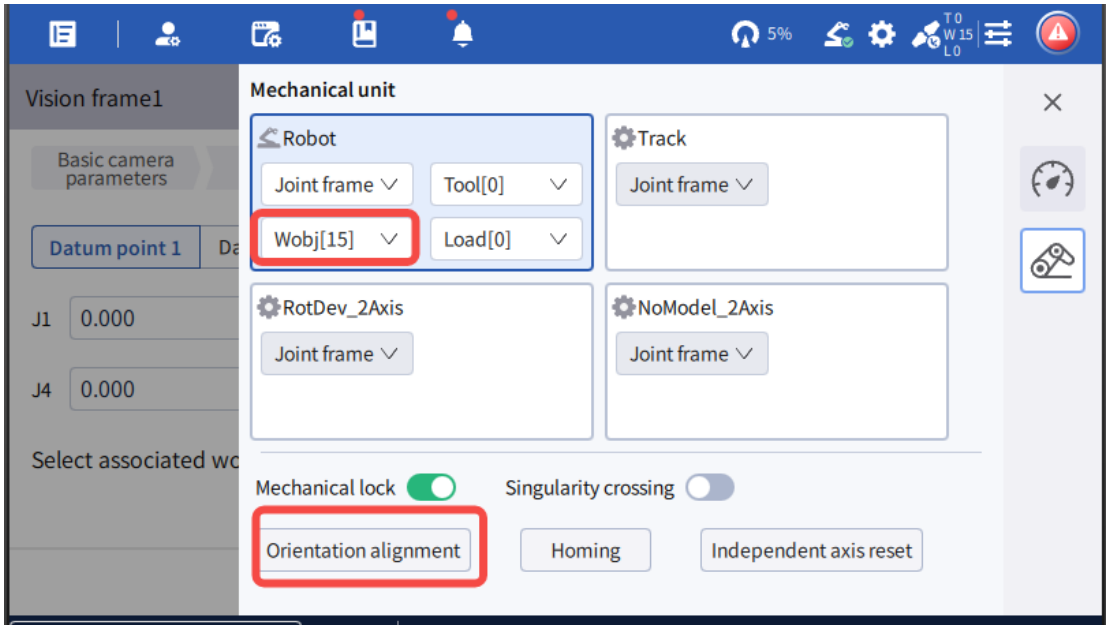
1. Calibrate the datum point by "Calibrate datum point with end tool" method. The calibration requires three datum points. Align the tip of the fixture with the marker point at the of the calibration board in three different orientations.
2. Click "Get current point" to get the current joint position of the robot.
3. Select the associated workobject frame number corresponding to the user plane (here, Wobj15) by the "Select associated workobject frame number" option.

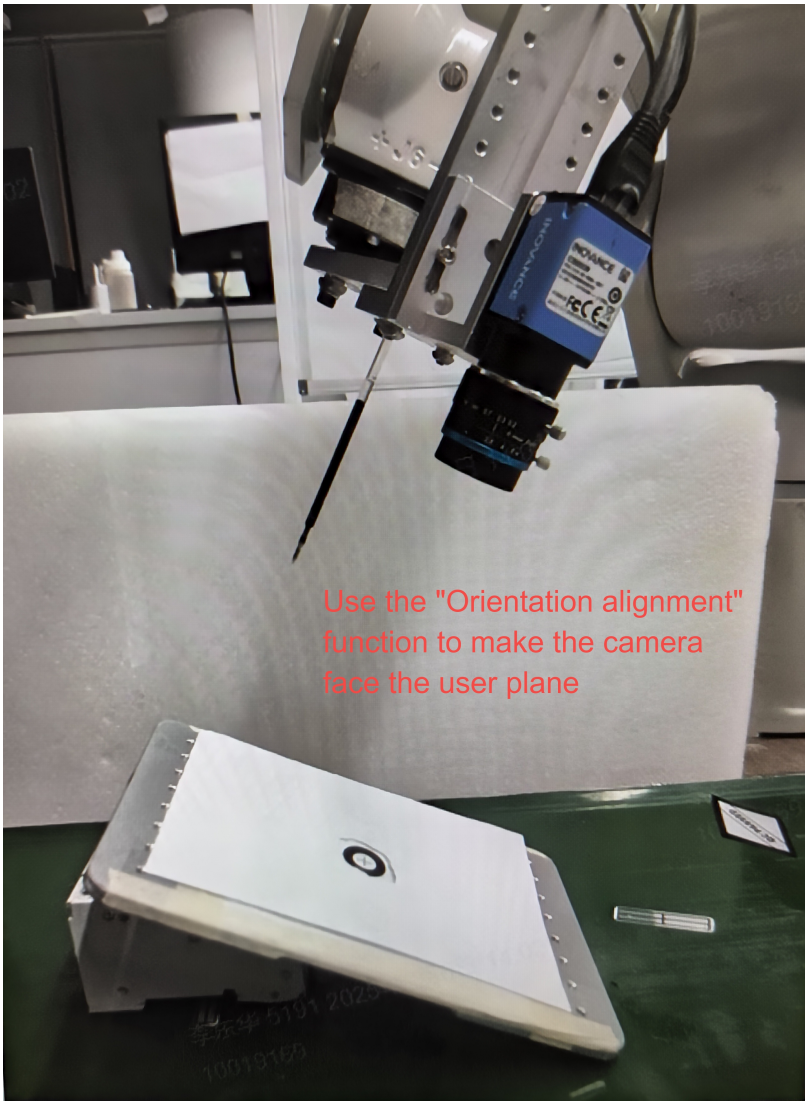




Step 9: Teach the robot with nine points on a pallet.

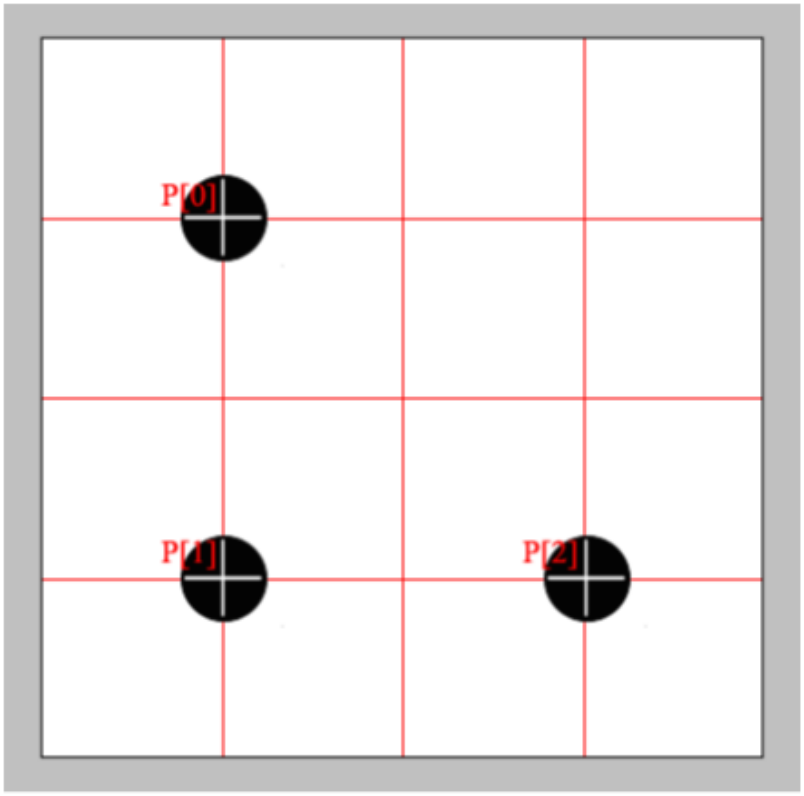
Adjust the robot's pose so that the camera is relatively parallel to the user plane. Then, switch to the workobject frame and select the workobject frame number corresponding to the user plane. Use the "Orientation alignment" button to make the camera face the user plane, as shown in the following figure.

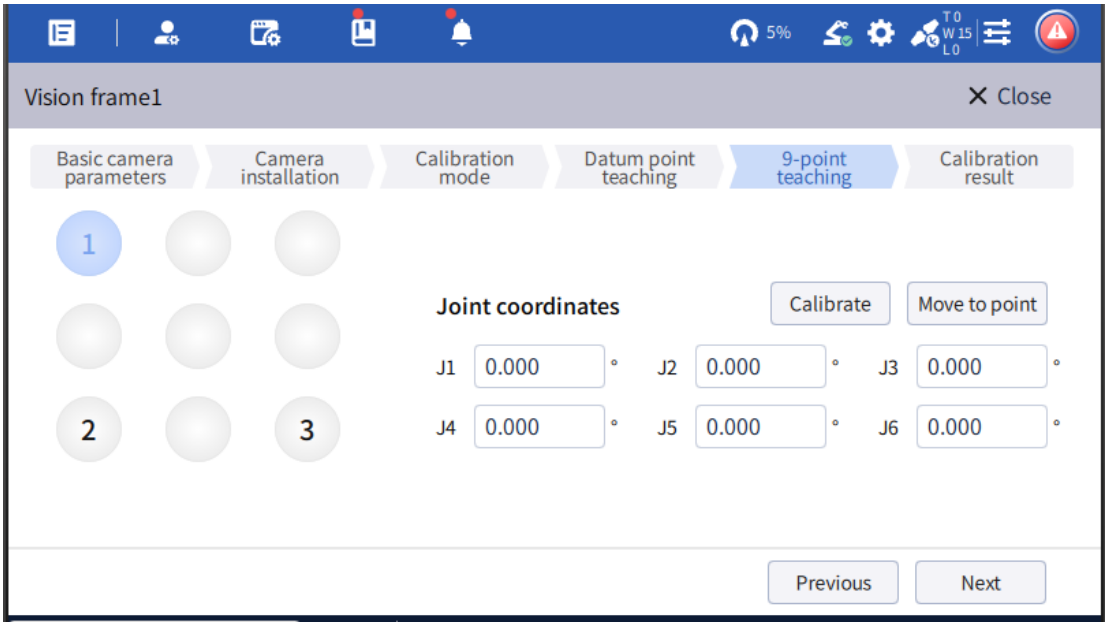




(1) Adjust the relative height between the camera and the user plane in the Wobj15 frame and focus the camera.

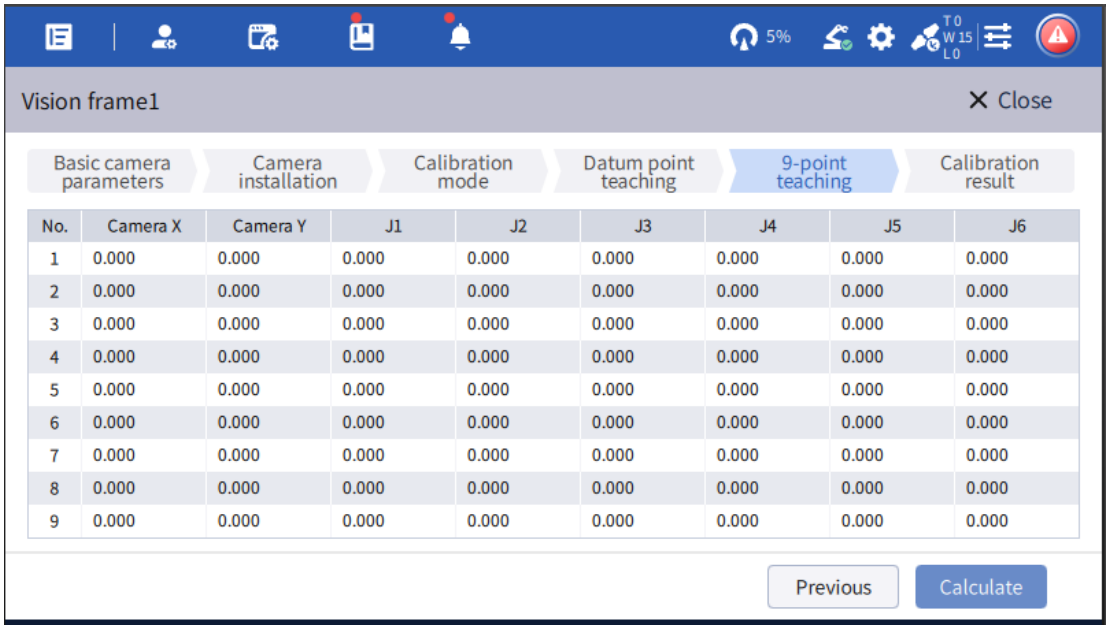
(2) After establishing communication between the robot and the camera, select three points in the camera's field of view and click "Get current point" to obtain P[0], P[1], and P[2], as shown below. Align the intersection points of the grid lines in the camera's field of view with the marker points on the calibration board in sequence, and complete the nine-point pallet teaching. And then click "Calibrate" to allow the robot to automatically complete acquisition of the coordinates of the nine points.





Step 10: Check the information about the nine points.

On the teaching point list, check whether each of the position coordinates and pixel coordinates is abnormal, for example: whether there are duplicate points, pixel coordinates error, etc., Then, click "Calculate".



Step 11: Check the calibration results.

The system calculates and generates the vision frame calibration matrix and the calibration result parameters, as shown below. The calibration tool offset in X direction and calibration tool offset in Y direction indicate the tool parameters of the tip tool without rotation direction.



CAUTION

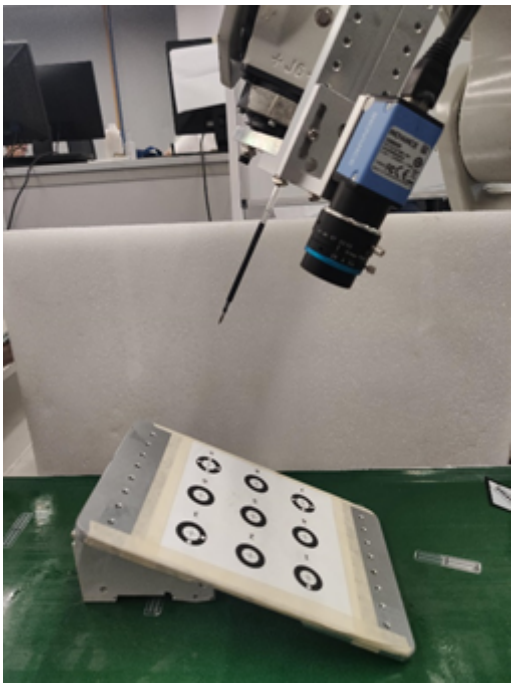
Under normal calibration conditions, the error is generally controlled below 2 mm.

Step 12: Select "Apply" to complete the vision calibration operation.

The calibration results can be verified through programming.

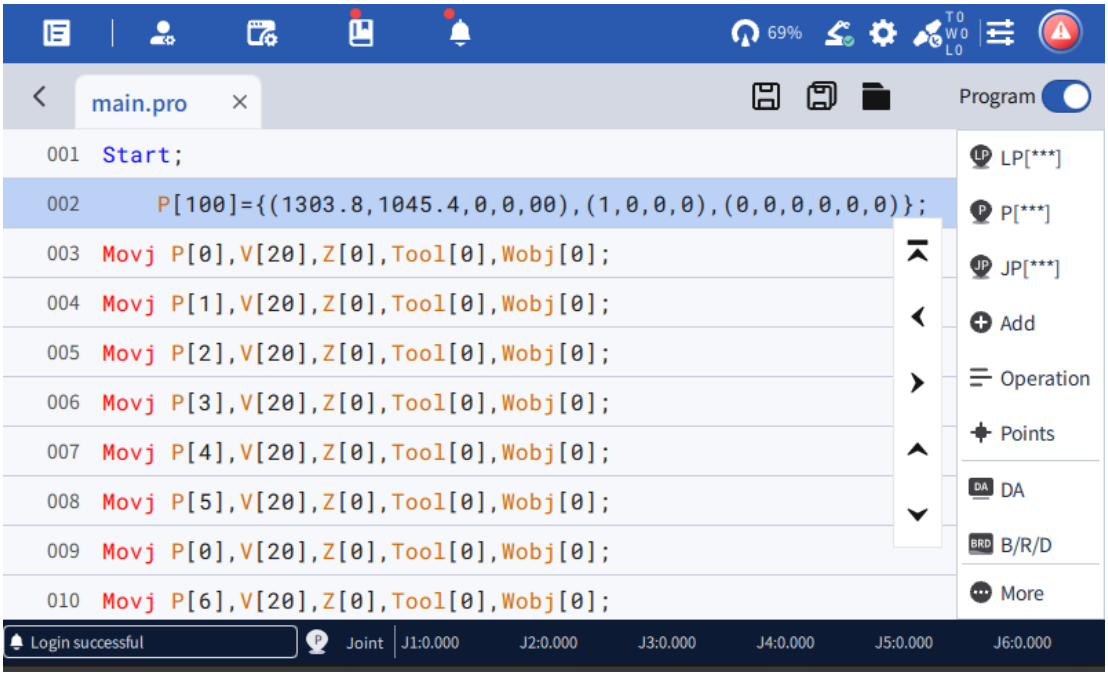
Step 13:

Move the camera relative to the user plane while keeping the camera parallel to the user plane and the distance between the camera and the user plane unchanged. As shown below, the camera takes a photo of a random point on the user plane to get the pixel coordinates of the point. At the same time, record the current joint value of the robot at the time of photo taking.



Step 14: Write the calibration program to verify the calibration results.

The following shows an example of vision calibration program.



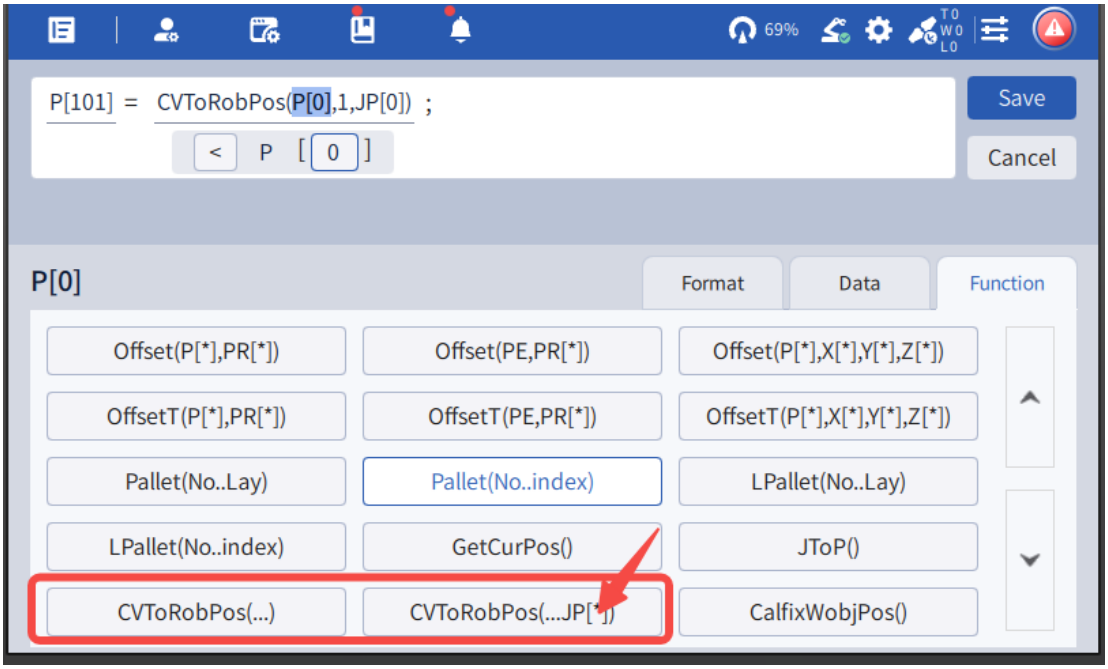
CVToRobPos instruction: Converts the pixel coordinates to the workobject coordinates.

(1) CVToRobPos (VisionP, VisionCrdNo) is the conversion format for camera installed in eye-to-hand mode.

VisionP is the vision pixel point, stored in the P or LP variable, and VisionCrdNo is the vision calibration frame number (0-15).

(2) CVToRobPos (VisionP, VisionCrdNo, TrigJP) is the conversion format for camera installed in eye-in-hand mode.

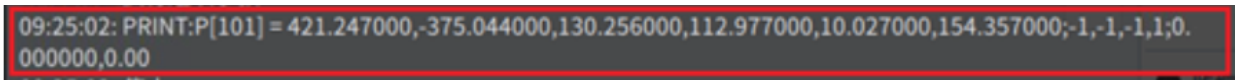
TrigJP is the robot joint value at the position where photo is taken, stored in the JP variable.



In this example, the camera is installed on the J6 axis. Therefore, the second format of CVToRobPos instruction is used, for example, P[101] = CVToRobPos(P[100],1,JP[0]), where:

- The parameter "P[100]" indicates the pixel coordinates in the vision frame, wherein X, Y, and A indicate the visually recognized pixel coordinates and angle.
- The parameter "1" indicates the vision frame number used in the previous vision calibration.
- The parameter "JP[0]" indicates the joint value of the robot at the photo-taking point.

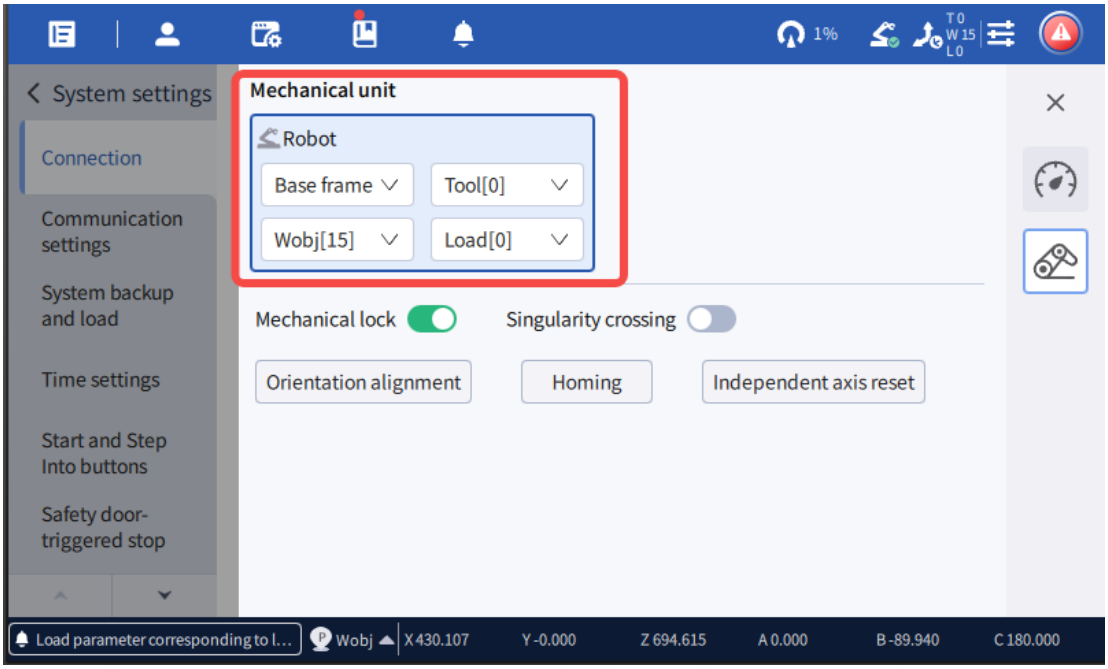
Run the program to calculate the converted workobject coordinates, as shown below. The meaningful coordinates (X,Y) = (421.246955,-375.044309) indicate the coordinates of the marker point in the base frame.



Teach the robot to align the tip tool with the marker point, as shown below.



Switch the frame to the base frame, and tool to the tip tool. Then view the robot coordinate, namely, the actual spatial position value of the recognized point, (423.198, -375.175). Compare this coordinate with the converted workobject coordinate (421.246955, -375.044309) to determine the calibration accuracy.



The value A -140.896 of the converted tool coordinates is inconsistent with value A 137.574 of the tool coordinates of the robot where the photo is taken, due to the inconsistency in direction of the vision frame, direction of the robot frame, and direction of the tool.

"A" indicates the rotation angle of the object in the vision frame, and is converted to the angle in the tool frame as A1.

A1 = A + A', where A' indicates the conversion angle difference.

A2 = Angular difference between the direction of the robot frame and the direction of the camera frame.

A3 = Angular difference between the direction of the robot frame and the gripper direction or load gripping direction.

A4 = Angle at the position where photo is taken in the tool frame.

A4 = A + A'+ A2 + A3 or A4 = A1 + A2 + A3

It is known that A4 = 137.574, A = 137.574, and A1 = -140.896, then:

A2 + A3 = A4-A1 = 137.574 – (-140.896) = 278.47 or

A' + A2 + A3 = A4-A = 137.574 – 137.574 = 0

Therefore, when a pixel coordinate A is given, the coordinates of the robot at the position where the photo is taken can be calculated as: A4 = A + A' + A2 + A3 = A + 0.

Alternatively, you can use the CVToRobPos instruction to obtain the corresponding value A1 in the tool frame from the pixel coordinate A:

A4= A1 + A2 +A3 = 278.47 + A1

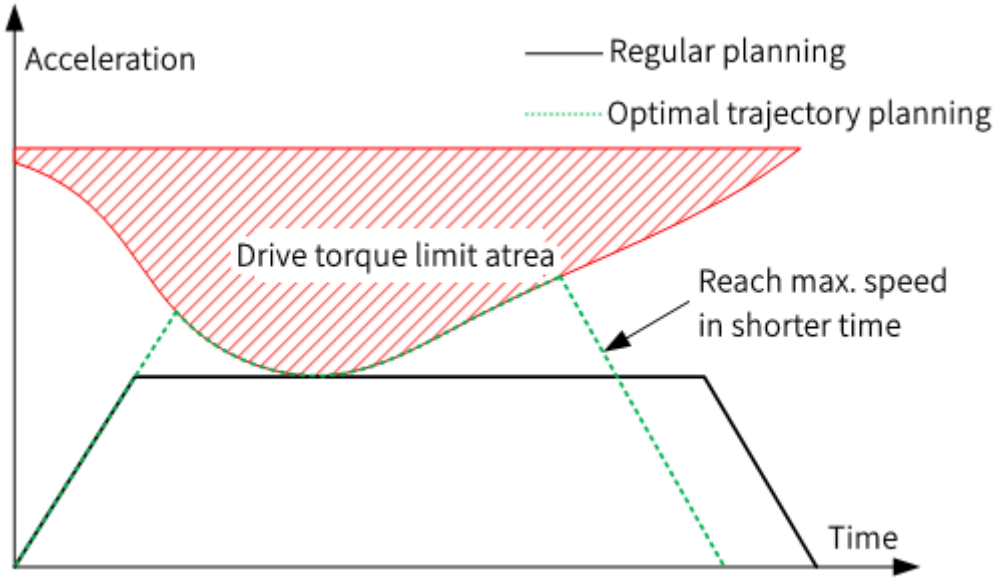
12 Function Application

12.1 Optimal Trajectory

12.1.1 Function Introduction

The optimal trajectory function automatically adjusts motion parameters based on the load, requiring no user intervention. It brings about two improvements.

1. Improved ease of use. The robot automatically uses the suitable acceleration to realize the best cycle time, without exceeding the electrical current specifications.
2. Improved efficiency. As shown below, the acceleration allowed varies from position to position. The optimal trajectory can continuously change with the allowable value, keeping the joint output at maximum and achieving optimal acceleration and deceleration efficiency.



12.1.2 Debugging Steps

After the optimal trajectory function is enabled, the motion is not affected by the "Acceleration" parameter configured on the software interface. Instead, the acceleration parameter is determined automatically based on the model. Follow the steps below.

1. Set the load parameters correctly, mainly including the tool load and workobject load.

> CAUTION
>
> The load must be set even if it is very small. If the load mass is zero, the system assumes that the user forgets to set the load and moves according to the maximum load for safety reasons, resulting in very slow motion.

2. Use the instruction "RapidMove (PTP, ON)" to enable the RapidMove mode. You can enable the RapidMove mode at the beginning of the program, so that the RapidMove mode takes effect for the entire project. You also can enable or disable the RapidMove mode as needed during execution of the program. For details, see the "Industrial Robot Instruction Guide".
3. Debug the electrical current and cycle time using instructions.

▪ The magnitude of the current is positively related to the acceleration coefficient in the instruction. You can modify the acceleration coefficient of a single instruction, or modify the acceleration coefficient of multiple instructions in batch using the SetAcc instruction. For details of the SetAcc instruction, see the instruction guide.

▪ If it is found during execution of the program that the maximum current is less than 100%, it indicates that the cycle time can be further improved. In this case, you can gradually increase the acceleration to 120%. If no vibration or current alarm occurs, you can increase the value of SetAccRamp parameter gradually from 50.

▪ If the current overlimit alarm or drive alarm occurs, first check whether the load is set correctly. If the vibration is obvious, reduce the value of SetAccRamp parameter first, and then reduce the value of SetAcc parameter.

4. If the requirement on the cycle time is high and cannot be met by the preceding steps, you can reduce the acceleration coefficient at the place where the current overlimit alarm occurs. The acceleration coefficient at other places can still use 100% or 120%.



This function is based on the dynamics model. If the model is inaccurate, it may cause current alarms or low efficiency. If the over-current alarm occurs only on certain axes, the model may be inaccurate. In this case, you can correct the model by using the model correction function. For details, see related section for toque model correction.

12.1.3 Application Example

```
Start;
  GripLoad 1;       //Activates the load and sets the corresponding load parameters
  RapidMove( ALL,ON);  //Enables the optimal trajectory function
  SetAcc(100,100);    //Adjusts the magnitude of the current through the SetAcc instruction
  L[0]:
  Movj P[0],V[100],fine,Tool[0];
  Movj P[1],V[100],fine,Tool[0];
Goto L[0];
End;
```

12.2 ECP Function

12.2.1 Overview

The robot generally operates in TCP mode. In the TCP mode, the robot holds a tool and moves in a frame of a workobject that is not held by the robot. However, when the size or mass of the machining tool/equipment is large, the robot cannot hold the tool for operation due to limits of its motion space and rated load. In this case, you can choose to fix the large volume and high weight machining tool relative to the ground, and configure the robot to hold the workobject to complete the machining. In this situation, the robot works in ECP mode.

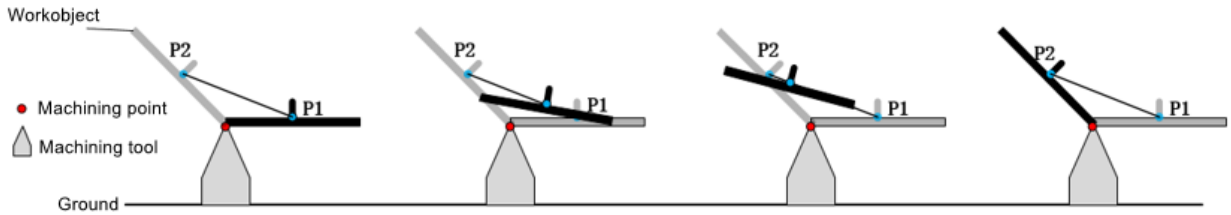
12.2.2 Calibration of the ECP Frame

For details, see 10.3 Installation Parameters Settings.

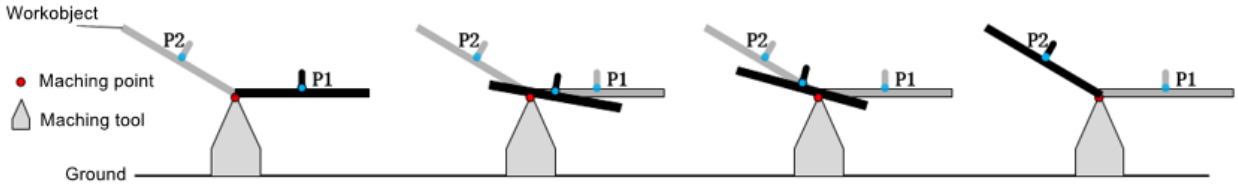
12.2.3 Motion in ECP Mode

In contrast to the TCP mode, the ECP mode simplifies the teaching process as the machining tool is fixed relative to the world frame (that is, the tool is an external fixed tool). The robot holds the workobject and moves around the external fixed tool, performing linear, circular, and other movements on the surface of the workobject for machining.

Here we take machining a straight line on the workobject surface as an example to illustrate the differences between the motion in ECP mode and the motion in TCP mode.



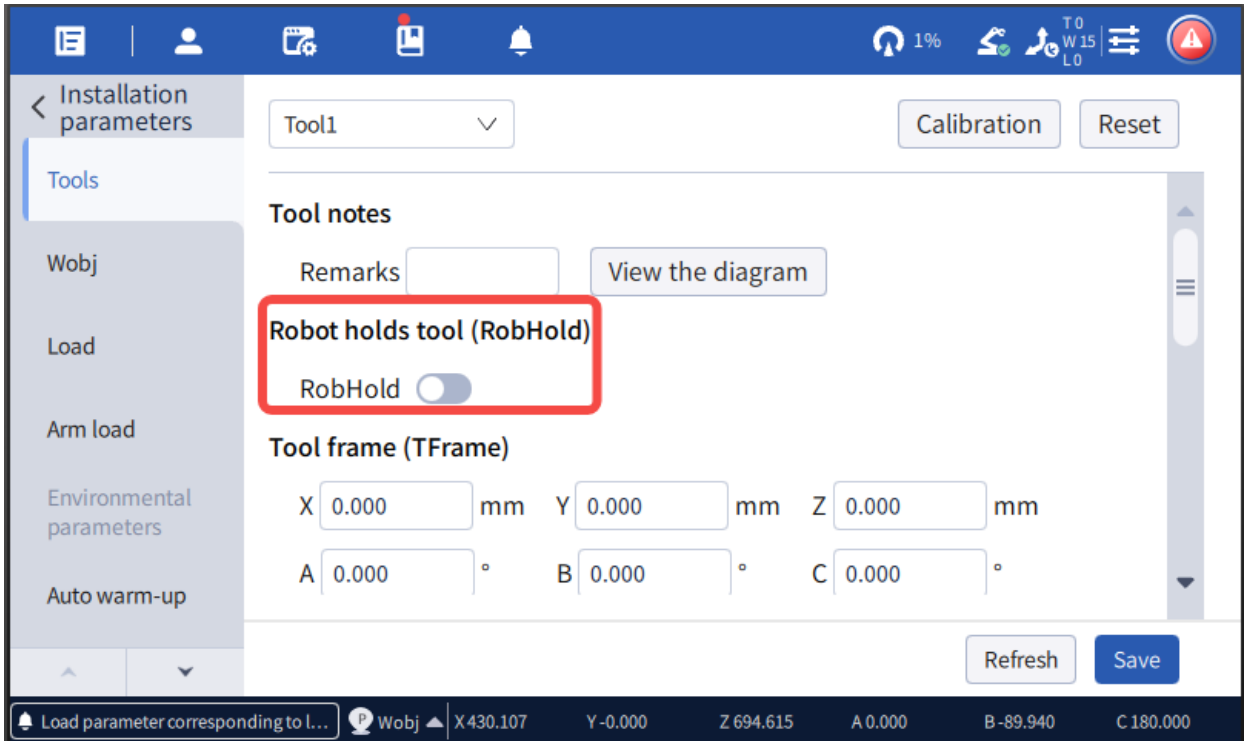
The above figures show the linear motion in ECP mode. P1 and P2 are center points of the workobject at the start and end of the straight line to be machined on the workobject surface. Due to factors such as the size or load of the tool, the machining tool must be fixed relative to the ground and the robot holds the workobject for processing. As shown in the above figures, the solid line between P1 and P2 represents the trajectory of the robot performing linear motion in TCP mode. When the robot is only taught with two points P1 and P2, it is unable to machine a straight line on the surface of the workobject. An additional teaching point is required.



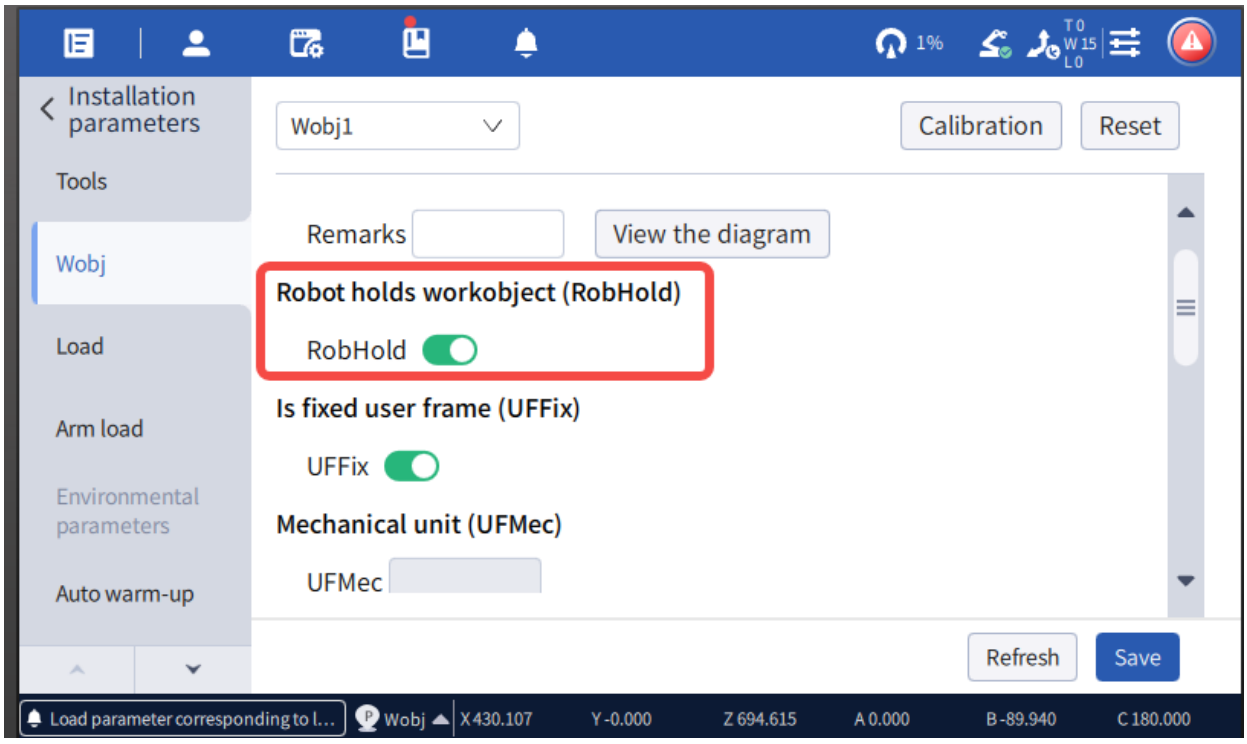
The above figures show the linear motion in ECP mode. P1 and P2 are center points of the workobject at the start and end of the straight line. Due to factors such as the size or load of the tool, the machining tool must be fixed relative to the ground and the robot holds the workobject for processing. In ECP mode, the robot can machine a straight line using only two teaching points.

Use cases of instructions in ECP mode:

External fixed tool1 is used, as shown below.



Wobj1 is set to be held by the robot, as shown below.



Example of program instructions in ECP frames tool1 and wobj1:

MovAbsJ JP[0],V[100],Z[0],Tool[1],Wobj[1]; #MovAbsJ instruction in ECP frames tool1 and wobj1

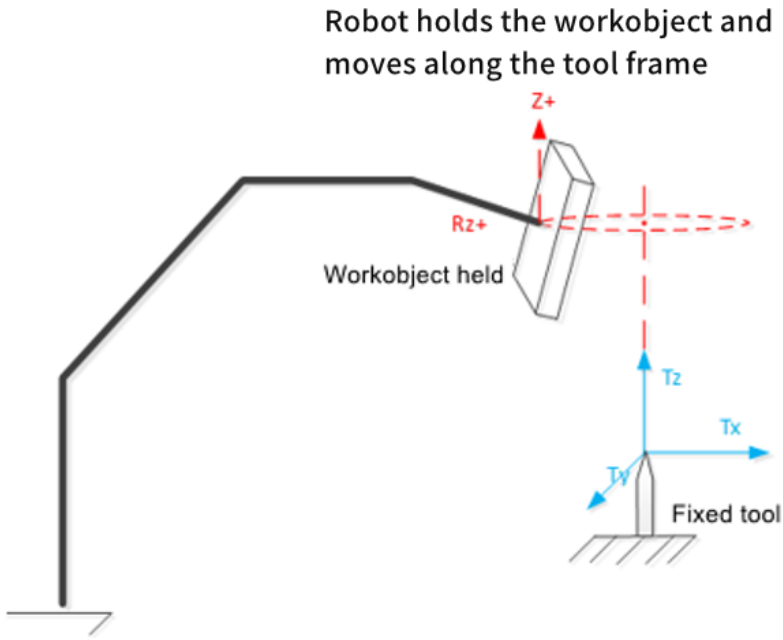
Movj P[0],V[100],Z[0],Tool[1],Wobj[1]; #Movj instruction in ECP frames tool1 and wobj1

Movl P[1], V[30], Z[0], Tool[1] Wobj[1]; #Movl instruction in ECP frames tool1 and wobj1

12.2.4 Jog Motion in ECP Mode

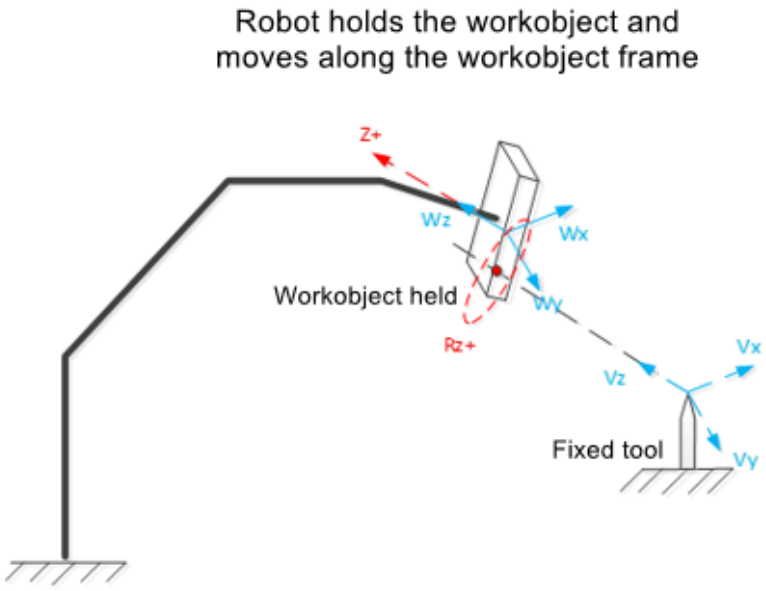
1. **Motion along tool frame**

   The robot gripping workobject moves along the frame of the external fixed tool, as shown below.



2. **Motion along workobject frame**

   The workobject moves around a virtual frame established on the external fixed tool and parallel to the workobject frame. For the offset movement, it can be considered that the workobject moves in the direction of the workobject frame itself. For the RZ, RY, and RX movement, the position and orientation of the robot change at the same time, as shown below.



12.2.5 Notes

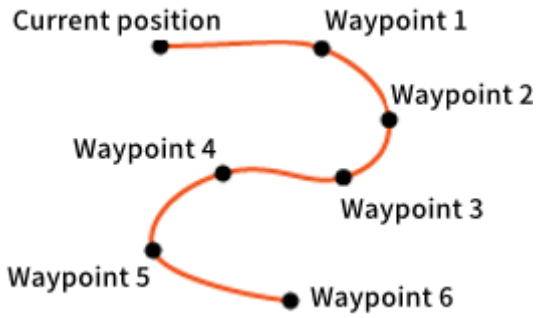
- In this section, when the robot works in TCP mode, set the "RobHold" parameter of the tool to "True" and the "RobHold" parameter of the workobject to "False". That is, the tool is held by the robot and fixed relative to the flange, and the workobject is not held by the robot and fixed relative to the world frame.
- When the robot works in ECP mode, set the "RobHold" parameter of the tool to "False" and the "RobHold" parameter of the workobject to "True". That is, the tool is an external tool and not held by the robot and fixed relative to the world frame, and the workobject is held by the robot and fixed relative to the flange.
- In both TCP and ECP modes, make sure the "RobHold" parameter of the workobject and tool are correctly configured. Otherwise, an alarm occurs that the activated tool and workobject parameters do not match.

- The ECP mode supports no-model external axis only. In ECP mode, the load properties of the activated external fixed tool are those of the activated workobject whose "RobHold" parameter is set to "True".
- If there is a transition between TCP and ECP movements, the transition does not take effect.
- ECP does not support the Jump/JumpL instruction or dynamic tracking function, which when used, causes an alarm.

12.3 Free Curve

12.3.1 Overview

The free curve function is applicable to motion with a large number of path points. Free curves are used to fit the sequence of spatial points input by the user, allowing the robot to perform curve motion based on the input sequence of spatial points. The free curve function supports two forms of instruction. You can use an independent Movs instruction in the program to implement a curve motion, or use the Curve instruction to implement a combination of single/multiple curve segments.



No.	Specifications
1	Number of input points: 4 to 500
2	Maximum spacing of input points: 100 mm
3	Minimum spacing of input points: 0.5 mm
4	Maximum orientation spacing of input points: 60°
5	Maximum curve length: 10,000 mm

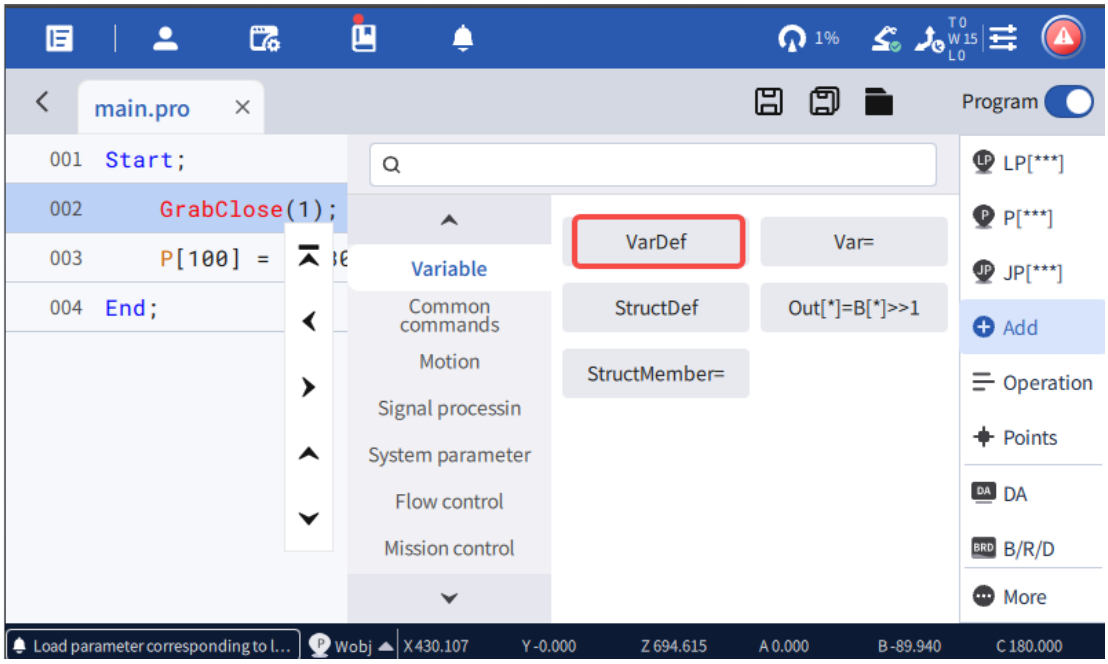
12.3.2 Steps

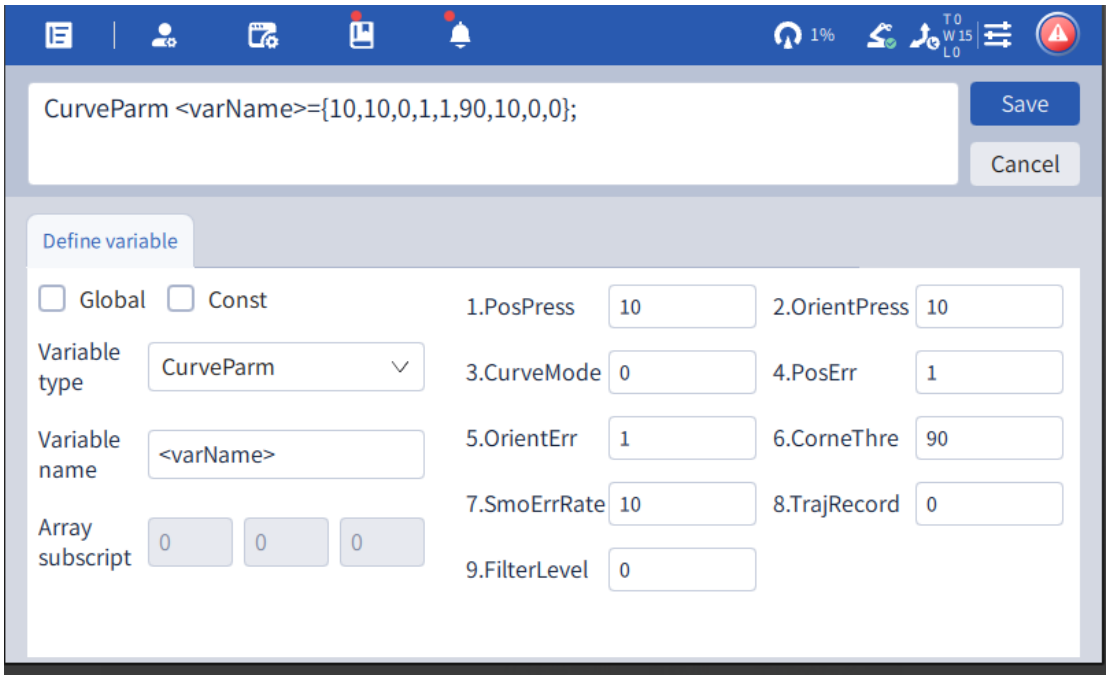
For details of the Movs and Curve instructions, see the robot instruction guide.

12.3.3 Configuration of Curve Parameters

To adapt to the specific application conditions, you can configure "CurveParm" parameter in the curve instruction to adjust the trajectory properties of the curve. The "CurveParm" parameter includes the position stress coefficient, orientation stress coefficient, curve mode, basic error, corner determination threshold, smoothing error rate and filter level.

In the program editing interface, add an instruction: "Common commands" > "VarDef" > "CurveParm".





CurveParm#Curve property tuning parameters

{

int PosPress; #Position stress coefficient, default value 10, range 1 to 100

int OrientPress; #Orientation stress coefficient, default value 10, range 1 to 100

int CurveMode; #Curve mode, 0 default mode, 1 smoothing mode, 2 precision mode

double PosErr; #Basic position error, default value 1 mm, range 0.1 to 100

double OrientErr; #Basic orientation error, default value 1°, range 0.1 to 10

double CorneThre: # Corner determination threshold, default value 90°, range 45° to 135°

double SmoErrRate; #Corner smoothing error rate, default value 10, range 1 to 100

int TrajRecord; #Trajectory record switch, default value 0 (OFF), range 0/1

int FilterLevel; #Filter level, default value 0, range 0/1/2/3

}

(1) PosPress: Position stress coefficient

Data type: integer (supports variables)

Default: 10

Range: 1 to 100

Parameter description:

When the robot moves in a curve through a position corner, the running speed is automatically limited due to the position stress limit. Based on actual application requirements, you can adjust the speed limit of the robot when it passes the position corner by adjusting the position stress coefficient.

- When the position stress coefficient increases, the robot running speed near the position corner increases, but the motion shock or vibration becomes obvious.
- When the position stress coefficient decreases, the robot running speed decreases near the position corner, and the motion shock or vibration decreases. Avoid specifying an excessively large position stress coefficient to avoid severe shock and vibration or triggering an excessive acceleration alarm.

(2) OrientPress: Orientation stress coefficient

Data type: integer (supports variables)

Default: 10

Range: 1 to 100

Parameter description:

When the robot moves in a curve through an orientation corner, the running speed is automatically limited due to the orientation stress limit. Based on actual application requirements, you can adjust the speed limit of the robot when it passes the orientation position by adjusting the orientation stress coefficient.

- When the orientation stress coefficient increases, the robot running speed near the orientation corner increases, but the motion shock or vibration becomes obvious.
- When the orientation stress coefficient decreases, the robot running speed decreases near the orientation corner, and the motion shock or vibration decreases. Avoid specifying an excessively large orientation stress coefficient to avoid severe shock and vibration or triggering an excessive acceleration alarm.

(3) CurveMode: Curve mode setting

Data type: integer (supports variables)

Default: 0

Value range: 0 default mode, 1 smoothing mode, 2 precision mode

Parameter description:

You can select different modes based on the application scenario.

- The default mode is applicable to most operating conditions and can tune the curve according to default or user input curve parameters.
- The smoothing mode is applicable to operating conditions with dense input data, high acquisition noise, and low path accuracy requirements. In this mode, the curve does not pass strictly through the input points, but moves in the form of approaching the target points. The proximity of the motion is related to the density of the points, and the trajectory error does not exceed 50% of the spacing of neighboring points. This mode provides better smoothness.

- The precision mode is applicable to operating conditions with accurate input data, low noise, smooth original trajectory, and strict requirements for reaching the path points. The global trajectory error in this mode does not exceed the basic trajectory error, and the accuracy is not affected by the smoothing error rate.



(4) PosErr: Basic position error

Data type: Float (supports variables)

Default: 1 (mm)

Range: 0.1 to 100

Parameter description:

Because the position of the curve does not always pass the input point, there may be a theoretical position approximation error between the curve path and the input point. The allowable position error between the curve path and the target point is generally referred to as the basic position error. Generally, the default basic position error of the curve is 1 mm. This parameter is used as the reference value for curve fitting. In applications with high precision requirements, you can reduce the position error of the curve by adjusting this parameter. Note that when the maximum position error allowed for the curve decreases, the smoothness of the curve path generated by the robot decreases. This may cause the robot to stall or generate shock and vibration.

(5) OrientErr: Basic orientation error

Data type: Float (supports variables)

Default: 1 (°)

Range: 0.1 to 10

Parameter description:

Because the orientation of the curve does not always pass the input point, there may be a theoretical position approximation error between the curve path and the input point. The allowable orientation error between the curve path and the target point is generally referred to as the basic orientation error. Generally, the curve allows a 1° orientation error by default. This parameter is used as the reference value for curve data processing. In applications with high precision requirements, you can reduce the orientation error of the curve by adjusting this parameter. Note that when the maximum orientation error allowed for the curve decreases, the smoothness of the curve path generated by the robot decreases. This may cause the robot to stall or generate shock and vibration.

(6) CorneThre: Corner determination threshold

Data type: Float (supports variables)

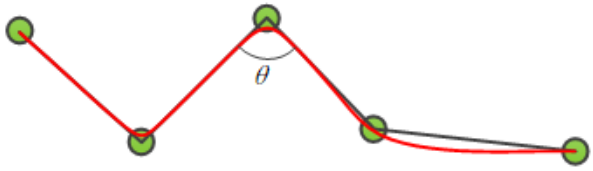
Default: 90 (°)

Range: 45° to 135°

Parameter description:

When there are obvious corner features in the curve path, the smoothness of the path is greatly affected. This can easily lead to local sharpness or twisted curves that may cause interference with the environment, resulting in impacts or significant speed reduction. You can adjust the smoothing level of the curve by adjusting the

corner determination threshold θ and smoothing error rate, to smooth the corner features in the trajectory. The corner determination threshold is used to set the maximum path angle that allows for smoothing. Path points smaller than this angle will be determined as corners. In particular, points with a spacing less than 5 mm between them will not be included in the corner determination.



(7) SmoErrRate: Smoothing error rate

Data type: Float (supports variables)

Default: 10

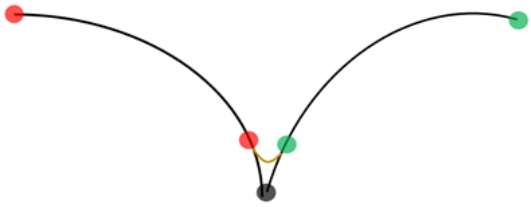
Range: 1 to 100

Parameter description:

When the corner features of the trajectory are smoothed, the smoothness of the trajectory will be improved, but the accuracy of the trajectory at the corners may be affected. Therefore, it is necessary to limit the smoothing error. The corner determination threshold determines area on the curve that need to be smoothed, while the smoothing error rate determines the degree of smoothing. This parameter represents the rate of the maximum allowable error at the smoothed points relative to the set position and orientation error. Note that the lager the smoothing error rate the better the smoothing effect of the curve, but the arrival accuracy at the corners will be reduced. The default value of the rate is 10. You need to adjust the rate according to practical conditions.

CAUTION

Smoothing error = Basic error * Smoothing error rate



(8) TrajRecord: TCP trajectory record switch (not valid in the current version)

Data type: integer (supports variables)

Default: 0

Range: 0/1

Parameter description:

Used to identify whether to record the current segment of the trajectory. 0 for no, and 1 for yes.

(9) FilterLevel: Filter level

Data type: integer (supports variables)

Default: 0 (no filtering)

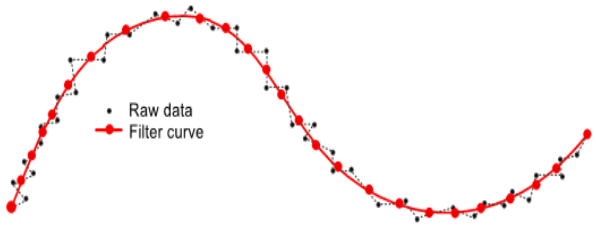
Range: 0 to 3

Parameter description:

For applications where the accuracy of the path identification sensor is low, the curve motion may become stuck and have poor data collection accuracy and severe jitter. You can adjust the filter level to trim the raw data to filter out high-frequency noise spikes, and improve the smoothness of the curve.

CAUTION

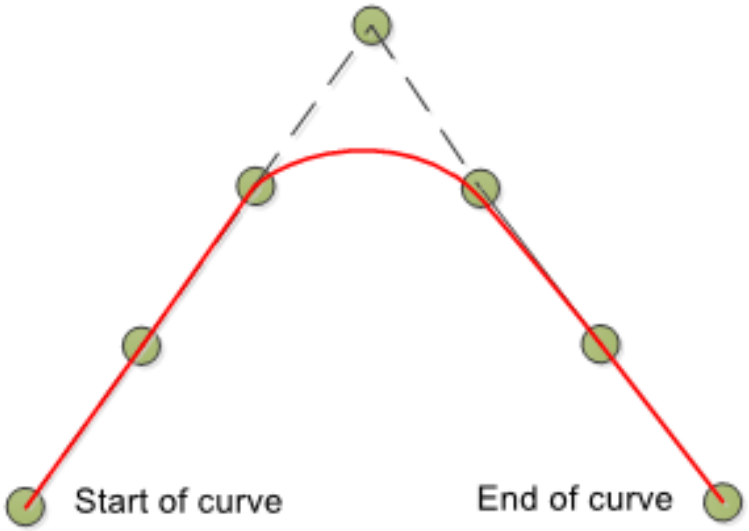
The default value is 0, indicating that filtering is not performed. After the filter is turned on, the system filters the raw data to remove jitter noise. It is recommended to turn on the filter in situations with dense data and turn off the filter in situations with sparse data. In particular, filter processing will not be performed on points with a spacing greater than 2 mm or 2°.



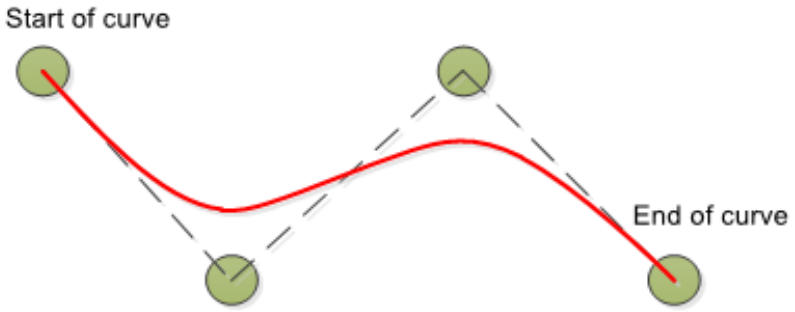
12.3.4 Notes

(1) It is not allowed to change the tool and workobject during the same curve motion.

(2) In the default mode, you can adjust the smoothing level of the trajectory by adjusting the corner determination threshold and smoothing error rate, to smooth the corner features in the trajectory to improve the passability. Note that the trajectory smoothness increases as the smoothing error rate increases, but the trajectory accuracy at the corners decreases accordingly. The curve will not pass through the original input points. Therefore, the smoothing coefficient needs to be adjusted considering both the precision and smoothness requirements.



(3) In the default mode, after the smoothing error rate is configured, the robot approaches the corners but does not pass the points at corners when multiple teaching points form consecutive corners.

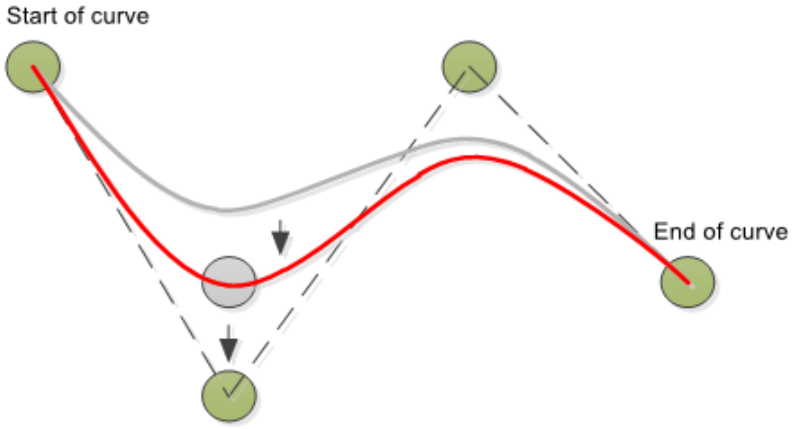


As the path errors at the corners cannot be guaranteed, avoid input points with excessive spacing. The recommended spacing of input points is 1 to 10 mm. In applications with high precision requirements or interference risk, reduce the spacing of input points and check whether the robot motion path interferes with surrounding objects at low speed.

(4) When using the free curve function, it is generally required that all data points be described with the correct arm parameters. If you want the robot to automatically rotate in the shortest path, use the SlewMode instruction to switch the current rotation mode to continuous rotation mode before performing curve motion. For details, see the description of the SlewMode.

(5) If the spacing of the two adjacent input points is smaller than the minimum specification and smaller than the trajectory accuracy setting in the curve parameter, the previous input point will be ignored. If a previous point is bound to a motion I/O, the motion I/O will be transferred to a next point. If the previous point is the start point, the start point will be retained. The next point will be ignored and its I/O will be transferred to the start point. If the total number of I/Os of the next point exceeds the limits, an alarm occurs.

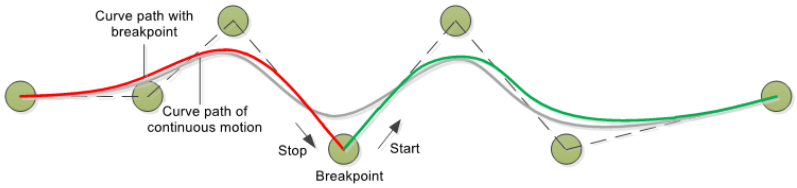
(6) The path of any point on the curve is affected by the pose and distribution of multiple input points before and after that point. When one of the input points is changed, the curve path of multiple points before and after that point changes.



(7) When a breakpoint debugging is performed on a curve group, the robot ends the motion before entering the breakpoint and stops at the target position.

CAUTION

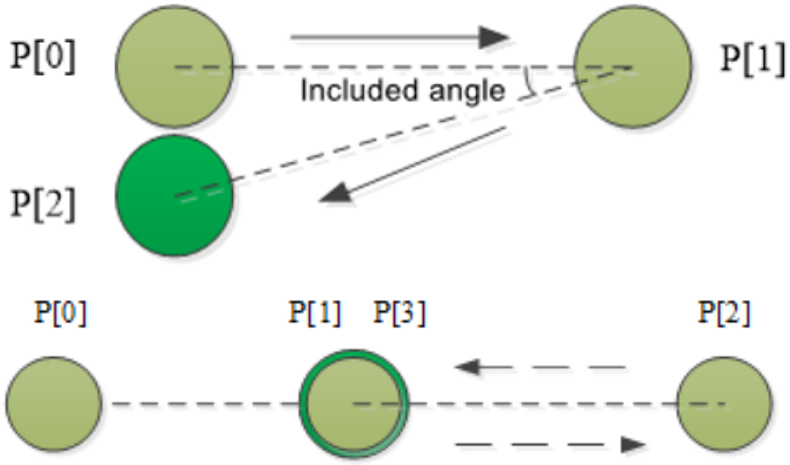
The motion path of the robot near the stop point will be different from the curve path during continuous teaching or automatic running. If the Movs motion delimited by a single-step operation or a breakpoint contains only one point, the robot performs a Movl motion instead of the Movs motion.



(8) When the input points are close to a robot workspace boundary or a singular area, the curve path constituted by the input points may trigger an alarm even if the input points are inside the robot workspace. Adjust the working area or the position of the input points properly to avoid going beyond the workspace or entering the singular area.

(9) The Movs instruction supports up to three motion I/Os associated with the input points (one motion I/O per point). The I/O action is triggered automatically when the robot moves near the input point.

(10) As the reciprocating line cannot be approximated through the free curve, the robot alarm may be triggered when the angle of two motion paths formed by three consecutive input points is less than 0.5°.

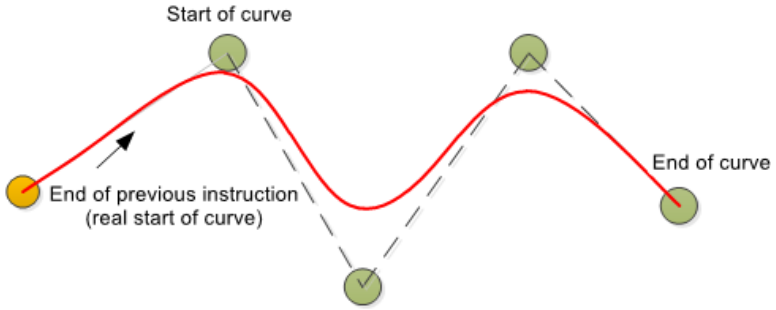


(11) When you specify the motion speed of the curve through the Movs instruction, be aware that the robot is limited by motion performance and thus requires a certain distance for acceleration and deceleration when changing the speed. When the distance the robot moves is smaller than the distance required for the robot to change speed or multiple different desired speeds are specified within the distance for speed change, the robot may not reach the desired speeds.

(12) When a free curve is defined as a curve group, the robot calculates the transition length of the curve path based on the transition level of the last target teach point in the curve group. Transition level settings of input points other than the end point are ignored.

(13) During curve transition, the maximum allowable transition length of the curve path cannot exceed half the curve length and cannot exceed the total length of the curve segment consisting of the first or last four points.

(14) The free curve starts with the current position of the robot as the true start point of the curve, and always approaches the start point by a motion approaching a straight line. If there is a large gap or bend angle between the current point and the nominal start point of the curve segment to be executed, in particular, when the curve instruction is set as the start line, an error will be occur because the motion planning conditions between the current point and the executed curve segment are not met, for example, the arm parameters are different or a reciprocating motion is caused. Therefore, it is recommended to move to the nominal start point of the curve through other motion instructions before executing the curve instruction.



(15) Function compatibility description

No.	Function specifications
1	Teaching (single-step debugging, breakpoint debugging, etc.) and automatic modes supported
2	Motion I/O supported
3	Dynamic tracking supported
4	ECP supported
5	Nwait supported
6	Until, Offset, and self-learning vibration suppression not supported
7	All external axes remain static during free curve motion
8	Free curves are not supported when the guide rail is used or when a curve workobject is bound to the positioner
9	J6 independent axis not supported

(16) Error description

No.	Description
1	Too big spacing of input points
2	Too small spacing of input points
3	Too big change in orientation of input points
4	Number of curves exceeds the limit
5	Too many input points
6	Too less input points
8	Incompatible instruction parameters or functions
9	Too large curve length
10	Too small angle between input points

No.	Description
11	Non-MOVS instructions included in curve group
12	Target point associated with motion I/O is not on the current curve segment.
13	The true start point of the curve is incompatible.

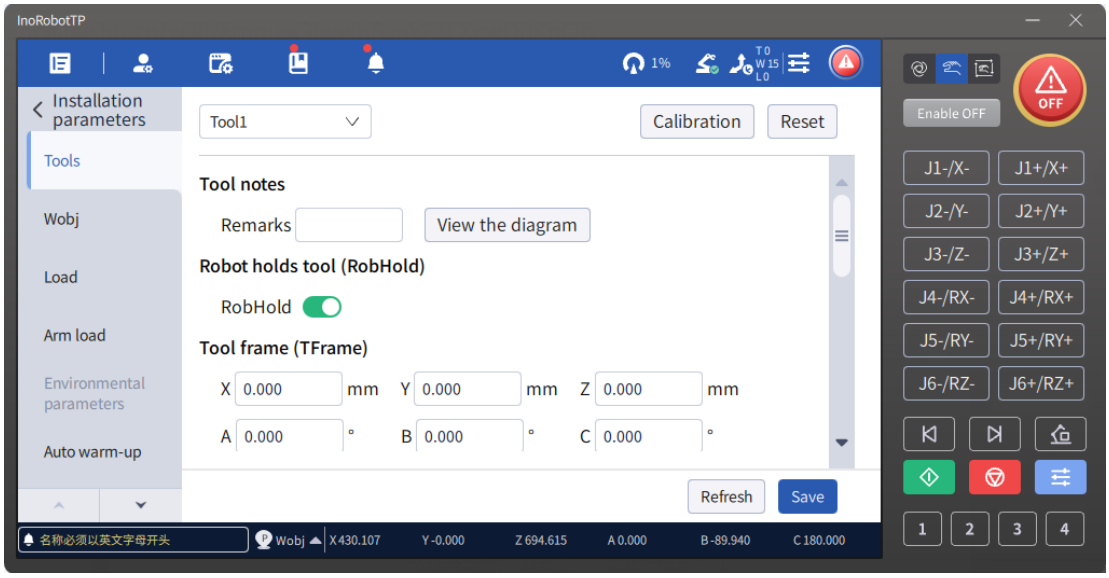
12.4 Load Auto-Tuning

12.4.1 Function Introduction

- The load auto-tuning function is used to obtain load parameters by running set robot motion trajectories. It simplifies the acquisition of load parameters.
- The load auto-tuning function supports the auto-tuning of tool load (TLoad) and grip load (Load).
- Load auto-tuning is recommended when the shape of load is complex and no 3D load model is available. If the 3D load model is available, it is recommended to use 3D software to export the load parameters. Generally, the accuracy of the exported load parameters is higher than that obtained by the load auto-tuning function.

12.4.1.1 Opening Load Auto-Tuning

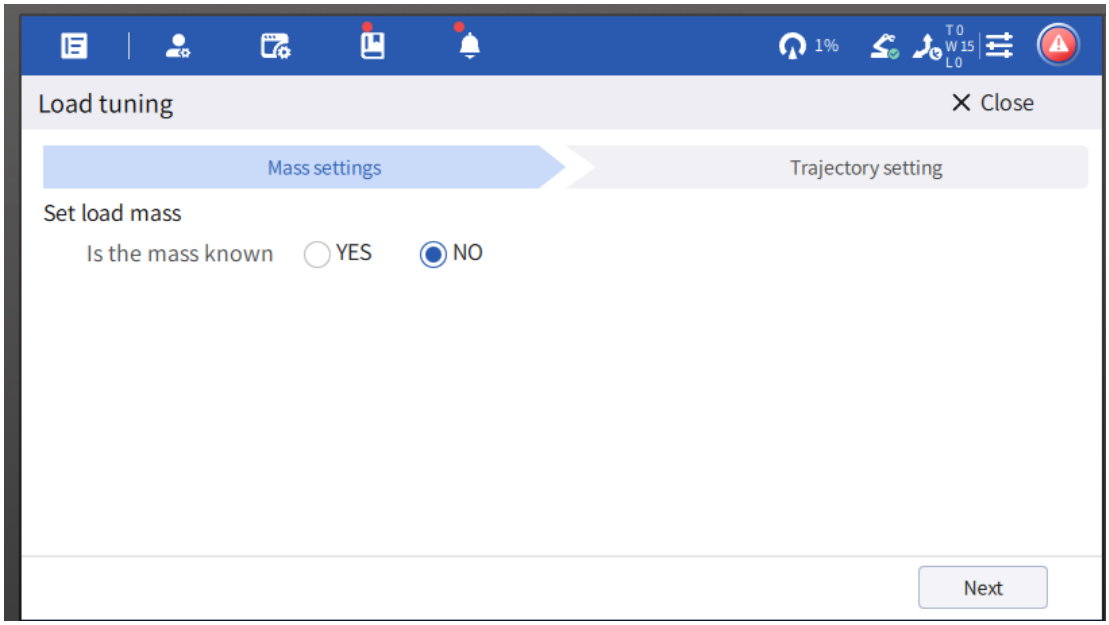
Tool load auto-tuning: Go to "Settings" > "Installation parameters" > "Tools", select a tool other than Tool0, and click "Load tuning" under "Mass" section to enter the load tuning interface. This can only be accessed in Edit/ Admin/Manufacturer mode.



12.4.1.2 Tool Load Auto-Tuning

1. Set the mass. If the load mass is known, select "YES" and enter the mass. If the load mass is unknown, select "NO". Select "YES" and correctly set the load weight for more accuracy result.

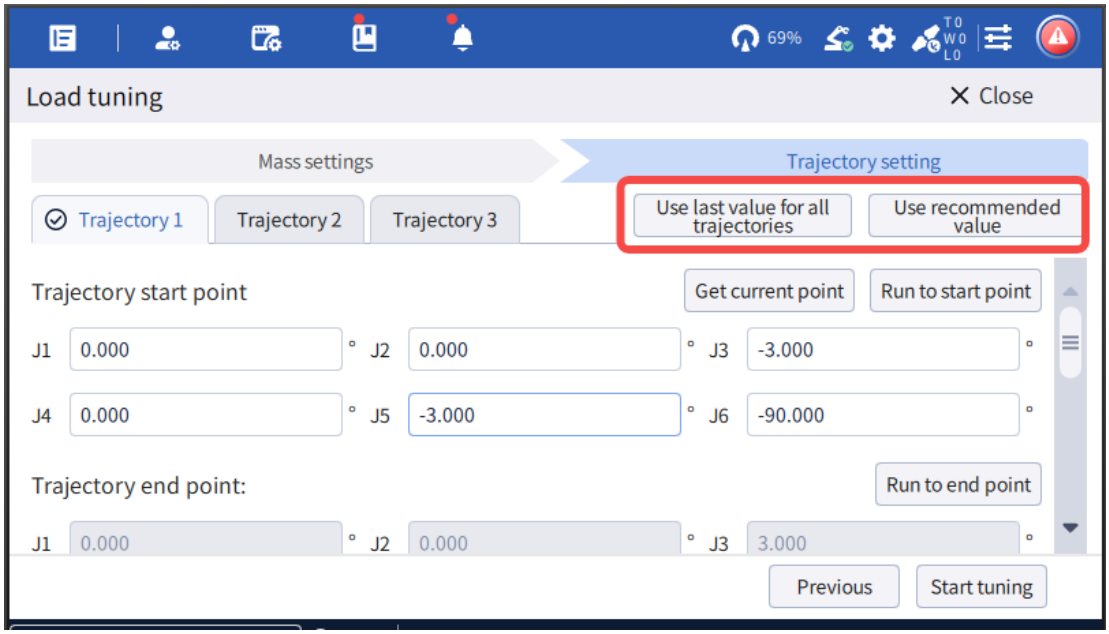
Click."Next"to enter the trajectory setting interface.



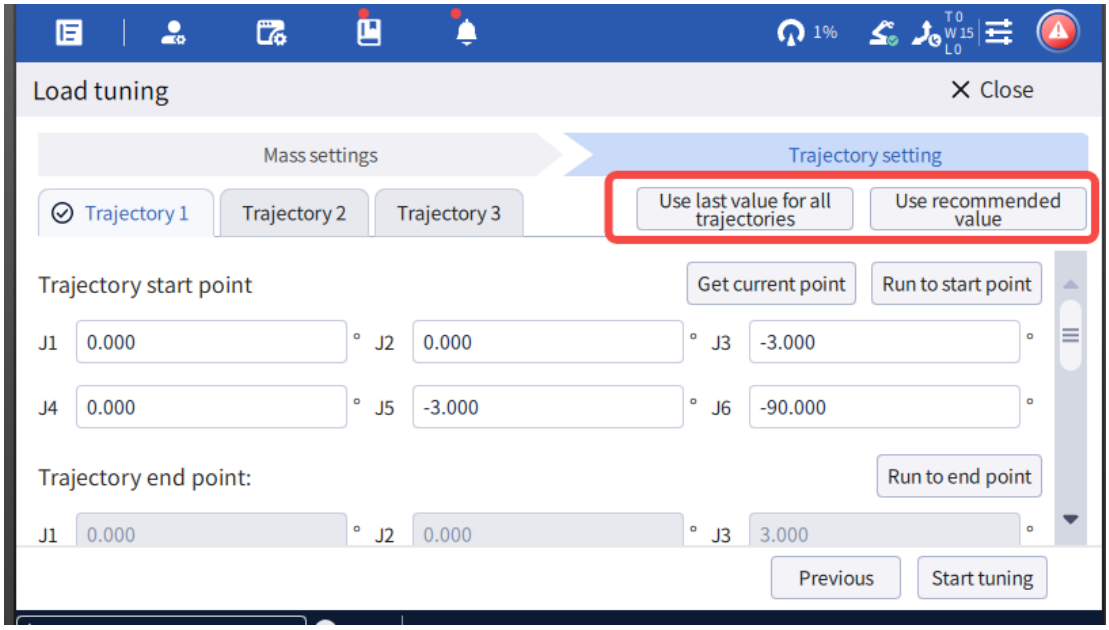
2. Set the auto-tuning trajectory.

1) If it is the first use of the load auto-tuning function or the robot installation method has changed, it is recommended to click "Use recommended value" to recalculate the recommended trajectory; in other cases, it is recommended to click "Use last value for all trajectories", which will default to using the last successfully auto-tuned trajectory.

6-axis robot:



SCARA robot:



2) You need to set 3 auto-tuning trajectories: If they have been successfully auto-tuned before, the successful trajectories will be displayed by default; otherwise, the recommended values will be displayed.

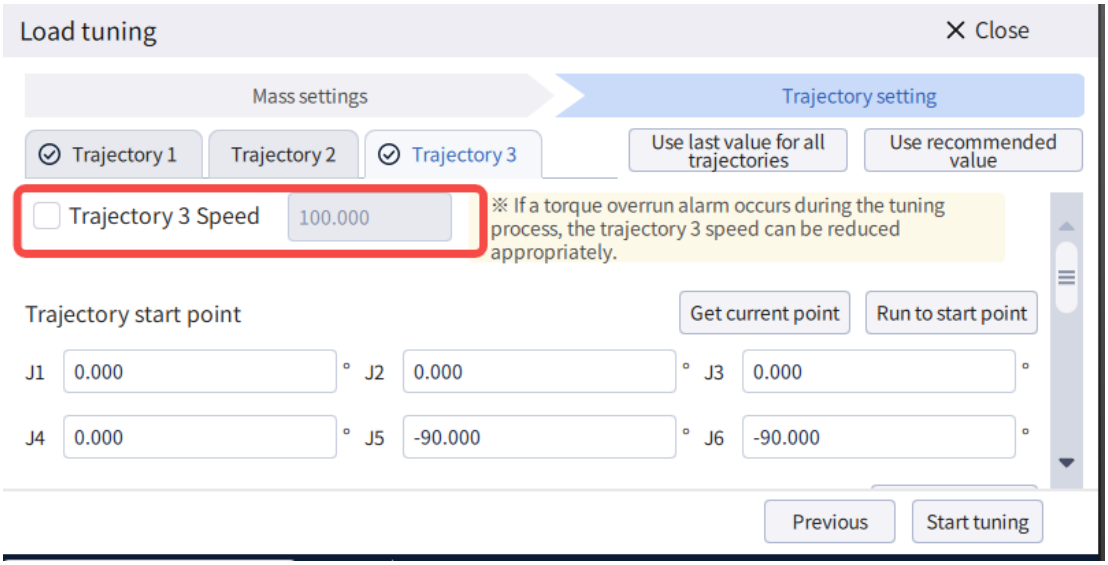
6-axis robot trajectory requirements:

For Trajectory 1 and Trajectory 2, ensure the forearm and the axes of J3/J5 are as parallel to the ground as possible, otherwise the auto-tuning accuracy may be affected. It is recommended to use the recommended values as much as possible. The joint angles in the edit box can only be manually modified in Admin/Manufacturer mode.

- Trajectory 1: For J1, J2, J4 and J6, the joint angle at the start point is identical to that at the end point. For J3 and J5, the displacement from the start point to the end point is 6°.
- Trajectory 2: For J1 to J5, the joint angle at the start point is identical to that at the end point. For J6, the difference between the joint angles at start point and the end point should be as large as possible.
- Trajectory 3: For J1 to J4, the joint angle at the start point is identical to that at the end point. For J5 and J6, the difference between the joint angles at start point and the end point should be as large as possible.

CAUTION

If a "Torque overlimit" alarm occurs during the auto-tuning process, return to the Trajectory 3 settings interface, check "Trajectory 3 Speed", and appropriately reduce the speed value. The adjustment principle is: Choose the highest possible operating speed without triggering a "Torque overlimit" alarm.



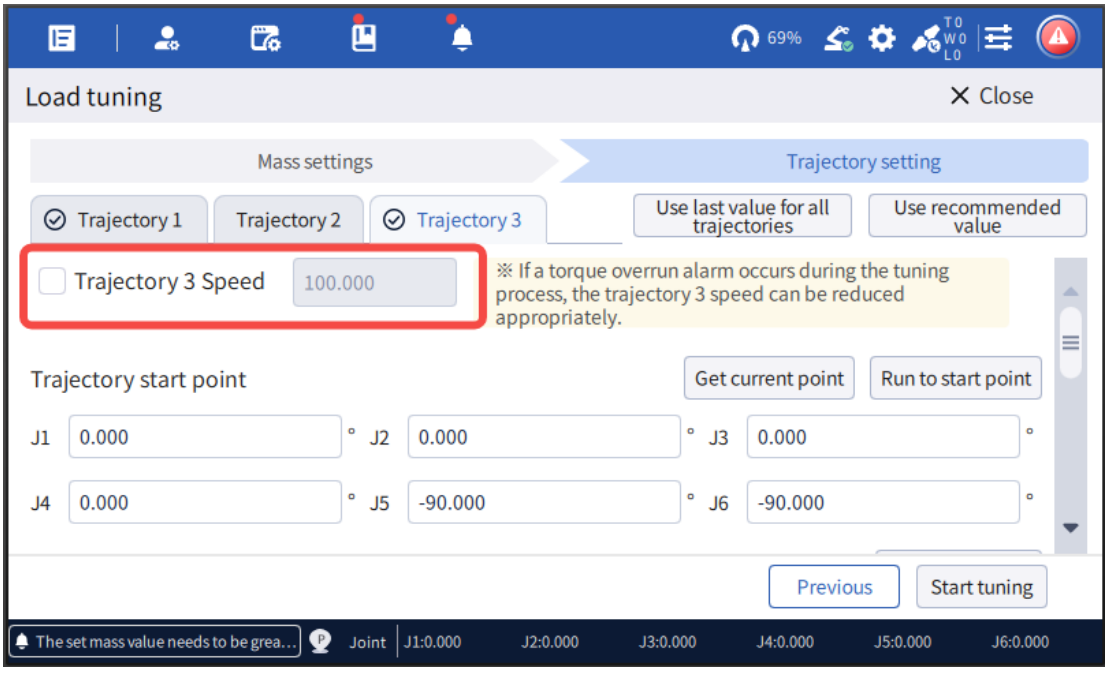
SCARA robot trajectory requirements:

It is recommended to use the recommended values as much as possible. The joint angles in the edit box can only be manually modified in Admin/Manufacturer mode.

- Trajectory 1: For J1, J2 and J4, the joint angle at the start point is identical to that at the end point. For J3, the displacement from the start point to the end point is 50 mm.
- Trajectory 2: For J1 to J3, the joint angle at the start point is identical to that at the end point. For J4, the difference between the joint angles at start point and the end point should be as large as possible.
- Trajectory 3: For J3, the joint angle at the start point is identical to that at the end point. For J1, J2 and J4, the difference between the joint angles at start point and the end point should be as large as possible.

CAUTION

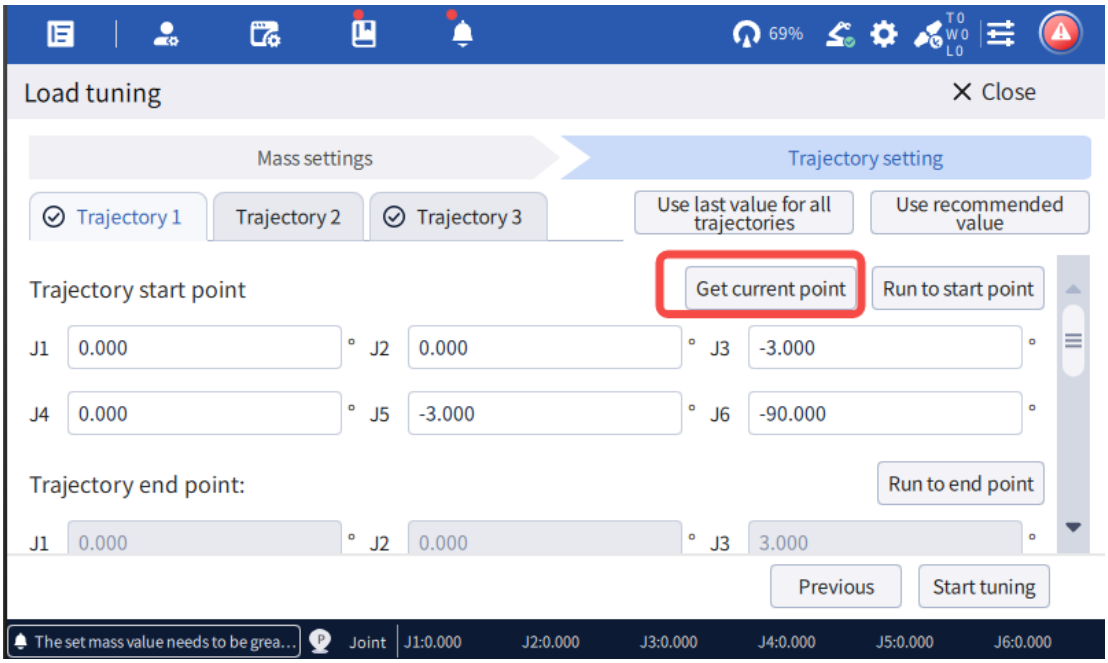
If a "Torque overlimit" alarm occurs during the auto-tuning process, return to the Trajectory 2/3 settings interface, check "Trajectory 2/3 Speed", and appropriately reduce the speed value (30 by default). The adjustment principle is: Choose the highest possible operating speed without triggering a "Torque overlimit" alarm.

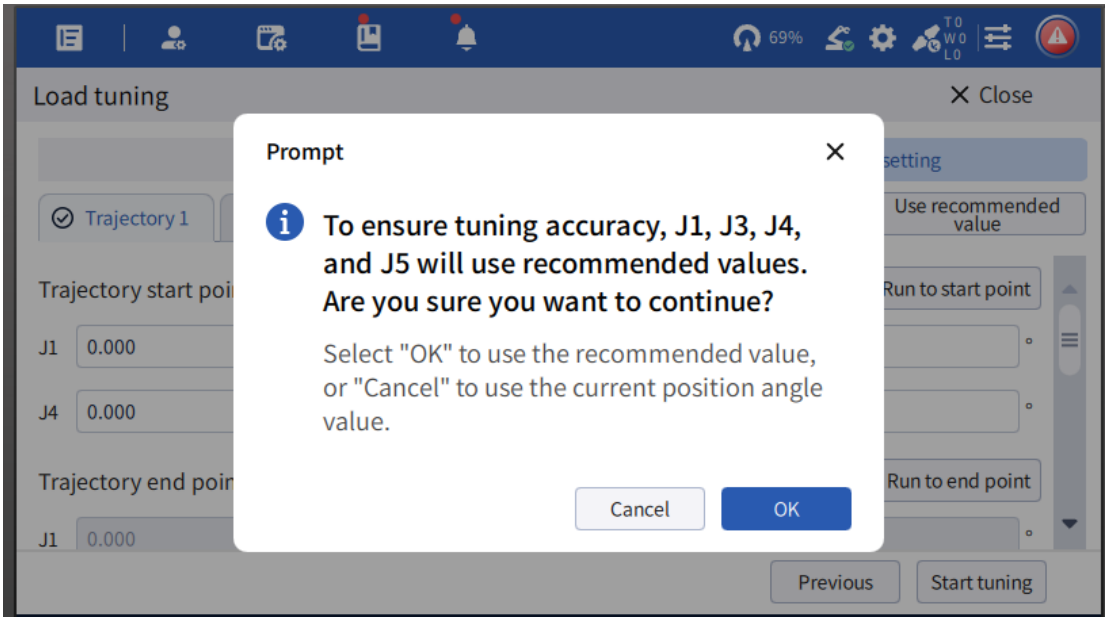


3) Check that the recommended trajectory is reachable. You can click "Run to start point" and "Run to end point" to see whether interference occurs on the current trajectory. If the trajectory is unreachable, adjust it manually according to the orientation requirements of the trajectory.

6-axis robot:

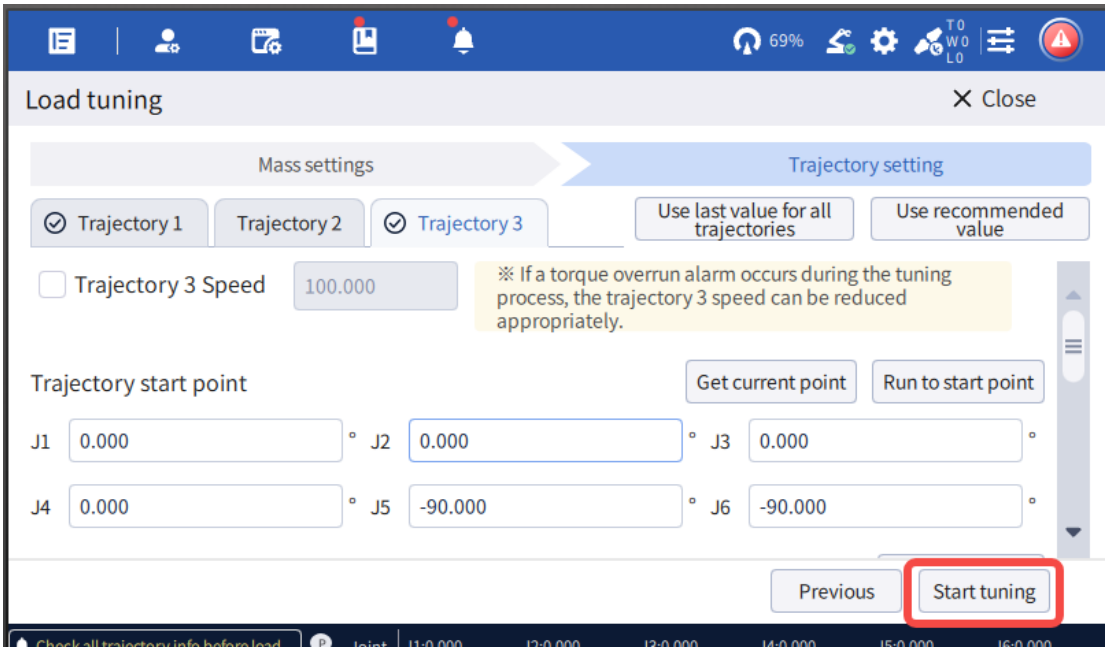
It is recommended to use "Get current point" for point calculation, and the system will automatically calculate the recommended point positions for Trajectory 1 and Trajectory 2 based on the robot installation angle and J2 joint angle. After using "Get current point", reconfirm whether the start/end points are reachable.



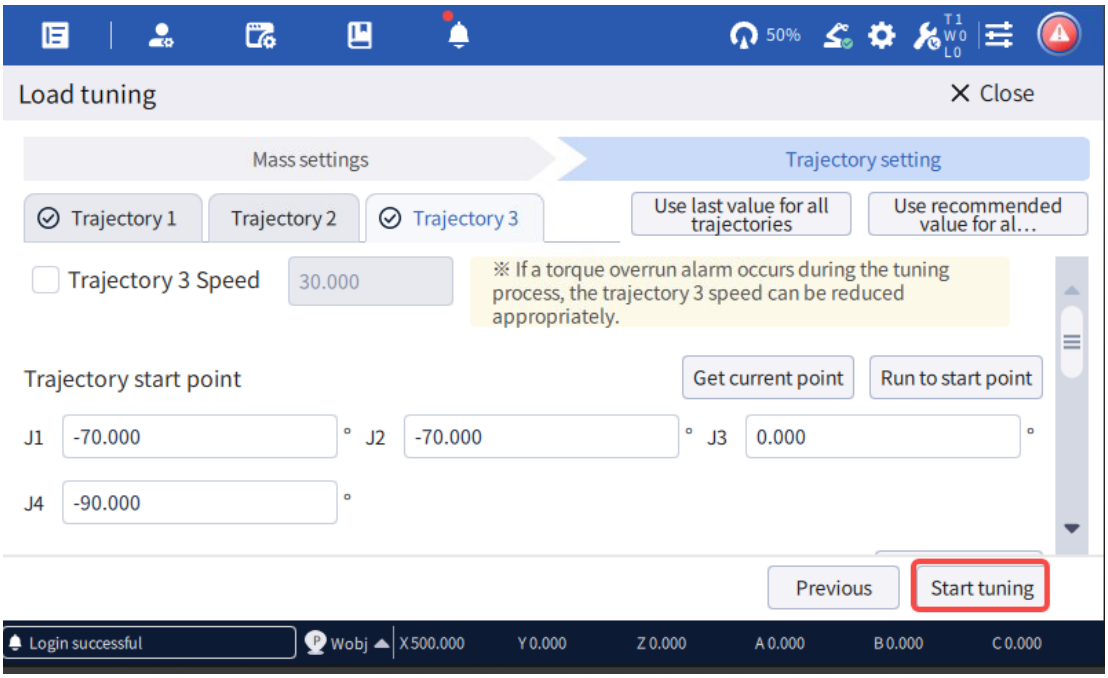


4) If you confirm that the trajectory is reachable, switch the robot operating mode to "Auto" and click "Start tuning".

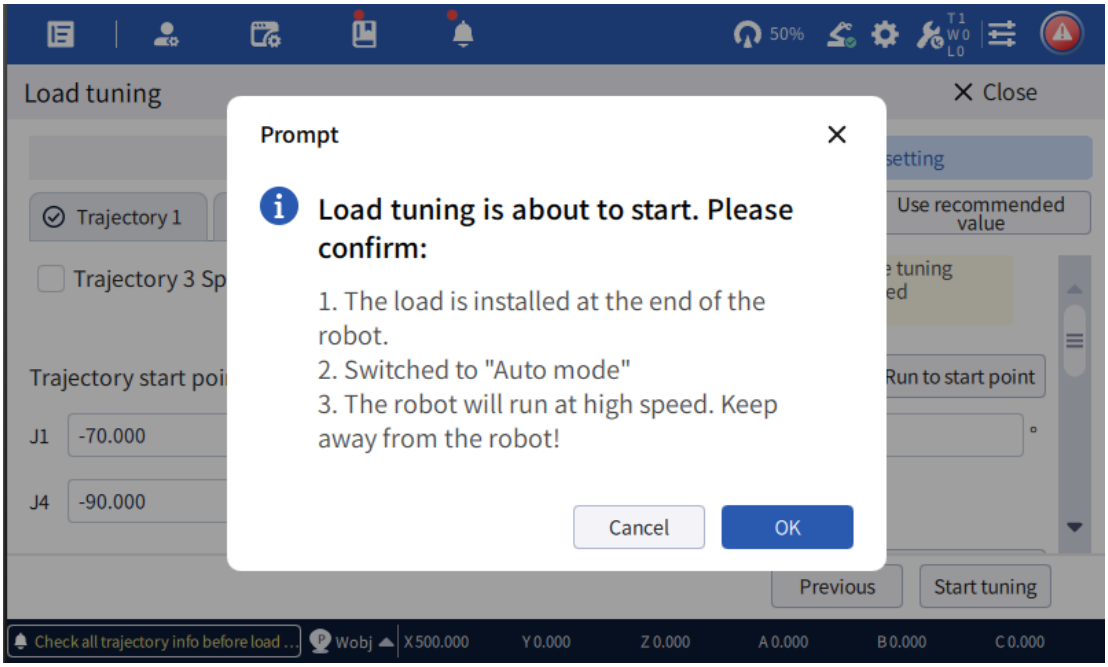
6-axis robot:



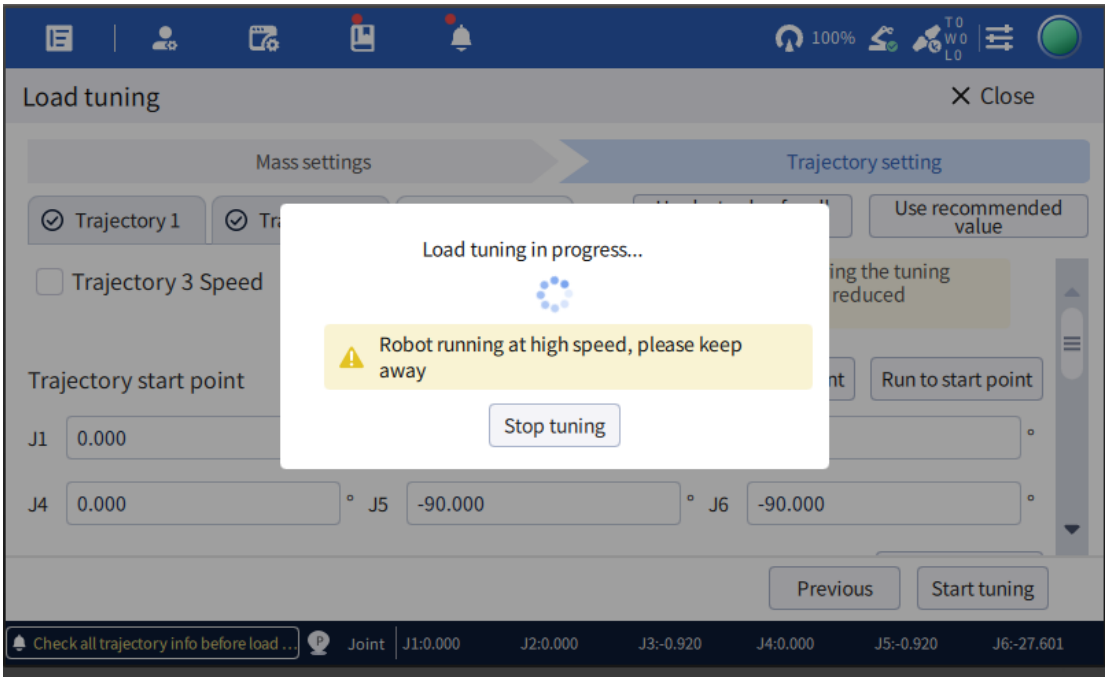
SCARA robot:



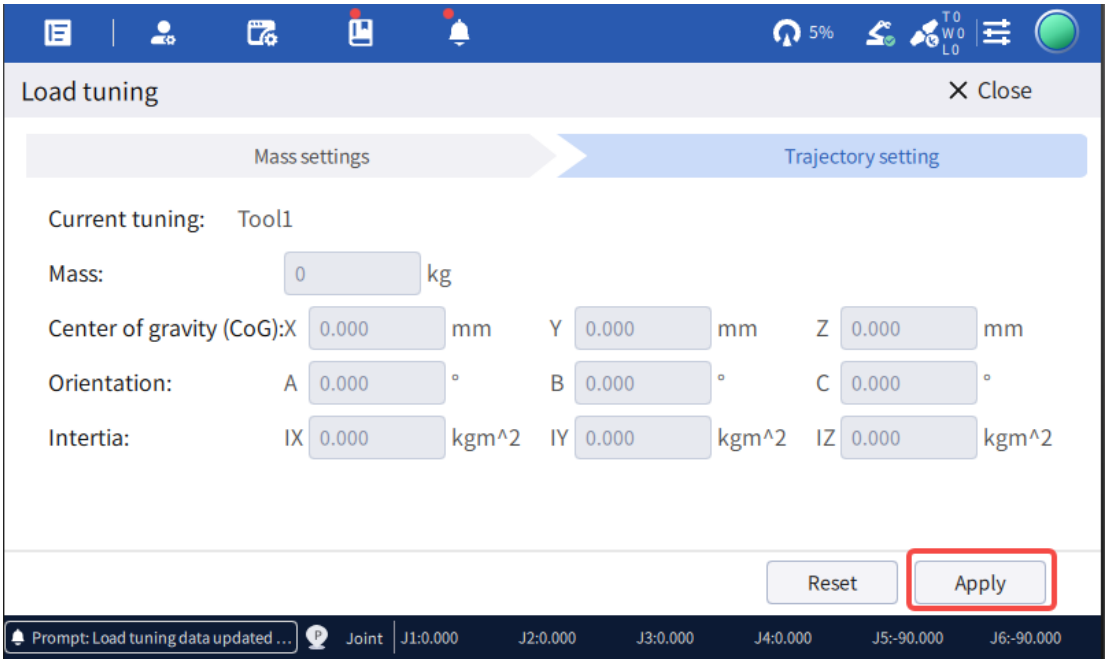
3, In the pop-up dialog, click "OK" if all conditions are met. Otherwise, click "Cancel".

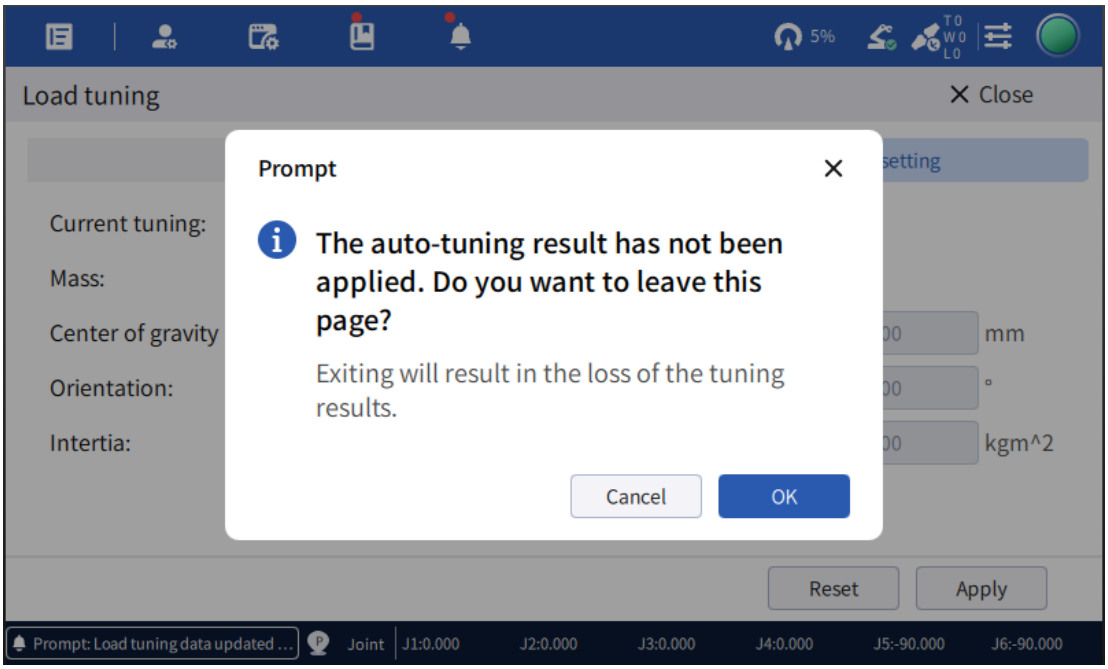


4, During auto-tuning, if you want to stop auto-tuning in advance, click "Stop tuning".



5, After auto-tuning is completed, the screen displays the auto-tuning results. Click "Apply" to write the auto-tuning results to the corresponding tool. If you want to discard the auto-tuning results, click "Return" and then click "Yes" in the pop-up dialog.



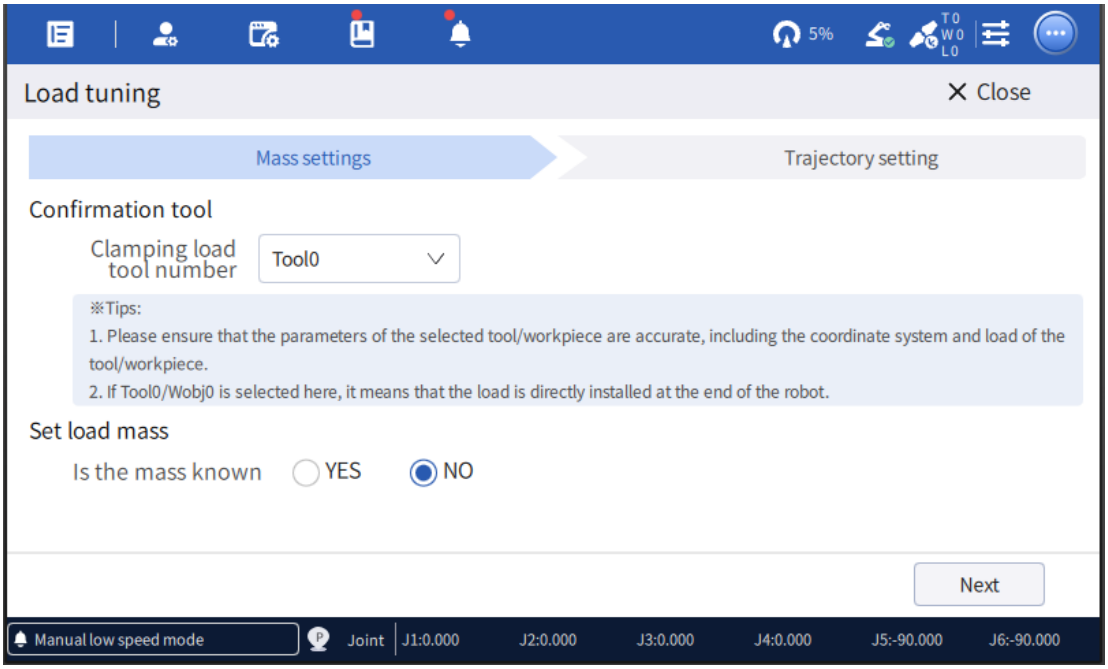


12.4.1.3 Grip Load Auto-Tuning

1. Set the mass.

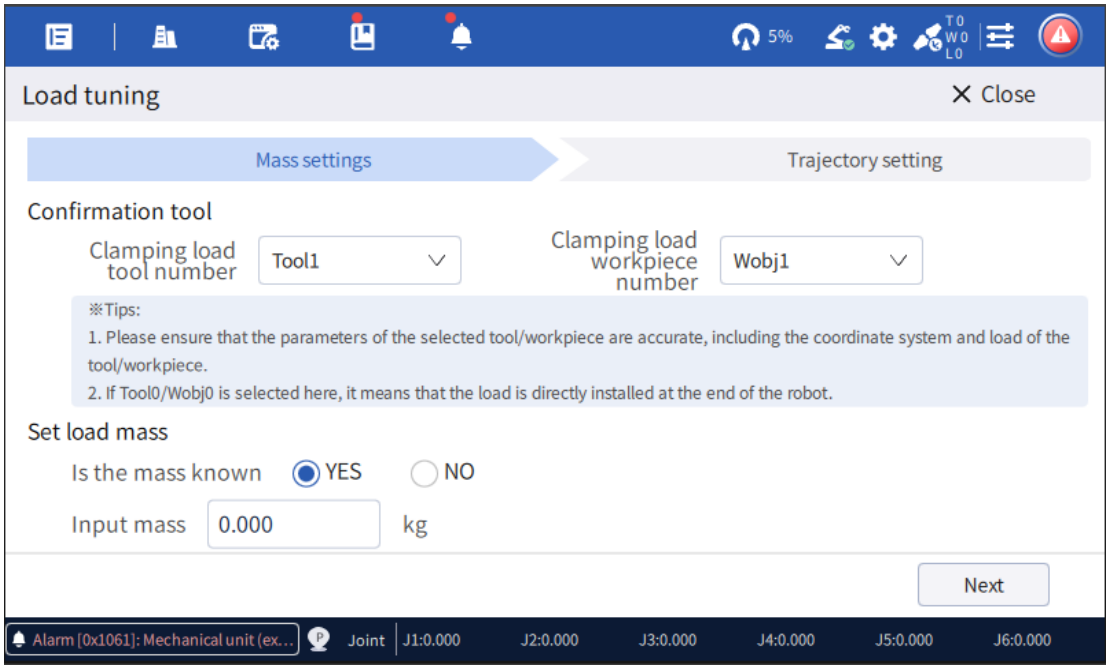
TCP mode:

In TCP mode (the selected tool number is in gripping state), the setting of workobject number is automatically hidden.



ECP mode:

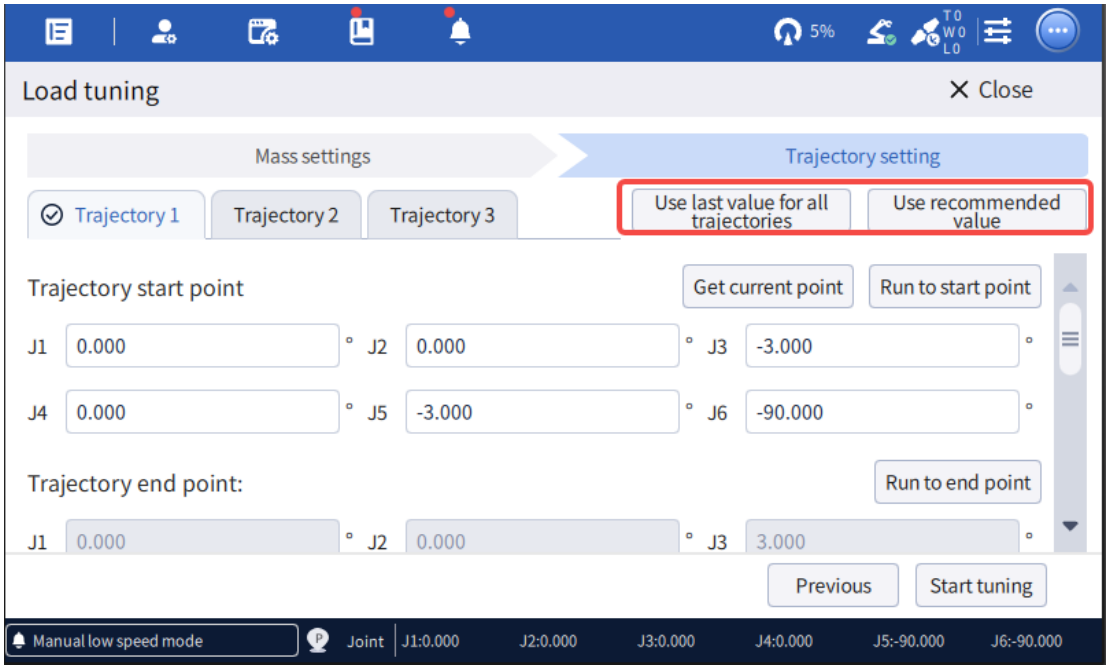
In ECP mode (the selected tool number is in non-gripping state), the setting of workobject number is displayed. The tool number and workobject number must be used in pairs (to ensure mutual exclusivity between gripping and non-gripping states). If you click "Next" with incorrect settings, a warning dialog will appear.



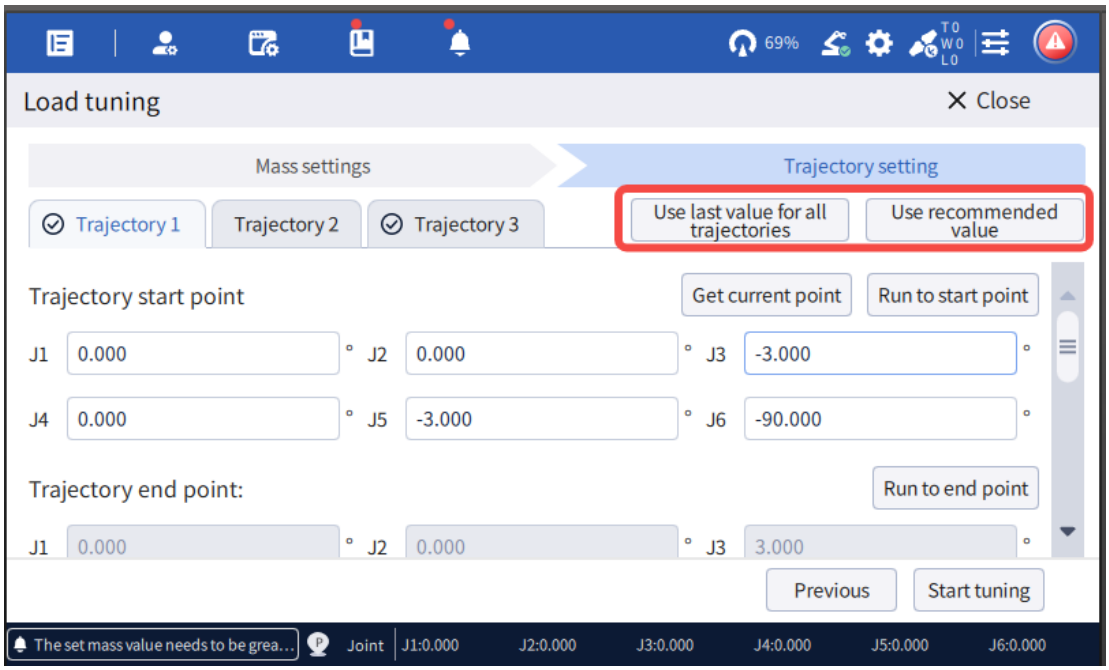
2. Set the auto-tuning trajectory.

1) If it is the first use of the load auto-tuning function or the robot installation method has changed, it is recommended to click "Use recommended value" to recalculate the recommended trajectory; in other cases, it is recommended to click "Use last value for all trajectories", which will default to using the last successfully auto-tuned trajectory.

6-axis robot:



SCARA robot:



3) You need to set 3 auto-tuning trajectories: If they have been successfully auto-tuned before, the successful trajectories will be displayed by default; otherwise, the recommended values will be displayed.

6-axis robot trajectory requirements:

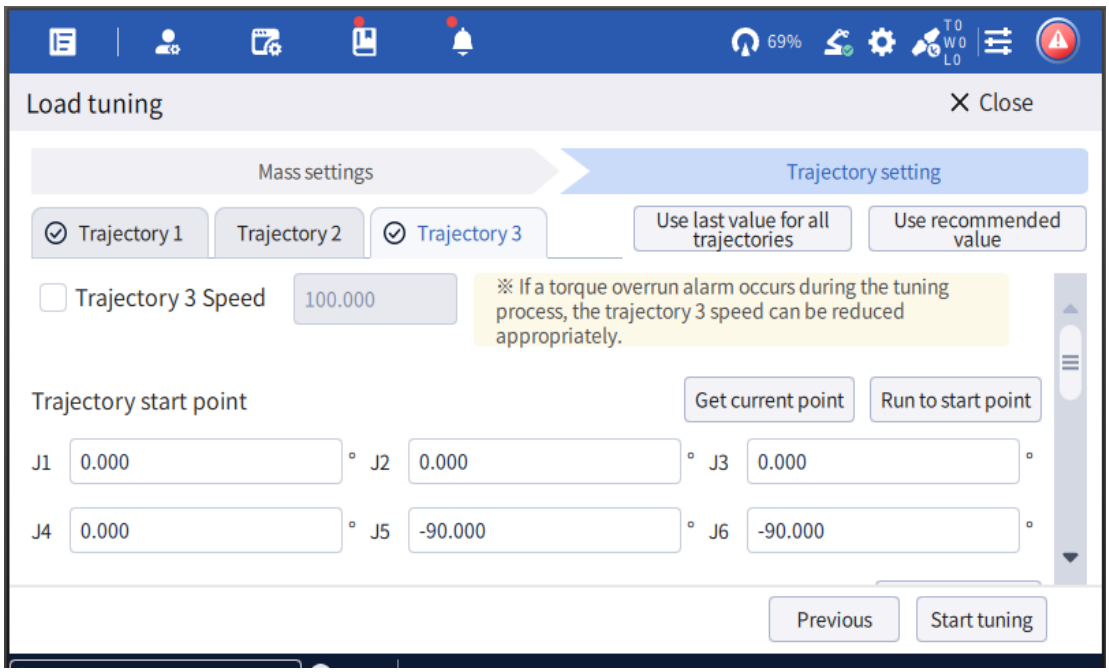
For Trajectory 1 and Trajectory 2, ensure the forearm and the axes of J3/J5 are as parallel to the ground as possible, otherwise the auto-tuning accuracy may be affected. It is recommended to use the recommended values as much as possible. The joint angles in the edit box can only be manually modified in Admin/Manufacturer mode.

- Trajectory 1: For J1, J2, J4 and J6, the joint angle at the start point is identical to that at the end point. For J3 and J5, the displacement from the start point to the end point is 6°.
- Trajectory 2: For J1 to J5, the joint angle at the start point is identical to that at the end point. For J6, the difference between the joint angles at start point and the end point should be as large as possible.

- Trajectory 3: For J1 to J4, the joint angle at the start point is identical to that at the end point. For J5 and J6, the difference between the joint angles at start point and the end point should be as large as possible.

CAUTION

If a "Torque overlimit" alarm occurs during the auto-tuning process, return to the Trajectory 3 settings interface, check "Trajectory 3 Speed", and appropriately reduce the speed value. The adjustment principle is: Choose the highest possible operating speed without triggering a "Torque overlimit" alarm.



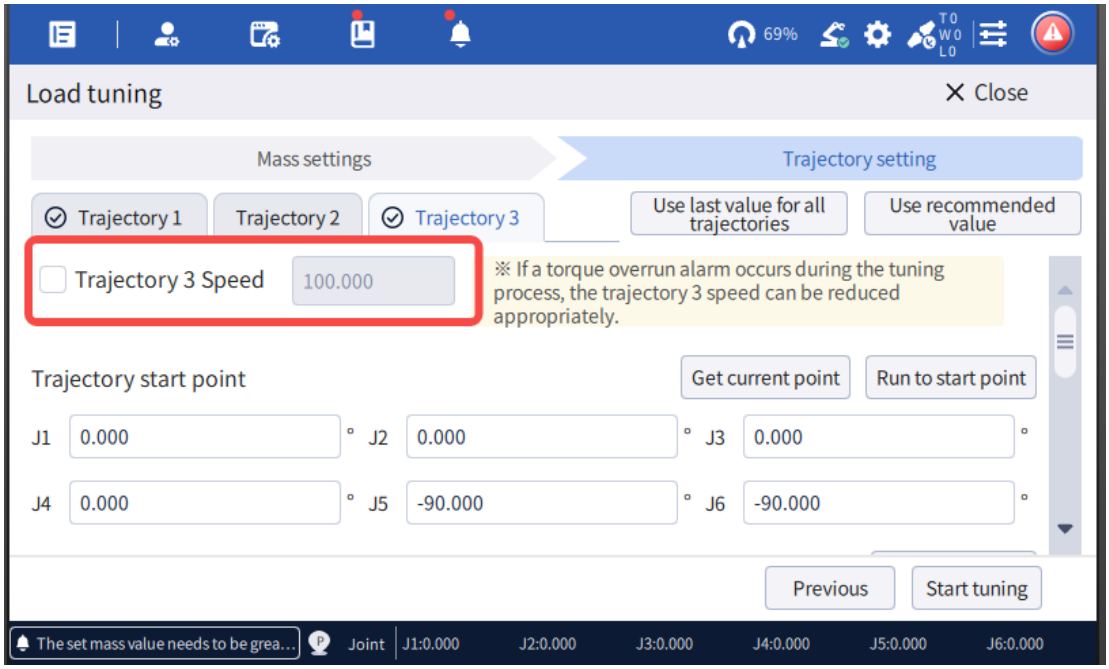
SCARA robot trajectory requirements:

It is recommended to use the recommended values as much as possible. The joint angles in the edit box can only be manually modified in Admin/Manufacturer mode.

- Trajectory 1: For J1, J2 and J4, the joint angle at the start point is identical to that at the end point. For J3, the displacement from the start point to the end point is 50 mm.
- Trajectory 2: For J1 to J3, the joint angle at the start point is identical to that at the end point. For J4, the difference between the joint angles at start point and the end point should be as large as possible.
- Trajectory 3: For J3, the joint angle at the start point is identical to that at the end point. For J1, J2 and J4, the difference between the joint angles at start point and the end point should be as large as possible.

CAUTION

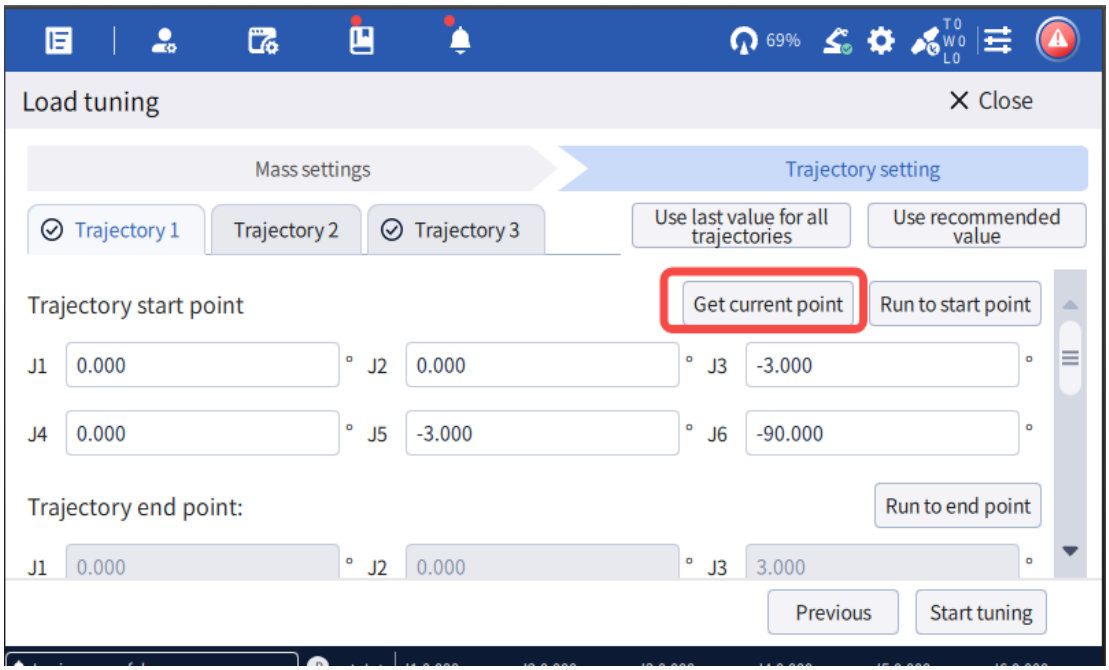
If a "Torque overlimit" alarm occurs during the auto-tuning process, return to the Trajectory 2/3 settings interface, check "Trajectory 2/3 Speed", and appropriately reduce the speed value (30 by default). The adjustment principle is: Choose the highest possible operating speed without triggering a "Torque overlimit" alarm.

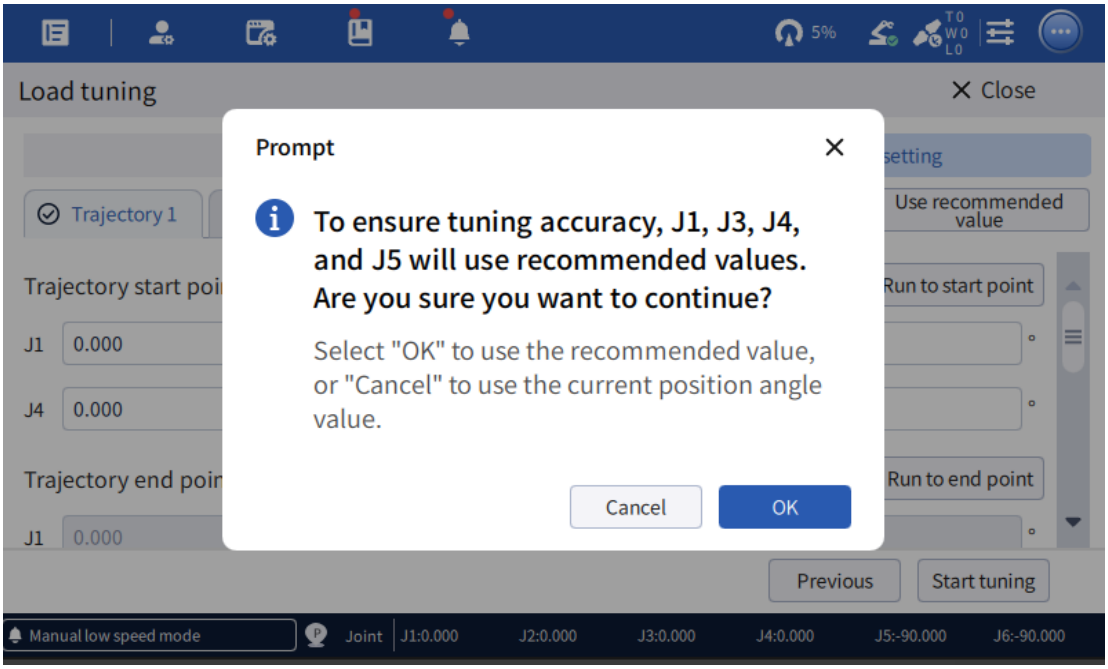


4) Check that the recommended trajectory is reachable. You can click "Run to start point" and "Run to end point" to see whether interference occurs on the current trajectory. If the trajectory is unreachable, adjust it manually according to the orientation requirements of the trajectory.

6-axis robot:

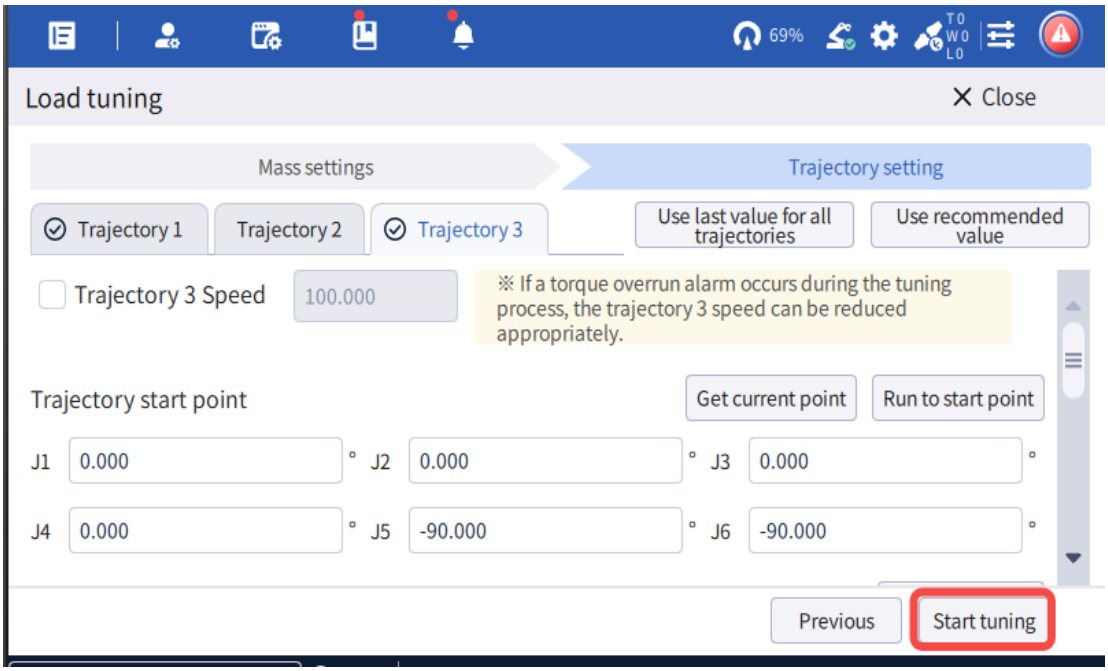
It is recommended to use "Get current point" for point calculation, and the system will automatically calculate the recommended point positions for Trajectory 1 and Trajectory 2 based on the robot installation angle and J2 joint angle. After using "Get current point", reconfirm whether the start/end points are reachable.



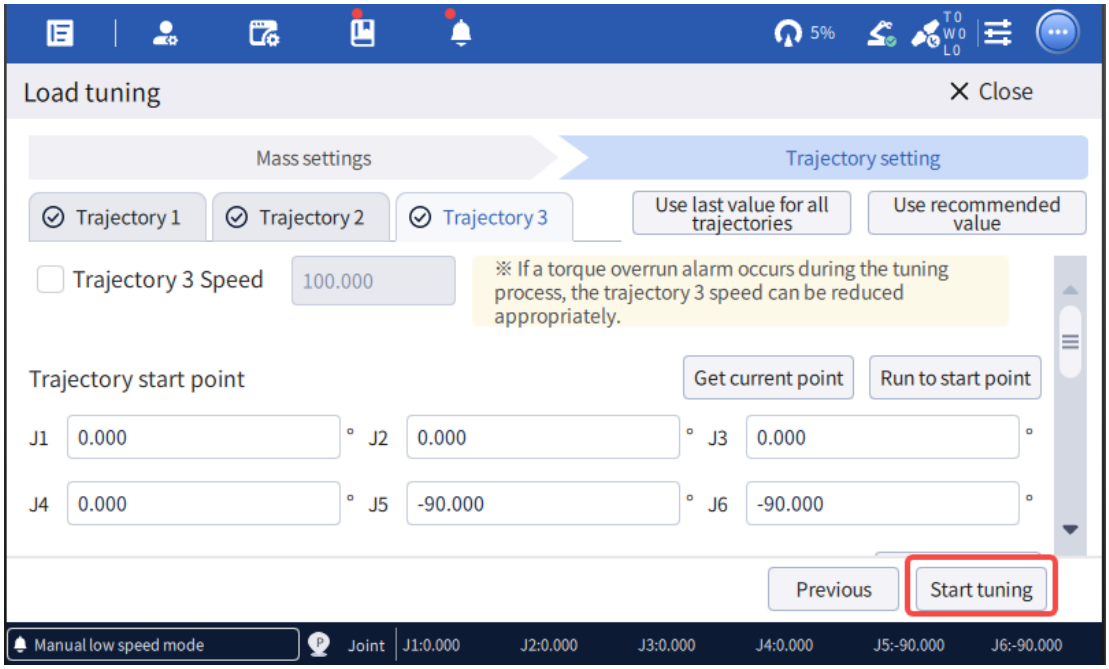


5) If you confirm that the trajectory is reachable, switch the robot operating mode to "Auto" and click "Start tuning".

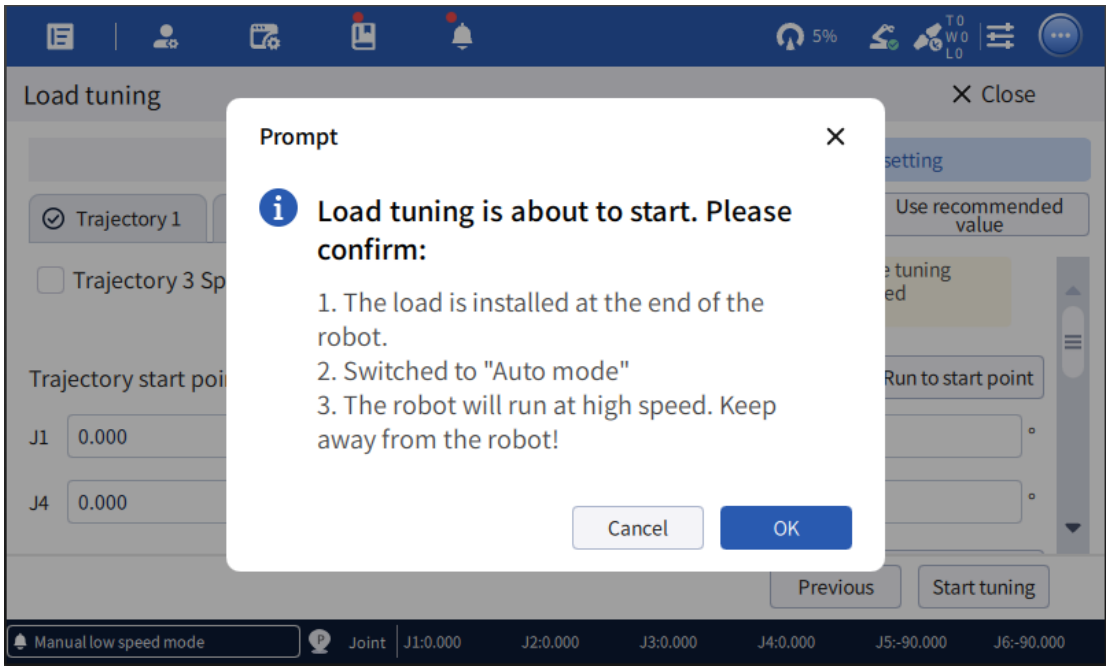
6-axis robot:



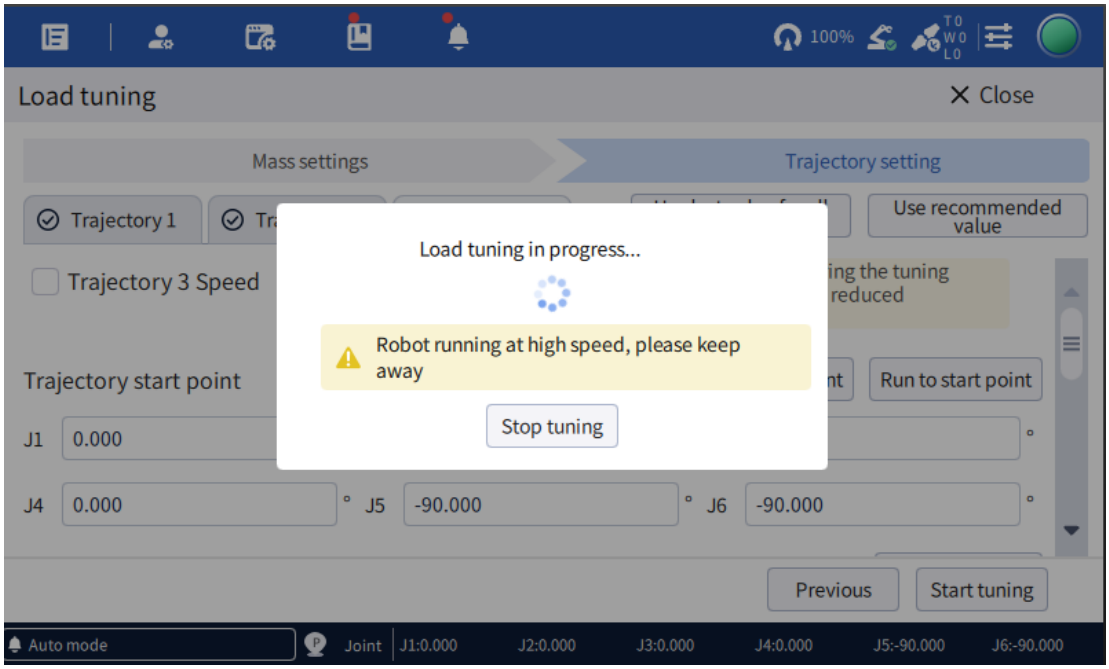
SCARA robot:



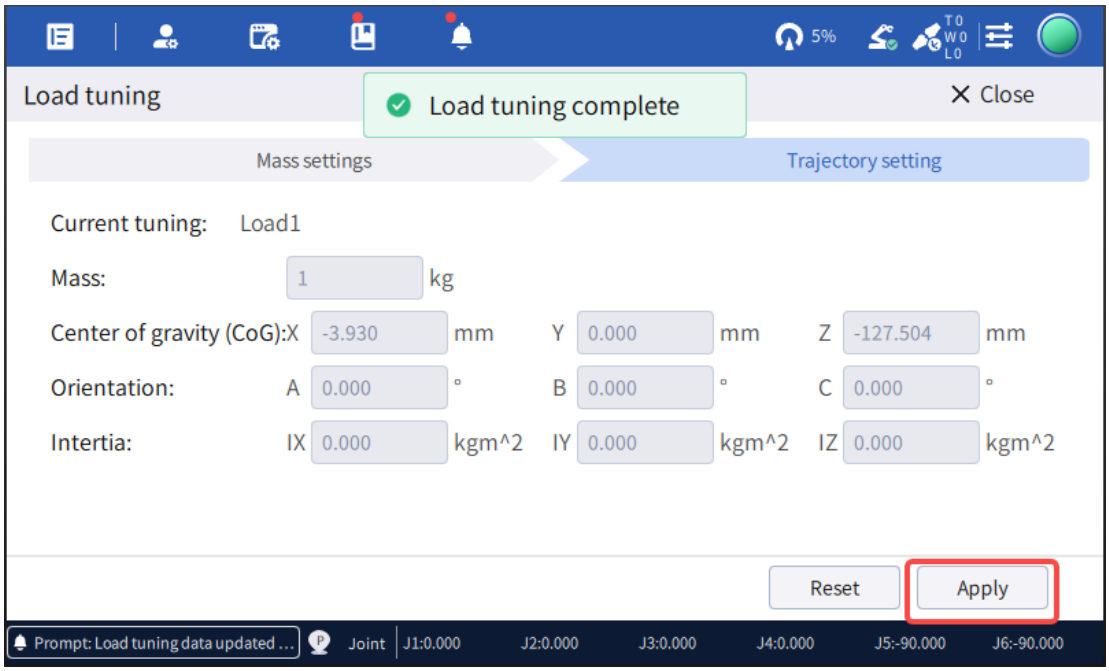
3, In the pop-up dialog, click "OK" if all conditions are met. Otherwise, click "Cancel".



4, During auto-tuning, if you want to stop auto-tuning in advance, click "Stop tuning".



5, After auto-tuning is completed, the screen displays the auto-tuning results. Click "Apply" to write the auto-tuning results to the corresponding load. If you want to discard the auto-tuning results, click "Return" and then click "OK" in the pop-up dialog.



12.4.2 Notes

1. Ensure that the zero point of the robot is set correctly before performing load auto-tuning.
2. The accuracy of load auto-tuning is affected by the warm or cold state of the robot. It is recommended to perform load auto-tuning after the robot is warmed up and the temperature is stable. The auto-tuning in the cold state may result in poor auto-tuning accuracy.
3. If the robot is a new robot, or is not warmed up, a collision detection alarm may occur. In this case, you can temporarily disable the collision detection function if the auto-tuning trajectory does not collide with the surrounding environment and people. After auto-tuning is completed, enable the collision detection function manually again.
4. 6-axis robot trajectory requirements:
   (1) For Trajectory 1 and Trajectory 2, ensure the forearm and the axes of J3/J5 are as parallel to the ground

as possible, otherwise the auto-tuning accuracy may be affected. It is recommended to use the recommended values first when conditions allow. If the recommended values are not reachable, it is recommended to change the angle of J1 and J2 at the current position of the robot, and use the "Get current point" function to calculate the recommended angle for Trajectory 1 and Trajectory 2. If none of the above conditions can be met, adjust according to the trajectory orientation requirements. The joint angles in the edit box can only be manually modified in Admin/Manufacturer mode.
(2) When setting the auto-tuning trajectory, ensure that the angle difference between the start point and end point of Trajectory 2 for J6, and the angle difference between the start point and end point of Trajectory 3 for J5/J6 is large, preferably greater than 90°. If the angle difference is small, the auto-tuning error increases. It is recommended to use the default recommended values when conditions allow. (3) If the robot arm Arm3 is equipped with a load on arm, correctly set the load on arm parameters or remove the load on arm from Arm3 before performing load auto-tuning.

5. SCARA robot trajectory requirements:
   (1) The joint angles in the edit box can only be manually modified in Admin/Manufacturer mode.
   (2) When setting the auto-tuning trajectory, ensure that the angle difference between the start point and end point of Trajectory 2 for J4, and the angle difference between the start point and end point of Trajectory 3 for J1/J2/J4 is large, preferably greater than 90°. If the angle difference is small, the auto-tuning error increases. t is recommended to use the default recommended values when conditions allow.
   (3) If significant shaking of the robot occurs during the auto-tuning process, first correctly identify the inertia ratio in the servo background; (4) The accuracy of the load auto-tuning results is related to the dynamics model. When the ratio of actual-to-rated load mass is greater than 20%, the load mass error is generally within 20%, and the center of mass error is generally within 25%.
6. Custom speed operations for each trajectory should be used when a "Torque overlimit" alarm occurs, and the value set should not be too small when in use;
7. The center of mass of the load should be sufficiently far away from the flange. For loads with small eccentricity, the error in auto-tuning results is often large.
8. If the load mass is known, it is preferred to enter the mass.
9. When performing grip load auto-tuning, you need to select the tool that grips the load. Ensure that the "TFrame" and "TLoad" parameters are correctly set. Otherwise, errors occur in the auto-tuning results.
10. When load auto-tuning is performed, all tasks except static tasks must be stopped.
11. If an emergency occurs during auto-tuning, press an emergency stop button to stop the motion.
12. When auto-tuning of tools/workobjects are performed, all tasks will return to the start line except for clearing the motion trajectory.

12.5 Independent Axis Function

12.5.1 Overview

The independent axis function allows an axis in the robot system to perform independent motion without being affected by other axes. When the independent axis function is enabled for a certain axis, the motion of this axis is affected only by the series of independent axis instructions (IndXXX). After the independent axis rotates for multiple turns, you can reset it to the normal axis by instruction IndReset. Also, you can control the multi-turn value of this independent axis.

Target axis that can be set as an independent axis has no hard limit. For the 6-axis robots, only the J6 axis can be set as an independent axis. The external axis whose transmission mode is set to "rotation-rotation" can be set as an independent axis.

12.5.2 Function Introduction

See the instruction manual for details of the independent axis instructions.

Function 1: Switch the independent axis to speed mode and move it

IndCMove MechUnit, Axis, Speed, [Acc] [Dec]; This instruction commands an axis in the mechanical unit to move at constant speed.

Function 2: Detect whether the independent axis reaches specified speed

Wait IndSpeed MecUnit Axisl; This instruction checks whether an axis in the mechanical unit reaches the planned speed.

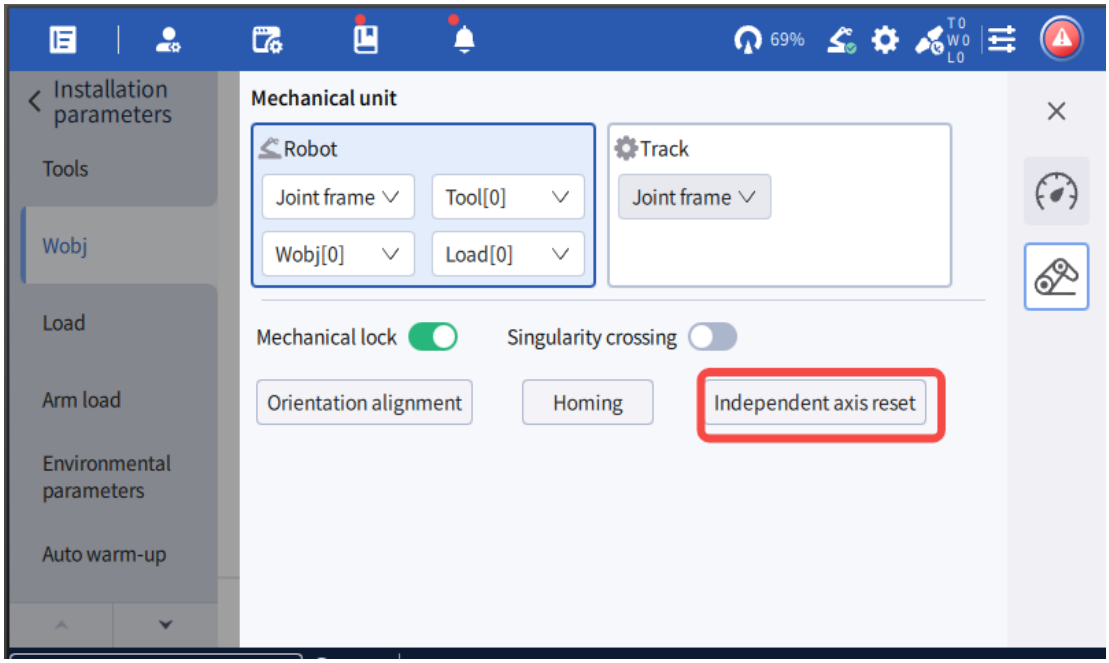
Function 3: Switch the independent axis to normal mode

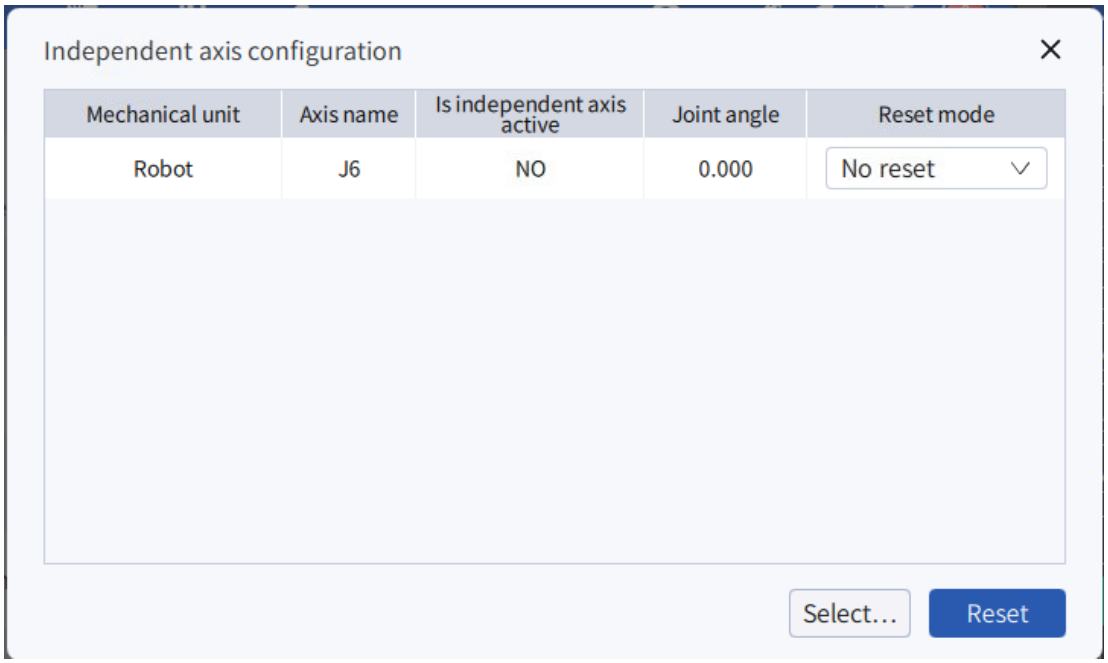
Instruction	Description
IndReset MecUnit, Axis, Old;	This instruction resets an axis in the mechanical unit to the normal mode.
IndReset MecUnit, Axis, RefPos, Direction;	This instruction switches the independent axis to the normal mode. The number of turns of the axis is adjusted according to RefPos and Direction.
IndReset MecUnit, Axis, RefNum, Direction;	This instruction switches the independent axis to the normal mode. The number of turns of the axis is adjusted according to RefNum and Direction.



- When the IndReset instruction is executed, the current independent axis and normal axis must not be in motion. After executing the IndCMove instruction at zero speed, pause for 0.2 seconds to ensure the correct state is achieved. For the external axis with poor performance, pause for a longer time to ensure that the axis stops completely.
- For the IndCMove instruction, the speed must be greater than or less than 0 so that the independent axis can move. During motion, you can detect whether the independent axis reaches the specified speed by using the IndSpeed instruction. To end continuous rotation of independent axes, set the speed of the axis to 0 by using the IndCMove instruction. After the axis stops rotation, you can reset the independent axis using the IndReset instruction to switch it back to a normal axis.

Function 4: Monitoring and quick reset of the independent axis





You can quickly view and reset the independent axis state on the axis control panel.

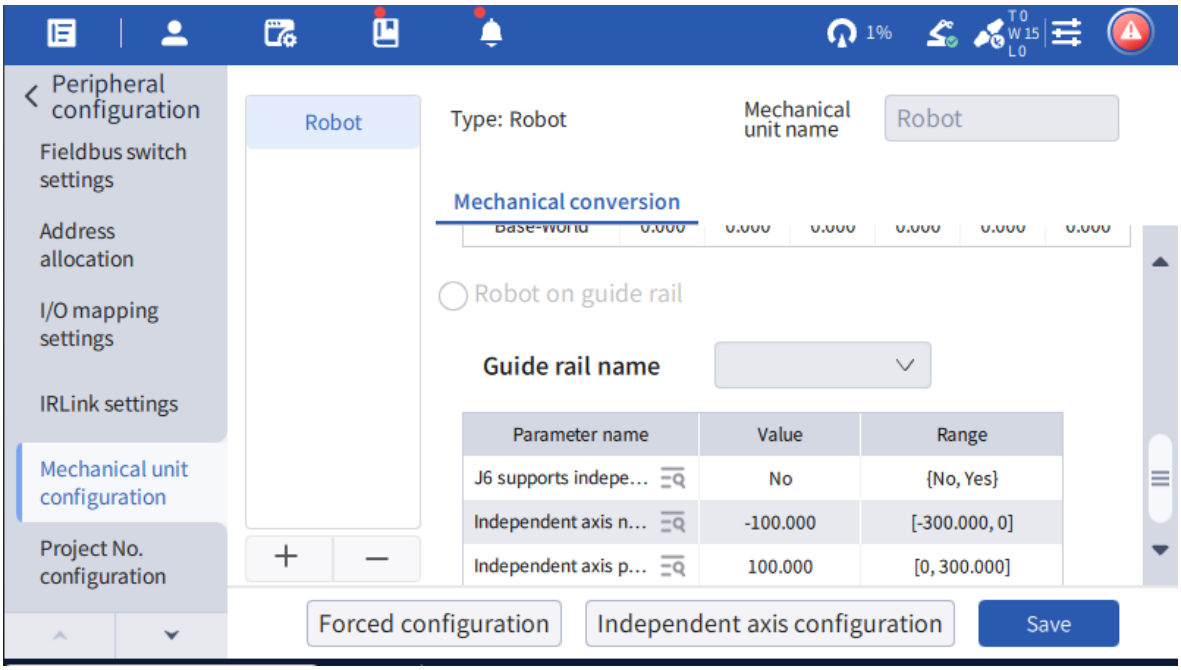
12.5.3 Steps

1. Configure the servo parameters (620N servo not supported).
   For the external axis, you need to configure the servo parameter according to the following table.

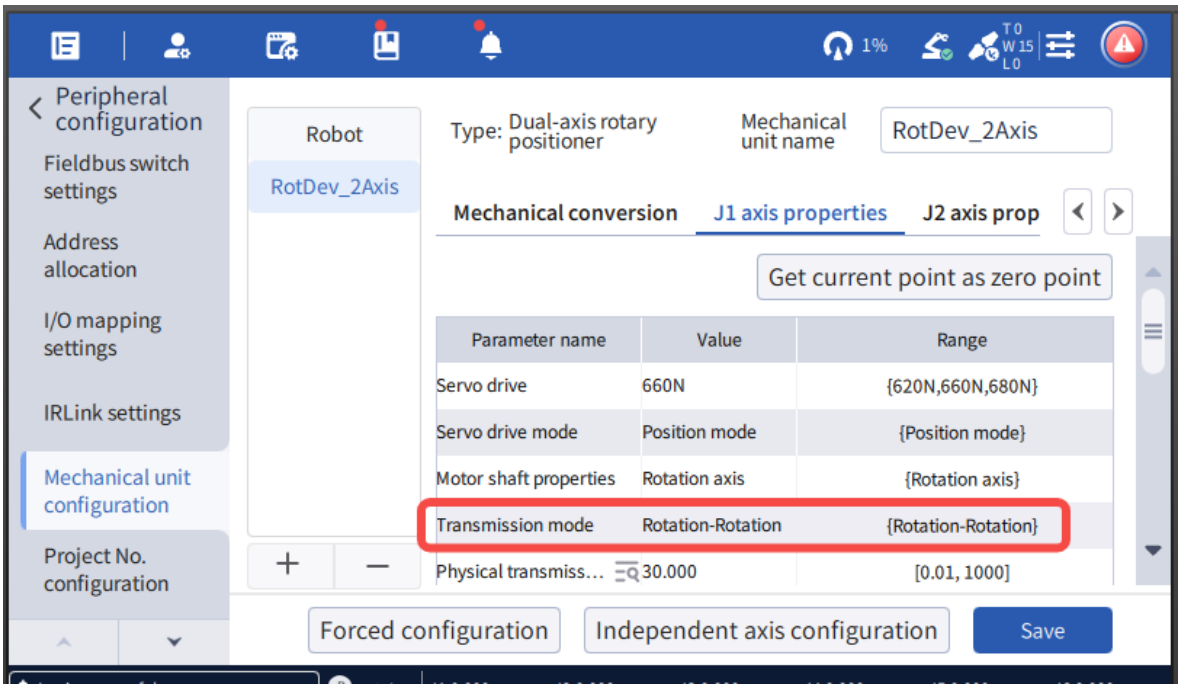
Parameter	Description	Setting value
H0A-36	Encoder multi-turn overflow fault selection	1: Enabled

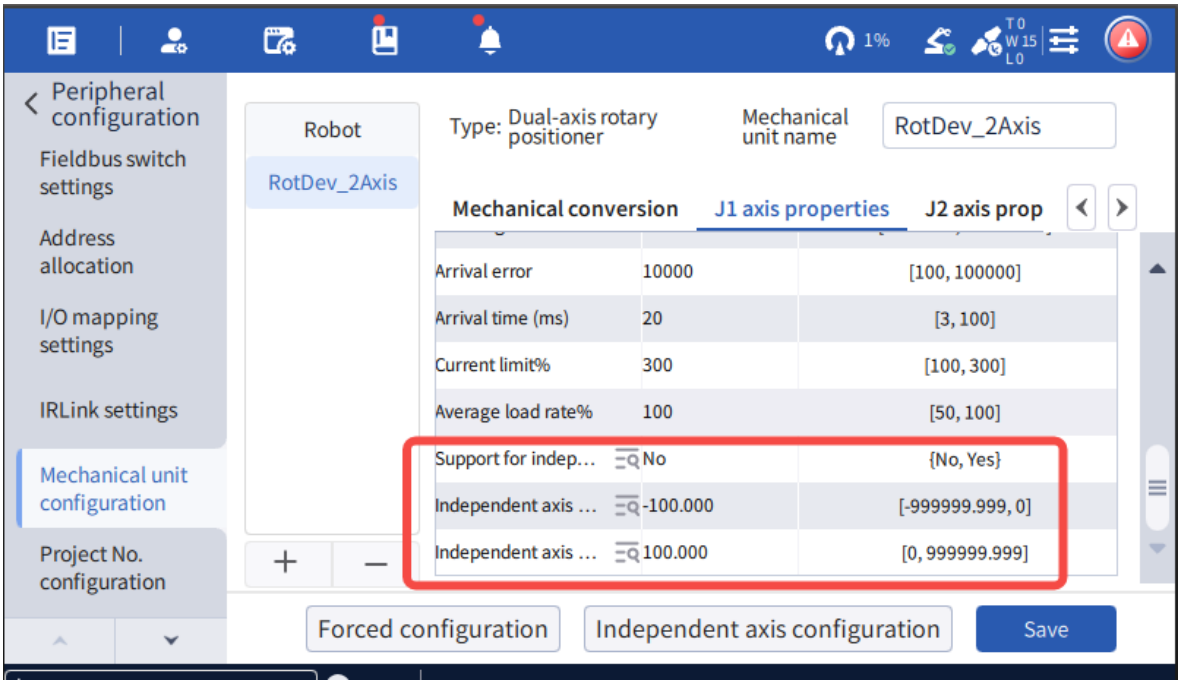
2. Configure the robot controller.
   The interface for configuring the robot independent axis is as follows. Only the last axis of the 6-axis robot can be set as an independent axis. Set the "Support for independent axis" parameter to "YES". Set the limit of the independent axis as needed. The unit is the number of turns. After the "Support for independent axis" parameter of J6 axis is set to "YES", the original joint limit is changed to the independent axis limit. To

make the independent axis configuration take effect, save the configuration in emergency stop state and restart the robot controller.



The following is the interface for configuring the independent axis function for external axes. Only the external axis whose transmission type is set to "rotation-rotation" can be set as an independent axis. Set the "Support for independent axis" parameter to "YES". Set the limit of the independent axis as needed. The unit is the number of turns. After the "Support for independent axis" parameter is set to "YES", the original joint limit is changed to the independent axis limit. To make the independent axis configuration take effect, save the configuration in emergency stop state and restart the robot controller.





3. Instructions for use

1) Independent axis configuration takes effect after the robot controller is restarted.

2) After the independent axis function is enabled for a normal axis, you need to switch the normal axis to the independent axis and the position mode to the speed mode in the static state of the robot before continuous rotating motion. After that, the robot ignores the position of the independent axis in the point data when executing motion instructions of non-independent axes.

3) A new IndCMove instruction can be executed immediately before the speed specified in the first IndCMove instruction is reached. If a new IndcMove instruction is executed immediately before the execution of the previous instruction is completed, the new instruction immediately overwrites the previous instruction.

4) If the program is stopped or the robot is disabled during continuous rotational motion of an independent axis, the axis will stop. When the program is resumed, the independent axis is started automatically.

5) If the program returns to the start line by user manually or due to other conditions, the independent axis is automatically reset and returns to the normal mode. (The effect is equivalent to executing the instruction IndReset MecUnit, Axis,Old.)

6) If the power is lost during continuous rotating motion of the independent axis, the axis properties of the robot will remain unchanged after power-on again. The independent axis is automatically reset to the normal mode. If the independent axis has a large joint angle upon power loss, the joint angle will be reset upon power-on again.

7) Before executing the IndRest instruction, make sure axes other than the independent axis arrive at the specified position or speed.

8) In single-step motion, when the IndcMove instruction is executed, the independent axis starts and pauses as the program starts and pauses. When the program is in the running state, the independent axis also runs. When the program stops, the independent axis also stops.

9) When the motion trajectory of the robot contains an independent axis, if the program is paused and the independent axis is reset to a normal axis, the trajectory recovery will not be performed.

10) When the program is finished, the independent axis stops.

4. Jogging and teaching

▪ When an active independent axis exists, the axis motion function cannot be used, and teaching cannot be performed. If you need to teach an axis, execute the IndReset instruction, or reset all active independent axes to normal axes in the axis control panel.

▪ When a certain joint is configured as an independent axis, the position limit of the joint is modified to the position limit of the independent axis. When this axis exceeds the original joint limit, the inverse kinematics fails when the joint is involved. Before teaching, clear the multi-turn value of the axis in the axis control panel.

12.5.4 Notes

1. The target axis to be set as an independent axis must not have a hard limit.
2. If an external axis is configured as an independent axis, functions not supported by the external axis are not supported by the independent axis either.
3. The trajectory recovery function is not available to joints set as independent axes.
4. If a joint is switched to the independent axis state, the points of the joint can be acquired, but the acquired points cannot be reached.
5. If a joint is switched to the independent axis state, the joint will not return to zero.
6. The independent axis function cannot be used with the ECP function.
7. When an active independent axis exists, the self-learning vibration suppression function is not supported. When the "SLVSNode level" parameter is used, all instructions are configured with a self-learning level. This is mutually exclusive with the independent axis unless this parameter is set to "OFF".
8. When the J6 axis is configured as the active independent axis, high trajectory precision feature is automatically turned off.
9. When the angle of a joint configured as an independent axis is greater than the original joint limit, the "Move to point" operation results in a prompt that the point exceeds the limit range. When the CP instruction is executed, it prompts that inverse kinematics cannot be performed.
10. The independent axis function does not support the use of eccentric tools.
11. When the robot is in dynamic tracking state, independent axis instructions are not supported.
12. When an active independent axis exists, the teaching function is not supported unless all the independent axes are reset to normal axes.
13. If a coordination axis is configured as an independent axis and the coordination function is enabled, the coordination effect may not be satisfying. This is not recommended.
14. The independent axis function is not supported for 620N servo drives.
15. After the independent axis is reset, the trajectory is cleared. If the independent axis reset is triggered in the stop state, the program runs from the yellow cursor line when it is restarted and the preceding trajectory is cleared.
16. For the IR-R60-210S5-E1N, IR-R60-210S5, IR-R60-210S5-E1ZY, IR-R80-210S10-E1N, and IR-R80-210S5-E1ZY series robots, their axes cannot be configured as independent axes.
17. When the joint angle exceeds the joint threshold of the axis before it is configured as an independent axis, the joint angle is only used as a reference. When the joint angle is very large, it will be reset to a reasonable value after the controller is powered on again.
18. Do not take points when the joint angle is very large. When the axis pulse of the start, intermediate, and target points of the motion instruction exceed 2147480000, the motion instruction cannot be executed.

19. If the J6 axis of the robot is in the independent axis state and does not move, the position of the J6 axis changes slightly due to axis coupling when the J5 axis moves.

12.6 Current Protection and Temperature Rise Protection

12.6.1 Current Protection

12.6.1.1 Application Scenario

By default, the motion parameters of each robot model are factory default. When the motion efficiency on the application site cannot meet the requirements, you can adjust the motion parameters of the robot. For example, you can appropriately increase the motion speed and acceleration on the setting page.

When debugging the motion parameters, pay attention to the percentage of the average load rate and of the current.

- When the rate is too high, the robot generates warnings and alarms to protect the motor and reducer.
- When you have adjusted the motion parameters and do not want to generate warnings or alarms, you can appropriately increase the "global limit coefficient" and "local limit coefficient" to reduce the percentage.

> CAUTION
>
> Increase the coefficient moderately since excessive increase will reduce the performance and life of the motor and reducer.

Description of parameters of the current protection function:

$$\frac{\text{Real time value of average load rate}}{\text{Average load rate protection threshold}*\text{Global average load rate limit coefficient}*\text{Local average load rate limit coefficient}} = \text{Average load rate}$$

$$\frac{\text{Real-time current value}}{\text{Current protection threshold}*\text{Global current limit coefficient}*\text{Local current limit coefficient}} = \text{Current rate}$$

$$\frac{\text{Max current value}}{\text{Current protection threshold}*\text{Global current limit coefficient}*\text{Local current limit coefficient}} = \text{Max current rate}$$

- To set the global current limit coefficient, go to "Settings" > "More" > "Motion parameter" > "Axis parameter settings" > "Current limit".
- To set the local current limit coefficient, use the **MaxTrqLmt** instruction.
- To view the real time percentage of the current, go to "Monitor" > "More" > "Work condition monitor" > "Current".

- To view the real time percentage of the maximum current, go to "Monitor" > "More" > "Work condition monitor" > "Current". During robot motion, the current changes quickly and is not easy to view. Therefore, the maximum percentage is provided to allow users to view the maximum history value.

12.6.1.2 Monitoring and Debugging Method

You can monitor the percentage of the average load rate and of the current in the "Work condition monitor" page.



CAUTION

For the current, in addition to the current value percentage, the maximum value percentage is also displayed to record the historical maximum current. You can reset the value by clicking the "Reset" button.

The percentage is divided into the following three levels.

Level	Safe	Alarm	DANGER
Average load rate/Set threshold	0 to 100%	100% to 110%	Above 110%
Current/Set threshold	0 to 110%	110% to 130%	Above 130%

- The above thresholds are applicable after the robot is warmed up.
- The current detection needs to last for 30 ms. A warning or alarm can be triggered only when the threshold is exceeded for 30 ms consecutively. An alarm will also be triggered when the instantaneous current is too high, at which time the maximum current value may not have exceeded 130%.
- A warning or alarm can be triggered only when the average load rate exceeds the threshold for 30s consecutively.

Debugging principles:

- Ensure that the percentage of the average load rate and of the current is in the "Safe" state.
- When in the "Warning" state, a system warning is triggered, but the robot does not stop. In this case, the current parameters can still be used.
- When in the "Danger" state, a system alarm is triggered and the robot is disabled and stops. In this case, adjust the motion parameters to return them to the safe range.
- In particular, if you need to adjust motion parameters in applications where efficiency is required, without causing warnings or alarms due to too high average load rate or current, you can appropriately increase the "global limit coefficient" and "local limit coefficient" to reduce the percentage. It should be noted that in this case the performance and life of the motor and reducer are compromised. It is recommended that debugging be carried out under the guidance of the manufacturer.
- A low ambient temperature may cause an average load rate alarm. Warm up the robot before use.

12.6.1.3 Setting the Limit Coefficient

You can set the global limit coefficient of all axes through the software interface. Also, you can set the local limit coefficient of a certain axis in the program.

Characteristics:

- Switch: Only when both the master switch and the sub-switch for a particular axis are switched on, continuous detection of an axis is performed. If the master switch is turned on while the sub-switch for a particular axis is turned off, the detection of the axis is not possible.
- Value: The global limit coefficient and local limit coefficient act together. Multiplying the two together acts on the threshold value.

To configure the global limit coefficient through the software interface, go to "Settings" > "More" > "Motion parameters" > "Axis parameter settings" > "Current limit / Average load rate limit".

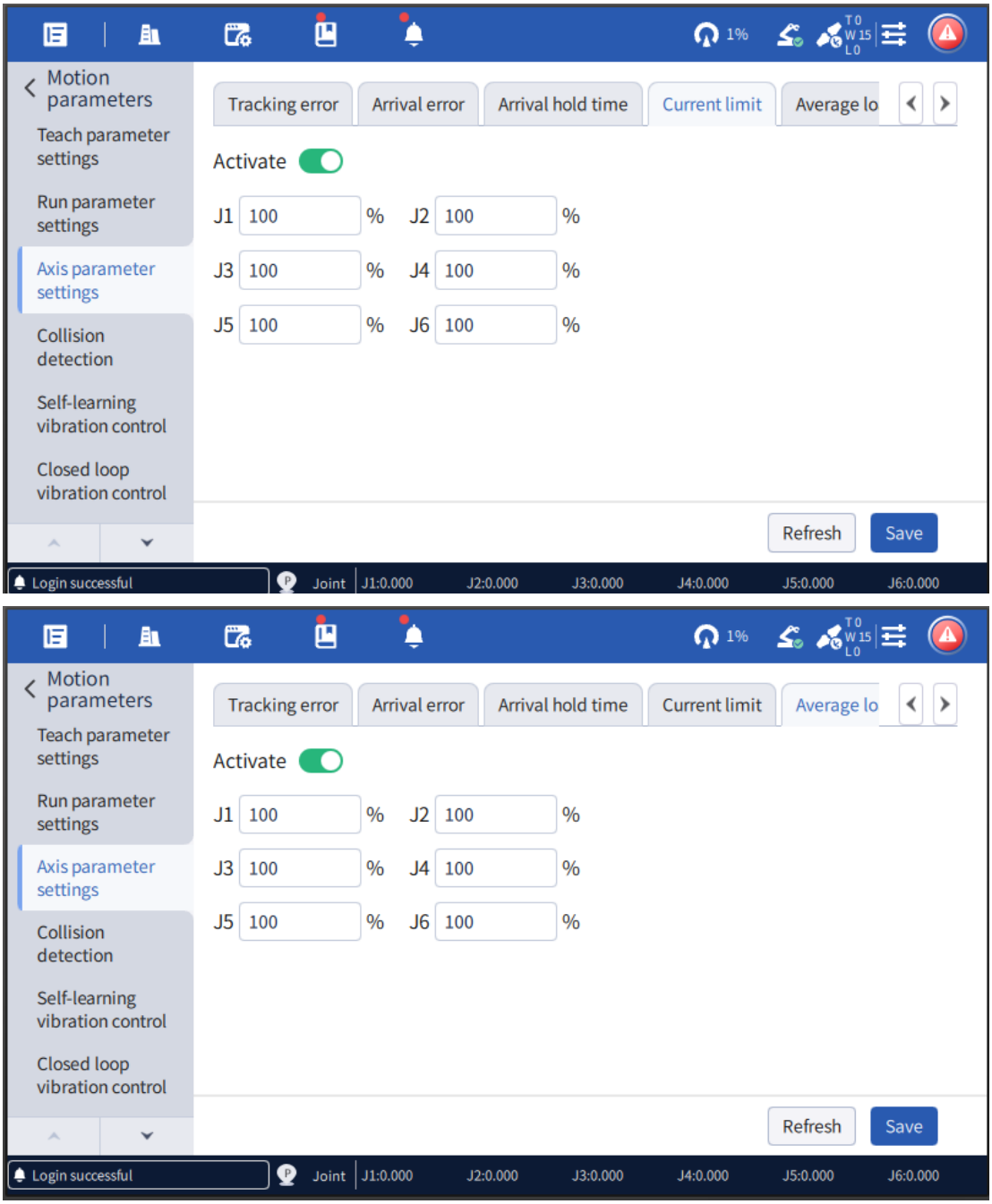
You can configure the local limit coefficient using AvgCurLmt/MaxTrqLmt instructions.

1. Configuration through software interface

Only the Manufacturer user can configure the current protection-related parameters.

Detection switch: Once turned on, all motion detection takes effect; and once turned off, no detection is performed. By default, it is turned on.

Configuration value: Set the global limit coefficient. The value is in percentage, which is 100% by default.



2. Configuration through instructions

You can dynamically configure a single axis through instructions.

You can flexibly and conveniently turn off/on single-axis detection and adjust the detection threshold in a certain section of the robot program.

(1) AvgCurLmt

Function: Configures average load rate limit

Description: Sets whether to enable the average load rate detection and sets the average load limit parameters in the program. This instruction is applicable to a single axis, or to all axes.

Format: AvgCurLmt (Enable,AxisNo,ratio);

Parameters:

- Enable: Specifies whether the instruction is active or not by integer data. 1: Active; 0: Inactive
- AxisNo: Specifies the axis number with integer data Special case: You can use "0" to make all axes the object.

- ratio: Specifies the local limit coefficient of the single-axis average load rate with integer data. The unit is 1% and the value range is 1 to 150. If Enable is "0", this parameter is invalid.

Properties of the detection switch:

1) The detection switch on the setting interface of the teach pendant defaults to "Open", and the default setting will be restored when the robot restarts.

2) The detection switch for each single axis in the instruction defaults to "True", and the default local limit coefficient for a single axis is 100. In the following conditions, the default parameters are restored:

- The robot restarts.
- The program is executed from the beginning (stop and start again from the beginning).
- Switch programs or exit programs (excluding Call).
- Save the program.
- Switch between manual and auto modes.

(2) MaxTrqLmt

Function: Configures the maximum torque limit (current limit)

Description: Sets whether to enable the current detection and sets the current limit parameters in the program. This instruction is applicable to a single axis, or to all axes.

Format: MaxTrqLmt (Enable,AxisNo,ratio);

Parameters:

- Enable: Specifies whether the instruction is active or not by integer data. 1: Active; 0: Inactive
- AxisNo: Specifies the axis number with integer data Special case: You can use "0" to make all axes the object.
- ratio: Specifies the local limit coefficient of the single-axis current with integer data. The unit is 1% and the value range is 1 to 150. If Enable is "0", this parameter is invalid.

Properties of the detection switch:

1) The detection switch on the setting interface of the teach pendant defaults to "Open", and the default setting will be restored when the robot restarts.

2) The detection switch for each single axis in the instruction defaults to "True", and the default local limit coefficient for a single axis is 100. In the following conditions, the default parameters are restored:

- The robot restarts.
- The program is executed from the beginning (stop and start again from the beginning).
- Switch programs or exit programs (excluding Call).
- Save the program.
- Switch between manual and auto modes.

12.6.2 Temperature Rise Protection

12.6.2.1 Application Scenario

When the robot works in harsh conditions (short cycle time, heavy load, large motion duty cycle) or when the ambient temperature is high, it can easily cause overheating of core components such as the motor and reducer, shortening the service life of the robot. This function provides temperature protection for the robot by predicting the steady state temperature and real-time temperature.

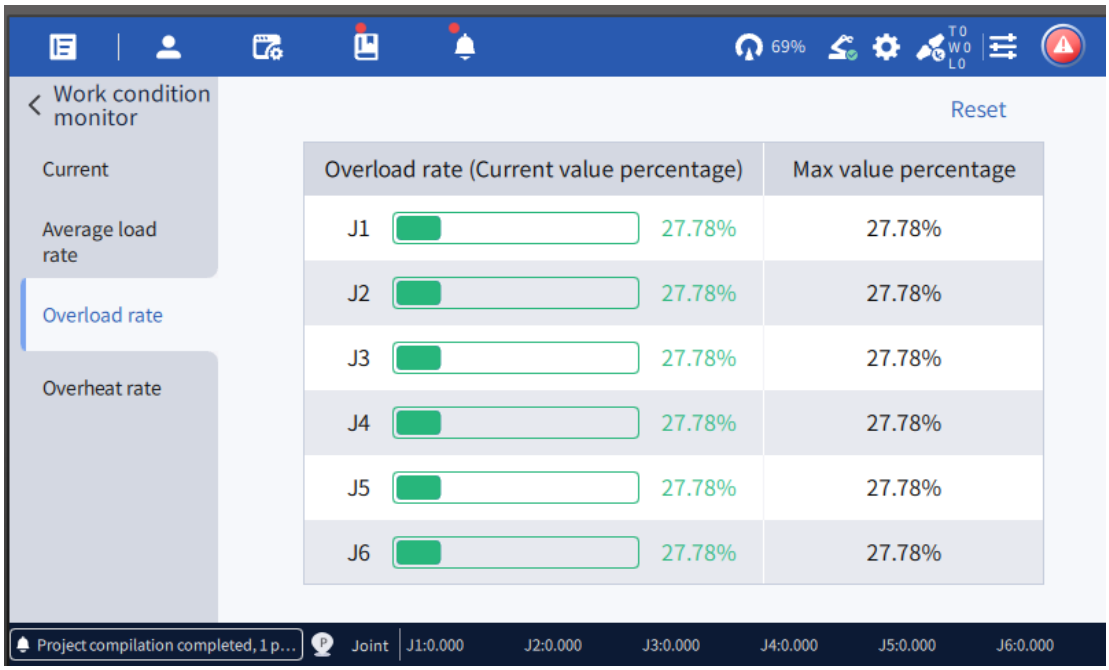
The supported robot models are as follows:

- Models with imported V4R24C1SPC1 and subsequent versions.
- Large-size 6-axis robot models (≥ 35 kg): All supported.
- SCARA models: All standard SCARA 2.0 models, 20kg, and 50kg models.
- Small-size and medium-size robot models (≤ 35 kg): All models except the newly developed 12kg2000 and 35kg1850 this year.

For models supported by the current version, if the function is blocked after loading a backup file from a previous version, contact the manufacturer for assistance.

12.6.2.2 Software Interface and Function Description

(1) Overheat rate/overload rate

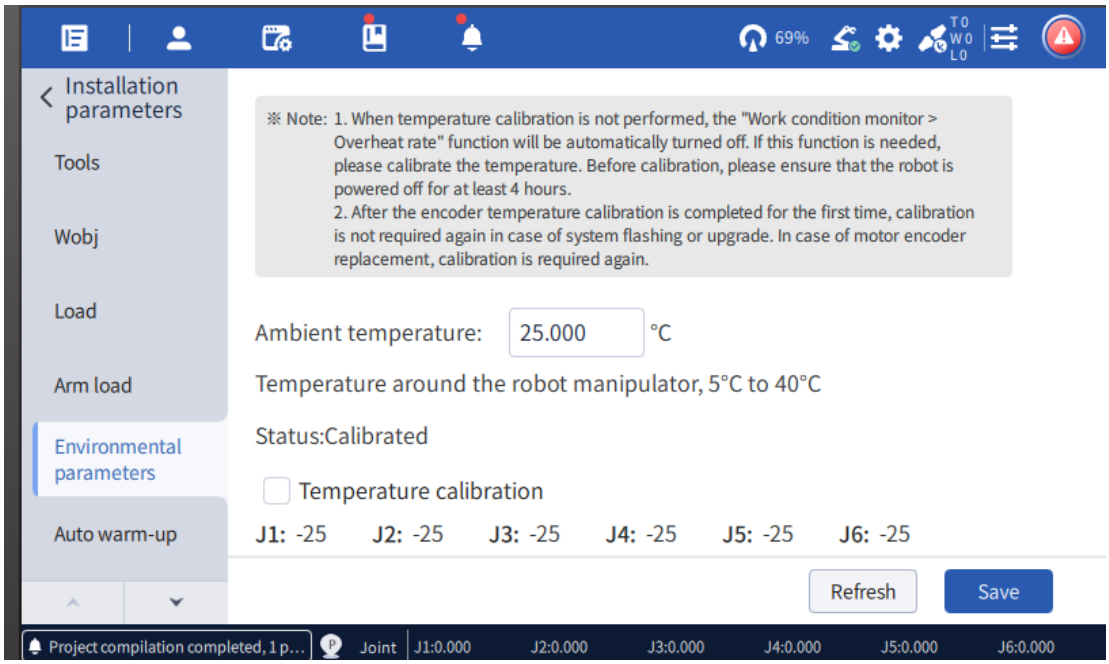




Function	Software interface	Overview	Description
Overheat/overload rate monitor	Monitor/Work condition monitor	This function is used to dynamically indicate the overheat rate and overload rate of each axis in a visual bar graph.	1. Parameter definition: $\text{Overload rate} = \frac{\text{Steady-state temperature prediction}}{\text{Temperature alarm threshold}}$ $\text{Overheat rate} = \frac{\text{Real-time temperature prediction}}{\text{Temperature alarm threshold}}$ 2. Alarm (warning) condition: Warnings/alarms are generated when running program instructions. ▪ Motor/Reducer overload warning: The overload rate exceeds 90% for 30s continuously. ▪ Motor/Reducer overheat warning: The overheat rate exceeds 90% for 10s continuously. ▪ Motor/Reducer overheat alarm: The overheat rate exceeds 100% for 10s continuously. 3. In the following situations, the joint axes do not support the overheat rate (overheat rate is 0):

Function	Software interface	Overview	Description
			▪ The corresponding axis's servo parameter H0004 is 2312.2. ▪ The corresponding axis's servo parameter H0B66 is 0. ▪ The mechanical lock is enabled.

(2) Ambient parameter settings



Function	Software interface	Description	Note
Set the ambient temperature/perform temperature calibration	Go to "Installation parameters" > "Environmental parameters".	This function is used to set the ambient temperature and perform temperature calibration.	1. The real-time calculation of the overload rate is affected by the set ambient temperature and robot operating conditions. Therefore, setting the ambient temperature correctly facilitates accurate calculation of the overload rate. 2. The real-time calculation of the overheat rate is affected by whether temperature calibration is performed. If the temperature is not calibrated, the overheat rate will be set to 0

Function	Software interface	Description	Note
			automatically and no overheat warning or alarm will occur. If necessary, ensure that the robot is powered off at least 4h before calibration. After the ambient temperature is set correctly, check "Temperature calibration" and click "Save". After the temperature calibration is done for the first time, there is no need to recalibrate during subsequent robot flashing and upgrading. After the motor encoder is replaced, recalibration is required.

(3) Overheat/Overload rate protection switch

Go to "Settings" > "More" > "Motion parameters" > "Axis parameter settings" > "Temperature rise protection".

Function	Software interface	Description
Overheat/Overload rate protection switch	Go to "Settings" > "More" > "Motion parameters" > "Axis parameter settings" > "Temperature rise protection".	This function is used to enable and disable the overheat rate/overload rate warnings/alarms.

(4) GetEncoderTemper instruction

Function	Description	Format	Parameter	Return value
Get the current temperature information of the encoder	This instruction is used to obtain the current encoder temperature. 1. In the following situations, the encoder temperature is valid: The servo parameter H0B66 (encoder temperature) is not 0 and H0004 (encoder version) is not 2312.2.	GetEncoderTemper (index)	index: Specifies an axis of the robot.	Double type. An alarm occurs when the encoder temperature of the i^{th} axis is wrong.

Function	Description	Format	Parameter	Return value
	2. This instruction can only be used in robot models that support the temperature rise protection function. Otherwise, the error code -505 will be returned. If the input axis number is incorrect (not between 1 and 8), the error code -404 will be returned.. 3. About encoder temperature and related alarms: Encoder overheat alarm: The real-time encoder temperature exceeds the encoder temperature warning threshold for 10s continuously.			

13 Robot Alarms and Handling Method

Error code	Description	Cause	Solution
0x0001	Initialization failed (Reboot required after error is fixed)	1. PF file creation or opening failed. 2. PF file parsing failed.	Restart the controller and check if the error is fixed. If not, please contact the manufacturer.
0x0002	Starting teach pendant communication failed (Reboot required after error is fixed)	The teach pendant thread was not started properly.	Restart the controller and check if the error is fixed. If not, please contact the manufacturer.
0x0003	Starting vision communication failed (Reboot required after error is fixed)	The vision communication thread was not started properly.	Restart the controller and check if the error is fixed. If not, please contact the manufacturer.
0x0004	Starting internal communication thread failed (Reboot required after error is fixed)	The DSP communication thread was not started properly.	Restart the controller and check if the error is fixed. If not, please contact the manufacturer.
0x0005	Automatic and manual function module scheduling failed (Reboot required after error is fixed)	The ARM scheduling thread not started properly.	Restart the controller and check if the error is fixed. If not, please contact the manufacturer.
0x0006	Starting interpolation test failed (Reboot required after error is fixed)	The interpolation thread not started properly.	Restart the controller and check if the error is fixed. If not, please contact the manufacturer.
0x0007	Opening EtherCAT communication failed (Reboot required after error is fixed)	1. Configuration file error. 2. EtherCAT slave does not match system configuration.	1. Check if the EtherCAT connection status is abnormal. 2. Contact the manufacturer.
0x0008	Opening parameter configuration file failed	1. Failed to open parameter configuration file. 2. Parameter configuration file was corrupted.	System configuration file error, please contact the manufacturer.
0x0009	Decoding error	Program syntax error	Check the program for syntax errors. For details, see the output bar.
0x000A	Program line invalid	The program line number sent by the	Check if the line where the blue cursor is located exceeds the program range or reselect the start line number.

Error code	Description	Cause	Solution
		teach pendant is out of range.	
0x000B	Instruction reading error	The wait time exceeds the set range.	1. Check wait conditions. 2. Reset the wait time.
0x000C	Instruction reading error	1. The teaching program was corrupted. 2. The teaching program does not meet the specifications.	1. Rewrite the teaching program. 2. Check the teaching program.
0x000D	Nested call of subroutine not allowed	Nested call of subroutine occurs.	Check if the Call instruction is nested to subroutines.
0x000E	Motion instruction decoding error	Motion instruction decoding error	Check the teaching program.
0x000F	Configuration file operation failed	1. Configuration file save failed. 2. Configuration file restore failed.	1. Restore to the factory defaults and power on again. 2. Power off and restart.
0x0011	Creating coordinate interpolation thread failed	1. Creating coordinate interpolation thread failed. 2. The internal test function is not open.	1. Replace hardware. 2. Update software.
0x0012	Jump instruction failed	Point data calculation error exists in the Jump instruction.	Reselect a teaching point.
0x0013	IR-Link initialization failed (Reboot required after error is fixed)	1. The number of IR-Link slaves was configured incorrectly. 2. The sequence of IR-Link slaves was configured incorrectly.	Reconfirm the IR-Link configurations.
0x0014	Saving teaching program failed	The memory card is loose or not recognized.	Check the memory card.

Error code	Description	Cause	Solution
0x0015	Motion module communication error	DSP software running error	Power on the controller again.
0x0016	Enable error	DSP software running error	Power on the controller again.
0x0017	Internal program running error	DSP software running error	Power on the controller again.
0x0018	Homing failed	Homing motion failed	Perform homing again.
0x0019	Enablement lost	The enablement of the running state is lost.	Check whether the system is in enabled state.
0x001A	Servo parameter error detected	The set parameters do not match the actual servo parameters.	Change servo parameters using operating panel or software. If the actual parameters do not match the factory defaults, replace the motor or servo.
0x001B	Error getting motion state	1. System busy. 2. Motion firmware damaged.	1. Restart the controller. 2. Contact the manufacturer.
0x001C	The configuration failed, the PLC configuration is in conflict with the actual cabinet type.	The PLC configuration conflicts with the actual controller model.	Check that the PLC configuration parameters match the actual controller model.
0x001D	Some functions are affected because of old version of PLC configuration.	Old version PLC configuration	The secondary development version number and the robot secondary development version number do not match, please contact the manufacturer.
0x001E	Error verifying planned servo position and feedback position	The planned servo position and the encoder feedback position are inconsistent.	System fault, please contact the manufacturer.
0x001F	Position synchronization error (Reboot required after error is fixed)	Error in synchronizing position between controller and servo.	1. Restart the controller. 2. Contact the manufacturer.
0x0020	Robot not allowed to start when in motion.	The robot is moving when started.	Restart the robot after it is stopped.

Error code	Description	Cause	Solution
0x0021	Parameter passing in error (Reboot required after error is fixed)	The parameters passed in are incorrect.	Check the basic system settings.
0x0022	Command line not found	The line number entered is out of range.	Select a command line that is running.
0x0023	Point data not found	No point is defined.	Check whether a point is defined.
0x0024	Inverse kinematics error	This point is a singular point of the robot.	Modify the coordinate of this point.
0x0025	Point data coordinate error	The frame values exceed the range.	Get a point again.
0x0026	Armtype in MOVL/MOVC cannot be changed.	Armtype in MOVL/ MOVC/JUMPL cannot be changed.	Get a point again or add a joint transition point.
0x0027	V parameter out of range	The V parameter exceeds the range (1-100).	Modify the V parameter.
0x0028	Z parameter out of range	The Z parameter exceeds the range (0-5).	Modify the Z parameter.
0x0029	TOOL parameter out of range	The TOOL parameter exceeds the range (0-15).	Modify the Tool parameter
0x002A	Wobj parameter out of range	The Wob parameter exceeds the range (0-15).	Modify the User parameter.
0x002B	ACC parameter out of range	The ACC parameter exceeds the range (1-100).	Modify the Acc parameter.
0x002C	until parameter out of range	The I/O number exceeds the range (0-255).	Modify the Until In parameter.
0x002D	Pallet parameter error	PNo,i,j and k of Pallet (PNo,i,j,k) are greater than or equal to 0.	Modify the Pallet parameter.
0x002E	Pallet not defined	The pallet number is not defined.	Define the pallet before use.

Error code	Description	Cause	Solution
0x002F	Repeat parameter error	The Repeat parameter exceeds the range.	Modify the Repeat parameter.
0x0030	Running decoding error	Error in instruction parsing during running	Check the running instructions and modify them according to the prompts.
0x0031	Inverse kinematics calculation error in CART	The jog motion destination is out of the motion space or in singularity.	1. Check the step of jog motion. 2. Check the direction of jog motion.
0x0032	Inverse kinematics calculation error in TOOL	The jog motion destination is out of the motion space or in singularity.	1. Check the step of jog motion. 2. Check the direction of jog motion.
0x0033	Inverse kinematics calculation error in Wobj	The jog motion destination is out of the motion space or in singularity.	1. Check the step of jog motion. 2. Check the direction of jog motion.
0x0034	Tool load parameter out of range	The value of Tool load parameter is out of range.	Modify the Tool load parameter.
0x0035	Load parameter out of range	The value of load parameter is out of range.	Modify the load parameter.
0x0036	Arm load parameter out of range	Arm load parameter out of range	Modify the arm load parameter.
0x0038	Parameter setting error	The parameter setting value is out of range.	Check that the set parameter meets the range.
0x0039	API initialization failed (Reboot required after error is fixed)	The API communication thread was not started properly.	1. Restart the controller. 2. Contact the manufacturer.
0x003A	Authentication failure, system is not available.	Fail to authenticate the hardware encryption.	Contact the manufacturer.
0x003B	MC module process does not exist.	The MC module process does not exist.	Update the servo firmware.

Error code	Description	Cause	Solution
0x003C	Robot system parameter reset, please restart the controller.	The robot system parameters are reset (configuration file loading/factory settings restore/ memory card formatting/system upgrade/system degrade).	Power on the controller again.
0x003F	Exception initializing soft float parameters, please restart the controller.	The soft float parameter initialization is abnormal.	Restart the controller.
0x003d	Failed to initialize balancer parameters	Balancer parameter initialization failed on startup.	Import the correct balancer parameters.
0x0040	System diagnostics trigged	System diagnostics is trigged.	No action required, clear the message.
0x004B	Failed to mount memory card	Failed to mount memory card.	1. Restart the controller. 2. Reinstall the memory card. 3. Replace the memory card.
0x004C	Duplicate port or IP address	Duplicate port or IP address	Change port or IP address.
0x004D	Ethernet communication error	Ethernet communication error	Check the network connection and retransmit the data.
0x004E	Network is disturbed.	Multiple Ethernet terminals are connected to one controller.	Check whether multiple terminals are connected to the same controller.
0x004F	Network communication port opening failed	Network communication open instruction error	Check the network communication instructions.

Error code	Description	Cause	Solution
0x0050	Memory card not identified	1. Memory card is not inserted. 2. Poor contact with memory Card. 3. Memory card is damaged. 4. Memory card has a problem with the power-on initialization.	Check system hardware; restart the controller.
0x0051	EtherCAT disconnected	EtherCAT communication is disconnected.	Check EtherCAT communication.
0x0052	IR-Link disconnected	IR-Link is disconnected after connection.	Check IR-Link communication status.
0x0053	Too short interval between start and pause	The interval between start and pause is too short.	Restart operation.
0x0054	Failed to acquire vision feature values	Failed to acquire vision feature values while executing the instruction.	Failed to acquire vision feature values while executing the instruction.
0x0055	Decoding not finished	The program may have instruction symbols or syntax errors.	Check the command syntax of the edited program.
0x0056	Robot type error	The robot has no associated type firmware.	Restart the system or check the DSP firmware.
0x0057	FPGA firmware loading error (Reboot required after error is fixed)	FPGA firmware error or startup exception	Restart the system or check the FPGA firmware.
0x0058	DSP firmware loading error (Reboot required after error is fixed)	DSP firmware error or startup exception	Restart the system or check the DSP firmware.

Error code	Description	Cause	Solution
0x0059	System error after mode change	After switching to the play mode, it was detected that the project was not properly compiled or the configuration file was not completed properly.	Internal system error, please contact the manufacturer.
0x005A	I/O parameter setting error	Error setting I/O parameters	Check the I/O parameter settings.
0x005B	IP address error	Error getting or setting IP address	Check the network connection.
0x005C	Teach pendant has no authority to configure IR-Link.	The secondary development platform has been configured with IR-Link.	Use the current configuration, or cancel the secondary development configuration.
0x005D	Shared memory mapping error	Shared memory mapping error between robot and PLC.	Contact the technical support.
0x005E	(User-defined alarm 0)	The system triggered a user-defined alarm 0.	Check the user alarm 0.
0x005F	(User-defined alarm 1)	The system triggered a user-defined alarm 1.	Check the user alarm 1.
0x0060	(User-defined alarm 2)	The system triggered a user-defined alarm 2.	Check the user alarm 2.
0x0061	(User-defined alarm 3)	The system triggered a user-defined alarm 3.	Check the user alarm 3.
0x0062	(User-defined alarm 4)	The system triggered a user-defined alarm 4.	Check the user alarm 4.
0x0063	(User-defined alarm 5)	The system triggered a user-defined alarm 5.	Check the user alarm 5.
0x0064	(User-defined alarm 6)	The system triggered a user-defined alarm 6.	Check the user alarm 6.
0x0065	(User-defined alarm 7)	The system triggered a user-defined alarm 7.	Check the user alarm 7.

Error code	Description	Cause	Solution
0x0066	(User-defined alarm 8)	The system triggered a user-defined alarm 8.	Check the user alarm 8.
0x0067	(User-defined alarm 9)	The system triggered a user-defined alarm 9.	Check the user alarm 9.
0x0068	(User-defined alarm 10)	The system triggered a user-defined alarm 10.	Check the user alarm 10.
0x0069	(User-defined alarm 11)	The system triggered a user-defined alarm 11.	Check the user alarm 11.
0x006A	(User-defined alarm 12)	The system triggered a user-defined alarm 12.	Check the user alarm 12.
0x006B	(User-defined alarm 13)	The system triggered a user-defined alarm 13.	Check the user alarm 13.
0x006C	(User-defined alarm 14)	The system triggered a user-defined alarm 14.	Check the user alarm 14.
0x006D	(User-defined alarm 15)	The system triggered a user-defined alarm 15.	Check the user alarm 15.
0x006E	Interference zone 0 alarm	The robot entered the interference zone 0.	Check the position of robot and the settings of interference zone 0.
0x006F	Interference zone 1 alarm	The robot entered the interference zone 1.	Check the position of robot and the settings of interference zone 1.
0x0070	Interference zone 2 alarm	The robot entered the interference zone 2.	Check the position of robot and the settings of interference zone 2.
0x0071	Interference zone 3 alarm	The robot entered the interference zone 3.	Check the position of robot and the settings of interference zone 3.
0x0072	Interference zone 4 alarm	The robot entered the interference zone 4.	Check the position of robot and the settings of interference zone 4.
0x0073	Interference zone 5 alarm	The robot entered the interference zone 5.	Check the position of robot and the settings of interference zone 5.
0x0074	Interference zone 6 alarm	The robot entered the interference zone 6.	Check the position of robot and the settings of interference zone 6.
0x0075	Interference zone 7 alarm	The robot entered the interference zone 7.	Check the position of robot and the settings of interference zone 7.
0x0076	Interference zone 8 alarm	The robot entered the interference zone 8.	Check the position of robot and the settings of interference zone 8.

Error code	Description	Cause	Solution
0x0077	Interference zone 9 alarm	The robot entered the interference zone 9.	Check the position of robot and the settings of interference zone 9.
0x0078	Interference zone 10 alarm	The robot entered the interference zone 10.	Check the position of robot and the settings of interference zone 10.
0x0079	Interference zone 11 alarm	The robot entered the interference zone 11.	Check the position of robot and the settings of interference zone 11.
0x007A	Interference zone 12 alarm	The robot entered the interference zone 12.	Check the position of robot and the settings of interference zone 12.
0x007B	Interference zone 13 alarm	The robot entered the interference zone 13.	Check the position of robot and the settings of interference zone 13.
0x007C	Interference zone 14 alarm	The robot entered the interference zone 14.	Check the position of robot and the settings of interference zone 14.
0x007D	Interference zone 15 alarm	The robot entered the interference zone 15.	Check the position of robot and the settings of interference zone 15.
0x007F	Data stream mode not closed	The system is in data stream mode.	Close the data stream mode.
0x0080	Emergency stop alarm	The emergency stop button was pressed.	Release the emergency stop and clear the alarm.
0x0081	No reverse movement data found	The reverse movement data has been executed.	Terminate the reverse movement.
0x0082	Port number closing error	The port number is not within the range or the port has not been opened.	Check the port number.
0x0083	TCP port overflow	Excessive peripheral TCP application connections.	Close unused TCP connections.
0x0084	API communication processing error	The API channel is occupied by other applications for a long time or the previous API application processing is blocked due to fault.	Close or reduce the previous API application processes.

Error code	Description	Cause	Solution
0x0085	Arc trajectory uncontrollable	The arc start point is uncertain.	Add other motion instructions before and after the arc instruction.
0x0086	Version information mismatch, use software that matches the controller version	The version of the teach pendant or InoRobotLab does not match the version of the controller.	Use a teach pendant or InoRobotLab that matches the version of the controller.
0x0089	IP address conflict	IP settings conflict.	Reconfigure IP.
0x008A	File system not identified in the memory card	The file system on the memory card is incorrect.	Reformat the memory card on the teach pendant.
0x008B	Reading servo parameter failed	The controller fails to read servo parameters.	Optimize the connection between the servo and the controller.
0x008C	Parameter out of range	Parameter out of range	Set the parameters within the range.
0x008D	Illegal I/O configuration	Configured I/O is controlled by a PLC or does not exist.	Reconfigure IO.
0x008E	Illegal I/O setup operation	The set I/O lacks the I/O control.	Check the I/O control.
0x008F	I/O does not exist	Failed to send screw locking startup parameters to the servo.	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0090	Failed to start tightening	Failed to send screw locking startup parameters to the servo.	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0091	Failed to stop electric screwdriver	Failed to read screw locking status from the servo.	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.

Error code	Description	Cause	Solution
0x0092	Failed to read screw tightening parameters	Failed to read screw locking setting parameters from the servo	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0093	Failed to read screw tightening parameters	Failed to read screw locking setting parameters from the servo	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0094	Failed to write screw tightening parameters	Failed to write screw locking setting parameters to the servo.	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0095	Screw data display failed	Failed to obtain screw locking display data from the servo	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0096	Failed to reset screw tightening count	Failed to write a screw tightening counter clearing flag to the servo.	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0097	Failed to get thread for servo error	Failed to get thread for servo error	Restart the robot.
0x0098	Failed to start loosening	Failed to send screw removal startup parameters to the servo	1. Check that the electric screwdriver servo firmware matches with the controller. 2. Clear parameters and restart the system.
0x0099	Failed to write screw loosening parameters	Failed to write screw removal setting parameters to the servo.	Check the electric screwdriver servo firmware matches with the controller.
0x009A	Failed to read screw loosening parameters		Check the electric screwdriver servo firmware matches with the controller.

Error code	Description	Cause	Solution
		Failed to obtain screw removal setting data from the servo.	
0x009B	Fallback point setting out of range	Fallback point setting out of range	Set the fallback point for screw loosening within the range.
0x009C	Failed to initialize tracking process data	There are errors in the tracking process data or the system is busy.	Check for parameter errors.
0x009D	Interrupt operation ended. Failed to restore the original task trajectory	The restoration of original task trajectory was abnormally terminated, causing the restoration to fail.	Reset the start line/return to the start line or resynchronize the projects.
0x009E	Interrupt queue overflow	The interrupt queue has been saturated by pending interrupt tasks.	1. Check if interrupt triggers occur too rapidly, overwhelming task processing capacity. 2. Return to the start line or synchronize the project to clear the interrupt tasks.
0x009F	Interrupt exit position deviation	Failed to restore to the pre-interrupt waypoint upon exit, due to missing restoration instruction execution.	Restore to the pre-interrupt waypoint during interrupt exit sequence.
0x00A0	TCP port for reading and writing is not open.	The TCP port is not open.	Make sure that the TCP port is properly connected.
0x00A1	Dynamic network communication port not closed	Standard network communication is used while dynamic network communication is not closed.	Use the command CNVVIOSION OFF to close the dynamic network communication.
0x00A2	Conveyor error or camera pixel error	The conveyor number is incorrect or the transfer data type of the camera is incorrect.	Reset the conveyor number or camera data transfer type.
0x00A3	Dynamic vision coordinates conversion error		

Error code	Description	Cause	Solution
		Error converting dynamic vision pixels to camera frame.	Check that the pixels sent from vision equipment are correct, otherwise the camera needs to be recalibrated.
0x00A4	No reverse movement data found	There is no reverse movement data.	Clear the error.
0x00A5	Lack of motion instructions before arc instruction	The command before arc motion is not Movj or Movl. (This appears in only the single-step teaching.)	Ensure that the command before the arc command is not Movj or Movl.
0x00A6	Specified file not found	The file does not exist or the file path is incorrect.	Check that the file exists or the file path is correct.
0x00A7	Error saving diagnostic information	The relevant files do not exist during the process of saving diagnostic information.	Internal system error, please contact the manufacturer.
0x00A8	Error exporting diagnostic information	The relevant files do not exist during the process of exporting diagnostic information.	Check that the USB device is normal; otherwise it is an internal system error, please contact the manufacturer.
0x00A9	The number of files exceeds the limit or the SD card is out of space.	1. There are too many files (including folders) in the /media/sdcard1/ Folder. 2. There is no insufficient remaining space on the SD Card.	1. Delete excessive files and ensure the number of files+folders in a single folder is not greater than 100. 2. Clean up the SD card.
0x00AA	Pause buffer data sending failed	Failed to send buffer data when going from pause to start.	Restart from stop.
0x00AB	Multitasking number does not exist.	Multitasking number is written incorrectly or in the wrong range.	Check the task number.
0x00AC	Multitasking number incorrect or occupied	The multitasking number is incorrect or has been occupied.	Check the task number.

Error code	Description	Cause	Solution
0x00AD	Multitasking creation failed	The system is busy; the task is already running or has been restarted; task 0 was started under non-remote I/O permissions.	1. Re-run the XQT command to check that it runs normally. 2. Stop the current multitasking and start it again. 3. Switch to remote I/O permissions and restart task 0.
0x00AE	Failed to open or close the position latching function	The hardware is not connected or the servo is not ready.	Check the hardware connections and servo configuration.
0x00AF	Failed to call the controller debug function	The controller debug function module failed.	Check that the configuration of the controller debug switch is correct.
0x00B0	Failed to set load parameters	The system is busy or the parameter is out of range.	Reset or check the parameter.
0x00B1	Serial port or baud rate error	1. The input serial port number is out of range. 2. With the serial port not closed, another serial port with the same number but different baud rate is opened.	1. Check that the input serial port number is within the range. 2. Close the serial port via the close instruction and open a serial port with new baud rate via the close instruction.
0x00B2	Modbus parameter read-write error	Modbus read-write execution failed	Update the software version.
0x00B3	Failed to modify P variable	Failed to open or write the program file where the P variable is located	Re-modify it or update the software version.
0x00B4	Abnormal network communication: Client and server connection error	The communication between the robot and the target device has been interrupted.	Reestablish the connection.
0x00B5	Abnormal network communication: Robot sending data error	The network was disconnected while the robot was sending data or there was an error while transmitting data.	Check that the network connection is normal

Error code	Description	Cause	Solution
0x00B6	Orientation correction calculation error	Wrong tool was selected or the alignment position is a singularity.	1. Check that the tool selection is correct. 2. Check that the position that the robot needs to align with is not a singularity.
0x00B7	Error in switching station program in Modbus mode	In Modbus mode, the station program is switched when the current station program is not stopped.	Set the current station program to the stop state, and then switch the station program.
0x00B8	Supply voltage error	The system suddenly loses power during operation.	Clear the alarm.
0x00B9	Illegal InoRobShop axis configuration	The number or type of axes configured by InoRobShop does not match the actual condition.	1. Reconfigure the correct axis in InRobShop. 2. In InoTeachPad, go to Set > System > Others > Clear PLC-CFG and clear the PLC configuration (Note: The built-in PLC program will also be cleared).
0x00BA	Error selecting multiple programs in Modbus mode	In Modbus mode, multiple station programs are selected simultaneously.	Select only one program.
0x00BB	Network disconnected during motion in teach mode under teach pendant control.	When the robot is under the control of teach pendant and operating in teach mode, it is detected that the network connection between the teach pendant and the controller is disconnected.	Clear the alarm after reconnecting the teach pendant and the controller.
0x00BC	Read-write serial port not open	The read-write serial port is not opened.	Open the serial port by configuring the controller parameter or by executing the open instruction.
0x00BD	P variable cannot be changed before a program is selected or when the program is running.	P variable cannot be changed before a program is selected or	Select a program or make sure that the robot is stopped.

Error code	Description	Cause	Solution
		when the program is running.	
0x00BE	Client-server communication timeout, network connection lost	Client-server communication timeout, network connection lost	Check the network connection.
0x00BF	Peer server shutdown, network connection lost	Peer server shutdown, network connection lost	Open the server.
0x00C0	J1 servo parameter error detected (Reboot required after error is fixed)	One or more servo parameters of J1 are wrong.	Reboot the robot after modifying the wrong servo parameter values.
0x00C1	J2 servo parameter error detected (Reboot required after error is fixed)	One or more servo parameters of J2 are wrong.	Reboot the robot after modifying the wrong servo parameter values.
0x00C2	J3 servo parameter error detected (Reboot required after error is fixed)	One or more servo parameters of J3 are wrong.	Reboot the robot after modifying the wrong servo parameter values.
0x00C3	J4 servo parameter error detected (Reboot required after error is fixed)	One or more servo parameters of J4 are wrong.	Reboot the robot after modifying the wrong servo parameter values.
0x00C4	J5 servo parameter error detected (Reboot required after error is fixed)	One or more servo parameters of J5 are wrong.	Reboot the robot after modifying the wrong servo parameter values.
0x00C5	J6 servo parameter error detected (Reboot required after error is fixed)	One or more servo parameters of J6 are wrong.	Reboot the robot after modifying the wrong servo parameter values.
0x00CB	Robot software version and servo version do not match.	Robot software version and servo version do not match.	Upgrade the servo version to match the robot software.
0x00CC	The MC failed to read the M register.	1. MC not connected. 2. The format of the feedback message from the peer device is incorrect.	1. Check the protocol type, IP address, and port number set by the peer PLC, and confirm the address and port number set by the robot end.

Error code	Description	Cause	Solution
0x00CD	The MC failed to write the M register.	1. MC not connected. 2. The format of the feedback message from the peer device is incorrect.	1. Check the protocol type, IP address, and port number set by the peer PLC, and confirm the address and port number set by the robot end.
0x00CE	The MC failed to read the D register.	1. MC not connected. 2. The format of the feedback message from the peer device is incorrect.	1. Check the protocol type, IP address, and port number set by the peer PLC, and confirm the address and port number set by the robot end.
0x00CF	The MC failed to write the D register.	1. MC not connected. 2. The format of the feedback message from the peer device is incorrect.	1. Check the protocol type, IP address, and port number set by the peer PLC, and confirm the address and port number set by the robot end.
0x00D0	Failed to set servo acceleration parameter	Failed to set servo acceleration parameter	Check the servo module status
0x00D1	Failed to recover system configuration profile	Failed to recover system configuration profile	Re-save the configuration file or restart the robot.
0x00D2	P variables are not allowed to be modified in play mode or during program execution.	P-variable was modified in play mode or during program execution under the remote Modbus control.	Stop the program and switch to teach mode before modifying the P variable.
0x00D3	Failed to modify P variable	Failed to modify P variable in memory or failed to modify P variable in file.	1. Try to modify again. 2. Check that the GP variable to be modified exists in the file. 3. Update the software version. 4. Contact the manufacturer.
0x00D4	Configured I/O program does not exist.	Configured I/O program does not exist.	Check that the configured I/O program file exists.
0x00D5	The length of data sent by the peer device exceeds the limit.	The length of the data sent by the peer device exceeds the limit when	Reduce the length of data sent by the peer.

Error code	Description	Cause	Solution
		communicating via socket or serial port.	
0x00D6	The BRD variables entered under Modbus control are out of range.	The BRD variables entered under Modbus control are out of range.	Check the range of BRD values set via Modbus.
0x00D7	The calculated P value is illegal.	Internal system error	1. Try to modify the P variable again. 2. Contact the manufacturer.
0x00D8	The input P value is illegal.	The arm parameter of the entered P variable is illegal.	Check the arm parameter of the entered P variable.
0x00D9	GetCurPoint instruction failed to get current location.	GetCurPoint instruction failed to get current location.	Reduce the frequency of GetCurPoint instruction calls as appropriate.
0x00DA	Start position deviates too much from the motion interrupt position.	Under the remote control, the motion was interrupted in auto mode. When the motion was restarted, it was detected that the difference between the current position and the interrupt position exceeds the following thresholds: SCARA robot: 5° 5° 500° 3° (any joint angle); 6-axis robot: 5° 5° 5° 5° 5° 5°.	1. Manually move the robot to the interrupt position. 2. Return to the start line of the program and run the program again.
0x00DB	Failed to clear trajectory data	Failed to clear trajectory data	Contact the manufacturer.
0x00DC	Failed to write servo parameters	Failed to write the servo parameters into the controller	Optimize the connection between the servo and the controller.
0x00DD	Direct motion point not reachable	1. The target point of direct motion exceeds the limit.	1. Check the range of the target point and whether the target point is a singular point.

Error code	Description	Cause	Solution
		2. The target point of direct motion is a singular point.	
0x00DE	Encoder multi-turn value has been cleared, please restart.	The encoder multi-turn value is too large and is cleared when the encoder is zeroed. A reboot is required.	Restart the controller.
0x00DF	Periodic synchronization error between FPGA and servo	The servo version is incorrect, please update the servo firmware.	Update the servo firmware.
0x00E0	SN mismatch between drive and encoder (motor)	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.
0x00E1	Bus undervoltage	1. The main circuit power supply voltage is low. 2. The power supply voltage drops during operation. 3. The power cord does not meet the specifications. 4. Main circuit powder supply dropout. 5. Controller fault.	1. Check the voltage and stability of the power supply, replace or regulate the power supply. 2. If the voltage is normal, check the voltage at the air-break switch. If it is low, check if the power cord meets the specifications and replace it if necessary. 3. Reduce operating speed.

Error code	Description	Cause	Solution
0x00E2	Bus overvoltage	1. The voltage input to the main circuit is too high. 2. The power supply is unstable or affected by lightning. 3. The motor is in abrupt deceleration status and the maximum braking energy exceeds the energy absorption value. 4.The bus voltage sampling value deviates greatly from the measured value. 5. Controller fault.	1. Replace or adjust the power supply according to the following specifications: 220V-240V±10% (198V to 264V). 2. Connect a surge protection device and then switch on the main circuit and control circuit power supplies again. If the fault persists, replace the servo drive. 3. After confirming the input voltage of the main circuit is within the specified range, increase the acceleration/ deceleration time if the operating conditions allow. 4. Contact the technical support. 5. Replace the controller.
0x00E3	Main circuit open	Mains power supply is unstable with voltage fluctuations.	Check if the power supply system is stable and if there are fluctuations in the voltage range.
0x00E4	Controller and drive power undervoltage	Controller fault	Replace the controller.
0x00E5	Controller and drive power overvoltage	Controller fault	Replace the controller.
0x00E6	Abnormal brake and I/O power supply	Controller fault	Replace the controller.
0x00E7	System power detection error	A power loss was detected by the servo module, but not by the controller module, and the power detection module is faulty.	Ensure the stability of the power supply and restart the system.
0x00E8	The power under current operating conditions exceeds the limit of the controller.	The controller power is insufficient.	Reduce the operating speed.

Error code	Description	Cause	Solution
0x00E9	Dedicated action execution failed	1. The current dedicated action is not activated. 2. No dedicated actions are configured. 3. The executed action is not in the safety zone. 4. The dedicated I/O setup failed.	1. Check whether the dedicated action function is activated. 2. Check whether dedicated actions are used incorrectly or whether related dedicated actions have been configured. 3. Check whether the executed action is within the safety zone. 4. Check whether the I/O related to the action is normal.
0x00EA	Power supply phase loss alarm	See servo user guide.	See servo user guide.
0x00F0	J1 axis encoder battery alarm	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.
0x00F1	J2 axis encoder battery alarm	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.
0x00F2	J3 axis encoder battery alarm	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.
0x00F3	J4 axis encoder battery alarm	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.
0x00F4	J5 axis encoder battery alarm	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.

Error code	Description	Cause	Solution
0x00F5	J6 axis encoder battery alarm	1. The encoder voltage is too low. 2. The battery is not connected during power-off.	1. Replace the encoder cable; replace a new battery with matching voltage. 2. Set the parameter "Absolute encoder reset enable" to 1 to clear the fault.
0x00F6	J1 axis encoder overtemperature	The encoder temperature is too high.	Cooling
0x00F7	J2 axis encoder overtemperature	The encoder temperature is too high.	Cooling
0x00F8	J3 axis encoder overtemperature	The encoder temperature is too high.	Cooling
0x00F9	J4 axis encoder overtemperature	The encoder temperature is too high.	Cooling
0x00FA	J5 axis encoder overtemperature	The encoder temperature is too high.	Cooling
0x00FB	J6 axis encoder overtemperature	The encoder temperature is too high.	Cooling
0x00FC	Failed to set servo acceleration parameter	1. The servo SDO channel is not smooth. 2. The servo has a hardware or software fault.	1. Try to save the acceleration parameters again. 2. Contact the manufacturer to update the servo software.
0x00FD	Failed to recover system configuration profile	The file system is corrupted, or the internal channel of the system is damaged.	Try to save the acceleration parameters again or restart the robot.
0x00FF	Failed to return to the starting line	Failed to return to the starting line	Ensure that no project compiling errors are returned and all files are present, then sync and retry.
0x01F0	E1 external shaft encoder battery low alarm	The battery level of the external shaft encoder is too low or the	Connect the battery to the external shaft and restart the controller and external shaft.

Error code	Description	Cause	Solution
		external shaft is not connected to the battery.	
0x01F1	E2 external shaft encoder battery low alarm	The battery level of the external shaft encoder is too low or the external shaft is not connected to the battery.	Connect the battery to the external shaft and restart the controller and external shaft.
0x01F2	E3 external shaft encoder battery low alarm	The battery level of the external shaft encoder is too low or the external shaft is not connected to the battery.	Connect the battery to the external shaft and restart the controller and external shaft.
0x01F3	E4 external shaft encoder battery low alarm	The battery level of the external shaft encoder is too low or the external shaft is not connected to the battery.	Connect the battery to the external shaft and restart the controller and external shaft.
0x01F4	E5 external shaft encoder battery low alarm	The battery level of the external shaft encoder is too low or the external shaft is not connected to the battery.	Connect the battery to the external shaft and restart the controller and external shaft.
0x01F5	E6 external shaft encoder battery low alarm	The battery level of the external shaft encoder is too low or the external shaft is not connected to the battery.	Connect the battery to the external shaft and restart the controller and external shaft.
0x01F6	E1 external shaft encoder overtemperature alarm	The temperature of the external shaft encoder is too high.	Cut off the power supply to the external shaft and check if the encoder temperature is abnormal.
0x01F7	E2 external shaft encoder overtemperature alarm	The temperature of the external shaft encoder is too high.	Cut off the power supply to the external shaft and check if the encoder temperature is abnormal.

Error code	Description	Cause	Solution
0x01F8	E3 external shaft encoder overtemperature alarm	The temperature of the external shaft encoder is too high.	Cut off the power supply to the external shaft and check if the encoder temperature is abnormal.
0x01F9	E4 external shaft encoder overtemperature alarm	The temperature of the external shaft encoder is too high.	Cut off the power supply to the external shaft and check if the encoder temperature is abnormal.
0x01FA	E5 external shaft encoder overtemperature alarm	The temperature of the external shaft encoder is too high.	Cut off the power supply to the external shaft and check if the encoder temperature is abnormal.
0x01FB	E6 external shaft encoder overtemperature alarm	The temperature of the external shaft encoder is too high.	Cut off the power supply to the external shaft and check if the encoder temperature is abnormal.
0x01FC	Zero point calibration sensor connection interrupted	The communication is interrupted or unstable.	Connect the sensor correctly and check the connection for any abnormalities.
0x01FD	Failed to reset zero point calibration sensor	The communication is interrupted or unstable.	Connect the sensor correctly and check the connection for any abnormalities.
0x01FE	Failed to open zero point calibration serial port	The system failed to open the file.	Re-calibrate the axis.
0x01FF	Failed to set zero point calibration serial port parameter	The system failed to set terminal attributes.	Re-calibrate the axis.
0x0200	Failed to close zero point calibration serial port	The system failed to close the file.	Re-calibrate the axis.
0x0201	Failed to send motion segment number for zero point calibration	The system failed to send information to DSP.	Re-calibrate the axis.
0x0202	Workobject and tool both in gripping state or both in non-gripping state during zero point calibration	The workobject and tool are both in clamping state or both in non-clamping state.	Avoid setting both the workobject and the tool to clamping state or non-clamping state in the settings.
0x0203	Zero point calibration function conflicted with bus function	Zero point calibration is performed when bus function is enabled.	Disable bus function before performing zero point calibration.
0x0204	Zero point calibration serial port conflicted with program serial port	Serial port in program has been opened	Use the CloseCom instruction to disable the opened serial port.

Error code	Description	Cause	Solution
		through OpenCom instruction.	
0x0205	Program serial port conflicted with zero calibration serial port	Serial port has been opened for zero point calibration function.	Exit the zero point calibration function.
0x0206	Failed to set the soft limit during zero point calibration	The robot is in motion state.	Re-calibrate or manually set correct system joint soft limits.
0x0207	Zero point calibration serial port not opened	The host controller software misjudged that the sensor is connected.	Restart the host controller software and then calibrate.
0x1001	Duplicate directory	The directory to be created already exists.	Replace the directory name to be created.
0x1002	Memory operation error, parent directory does not exist.	The current created directory has no parent directory.	Replace a path and recreate a directory.
0x1003	Renamed directory does not exist.	The directory to be renamed does not exist.	Refresh the directory and check whether the directory exists.
0x1004	Deleted directory does not exist.	The directory to be deleted does not exist.	Refresh the directory and check whether the directory exists.
0x1005	Error sending directory (not a directory or the directory does not exist)	The directory to be sent to the upper computer is illegal.	Refresh the directory and check whether the directory exists.
0x1006	Memory error and path error in creating file	Error creating path	Refresh the file and check the creation path.
0x1007	Renamed file does not exist.	The file to be renamed does not exist.	Refresh the file and check whether the file exists.
0x1008	Deleted file does not exist or the path does not exist.	The directory to be deleted does not exist.	Refresh the file and check whether the file exists.
0x1009	The given path to the file does not exist.	The given created file path is illegal.	Check the creation path for legality.
0x100A	Non-file sent	What is to be sent is not a file.	Check on the handheld teach pendant whether the object to send is a file.

Error code	Description	Cause	Solution
0x100B	Non-directory sent	What is to be sent is not a directory.	Check on the handheld teach pendant whether the object to send is a directory.
0x100C	Frame sequence error	Frame sequence error in the process of sending a large file.	Resave or open the file.
0x100D	The device is not functioning properly and is actively disconnected from the network.	1. The hand-held box is not closed according to normal operation s;2. The network is disconnected abnormally.	1. For any error due to abnormal operations, please actively disconnect the network cable. 2. For abnormality, check the error causes in conjunction with the existing error codes.
0x100E	Time format setting error	Time format setting error	Set the time according to correct format.
0x100F	System time correction error	System time calculation circuit error	Check the current network connection.
0x1010	RTC time correction error	RTC external batteries do not exist or are low.	Replace batteries or check the current hardware.
0x1011	Copy error	Misoperation during file copying	Perform copy operations again by referring to the user manual.
0x1012	Cut error	Misoperation during file cutting	Perform cut operations again by referring to the user manual.
0x1014	File encryption failed	Error encrypting file	Try to encrypt the file again.
0x1015	Unknown communication code	Version mismatch	Ensure the teach pendant and the controller match in version.
0x1016	Eth1 physical link down	Eth1 line is not working.	1. Check whether the network cable is properly plugged in or has poor contact. 2. Hardware failure, contact the manufacturer.
0x1017	Eth2 physical link down	Eth2 line is not working.	1. Check whether the network cable is properly plugged in or has poor contact. 2. Hardware failure, contact the manufacturer.

Error code	Description	Cause	Solution
0x1018	Controller fan 1 error	FAN1 blocked	1. Check if there are foreign objects blocking FAN1 in the front chamber of the cabinet, which prevents the fan from running. 2. The fan itself is faulty, replace it with a new fan.
0x1019	Controller fan 2 error	FAN2 blocked	1. Check if there are foreign objects blocking FAN1 in the front chamber of the cabinet, which prevents the fan from running. 2. The fan itself is faulty, replace it with a new fan.
0x101A	The temperature on the top of the controller is too high.	ST1 ambient temperature exceeds 60°C.	1. Check whether FAN1 in the front chamber operates normally and whether the dust-proof cotton of the fan cover is seriously blocked. 2. Check whether there are any components with abnormal temperature in the front chamber. The temperature control switch automatically resets when the ambient temperature drops to 45±5°C. 3. The temperature control switch is faulty, replace it with a new one.
0x101B	Transformer overtemperature	The transformer ST2 temperature exceeds 140°C.	1. Check whether FAN2 in the rear chamber operates normally and whether the dust-proof cotton of the fan cover is seriously blocked. 2. Check whether the QF2 circuit breaker is faulty, and whether there is an abnormally large load on the secondary side of the transformer. The temperature control switch automatically resets when the B-phase coil of the transformer cools down to 105±15°C. 3. The transformer is damaged, replace it with a new one.
0x101C	Output I/O overcurrent	Output I/O overcurrent	Check the hardware line.

Error code	Description	Cause	Solution
0x101D	Fan not installed	The fan is not installed or has poor contact.	Check the fan installation.
0x101E	Controller overtemperature alarm	The temperature inside the controller is too high.	Cooling and restart.
0x101F	Controller overtemperature warning	The temperature inside the controller is too high.	Cooling and restart.
0x1020	Oscilloscope function thread startup failed	System fault	Re-power
0x1021	Mains power fluctuations detected	Mains power supply is unstable with voltage fluctuations.	Check if the power supply system is stable and if there are fluctuations in the voltage range.
0x1022	J1 brake offline	1. The Power line is not connected. 2. Parameter H02-16 is incorrectly configured. 3. The brake is disconnected. 4. The power supply of the brake is abnormal.	1. Turn off the power supply, connect the power line and power up again. 2. For motors without brake function, set H02-16 to 0. 3. Replace the cable. 4. Replace the controller.
0x1023	J2 brake offline	1. The Power line is not connected. 2. Parameter H02-16 is incorrectly configured. 3. The brake is disconnected. 4. The power supply of the brake is abnormal.	1. Turn off the power supply, connect the power line and power up again. 2. For motors without brake function, set H02-16 to 0. 3. Replace the cable. 4. Replace the controller.
0x1024	J3 brake offline	1. The Power line is not connected. 2. Parameter H02-16 is incorrectly configured. 3. The brake is disconnected. 4. The power supply of the brake is abnormal.	1. Turn off the power supply, connect the power line and power up again. 2. For motors without brake function, set H02-16 to 0. 3. Replace the cable. 4. Replace the controller.

Error code	Description	Cause	Solution
0x1025	J4 brake offline	1. The Power line is not connected. 2. Parameter H02-16 is incorrectly configured. 3. The brake is disconnected. 4. The power supply of the brake is abnormal.	1. Turn off the power supply, connect the power line and power up again. 2. For motors without brake function, set H02-16 to 0. 3. Replace the cable. 4. Replace the controller.
0x1026	J5 brake offline	1. The Power line is not connected. 2. Parameter H02-16 is incorrectly configured. 3. The brake is disconnected. 4. The power supply of the brake is abnormal.	1. Turn off the power supply, connect the power line and power up again. 2. For motors without brake function, set H02-16 to 0. 3. Replace the cable. 4. Replace the controller.
0x1027	J6 brake offline	1. The Power line is not connected. 2. Parameter H02-16 is incorrectly configured. 3. The brake is disconnected. 4. The power supply of the brake is abnormal.	1. Turn off the power supply, connect the power line and power up again. 2. For motors without brake function, set H02-16 to 0. 3. Replace the cable. 4. Replace the controller.
0x1028	Safety door alarm	The safety circuit is open and the safety door is open.	Close the safety circuit or the safety door.
0x1029	System is not fully powered off and may cause system problems, power the system on again.	The servo's 24V drive power is cut off, causing abnormal power supply to the inverter module, resulting in an N-phase overcurrent alarm. The fault cannot be recovered and the system must be powered on again.	Re-power the system.
0x102A			Contact the manufacturer.

Error code	Description	Cause	Solution
	Program directory file path does not exist.	The program directory is missing.	
0x102B	Program file path does not exist.	The specified program file is missing.	1. Check that the program exists. 2. Contact the manufacturer.
0x102C	Invalid variable setting	Incorrect variable name or value.	1. Check if the variable name or label is P, B, R, D, Str, and whether the subscript is reasonable. 2. Check that the type of the value matches and is within the range.
0x1030	Self-learning vibration suppression data file missing	The self-learning vibration suppression data file is deleted after the robot is turned on.	1. Restart the robot to automatically restore the self-learning vibration suppression data file. 2. Import the self-learning vibration suppression data file from outside.
0x1031	The print message (from the "Print" instruction) may be lost, because of too many items.	The print instruction is used to print information too frequently, resulting in too many printed information, and the buffer is full.	Reduce the frequency of message print.
0x1032	The device is busy.	The device is in use.	Close any programs or windows that may use the device, and then try again.
0x1033	Controller fan rotor locked	The fan is blocked by foreign matter.	Turn off the power and remove the foreign matter, or contact the manufacturer.
0x1034	Number of axes or slaves mismatch	The number of axes or slaves does not match.	Check the number of configured axes (slaves).
0x1035	The soft float function has been enabled. The self-learning vibration suppression function cannot be enabled.	The soft float function and self-learning vibration suppression function are mutually exclusive.	Disable the soft float function and enable the self-learning vibration suppression function.
0x1038	EtherCAT slave mode status error	The EtherCAT slave module is offline or has internal module exception.	Check whether the EtherCAT communication cable is normal and try to clear the alarm.

Error code	Description	Cause	Solution
0x1039	Mismatch between the number of active EtherCAT bus slaves and scanned number	The number of active EtherCAT bus slaves does not match the scanned number.	Check the number of EtherCAT slaves.
0x103A	EtherCAT bus slave alias abnormal	The EtherCAT bus slave alias is abnormal.	Check if the slave alias is correct and try re-enabling the slave management function to resolve the issue.
0x1040	The self-learning vibration suppression profile does not exist.	The self-learning vibration suppression profile is deleted by mistake after the robot is turned on.	1. Restart the robot to automatically restore the self-learning vibration suppression data file. 2. Import the self-learning vibration suppression data file from outside.
0x1041	Failed to clear all self-learning vibration suppression data	1. The robot system is busy. 2. The file system is corrupted.	1. Try clearing again. 2. Contact the manufacturer.
0x1042	Failed to clear self-learning vibration suppression data file for current position	1. The robot system is busy. 2. The file system is corrupted.	1. Try clearing again. 2. Contact the manufacturer.
0x1043	Self-learning vibration suppression data file corrupted	Possible cause: Mismatch in robot name, file version, file type, and verification code.	Restore default parameters on the host controller and restart the robot.
0x1044	Failed to create self-learning vibration suppression data file	File system exception or other system exception	Contact the manufacturer.
0x1045	Failed to import self-learning vibration suppression data file	1. The contents of the imported file are illegal. 2. Channels are busy, causing failure in setting DSP parameters.	1. Re-import a legal file. 2. Try to restart the robot.

Error code	Description	Cause	Solution
0x1046	Self-learning vibration suppression data file version mismatch	The elf-learning vibration suppression data file is not the latest version.	Update the data file on PC and reload the file.
0x1050	Encoder battery voltage too low	Encoder battery is about to deplete.	Replace the encoder battery and perform corresponding operations in the robot maintenance interface.
0x1051	Insufficient grease on the lead screw	Insufficient grease on the lead screw	Refill the grease and perform corresponding operations in the robot maintenance interface.
0x1052	The controller system time is wrong. To enable the maintenance reminder function, you need to set the controller time correctly and restart the controller.	The controller system time is wrong. To enable the maintenance reminder function, you need to set the controller time correctly and restart the controller.	The controller system time is wrong. To enable the maintenance reminder function, you need to set the controller time correctly and restart the controller.
0x1053	Ball screw wear ratio approaching threshold limit	The wear ratio of the ball screw is about to reach the upper threshold limit.	Replace the ball screw.
0x1054	Ball screw grease degradation threshold imminent	The degradation threshold of ball screw grease is imminent.	Refill the ball screw with lubrication grease.
0x1055	Synchronous belt remaining life approaching zero	The synchronous belt remaining life is approaching zero.	Replace the synchronous belt.
0x1056	Reducer grease degradation threshold imminent	The degradation threshold of reducer grease is imminent.	Refill the reducer with lubrication grease.
0x1057	Reducer wear ratio approaching upper limit	The reducer wear ratio is approaching the upper limit.	Replace the reducer.
0x1058	Cross-model maintenance configuration file load prohibited; reset data before model change.	A maintenance configuration file for a different robot model has been loaded.	Clear maintenance data.

Error code	Description	Cause	Solution
0x1059	Encoder battery remaining life approaching zero	The encoder battery remaining life is approaching zero.	Replace the encoder battery.
0x1060	Failed to configure mechanical unit	Mechanical unit configuration error	Reconfigure the mechanical unit based on diagnostic prompts.
0x1061	Mechanical unit (external axis) servo type mismatch or servo verification failed	The mechanical unit servo type setting does not match the configuration type, external axis EtherCAT is not connected, or external axis electronic gear ratio and other parameters are invalid.	1. Ensure that the servo type is configured correctly. 2. Ensure that the EtherCAT cable is connected properly. 3. Ensure that the electronic gear ratio of the external axis is set correctly.
0x1062	The selected mechanical unit does not exist.	The selected mechanical unit does not exist.	Check that the input mechanical unit information is correct.
0x1063	Incorrect parameter passed to the mechanical unit	Incorrect parameter passed to the mechanical unit	Contact the manufacturer.
0x1064	Incorrect serial number of the movable guide rail passed to the mechanical unit	Incorrect serial number of the movable guide rail passed to the mechanical unit	Ensure that the robot is placed on the correct guide rail or contact the manufacturer.
0x1065	Incorrect axis logic passed to the mechanical unit	Axis logic error in the mechanical unit	Enter the correct mechanical unit axis logic.
0x1066	Mismatch in type and transmission mode passed to the mechanical unit	Mismatch in type and transmission mode passed to the mechanical unit	Check whether the type of mechanical unit matches the transmission mode.
0x1067	The axis is in motion when the mechanical unit is fed with parameters.	When saving the external axis parameters, it is detected that the additional axis is in motion.	Make sure that the additional axis is at rest before saving the mechanical unit.

Error code	Description	Cause	Solution
0x1068	Mechanical unit axis attribute error	Mechanical unit axis attribute parameter error	Contact the manufacturer.
0x1070	The active tool and workobject parameters do not match	The active tool and the workobject have the same RobHold parameter.	1. Switch the active tool and workobject matching the RobHold parameter. 2. Modify the RobHold parameter of the active tool and workobject to be different.
0x1071	The wobj parameters do not match.	RobHold is True, while UFFix is False.	Modify the configuration.
0x1072	Tool number switch failed	When the system switches to a tool, the mass of the tool that is not tool0 is 0.	Set the mass of the tool to be switched before switching to that tool.
0x1073	Load number switch failed	When the system switches to a grip load, the mass of the grip load that is not load0 is 0.	Set the mass of the load to be switched before switching to that load.
0x1074	Robot installation configuration has been switched. Reboot to apply changes.	Robot installation configuration has been switched. Reboot to apply changes.	Restart the controller.
0x1075	FPGA version is too low, please upgrade.	FPGA version is too low, please upgrade.	Upgrade to the correct FPGA version.
0x1076	Soft float function disable exception	Soft float function disable exception	Disable the soft float function again.
0x1080	External axis E1 electronic gear ratio verification failed	External axis E1 electronic gear ratio verification failed	Correctly set the servo parameters of the mechanical unit and check whether the electronic gear ratio and other parameters are legal.
0x1081	External axis E2 electronic gear ratio verification failed	External axis E2 electronic gear ratio verification failed	Correctly set the servo parameters of the mechanical unit and check whether the electronic gear ratio and other parameters are legal.

Error code	Description	Cause	Solution
0x1082	External axis E3 electronic gear ratio verification failed	External axis E3 electronic gear ratio verification failed	Correctly set the servo parameters of the mechanical unit and check whether the electronic gear ratio and other parameters are legal.
0x1083	The machine unit associated with the workobject does not exist.	The machine unit associated with the workobject does not exist.	Cancel existing association or re-associate configured mechanical unit.
0x1084	Failed to set homing method of servo	Servo feedback error when setting the servo homing method.	Check that the servo exists and is in normal condition, or contact the manufacturer.
0x1085	Axis teaching is not allowed because of the presence of independent axes in the system.	Axis teaching is not allowed because of the presence of independent axes in the system.	If teaching is required, reset all axes to normal axes before operation.
0x1086	Set all axes to normal axes before using self-learning vibration suppression.	The independent axis is not supported to use self-learning vibration suppression.	Set all axes to normal axes before using self-learning vibration suppression.
0x1087	When the robot axis is moving, the start is invalid.	When the robot axis is moving, the start is invalid.	When the robot axis is moving, the start is invalid, please restart.
0x1088	Mechanical unit needs to be restarted to take effect after configuration.	Mechanical unit needs to be restarted to take effect after configuration.	Mechanical unit needs to be restarted to take effect after configuration.
0x1089	Failure to read mechanical absolute position of servo	Failure to read mechanical absolute position of servo	Optimize the connection between the servo and the controller.
0x1090	Bus I/O mapping profile verification failed	Bus I/O mapping profile content verification failed	Reconfigure the I/O mapping.
0x1091	Bus I/O mapping profile version mismatch	Bus I/O mapping profile version mismatch	Reconfigure the I/O mapping.
0x1092	Machine unit configuration file verification failed	Machine unit configuration file	Reconfigure the mechanical unit.

Error code	Description	Cause	Solution
		content verification failed	
0x1093	Machine unit configuration file version mismatch	Machine unit configuration file version mismatch	Reconfigure the mechanical unit.
0x1094	Motor with 20-bit encoder not supported for external axis	The external axis function does not support using 20-bit encoder motors.	The external axis function does not support using 20-bit encoder motors.
0x1096	Linear motor pole pitch acquisition failure	Linear motor pole pitch acquisition failure	Check whether the slave is correctly configured or wired.
0x1097	Zero point calibration not supported for independent axis	The current calibration axis is an independent axis.	Set the current calibration axis to a non-independent axis before calibration.
0x1101	Invalid length of data exchanged internally	When requested to provide data, the DSP does not return valid data as required.	Check the DSP software version or replace the hardware.
0x1102	Verification error for data exchanged internally	When requested to provide data, the DSP does not return valid data as required.	Check the DSP software version or replace the hardware.
0x1103	Error writing block data	The GPMC channel is abnormal.	Check the DSP software version or replace the hardware.
0x1104	Error reading block data	The GPMC channel is abnormal.	Check the DSP software version or replace the hardware.
0x1105	Block data buffer full	The FPGA buffer is full and cannot accept new data.	Retry to write data after delay for a period of time.
0x1106	Channel opening error: The channel is abnormal or has been occupied.	The GPMC channel is abnormal or has been occupied.	Restart the controller.
0x1107	Channel opening error: The channel is abnormal or has been closed.	The GPMC channel is abnormal or has been closed.	Restart the controller.

Error code	Description	Cause	Solution
0x1108	System busy	The DSP does not respond to robot instructions.	1. Retry after a while. 2. Restart the robot. 3. Check whether the DSP has been suspended or terminated. 4. Divide long trajectory motion into multiple segments.
0x1109	Error getting channel resources	The CPMC channel is frequently occupied so that currently the system cannot apply for use of CPMC resources.	Retry to use them after delay for a period of time.
0x110A	Timeout waiting for motion module response	The response time to robot instructions from the DSP exceeds the set maximum waiting time.	1. Retry after a while. 2. Restart the robot. 3. Check whether the DSP has been suspended or terminated.
0x110B	Motion module failed to execute the command sent by ARM	The DSP failed to execute the robot instructions.	Check if the current operation is legal or check the DSP software version.
0x110C	Illegal parameters set for motion module.	Parameters set by the robot for the DSP are incorrect, e.g. out of the parameter range.	Check that function call interface parameters are correct.
0x110D	Illegal parameters set for motion module	Commands requested by the robot to the DSP are invalid.	Check the command word and ensure that there is processing on this command in the DSP.
0x110E	The number of axes configured for the system is inconsistent with the number of online scanned axes.	The model is not matched or servo is disconnected.	Check the model and servo connection to ensure that the current robot is consistent with the configured robot.
0x110F	The axis data sent is inconsistent with the data read.	Data check error	Check the software version or contact the manufacturer.
0x1110	The I/O data sent is inconsistent with the data read.	Data check error	Check the software version or contact the manufacturer.
0x1111	Error in servo entering homing mode via EtherCAT instructions	The servo cannot enter the homing mode.	Check the software version or contact the manufacturer.

Error code	Description	Cause	Solution
0x1112	Error in servo exiting homing mode via EtherCAT instructions	Servo cannot exit the homing mode.	Check the software version or contact the manufacturer.
0x1113	Error in setting homing parameters for the servo via EtherCAT instructions	The set homing parameters are not accepted by servo.	Check the software version or contact the manufacturer.
0x1114	System parameter check error	Data check error	Check the software version or contact the manufacturer.
0x1115	Error opening data channel	The GPMC channel number is incorrect.	The default channel is 0. Ensure that the channel No. is correct.
0x1116	Data channel mapping error	The GPMC data channel cannot map data to the memory.	Check the software version or contact the manufacturer.
0x1117	Data channel mapping error	The GPMC channel is abnormal.	Check the software version or contact the manufacturer.
0x1118	Data channel mapping error	The GPMC channel is abnormal.	Check the software version or contact the manufacturer.
0x1119	Device error	The GPMC channel is abnormal.	Check the software version or contact the manufacturer.
0x111A	Error opening data channel	The GPMC channel is abnormal.	Check the software version or contact the manufacturer.
0x111B	Data communication discrepancy	The GPMC channel is abnormal.	Check the software version or contact the manufacturer.
0x111C	Data communication discrepancy	The GPMC channel is abnormal.	Check the software version or contact the manufacturer.
0x111D	Error system requesting memory	The system cannot assign a required memory.	Check whether the system memory is close to the limit or whether the requested memory is too large.
0x111E	Error configuring I/O data bias information on the IR-Link bus	Data check error	Check the software version or contact the manufacturer.
0x111F	Error configuring AD data bias information on the IR-Link bus	Data check error	Check the software version or contact the manufacturer.
0x1120	Error configuring DA data bias information on the IR-Link bus	Data check error	Check the software version or contact the manufacturer.

Error code	Description	Cause	Solution
0x1121	Error configuring encoder data bias information on the IR-Link bus	Data check error	Check the software version or contact the manufacturer.
0x1122	Error configuring AD parameter (range) on IR-Link bus	Data check error	Check the software version or contact the manufacturer.
0x1123	Error configuring DA parameter (range) on IR-Link bus	Data check error	Check the software version or contact the manufacturer.
0x1124	Error configuring module number on IR-Link bus	Data check error	Check the software version or contact the manufacturer.
0x1125	Error synchronizing controller planning position with encoder feedback position	The current axis does not exist or the GPMC channel or DSP firmware is abnormal.	Check the software version or contact the manufacturer.
0x1130	Motion module failed to get the position	Internal error	Run again or contact the manufacturer.
0x1131	Motion module acquisition attempt limit exceeded	Failed to send motion data.	Run again or contact the manufacturer.
0x113A	Channel data address out of range	The channel data address is out of range.	Check the software version or contact the manufacturer.
0x1140	EcatPdo initialization parameter error	PDO data error occurs.	Run again or contact the manufacturer.
0x1140	EcatPdo initialization parameter error	PDO data error occurs.	Run again or contact the manufacturer.
0x11FF	Instruction not supported by virtual controller	The virtual controller does not currently support this instruction.	Do not use this instruction in the virtual controller.
0x1200	Robot in emergency stop state when enabled	The robot is in an emergency stop when the enable command is issued.	Check the emergency stop button, clear the emergency stop status and re-enable the robot.
0x1201	Excessive fluctuation in robot joint position when the robot is enabled	The robot is currently in a vibrating or dragged state.	Reduce the joint vibration of the robot and enable it after the robot stabilizes.
0x1202	Servo alarm present when the robot is enabled.	The robot has a servo alarm when enabled.	Clear the servo alarm and re-enable the robot.

Error code	Description	Cause	Solution
0x1203	Robot enabled too quickly after being disabled.	The robot is enabled too quickly after it is disabled.	Clear the alarm and re-enable the robot.
0x1204	Alarms other than joint overrun present when robot is enabled.	There are other alarms besides joint overrun.	Clear the alarm and re-enable the robot.
0x1205	Excessive fluctuation in robot joint position when getting zero point	The robot is currently in a vibrating or dragged state.	Reduce the joint vibration of the robot and get the zero point after the robot stabilizes.
0x1206	Soft float instruction timed out	Soft float instruction blocking timeout	Re-execute the instruction.
0x2001	Segment data overlap	The previously input target point is the same with the currently input target point.	Reteach the robot with different points.
0x2002	Error calculating input arc parameters	Circular arc interpolation information cannot be calculated because: 1. At least two points are too close. 2. Three points are nearly collinear. 3. Pose change is too large. 4. Transition is performed near a singularity.	Re-teach the robot with other points to calculate the arc interpolation information.
0x2003	Error calculating input linear parameters	Unable to calculate linear interpolation information. 1. Pose change is too large. 2. Transition is performed near a singularity.	Re-teach the robot with other points to calculate the linear interpolation information.
0x2004	Inverse kinematics error	The robot is at a singularity or out of reach.	Disable the robot, switch to the joint mode and then move the robot out of

Error code	Description	Cause	Solution
			the singularity, or change the target points to those that can be arrived.
0x2005	Singular position error	The robot moves to a singular position.	Switch to the joint mode and move the robot out of the singular position.
0x2006	Servo disabled during automatic running	1. Power failure of a drive occurs. 2. A drive is wired incorrectly. 3. A drive fails.	Check that the drive is normal.
0x2007	Reserved	Reserved	Reserved
0x2008	I/O index out of range	The physical I/O module does not exist.	Check that the corresponding physical I/O module exists.
0x2009	Jump parameter setting error	MH parameter is beyond the limit of J3 axis.	Modify the limit height or reselect a start or end point.
0x200A	Arm type parameter error	Three arm type parameters before the end point are not consistent with those of the start point in linear or circular motion.	Modify the motion to joint motion or reselect points to ensure consistent arm type.
0x200B	Inappropriate motion characteristic parameters	The motion parameter input range is unreasonable.	Modify motion parameters such as speed and acceleration.
0x200C	DA operation error	The channel is configured as current output, but the voltage command is used. Or the channel is configured as voltage output, but the current command is used.	Operate the DA port using a command consistent with the configuration.

Error code	Description	Cause	Solution
0x200D	The command to enable servo is sent, but the servo is not enabled actually.	1. The main power supply of the servo is not switched on. 2. The joint may be in deceleration process. 3. The joint is in motion state and does not arrive at the position.	1. Check whether the strong current button of the controller is pressed down. 2. The interval between servo stop and start or enable is too short. 3. Check whether the joint arrives at the position. Amplify the arrival error or adjust the servo parameters. 4. Status word feedback is too slow.
0x200E	Joint motion parameter input error	1. The points are beyond the space range for the Delta robots. 2. MoveJ and MOVL or MOVC performs transition near a singularity.	1. Check whether the points are beyond the space range for the Delta robots. 2. Check whether MoveJ and MOVL or MOVC performs transition near a singularity.
0x200F	Robot not returned to zero	The robot does not perform the homing operation when an incremental encoder is used.	For incremental encoder, perform the homing operation first.
0x2010	Robot radial direction out of bound	The X and Y combined radius at the end of the robot is greater than the set radius.	Under the rectangular frame, step so that the robot end moves in the direction of reduction of the X and Y combined radius.
0x2011	Robot Z positive direction out of bound.	The Z at the end of the robot is greater than the setpoint.	Under the rectangular frame, step so that the robot end moves in the negative direction of Z.
0x2012	Robot Z negative direction out of bound	The Z at the end of the robot is smaller than the setpoint.	Under the rectangular frame, step so that the robot end moves in the positive direction of Z.
0x2013	Robot out of bound	The teaching point exceeds the boundary.	Change the teaching points so that they are within the work space of the robot.
0x2014	System thread priority exception	System thread priority exception detected during operation	Export the diagnostic information and contact the manufacturer.

Error code	Description	Cause	Solution
0x2015	Real time task synchronization timeout	Real time task synchronization timeout	Export the diagnostic information and contact the manufacturer.
0x2016	The included angle between J2 and J3 axes of the palletizing robot is too small.	The included angle between J2 and J3 axes of the palletizing robot is too small.	In the manual mode, rotate the J3 axis positively or the J2 axis negatively.
0x2017	The included angle between J2 and J3 axes of the palletizing robot is too large.	The included angle between J2 and J3 axes of the palletizing robot is too large.	In the manual mode, rotate the J3 axis positively or the J2 axis negatively.
0x2018	Abnormal robot speed	The robot joint speed exceeds twice the allowable maximum speed.	1. Ensure that the settings of allowable maximum speed and acceleration of joints on the setting interface are reasonable. 2. Ensure that the robot is not near a singularity. 3. Reduce the linear motion speed.
0x2019	Motion parameter error	The motion planning parameters are abnormal.	Check that the motion parameters (speed, acceleration) are reasonable.
0x201A	The position speed or orientation speed exceeds the setting value.	The robot end motion exceeds the set position or orientation speed.	1. If the MoveJ instruction is used, set the MoveJ speed coefficient to a smaller value. 2. Check whether the set orientation speed is consistent with the J4 joint speed.
0x201D	Arm type change error	The arm type change instruction (specially used for SCARA robots) is not supported near a singularity.	Replace the point with a point far from the singular area and then call the arm type change command.

Error code	Description	Cause	Solution
0x201E	The robot acceleration is abnormal.	The robot joint speed exceeds 50 times the allowable maximum acceleration.	1. Ensure that the settings of allowable maximum speed and acceleration of joints on the setting page are reasonable. 2. Ensure that the robot is not near a singular position. 3. Reduce the speed and acceleration of line motion.
0x201F	Speed setting error	Insufficient internal storage in DSP	Decrease the Cartesian speed or increase the joint speed.
0x2020	Speed setting error	Insufficient internal spline storage in DSP	Reduce the position and orientation speed, or increase the joint speed.
0x2021	The lower worksapce boundary is too large or the stop distance is too small.	The lower worksapce boundary is too large or the stop distance is too small for the tracking process.	Decrease the lower worksapce boundary, and then increase the stop distance.
0x2022	Robot out of lower worksapce boundary	The robot exceeds the set workspace in the tracking process.	Adjust the lower worksapce boundary and the upper pickup boundary; increase the robot speed; reduce the conveyor speed.
0x2023	Conveyor speed too large	The conveyor belt speed exceeds a reasonable range.	The conveyor speed exceeds the maximum speed limit (1 m/s for the linear conveyor and 180°/s for the turntable conveyor).
0x2024	Conveyor speed fluctuation too large	The conveyor speed fluctuates excessively.	Check that the conveyor motor speed does not fluctuate excessively or that the conveyor is abnormal.
0x2025	Vision data waiting timeout	No returned data is received for a long period of time after vision triggering signals are sent, and the vision processing cycle is greater than the photographing interval.	1. Check whether the vision trigger signal is delivered successfully. 2. If the vision trigger signal is delivered successfully every time, check whether the camera will take pictures normally every time. 3. The processing time of vision software is too long, or the delay time of data transmission is too long.

Error code	Description	Cause	Solution
0x2026	Workobject parameter type error	A motion instruction with Wobj parameter is used in tracking motion，or a motion instruction with Cnv parameter is used in normal motion.	The workobject parameter of the motion instruction in the tracking motion shall be modified to Cnv, and the workobject parameter of the motion instruction in the normal motion shall be modified to Wobj.
0x2027	Dynamic point coordinate error	The given dynamic target position is incorrect, singular or out of bounds.	Check whether the coordinate given by vision is within a reasonable range.
0x2028	Syntax error in the conveyor tracking instruction	Refsys Convyor or Refsys Base is used continuously.	Check that RefConvyor and RefBase are jointly used.
0x2029	Failed to establish frame for grasping the work object	The Refsys Convyor instruction is executed before the GetCnvObject instruction is executed.	Call the GetCnvObject instruction first.
0x202A	Conveyor vision port error	Multiple conveyors adopting vision detection are used.	Check whether more than two vision inputs are used at the same time.
0x202B	Single-step teaching is not allowed.	The conveyor tracking-related instructions do not allow single-step teaching.	Single-step operation on instructions between Refsys Convyor and Refsys Base is not allowed.
0x202C	A disabled conveyor is used in the instruction.	A disabled conveyor is used in the instruction.	Check whether the conveyor used in the program is disabled.
0x202D	PTP motion is not allowed in the tracking process.	Joint motions such as MovJ and JumP are used in the tracking process.	Check whether the MovJ or jump instruction is used between Refsys Convyor and Refsys Base.
0x202E	Conveyor direction error	Conveyor direction error	1. Check whether the encoder direction parameter on the conveyor belt interface is correct. 2. Check whether the conveyor belt shows the evidence of slipping.

Error code	Description	Cause	Solution
0x202F	The start position for teaching in Cartesian system is at a singular position where inverse kinematic solution cannot be executed.	The start position for teaching in Cartesian system is at a singular position where inverse kinematic solution is impossible.	Switch to joint mode and move out of the singular position.
0x2030	Inconsistent latch counters	The robot position latching counters of the respective axes are inconsistent, resulting in incorrect latch state feedback from the servo. The latch I/O may have been called in static, dynamic, or xqt task.	Check that the latching signals of the respective axes are active. Check if the latch I/O has been called in static, dynamic, or xqt task. If it is called, change the latch I/O used in other tasks.
0x2031	Latching buffer full	When the robot position is latched, the latching buffer is full.	The latching speed is too fast, or there are too many latched positions that are not used.
0x2032	The motion range of J1 or J2 exceeds 180°.	When the inverted SCARA robot performs interpolation motion, the motion range of J1 or J2 axis exceeds 180°, making it impossible to ensure that the termination angle of interpolation motion is consistent with the predetermined angle.	Avoid the above situations.
0x2034	The motion range of J2 passes through the singular point.	When the inverted SCARA robot performs interpolation motion, the J2 axis moves through the singularity, making it impossible to ensure that the termination angle of interpolation motion is consistent with the predetermined angle.	Avoid the above situations.

Error code	Description	Cause	Solution
0x2035	EtherCAT communication feedback error	EtherCAT bus feedback data is missing.	Check that the EtheCAT cable is properly connected and there is no external interference.
0x5100	Balance cylinder spring maintenance interval reached	The balance cylinder spring has reached the set lifespan threshold. Continued use may pose a risk of component damage.	Contact the manufacturer for maintenance promptly.
0x2036	Position latch timeout	1. The servo is not properly configured with probe function. 2. The correct I/O edge signal is not triggered. 3. Hardware interference.	1. Check if a valid edge signal is output. 2. Check if the servo probe is configured. 3. Check for hardware interference.
0x2041	Limit-triggering point present in planned trajectory	The planned trajectory includes points that may trigger the limit.	Check the corresponding motion segment for points that may trigger limit.
0x2042	The constraint of velocity in trajectory is too small.	1. In the planning, the calculated spatial velocity constraint is too small, and the velocity parameters are set incorrectly. 2. The trajectory is close to a singularity.	1. Adjust the set speed parameters. 2. Adjust the trajectory away from the singularity.
0x2043	Path planning: inverse kinematics error	Inverse kinematic solution cannot be executed at an intermediate point of the planned trajectory.	Modify points in the erroneous segment.
0x2044	The position goes beyond the lower operating boundary during the dynamic tracking preprocessing.	The target point is detected to go beyond the lower operating boundary during the dynamic tracking preprocessing.	1. Check that the received vision data point is within a reasonable range. 2. Check that the dynamic coordinates in the given motion instruction are not out of the lower operating boundary.
0x2045	Path planning: J1 out of range		

Error code	Description	Cause	Solution
		A limit is triggered at J1 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2046	Path planning: J2 out of range	A limit is triggered at J2 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2047	Path planning: J3 out of range	A limit is triggered at J3 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2048	Path planning: J4 out of range	A limit is triggered at J4 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2049	Path planning: J5 out of range	A limit is triggered at J5 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x204A	Path planning: J6 out of range	A limit is triggered at J6 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x204B	Path planning: J7 out of range	A limit is triggered at J7 in the planned trajectory.	Change the motion points.
0x204C	Path planning: J8 out of range	A limit is triggered at J8 in the planned trajectory.	Change the motion points.
0x204D	Path planning: J9 out of range	A limit is triggered at J9 in the planned trajectory.	Change the motion points.
0x204E	Path planning: J10 out of range	A limit is triggered at J10 in the planned trajectory.	Change the motion points.
0x204F	Path planning: J11 out of range	A limit is triggered at J11 in the planned trajectory.	Change the motion points.
0x2050	Path planning: J12 out of range	A limit is triggered at J12 in the planned trajectory.	Change the motion points.
0x2051	Path planning: J13 out of range		Change the motion points.

Error code	Description	Cause	Solution
		A limit is triggered at J13 in the planned trajectory.	
0x2052	Path planning: J14 out of range	A limit is triggered at J14 in the planned trajectory.	Change the motion points.
0x2053	Too large orientation motion angle	J4: The orientation motion angle in the planned trajectory is greater than 360°; J6: The orientation motion angle in the planned trajectory is greater than 180°.	Re-select appropriate starting and target points for motion.
0x2054	J1 motion range exceeds 180° due to improper intermediate point in circular motion.	When the inverted SCARA robots performs circular motion, the difference in angle of the J1 axis between the starting point and the intermediate point plus the difference in angle of the J1 axis between the intermediate point and the end point exceeds 180°.	Re-select an appropriate intermediate point of the circular motion.
0x2055	Unable to reach the predetermined target angle	Unable to reach the predetermined target angle	Modify the arm parameters of "J4 range".
0x2056	During the transition movement, the robot's planned points cannot be solved inversely. Please reduce the transition or get the points again.	During the transition movement, the robot's planned points cannot be solved inversely. Please reduce the transition or get the points again.	During the transition movement, the robot's planned points cannot be solved inversely. Please reduce the transition or get the points again.
0x2057	Movc intermediate point pose mode: Intermediate point not in arc 1/4-3/4 range	In intermediate point pose mode, the intermediate point is not between 1/4 to 3/4 of the arc. Please	Re-select an appropriate intermediate point of the motion.

Error code	Description	Cause	Solution
		reselect the intermediate point for arc motion.	
0x2058	Movc intermediate point pose mode: Pose planning failed	Pose movement is too large in Movc intermediate point pose mode.	Re-select appropriate starting point, intermediate point, and target point of the motion
0x2060	Insufficient instruction space	The joint speed is too small while the spatial speed is too large.	1. Increase the joint speed. 2. Reduce the spatial speed.
0x2061	Insufficient space for planned positions	The joint speed is too small while the spatial speed is too large.	1. Increase the joint speed. 2. Reduce the spatial speed.
0x2062	Interpolation data error	1. The joint speed and acceleration are not reasonably set. 2. The motion trajectory is too long.	1. Set the joint speed and acceleration appropriately. 2. Split long trajectory into multiple segments.
0x2063	Insufficient spline space	1. The spline distance is too large. 2. The speed is too low during transition.	1. Reduce the transition length. 2. Increase the set speed. 3. Save the error message and contact the manufacturer.
0x2064	Spline interpolation planning error	Spline interpolation planning error	Save the error message and contact the manufacturer.
0x2065	Speed fitting error	Speed fitting error	Save the error message and contact the manufacturer.
0x2066	Speed planning error	Speed planning error	Save the error message and contact the manufacturer.
0x2067	Joint transition planning error	The calculation result is incorrect during joint transition planning due to improper input parameters.	If possible, fine-tune the points or motion parameters.
0x2068	Speed look-ahead check not reasonable	It is checked that the look-ahead results are not reasonable.	Save the error message and contact the manufacturer.

Error code	Description	Cause	Solution
0x2069	Adaptive planning results check not reasonable	Adaptive planning results check not reasonable	Save the error message and contact the manufacturer.
0x206A	General planning results check not reasonable	General planning results check not reasonable	Save the error message and contact the manufacturer.
0x206B	Joint speed or acceleration exceeds the set value during normal transition	The set joint speed may be exceeded during a normal transition in CP mode.	1. Decrease the position speed and orientation speed or increase the joint speed appropriately. 2. Ensure that points are out of singular area. Reduce the transition level and transition length.
0x206C	The joint speed in tracking motion exceeds the set value.	The joint speed in tracking motion exceeds the set value.	Reduce the conveyor speed or the robot speed.
0x206D	Smooth stop exception	The deceleration distance is insufficient when a smooth stop is made.	Save the error message and contact the manufacturer.
0x206E	Joint's acceleration overlimit	When the transition trajectory between CP instructions approaches to the singular area, the acceleration of the joint exceeds the limit.	Adjust the instruction's trajectory or the transition parameters to avoid singularities.
0x206F	Robot approaching singularity	The joint speed and acceleration are too large due to the robot approaching the singular position.	1. Ensure that motion points are out of singular area. 2. Set the motion speed near the singularities to a small value.
0x2070	Transition trajectory enters the singular area.	The transition trajectory between CP instructions enters the singular area.	Adjust the instruction's trajectory or the transition parameters to avoid singularities.
0x2071	Teach path planning: J1 out of range	A limit is triggered at J1 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.

Error code	Description	Cause	Solution
0x2072	Teach path planning: J2 out of range	A limit is triggered at J2 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2073	Teach path planning: J3 out of range	A limit is triggered at J3 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2074	Teach path planning: J4 out of range	A limit is triggered at J4 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2075	Teach path planning: J5 out of range	A limit is triggered at J5 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2076	Teach path planning: J6 out of range	A limit is triggered at J6 in the planned trajectory.	Check the corresponding motion segment for points that may trigger limit.
0x2077	Teach path planning: inverse kinematics error	Inverse kinematic solution cannot be executed at an intermediate point of the planned trajectory.	Modify points in the erroneous segment.
0x2078	Error in calculating linear input parameters in teaching mode.	Unable to calculate linear interpolation information.	Re-teach the robot with other points to calculate the linear interpolation information.
0x2079	The arm type is inconsistent with the current point during preprocessing in teaching state and space interpolation cannot be performed.	The ARM_TYPE parameter is inconsistent with the current point during preprocessing and spatial interpolation cannot be performed.	Modify points in the erroneous segment.
0x207A	In teaching state, the orientation change is too large.	The orientation motion angle is found to be greater than 180 degrees in the planned trajectory.	1. Reduce the pose change range of a single motion. 2, Check the difference in ARM_TYPE of points between the alarming program line and the previous program line.
0x207B	The constraint of velocity in trajectory is very low in manual mode.	The constraint of velocity in trajectory is too small.	In teaching mode, the spatial velocity constraint calculated in the planning is too small due to incorrect speed parameter setting or singularities.

Error code	Description	Cause	Solution
0x2081	Valid hardware signal for emergency stop	Hardware emergency stop is active.	A hardware emergency stop is active. Confirm safety and then dismiss the alarm.
0x2082	Mode switch timeout	1. The robot's acceleration setting, resulting in the robot stop overtime. 2. The robot is moving while switching mode.	1. Check that the motion parameters are set correctly. 2. Stop the current motion and make sure the robot is stationary before switching the mode.
0x2083	Power error	1. The input power supply is abnormal. 2. System hardware failure.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x2084	Fan error	1. The fan is not connected. 2. The fan cable has poor contact or broken wire.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x2085	Discharge tube shorted or regenerative resistor not connected.	1. The regenerative resistor is not connected. 2. The discharge tube is shorted.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x2086	Discharge tube open circuit	The discharge tube is open circuit.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x2091	Trajectory recovery exception	1. Exception in line number processing for trajectory recovery. 2. Exception in data communication for trajectory recovery.	1. Reset the line number. 2. Save the error message and contact the manufacturer.
0x2092	Trajectory recovery target point error	1. Exception in line number processing for trajectory recovery. 2. Exception in data communication for trajectory recovery.	1. Reset the line number. 2. Save the error message and contact the manufacturer.

Error code	Description	Cause	Solution
0x2093	Trajectory recovery motion state error	1. Exception in line number processing for trajectory recovery. 2. Exception in data communication for trajectory recovery.	1. Reset the line number. 2. Save the error message and contact the manufacturer.
0x2094	Trajectory recovery initialization error	1. Exception in line number processing for trajectory recovery. 2. Exception in data communication for trajectory recovery.	1. Reset the line number. 2. Save the error message and contact the manufacturer.
0x2095	Issued trajectory recovery instruction line/segment number error	1. Exception in line number processing for trajectory recovery. 2. Exception in data communication for trajectory recovery.	1. Reset the line number. 2. Save the error message and contact the manufacturer.
0x2096	Trajectory recovery current point deviated from stop position	Trajectory recovery current point deviated from stop position	1. Reset the line number. 2. Save the error message and contact the manufacturer.
0x2097	Trajectory recovery target point changed	Trajectory recovery target point changed	1. Reset the line number. 2. Save the error message and contact the manufacturer.
0x20A1	Data acquisition board communication failure	Communication between robot controller and data acquisition board is disconnected.	Check in the following order: 1. Check that signal cable is connected. 2. Check that the data acquisition board cable is connected. 3. Check that data acquisition board is installed. 4. Check that data acquisition board light is working improperly (green light flashing). 5. Check that data acquisition board has firmware. If the alarm persists, replace the data acquisition board.

Error code	Description	Cause	Solution
0x20A2	Data acquisition board data error	The data collection board is damaged.	Check in the following order: 1. Check that data acquisition board light is working improperly (green light flashing). 2. Check whether the alarm can be cleared after restart. 3. Check that the controller's power-up timing is normal. If the alarm persists, replace the data acquisition board.
0x20A3	Data acquisition board communication error	The data acquisition board encounters data frame loss.	Check in the following order: 1. Check that signal cable is connected. 2. Check that the data acquisition board cable is connected. 3. Check that the robot motion does not result in poor contact with the data acquisition board connector due to force during robot motion. 4. Check that the data acquisition board hardware circuit works properly. 5. Check whether the alarm can be cleared after restart. If the alarm persists, replace the data acquisition board.
0x20A4	Data acquisition board data changed significantly	Robot collides with environment; robot moves with abnormal sound.	Check in the following order: 1. Check whether robot collides with environment. 2. Check whether robot speed and acceleration is too high. If the alarm persists, replace the data acquisition board.
0x20A5	Data acquisition board overtemperature	Data acquisition board overtemperature	Check in the following order: 1. Check that the temperature of the robot's working environment meets the requirements. 2. If the alarm persists, reduce the speed and acceleration of the robot.

Error code	Description	Cause	Solution
0x20A6	Excessive robot vibration	Excessive robot vibration	Check in the following order: 1. Check the robot for visible vibrations. 2. Check the robot joints for obvious transmission clearance. If the alarm persists, reduce the speed and acceleration of the robot.
0x20A7	Robot positioning time too long	Residual robot vibration is significant, resulting in long positioning time.	Check in the following order: 1. Check the robot for visible vibrations. 2. Check the robot joints for obvious transmission clearance. If the alarm persists, reduce the speed and acceleration of the robot.
0x20A8	Collision detected	Robot collides with environment; robot moves with abnormal sound.	Check whether the robot collides with the environment; check whether there are abnormal noises during the robot motion.
0x20A9	Vibration reduction failure	Vibration reduction failure	Check in the following order: 1. Check that signal cable is connected. 2. Check that the data acquisition board cable is connected. 3. Check whether the alarm can be cleared after restart. If the alarm persists, turn off the closed loop vibration suppression function.

Error code	Description	Cause	Solution
0x20AA	Robot motion state error	1. The robot model in software is not consistent with actual one. 2. Mechanical causes: collision or loose or stuck transmission mechanism. 3. Home position deviation is too large. 4. Reduction ratio setting error. 5. Joint motion direction error. 6. Data acquisition board install direction error.	Check in the following order: 1. Make sure the robot model in software is the same as with the actual one. 2. Check for mechanical anomalies such as collision, loose or stuck drive mechanism. 3. Check that the zero point of the robot is accurate. 4. Check that the reduction ratio parameter is correctly set. 5. Check that the direction of joint movement is correct. 6. Check that the data acquisition board is mounted in the correct direction. If the alarm persists, turn off data acquisition board alarm function.
0x20AB	Self-learning vibration reduction function calculation error	Self-learning vibration reduction function calculation error	Reduce the motion speed; turn off the self-learning vibration suppression function.
0x20AC	Self-learning vibration suppression learning timeout	Self-learning vibration suppression learning timeout	1. Change the self-learning flag in the motor instruction to SLOff. 2. Contact the manufacturer.
0x20AD	Data acquisition board hardware failure	Data acquisition board hardware ID check failure	Check in the following order: 1. Check the data acquisition board for component damage. 2. Check that the data acquisition board hardware version and software version match. If the alarm persists, replace the data acquisition board.

Error code	Description	Cause	Solution
0x20AE	Data acquisition board self-test failure	Data acquisition board self-test failure	Check in the following order: 1. Check if the encoder cable and data acquisition board cable are hot swapped. 2. Check whether data acquisition board chips are damaged. 3. Check whether the alarm can be cleared after restart. If the alarm persists, replace the data acquisition board.
0x20B1	Tool load mass exceeds limit	The mass setting of the tool load exceeds the limit.	Reduce the mass setting of the tool load to the limit range.
0x20B2	Tool load centroid position exceeds limit	The centroid position setting of the tool load exceeds the limit.	Reduce the centroid position setting of the tool load to the limit range.
0x20B3	Tool load centroid orientation exceeds limit	The centroid orientation setting of the tool load exceeds the limit.	Reduce the centroid orientation setting of the tool load to the limit range.
0x20B4	Tool load inertia exceeds limit	The inertia setting of the tool load exceeds the limit.	Reduce the inertia setting of the tool load to the limit range.
0x20B5	Load mass exceeds the limit	The mass setting of the load exceeds the limit.	Reduce the mass setting of the load to the limit range.
0x20B6	Load centroid position exceeds limit	The centroid position setting of the load exceeds the limit.	Reduce the centroid position setting of the load to the limit range.
0x20B7	Load centroid orientation exceeds limit	The inertia setting of the load exceeds the limit.	Reduce the inertia setting of the load to the limit range.
0x20B8	Load centroid orientation exceeds limit	The inertia setting of the load exceeds the limit.	Reduce the inertia setting of the load to the limit range.
0x20B9	Arm load mass exceeds the limit	The mass setting of the arm load exceeds the limit.	Reduce the mass setting of the arm load to the limit range.

Error code	Description	Cause	Solution
0x20BA	Arm load centroid position exceeds limit	The centroid position setting of the arm load exceeds the limit.	Reduce the centroid position setting of the arm load to the limit range.
0x20BB	Arm load centroid orientation exceeds limit	The centroid orientation setting of the arm load exceeds the limit.	Reduce the centroid orientation setting of the arm load to the limit range.
0x20BC	Arm load inertia exceeds limit	The inertia setting of the arm load exceeds the limit.	Reduce the inertia setting of the arm load to the limit range.
0x20C1	Collision or anomaly detected on J1 axis	Check whether collision occurs; if there is no collision, check whether the motor on the axis fails; if there is no abnormality, check whether the load parameters are set correctly, check whether the collision detection parameters have been debugged, and check whether it is due to the limited servo tracking capability; if there is no abnormality, check whether the robot has experienced significant changes in friction after prolonged cooling or operation; if there is still no abnormality, refer to the instruction manual to investigate the cause or debug the collision detection parameters.	Check whether a collision has occurred, if not: 1. Check that the load parameters are set correctly; 2. Check that the robot model in the controller matches the actual robot. 3. Check the robot for motor jam, brake not opened, etc. 4. If the robot starts suddenly after a long cold state, perform appropriate warm-up before running; if the robot's friction significantly decreases after long-term running, contact the manufacturer to tune the friction parameters. 5. If the robot operates at high speed and heavy load, it will cause current saturation phenomenon, which is prone to false alarms, so prevent the robot from operating under such conditions; You can also try to enter the medium precision mode through commands or manually turn on the speed feedforward of all axes to solve this problem to some extent. 6. If it is determined to be a false alarm, the collision detection sensitivity of the axis can be appropriately increased, and it is recommended to use the recommended collision detection sensitivity value.

Error code	Description	Cause	Solution
			7. If the alarm persists, turn off the collision detection switch for that axis.
0x20C2	Collision or anomaly detected on J2 axis	Check whether collision occurs; if there is no collision, check whether the motor on the axis fails; if there is no abnormality, check whether the load parameters are set correctly, check whether the collision detection parameters have been debugged, and check whether it is due to the limited servo tracking capability; if there is no abnormality, check whether the robot has experienced significant changes in friction after prolonged cooling or operation; if there is still no	Check whether a collision has occurred, if not: 1. Check that the load parameters are set correctly; 2. Check that the robot model in the controller matches the actual robot. 3. Check the robot for motor jam, brake not opened, etc. 4. If the robot starts suddenly after a long cold state, perform appropriate warm-up before running; if the robot's friction significantly decreases after long-term running, contact the manufacturer to tune the friction parameters. 5. If the robot operates at high speed and heavy load, it will cause current saturation phenomenon, which is prone to false alarms, so prevent the robot from operating under such conditions; You can also try to enter the medium precision mode through

Error code	Description	Cause	Solution
		abnormality, refer to the instruction manual to investigate the cause or debug the collision detection parameters.	commands or manually turn on the speed feedforward of all axes to solve this problem to some extent. 6. If it is determined to be a false alarm, the collision detection sensitivity of the axis can be appropriately increased, and it is recommended to use the recommended collision detection sensitivity value. 7. If the alarm persists, turn off the collision detection switch for that axis.
0x20C3	Collision or anomaly detected on J3 axis	Check whether collision occurs; if there is no collision, check whether the motor on the axis fails; if there is no abnormality, check whether the load parameters are set correctly, check whether the collision detection parameters have been debugged, and check whether it is due to the limited servo tracking capability; if there is no abnormality, check whether the robot has experienced significant changes in friction after prolonged cooling or operation; if there is still no	Check whether a collision has occurred, if not: 1) Check that the load parameters are set correctly; 2) Check that the robot model in the controller matches the actual robot; 3) Check the robot for motor jam, brake not opened, etc.; 4) If there is a situation where the robot suddenly starts after being cold for a long time, please warm up the machine appropriately before running; If there is a significant decrease in the friction force of the robot after prolonged operation; contact the manufacturer to tune the friction parameters; 5) If the robot operates at high speed and heavy load, it will cause current saturation phenomenon, which is prone to false alarms, so prevent the robot from operating under such conditions; You can also try to enter the medium precision mode through commands or manually turn on the speed feedforward of all axes to solve this problem to some extent; 6) If

Error code	Description	Cause	Solution
		abnormality, refer to the instruction manual to investigate the cause or debug the collision detection parameters.	it is determined to be a false alarm, the collision detection sensitivity of the axis can be appropriately increased, and it is recommended to use the recommended collision detection sensitivity value; 7) If the alarm persists, turn off the collision detection switch for that axis.
0x20C4	Collision or anomaly detected on J4 axis	Check whether collision occurs; if there is no collision, check whether the motor on the axis fails; if there is no abnormality, check whether the load parameters are set correctly, check whether the collision detection parameters have been debugged, and check whether it is due to the limited servo tracking capability; if there is no abnormality, check whether the robot has experienced significant changes in friction after prolonged cooling or operation; if there is still no abnormality, refer to the instruction manual to investigate the cause or debug the	Check whether a collision has occurred, if not: 1) Check that the load parameters are set correctly; 2) Check that the robot model in the controller matches the actual robot; 3) Check the robot for motor jam, brake not opened, etc.; 4) If there is a situation where the robot suddenly starts after being cold for a long time, please warm up the machine appropriately before running; If there is a significant decrease in the friction force of the robot after prolonged operation; contact the manufacturer to tune the friction parameters; 5) If the robot operates at high speed and heavy load, it will cause current saturation phenomenon, which is prone to false alarms, so prevent the robot from operating under such conditions; You can also try to enter the medium precision mode through commands or manually turn on the speed feedforward of all axes to solve this problem to some extent; 6) If it is determined to be a false alarm, the collision detection sensitivity of the axis can be appropriately increased, and it is recommended to use the recommended collision detection

Error code	Description	Cause	Solution
		collision detection parameters.	sensitivity value; 7) If the alarm persists, turn off the collision detection switch for that axis.
0x20C5	Collision or anomaly detected on J5 axis	Check whether collision occurs; if there is no collision, check whether the motor on the axis fails; if there is no abnormality, check whether the load parameters are set correctly, check whether the collision detection parameters have been debugged, and check whether it is due to the limited servo tracking capability; if there is no abnormality, check whether the robot has experienced significant changes in friction after prolonged cooling or operation; if there is still no abnormality, refer to the instruction manual to investigate the cause or debug the	Check whether a collision has occurred, if not: 1) Check that the load parameters are set correctly; 2) Check that the robot model in the controller matches the actual robot; 3) Check the robot for motor jam, brake not opened, etc.; 4) If there is a situation where the robot suddenly starts after being cold for a long time, please warm up the machine appropriately before running; If there is a significant decrease in the friction force of the robot after prolonged operation; contact the manufacturer to tune the friction parameters; 5) If the robot operates at high speed and heavy load, it will cause current saturation phenomenon, which is prone to false alarms, so prevent the robot from operating under such conditions; You can also try to enter the medium precision mode through commands or manually turn on the speed feedforward of all axes to solve this problem to some extent; 6) If it is determined to be a false alarm, the collision detection sensitivity of the axis can be appropriately increased, and it is recommended to use the recommended collision detection

Error code	Description	Cause	Solution
		collision detection parameters.	sensitivity value; 7) If the alarm persists, turn off the collision detection switch for that axis.
0x20C6	Collision or anomaly detected on J6 axis	Check whether collision occurs; if there is no collision, check whether the motor on the axis fails; if there is no abnormality, check whether the load parameters are set correctly, check whether the collision detection parameters have been debugged, and check whether it is due to the limited servo tracking capability; if there is no abnormality, check whether the robot has experienced significant changes in friction after prolonged cooling or operation; if there is still no abnormality, refer to the instruction manual to investigate the cause or debug the	Check whether a collision has occurred, if not: 1. Check that the load parameters are set correctly; 2. Check that the robot model in the controller matches the actual robot. 3. Check the robot for motor jam, brake not opened, etc. 4. If the robot starts suddenly after a long cold state, perform appropriate warm-up before running; if the robot's friction significantly decreases after long-term running, contact the manufacturer to tune the friction parameters. 5. If the robot operates at high speed and heavy load, it will cause current saturation phenomenon, which is prone to false alarms, so prevent the robot from operating under such conditions; You can also try to enter the medium precision mode through commands or manually turn on the speed feedforward of all axes to solve this problem to some extent. 6. If it is determined to be a false alarm, the collision detection sensitivity of the

Error code	Description	Cause	Solution
		collision detection parameters.	axis can be appropriately increased, and it is recommended to use the recommended collision detection sensitivity value. 7. If the alarm persists, turn off the collision detection switch for that axis.
0x20D0	Collision signal received	Collision signal received	Clear the collision signal.

Error code	Description	Cause	Solution
0x20D1	Abnormal motion state detected on J1 axis	1. Robot collision; or abnormal current due to serious errors in load parameters, model parameters, and serious deviation of zero point. 2. Servo faults, including: power line UVW phase sequence error, motor angle error, encoder model mismatch, encoder wiring failure, servo gain mismatch, etc. 3. Robot motion speed and acceleration are too large, exceeding the robot's motion capability, resulting in excessive speed deviation and torque deviation.	When troubleshooting this fault, make sure that the personnel are outside the working range of the robot before enabling any axis motor. 1. First check if a violent collision has occurred, if no collision occurs, check that the load parameters are set correctly, check that the robot matches the model displayed in the controller, and check if there is a serious deviation from the zero point of the robot. 2. If there is no collision and no obvious abnormality, try increasing the servo gain and turning on the servo speed feedforward (which can be turned on through the command to enter the medium precision mode) to see if the alarm still persists. 3. If the collision and controller side factors are excluded, then investigate the servo side factors in order. 1). The UVW phase sequence is incorrect. Connect the U/V/W cables in the correct phase sequence. 2). An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on. Power on the system again. 4. The encoder model is wrong or the encoder is wired improperly. Confirm the motor model, the parameter H00-00, the encoder type, and the encoder wiring are correct. 5. The encoder is wired improperly, aged, or connected loosely. Re-solder, tighten or replace the encoder cable. 6. Improper parameter setting leads to excessive vibration. Set the parameters appropriately to avoid excessive vibration.

Error code	Description	Cause	Solution
			For more information, see "Robot Alarms and Handling Method" in the manual.

Error code	Description	Cause	Solution
0x20D2	Abnormal motion state detected on J2 axis	1. Robot collision; or abnormal current due to serious errors in load parameters, model parameters, and serious deviation of zero point. 2. Servo faults, including: power line UVW phase sequence error, motor angle error, encoder model mismatch, encoder wiring failure, servo gain mismatch, etc. 3. Robot motion speed and acceleration are too large, exceeding the robot's motion capability, resulting in excessive speed deviation and torque deviation.	When troubleshooting this fault, make sure that the personnel are outside the working range of the robot before enabling any axis motor. 1. First check if a violent collision has occurred, if no collision occurs, check that the load parameters are set correctly, check that the robot matches the model displayed in the controller, and check if there is a serious deviation from the zero point of the robot. 2. If there is no collision and no obvious abnormality, try increasing the servo gain and turning on the servo speed feedforward (which can be turned on through the command to enter the medium precision mode) to see if the alarm still persists. 3. If the collision and controller side factors are excluded, then investigate the servo side factors in order. 1). The UVW phase sequence is incorrect. Connect the U/V/W cables in the correct phase sequence. 2). An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on. Power on the system again. 4. The encoder model is wrong or the encoder is wired improperly. Confirm the motor model, the parameter H00-00, the encoder type, and the encoder wiring are correct. 5. The encoder is wired improperly, aged, or connected loosely. Re-solder, tighten or replace the encoder cable. 6. Improper parameter setting leads to excessive vibration. Set the parameters appropriately to avoid excessive vibration.

Error code	Description	Cause	Solution
			For more information, see "Robot Alarms and Handling Method" in the manual.

Error code	Description	Cause	Solution
0x20D3	Abnormal motion state detected on J3 axis	1. Robot collision; or abnormal current due to serious errors in load parameters, model parameters, and serious deviation of zero point. 2. Servo faults, including: power line UVW phase sequence error, motor angle error, encoder model mismatch, encoder wiring failure, servo gain mismatch, etc. 3. Robot motion speed and acceleration are too large, exceeding the robot's motion capability, resulting in excessive speed deviation and torque deviation.	When troubleshooting this fault, make sure that the personnel are outside the working range of the robot before enabling any axis motor. 1. First check if a violent collision has occurred, if no collision occurs, check that the load parameters are set correctly, check that the robot matches the model displayed in the controller, and check if there is a serious deviation from the zero point of the robot. 2. If there is no collision and no obvious abnormality, try increasing the servo gain and turning on the servo speed feedforward (which can be turned on through the command to enter the medium precision mode) to see if the alarm still persists. 3. If the collision and controller side factors are excluded, then investigate the servo side factors in order. 1). The UVW phase sequence is incorrect. Connect the U/V/W cables in the correct phase sequence. 2). An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on. Power on the system again. 4. The encoder model is wrong or the encoder is wired improperly. Confirm the motor model, the parameter H00-00, the encoder type, and the encoder wiring are correct. 5. The encoder is wired improperly, aged, or connected loosely. Re-solder, tighten or replace the encoder cable. 6. Improper parameter setting leads to excessive vibration. Set the parameters appropriately to avoid excessive vibration.

Error code	Description	Cause	Solution
			For more information, see "Robot Alarms and Handling Method" in the manual.

Error code	Description	Cause	Solution
0x20D4	Abnormal motion state detected on J4 axis	1. Robot collision; or abnormal current due to serious errors in load parameters, model parameters, and serious deviation of zero point. 2. Servo faults, including: power line UVW phase sequence error, motor angle error, encoder model mismatch, encoder wiring failure, servo gain mismatch, etc. 3. Robot motion speed and acceleration are too large, exceeding the robot's motion capability, resulting in excessive speed deviation and torque deviation.	When troubleshooting this fault, make sure that the personnel are outside the working range of the robot before enabling any axis motor. 1. First check if a violent collision has occurred, if no collision occurs, check that the load parameters are set correctly, check that the robot matches the model displayed in the controller, and check if there is a serious deviation from the zero point of the robot. 2. If there is no collision and no obvious abnormality, try increasing the servo gain and turning on the servo speed feedforward (which can be turned on through the command to enter the medium precision mode) to see if the alarm still persists. 3. If the collision and controller side factors are excluded, then investigate the servo side factors in order. 1). The UVW phase sequence is incorrect. Connect the U/V/W cables in the correct phase sequence. 2). An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on. Power on the system again. 4. The encoder model is wrong or the encoder is wired improperly. Confirm the motor model, the parameter H00-00, the encoder type, and the encoder wiring are correct. 5. The encoder is wired improperly, aged, or connected loosely. Re-solder, tighten or replace the encoder cable. 6. Improper parameter setting leads to excessive vibration. Set the parameters appropriately to avoid excessive vibration.

Error code	Description	Cause	Solution
			For more information, see "Robot Alarms and Handling Method" in the manual.

Error code	Description	Cause	Solution
0x20D5	Abnormal motion state detected on J5 axis	1. Robot collision; or abnormal current due to serious errors in load parameters, model parameters, and serious deviation of zero point. 2. Servo faults, including: power line UVW phase sequence error, motor angle error, encoder model mismatch, encoder wiring failure, servo gain mismatch, etc. 3. Robot motion speed and acceleration are too large, exceeding the robot's motion capability, resulting in excessive speed deviation and torque deviation.	When troubleshooting this fault, make sure that the personnel are outside the working range of the robot before enabling any axis motor. 1. First check if a violent collision has occurred, if no collision occurs, check that the load parameters are set correctly, check that the robot matches the model displayed in the controller, and check if there is a serious deviation from the zero point of the robot. 2. If there is no collision and no obvious abnormality, try increasing the servo gain and turning on the servo speed feedforward (which can be turned on through the command to enter the medium precision mode) to see if the alarm still persists. 3. If the collision and controller side factors are excluded, then investigate the servo side factors in order. 1). The UVW phase sequence is incorrect. Connect the U/V/W cables in the correct phase sequence. 2). An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on. Power on the system again. 4. The encoder model is wrong or the encoder is wired improperly. Confirm the motor model, the parameter H00-00, the encoder type, and the encoder wiring are correct. 5. The encoder is wired improperly, aged, or connected loosely. Re-solder, tighten or replace the encoder cable. 6. Improper parameter setting leads to excessive vibration. Set the parameters appropriately to avoid excessive vibration.

Error code	Description	Cause	Solution
			For more information, see "Robot Alarms and Handling Method" in the manual.

Error code	Description	Cause	Solution
0x20D6	Abnormal motion state detected on J6 axis	1. Robot collision; or abnormal current due to serious errors in load parameters, model parameters, and serious deviation of zero point. 2. Servo faults, including: power line UVW phase sequence error, motor angle error, encoder model mismatch, encoder wiring failure, servo gain mismatch, etc. 3. Robot motion speed and acceleration are too large, exceeding the robot's motion capability, resulting in excessive speed deviation and torque deviation.	When troubleshooting this fault, make sure that the personnel are outside the working range of the robot before enabling any axis motor. 1. First check if a violent collision has occurred, if no collision occurs, check that the load parameters are set correctly, check that the robot matches the model displayed in the controller, and check if there is a serious deviation from the zero point of the robot. 2. If there is no collision and no obvious abnormality, try increasing the servo gain and turning on the servo speed feedforward (which can be turned on through the command to enter the medium precision mode) to see if the alarm still persists. 3. If the collision and controller side factors are excluded, then investigate the servo side factors in order. 1). The UVW phase sequence is incorrect. Connect the U/V/W cables in the correct phase sequence. 2). An error occurs on the initial phase detection of the motor rotor due to disturbing signals upon power-on. Power on the system again. 4. The encoder model is wrong or the encoder is wired improperly. Confirm the motor model, the parameter H00-00, the encoder type, and the encoder wiring are correct. 5. The encoder is wired improperly, aged, or connected loosely. Re-solder, tighten or replace the encoder cable. 6. Improper parameter setting leads to excessive vibration. Set the parameters appropriately to avoid excessive vibration.

Error code	Description	Cause	Solution
			For more information, see "Robot Alarms and Handling Method" in the manual.
0x20DA	Unsupported feature	Features currently not supported (such as tracking).	Delete related instructions containing unsupported features.
0x20E0	CnvFastCatch instruction preprocessing planning error	No horizontal planning segment exists during CnvFastCatch instruction preprocessing.	Modify the start point of the CnvFastCatch instruction appropriately to ensure the motion of the instruction includes a horizontal segment during movement.
0x20E1	Conveyor index inconsistent	Conveyor index is inconsistent between GetCnvObject instruction and RefSys	Modify conveyor index to be consistent between the GetCnvObject instruction and the RefSys Conveyor and CnvFastCatch instructions.

Error code	Description	Cause	Solution
		Conveyor instruction, or between GetCnvObject instruction and CnvFastCatch instruction.	
0x20E2	Conveyor instruction conflict	RefSys Conveyor instruction and CnvFastCatch instruction are used at the same time.	RefSys Conveyor instruction and CnvFastCatch instruction must be separated by RefSys Base instruction.
0x20E3	Error in tool parameter of conveyor instruction	The tool used in tracking motion instruction is not a gripping tool.	Switch the tool used in tracking motion instruction to a gripping tool.
0x20E4	Error in parameter of workobject frame associated with the active conveyor	The attribute of workobject frame associated with the active conveyor: (1) the workobject is not held; or (2) the user frame is not fixed.	Switch the workobject frame connected with the active conveyor to the workobject frame whose workobject is held and user frame is fixed.
0x20E5	The tracking process does not support the installation of robot on a movable guide rail.	The tracking process does not support the installation of robot on a movable guide rail.	Change the installation mode of the robot to "Robot at fixed position" on the mechanical unit configuration interface.
0x20E6	CnvTrigVis instruction use error	The CnvTrigVis instruction is not allowed for the conveyor whose detection mode is not "vision+instruction".	Change the detection mode of the conveyor to "vision+instruction" or switch to a conveyor with the detection mode of "vision+instruction".
0x20E7	Sensor triggered too frequently	The material is fed too fast, resulting in a sensor triggering cycle of less than 0.6s, which can lead to excessively high photography frequency.	Reduce the trigger frequency of sensor.

Error code	Description	Cause	Solution
0x20E8	The holding time of DO level is too long.	The holding time of the DO level is less than the trigger cycle of sensor, which will cause that the sensor does not trigger to take pictures in time.	Reduce the DO level holding time, or reduce the trigger frequency of sensor.
0x20E9	Vision data sent too many times	After the robot triggers a photo, it receives vision data more than once before the next photo is taken.	Check whether the visual data is sent multiple times or whether the photographing is abnormal, and whether the camera trigger parameter is selected correctly.
0x20EA	CnvFastCatch instruction not supported for non-SCARA robots	The CnvFastCatch instruction does not support robots other than SCARA robots.	Do not use nvFastCatch instruction for non-SCARA robots.
0x20EB	SetCnvVisOTMode use error	The SetCnvVisOTMode instruction is not allowed if the detection mode is not "Vision", "Vision+Sensor", or "Instruction+Vision".	Switch the detection method of the conveyor to "Vision", "Vision+Sensor", or "Instruction+Vision".
0x20EC	The tracking process cannot be enabled when the soft float is enabled.	The soft float function and tracking process function are mutually exclusive.	Turn off the soft float function and then turn on the tracking process.
0x20ED	The encoder resolution should not be zero.	When the virtual conveyor speed is enabled, the encoder resolution should not be set to zero.	Adjust the encoder resolution to a non-zero value, or disable the virtual conveyor speed.
0x20EE	The speed setting is exceeded in the tracking state.	The robot approaches the singular position in the tracking state.	Adjust the lower workspace boundary so that the robot's singularity is not within the workspace of the tracking process.
0x20EF	The acceleration setting is exceeded in the tracking state.	The robot approaches the singular position in the tracking state.	Adjust the lower workspace boundary so that the robot's singularity is not within the workspace of the tracking process.

Error code	Description	Cause	Solution
0x20F1	Jump/JumpL motion is forbidden in ECP frame.	Jump/JumpL motion is forbidden in ECP frame.	Change the frame or change the motion instructions.
0x20F2	Tool frame and wobj frame do not match.	Tool frame and wobj frame do not match.	Change the frame.
0x20F3	External axis motion is forbidden in ECP frame.	External axis motion is forbidden in ECP frame.	Change the frame or change the motion instructions.
0x20F4	Tracking motion is forbidden in ECP frame.	Tracking motion is forbidden in ECP frame.	Change the frame or change the motion instructions.
0x20F5	Abnormal system time fluctuation	Excessive fluctuation of system scheduling time	Export the diagnostic information and contact the manufacturer.
0x20F6	NC thread scheduling time exception	NC thread scheduling time fluctuates too much.	Export the diagnostic information and contact the manufacturer.
0x20F7	NRT thread execution time exception	NRT thread execution timeout	Export the diagnostic information and contact the manufacturer.
0x20F8	Real time task execution time exception	Real time task execution timeout	Export the diagnostic information and contact the manufacturer.
0x20F9	Abnormal system timer feedback	System clock_nanosleep return value exception	Export the diagnostic information and contact the manufacturer.
0x20FA	Rtbus thread execution time exception	Rtbus thread execution timeout	Export the diagnostic information and contact the manufacturer.
0x20FC	Subdivision configuration information verification error	Subdivision configuration information verification error	Export the diagnostic information and contact the manufacturer.
0x20FD	Singularity crossing function fails to reach the taught joint positions	Singularity crossing function fails to reach the taught joint positions	Turn off singularity crossing function or change the target point.
0x20FE	MCU configuration information check error	MCU configuration information check error	Contact the manufacturer.

Error code	Description	Cause	Solution
0x2101	J1 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2102	J1 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2103	J1 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2104	J1 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2105	Excessive tracking error of J1 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2106	J1 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of the J1 axis.
0x2107	Strong current of J1 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2108	J1 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.

Error code	Description	Cause	Solution
0x2109	J1 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x210A	J1 axis average load rate overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x210B	J1 axis acceleration overlimit	When verifying the planned output, it was found that the set joint acceleration was exceeded.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x210C	J1 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x210D	J1 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x210E	J1 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.

Error code	Description	Cause	Solution
0x210F	J1 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2111	J2 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2112	J2 axis negative drive has an alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2113	J2 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2114	J2 axis path planning out of range	The planned value exceeds the maximum calculation range.	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2115	Excessive tracking error of J2 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2116	J2 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J2 axis.
0x2117	Strong current of J2 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2118	J2 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.

Error code	Description	Cause	Solution
0x2119	J2 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x211A	J2 axis average load rate overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x211B	J2 axis acceleration overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x211C	J2 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x211D	J2 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x211E	J2 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.

Error code	Description	Cause	Solution
0x211F	J2 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2121	J1 axis motor/reducer overheat	The motor/reducer temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x2122	J1 axis encoder overheat	The encoder temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x2141	J2 axis motor/reducer overheat	The motor/reducer temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x2142	J2 axis encoder overheat	The encoder temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.

Error code	Description	Cause	Solution
0x2161	J3 axis motor/reducer overheat	The motor/reducer temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x2162	J3 axis encoder overheat	The encoder temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x2181	J4 axis motor/reducer overheat	The motor/reducer temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x2182	J4 axis encoder overheat	The encoder temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.

Error code	Description	Cause	Solution
0x21A1	J5 axis motor/reducer overheat	The motor/reducer temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x21A2	J5 axis encoder overheat	The encoder temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x21C1	J6 axis motor/reducer overheat	The motor/reducer temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x21C2	J6 axis encoder overheat	The encoder temperature is too high, exceeding alarm threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x21E1	Robot enters interference zone 0	Robot enters interference zone 0	Disable the interference zone 0, and move the robot out of interference zone 0.

Error code	Description	Cause	Solution
0x21E2	Robot enters interference zone 1	Robot enters interference zone 1	Disable the interference zone 1, and move the robot out of interference zone 1.
0x21E3	Robot enters interference zone 2	Robot enters interference zone 2	Disable the interference zone 2, and move the robot out of interference zone 2.
0x21E4	Robot enters interference zone 3	Robot enters interference zone 3	Disable the interference zone 3, and move the robot out of interference zone 3.
0x21E5	Robot enters interference zone 4	Robot enters interference zone 4	Disable the interference zone 4, and move the robot out of interference zone 4.
0x21E6	Robot enters interference zone 5	Robot enters interference zone 5	Disable the interference zone 5, and move the robot out of interference zone 5.
0x21E7	Robot enters interference zone 6	Robot enters interference zone 6	Disable the interference zone 6, and move the robot out of interference zone 6.
0x21E8	Robot enters interference zone 7	Robot enters interference zone 7	Disable the interference zone 7, and move the robot out of interference zone 7.
0x21E9	Robot enters interference zone 8	Robot enters interference zone 8	Disable the interference zone 8, and move the robot out of interference zone 8.
0x21EA	Robot enters interference zone 9	Robot enters interference zone 9	Disable the interference zone 9, and move the robot out of interference zone 9.
0x21EB	Robot enters interference zone 10	Robot enters interference zone 10	Disable the interference zone 10, and move the robot out of interference zone 10.
0x21EC	Robot enters interference zone 11	Robot enters interference zone 11	Disable the interference zone 11, and move the robot out of interference zone 11.
0x21ED	Robot enters interference zone 12	Robot enters interference zone 12	Disable the interference zone 12, and move the robot out of interference zone 12.

Error code	Description	Cause	Solution
0x21EE	Robot enters interference zone 13	Robot enters interference zone 13	Disable the interference zone 13, and move the robot out of interference zone 13.
0x21EF	Robot enters interference zone 14	Robot enters interference zone 14	Disable the interference zone 14, and move the robot out of interference zone 14.
0x21F0	Robot enters interference zone 15	Robot enters interference zone 15	Disable the interference zone 15, and move the robot out of interference zone 15.
0x2201	J3 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2202	J3 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2203	J3 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2204	J3 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2205	Excessive tracking error of J3 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2206	J3 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J3 axis.
0x2207	Strong current of J3 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.

Error code	Description	Cause	Solution
0x2208	J3 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2209	J3 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x220A	J3 axis average load rate overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x220B	J3 axis acceleration overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x220C	J3 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x220D	J3 axis arrival timeout		

Error code	Description	Cause	Solution
		The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x220E	J3 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x220F	J3 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2211	J4 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2212	J4 axis negative limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2213	J4 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2214	J4 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2215	Excessive tracking error of J4 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2216	J4 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J4 axis.
0x2217	Strong current of J4 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.

Error code	Description	Cause	Solution
0x2218	J4 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2219	J4 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x221A	J4 axis average load rate overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x221B	J4 axis acceleration overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x221C	J4 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x221D	J4 axis arrival timeout		

Error code	Description	Cause	Solution
		The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x221E	J4 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x221F	J4 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2301	J5 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2302	J5 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2303	J5 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2304	J5 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2305	Excessive tracking error of J5 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2306	J5 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J5 axis.
0x2307	Strong current of J5 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.

Error code	Description	Cause	Solution
0x2308	J5 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2309	J5 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x230A	J5 axis average load rate overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x230B	J5 axis acceleration overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x230C	J5 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x230D	J5 axis arrival timeout		

Error code	Description	Cause	Solution
		The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x230E	J5 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x230F	J5 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2311	J6 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2312	J6 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2313	J6 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2314	J6 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2315	Excessive tracking error of J6 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2316	J6 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J6 axis.
0x2317	Strong current of J6 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.

Error code	Description	Cause	Solution
0x2318	J6 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2319	J6 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x231A	J6 axis average load rate overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x231B	J6 axis acceleration overlimit	The average load rate exceeds the limits of temperature rise and lifespan.	1. In case of CP motion, reduce position speed or increase joint speed appropriately, or adjust the points to move away from singularities. 2. Check if there are any other accompanying alarms in the alarm record.
0x231C	J6 axis enable synchronization error	Excessive tracking error	Check whether there is joint movement during power on.
0x231D	J6 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.

Error code	Description	Cause	Solution
0x231E	J6 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x231F	J6 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2401	J7 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2402	J7 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2403	J7 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2404	J7 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2405	Excessive tracking error of J7 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2406	J7 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J7 axis.
0x2407	Strong current of J7 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2408	J7 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate.

Error code	Description	Cause	Solution
			3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2409	J7 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x240A	J7 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x240B	J7 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x240C	J7 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x240D	J7 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x240E	J7 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.

Error code	Description	Cause	Solution
0x240F	J7 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2411	J8 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2412	J8 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2413	J8 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2414	J8 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2415	Excessive tracking error of J8 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2416	J8 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J8 axis.
0x2417	Strong current of J8 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2418	J8 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.

Error code	Description	Cause	Solution
0x2419	J8 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x241A	J8 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x241B	J8 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x241C	J8 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x241D	J8 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x241E	J8 axis position feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x241F	J8 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2501	J9 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.

Error code	Description	Cause	Solution
0x2502	J9 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2503	J9 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2504	J9 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2505	Excessive tracking error of J9 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2506	J9 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J9 axis.
0x2507	Strong current of J9 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2508	J9 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2509	J9 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Investigate brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add

Error code	Description	Cause	Solution
			delay such as waiting and logical interaction in actual application to the test program and test again.
0x250A	J9 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x250B	J9 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x250C	J9 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x250D	J9 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x250E	J9 axis encoder feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x250F	J9 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2511	J10 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2512	J10 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2513	J10 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.

Error code	Description	Cause	Solution
0x2514	J10 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2515	Excessive tracking error of J10 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2516	J10 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J10 axis.
0x2517	Strong current of J10 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2518	J10 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2519	J10 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Investigate brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.

Error code	Description	Cause	Solution
0x251A	J10 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x251B	J10 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x251C	J10 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x251D	J10 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x251E	J10 axis encoder feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x251F	J10 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2601	J11 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2602	J11 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2603	J11 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2604	J11 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.

Error code	Description	Cause	Solution
0x2605	Excessive tracking error of J11 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2606	J11 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J11 axis.
0x2607	Strong current of J11 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2608	J11 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2609	J11 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Troubleshoot brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x260A	J11 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x260B	J11 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.

Error code	Description	Cause	Solution
0x260C	J11 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x260D	J11 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x260E	J11 axis encoder feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x260F	J11 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2611	J12 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2612	J12 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2613	J12 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2614	J12 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2615	Excessive tracking error of J12 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.

Error code	Description	Cause	Solution
0x2616	J12 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J12 axis.
0x2617	Strong current of J12 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2618	J12 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2619	J12 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Investigate brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x261A	J12 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x261B	J12 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x261C	J12 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x261D	J12 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.

Error code	Description	Cause	Solution
0x261E	J12 axis encoder feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x261F	J12 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2701	J13 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2702	J13 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2703	J13 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2704	J13 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2705	Excessive tracking error of J13 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2706	J13 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J13 axis.
0x2707	Strong current of J13 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2708	J13 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate.

Error code	Description	Cause	Solution
			3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.
0x2709	J13 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Investigate brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x270A	J13 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x270B	J13 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x270C	J13 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x270D	J13 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x270E	J13 axis encoder feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.

Error code	Description	Cause	Solution
0x270F	J13 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2711	J14 axis positive limit alarm	The joint limit position is reached.	Perform negative motion to clear the alarm.
0x2712	J14 axis negative limit alarm	The joint limit position is reached.	Perform positive motion to clear the alarm.
0x2713	J14 axis drive alarm	The drive has an alarm.	Perform troubleshooting by referring to the servo manual according to fault codes.
0x2714	J14 axis path planning out of range	The planned value exceeds the maximum calculation range (-1073741823 to 1073741824).	Check whether the absolute origin position is selected to be near the counting limit. If the zero point is near the limit, clear the drive turns.
0x2715	Excessive tracking error of J14 axis	The difference between the planned and actual positions is too large.	1. View the tracking error threshold. 2. Check for mechanical stuck. 3. Check that the power lines are properly connected. 4. Check that the load matches the servo gain. 5. Consult the troubleshooting guide.
0x2716	J14 axis overspeed alarm	The running speed is greater than the set maximum speed.	Reduce the speed of J14 axis.
0x2717	Strong current of J14 axis not switched on	Strong current is not switched on.	Check the drive circuit for whether strong current is not switched on.
0x2718	J14 axis torque overlimit	The actual maximum current exceeds the limit.	1. Reduce the acceleration parameters appropriately. 2. Check that the load parameter settings are appropriate. 3. If the optimal trajectory is enabled, refer to the modulation guidance of the optimal trajectory.

Error code	Description	Cause	Solution
0x2719	J14 axis average load rate overlimit	When verifying the planned output, it was found that the set joint speed was exceeded.	1. Investigate brake, mechanical jamming, and drive. 2. Reduce the speed or acceleration percentage appropriately. 3. Extend the non-motion time. In the pure motion beat test, the average load rate may exceed the limit, which does not mean that it exceeds the limit in actual application. You can add delay such as waiting and logical interaction in actual application to the test program and test again.
0x271A	J14 axis planned speed error	The planned speed exceeds the limit too much.	Reduce the maximum speed in joint or Cartesian space.
0x271B	J14 axis planned acceleration error	The planned acceleration exceeds the limit too much.	Reduce the maximum acceleration or velocity in joint or Cartesian space.
0x271C	J14 axis enable synchronization error	The robot vibrates before it is enabled, or the robot moves due to external reasons during the enabling process.	Check whether there is joint movement during power on, and whether there is external interference during the enabling process.
0x271D	J14 axis arrival timeout	The servo takes too long to arrive the target position.	Check whether the arrival error threshold is too small or whether the servo gain is not proper.
0x271E	J14 axis encoder feedback error	1. Multi-turn value changes. 2. Encoder position jumps.	Check if the multi turn value has been manually cleared. If not, check for the interference source.
0x271F	J14 axis disable status error	The robot failed to be disabled at the specified time and distance.	1. Check that servo parameter 6084 and brake parameter 0209 are correctly set. 2. Check if the load exceeds the limit.
0x2801	Failed to switch servo drive to speed mode	Failed to switch servo drive to speed mode	Check that the servo drive is normal or contact the manufacturer.

Error code	Description	Cause	Solution
0x2802	Failed to switch servo drive to homing mode	Failed to switch servo drive to homing mode	Check that the servo drive is normal or contact the manufacturer.
0x2803	Failed to switch servo drive to position mode	Failed to switch servo drive to position mode	Check that the servo drive is normal or contact the manufacturer.
0x2804	An inactive independent axis is used in the instruction.	An inactive independent axis is used in the instruction.	Activate the independent axis before using it.
0x2805	When switching to the independent axis mode, the axis is still in motion.	When switching to the independent axis mode, the axis is still in motion.	Switch the axis mode after the axis stops completely.
0x2806	Reference position error for independent axis homing.	Reference position error for independent axis homing.	Check that the reference position for independent axis homing is within the specification.
0x2807	Independent axis mode error	The current version has no independent axis of position mode, but the independent axis mode is switched to the position mode.	Contact the manufacturer.
0x2808	ECP function is not supported when J6 is an active independent axis.	The ECP function is used when J6 is used as an active independent axis.	Switch J6 axis to normal axis before using the ECP function.
0x2809	When J6 is an active independent axis, the tool and flange are not concentric.	When J6 is an active independent axis, the tool and flange are not concentric.	When J6 is an active independent axis, use a tool concentric with the flange.
0x280A	The use of independent axis instructions in dynamic tracking mode is not supported.	The use of independent axis instructions in dynamic tracking mode is not supported.	Do not use independent axis instructions in dynamic tracking mode.
0x280C	Independent axis function cannot be enabled when the soft float function is enabled.	The soft float function and the independent axis function are mutually exclusive.	Disable the soft float function and then enable the independent axis function.

Error code	Description	Cause	Solution
0x280D	Free curve function is not supported when J6 is an active independent axis.	Free curve function is not supported when J6 is an active independent axis.	Switch J6 axis to normal axis before using free curve function.
0x2810	When clearing the multi-turn value of the independent axis joint, it is detected that the controller is in the non-enabled state.	When clearing the multi-turn value of the independent axis joint, it is detected that the controller is in the non-enabled state.	Clear the multi-turn value of independent axis joint when the controller is in the enabled state.
0x2811	The pulse at the robot's motion point is too large in the position mode.	The pulse at the robot's motion point is too large in the position mode.	Check if the joint angles at the starting and ending points are too large. If so, clear the multi-turn value of joint and then get new points.
0x2812	When taking the current point as zero point of the external axis, the current pulse is too large.	When taking the current point as zero point of the external axis, the current pulse is too large.	Set H0536 to 0 through the backend of the external axis servo, then set H0530 to 6, and then get the zero point of the external axis.
0x2813	When taking the current point as the robot zero point, it was detected that the robot axis pulse was too large.	When taking the current point as the robot zero point, it was detected that the robot axis pulse was too large.	Set H0D20 of the axis with excessive pulse to 2 through the servo backend, restart the controller, and then take the current point as the robot zero point.
0x2814	Robot entered non-movement areas	Robot entered non-movement areas	Move the robot out of the area where movement is prohibited.
0x2816	Failed to switch servo drive to torque mode	Failed to switch servo drive to torque mode	Check that the servo drive is normal or contact the manufacturer.
0x2815	Safety mode triggers Category 1 emergency stop	The safety module detected an abnormal behavior.	Disable safety module monitoring and clear the alarm.
0x281A	The speed exceeds 250mm/s in manual low speed mode.	Speed planning error	Save error information and contact the manufacturer.
0x281B	The conveyor speed is too high in manual low speed mode.	The conveyor speed exceeds 240mm/s in manual mode.	Reduce conveyor speed.

Error code	Description	Cause	Solution
0x281C	Manual low speed mode: CnvFastCatch instruction planning error	The conveyor speed is too high or the motion of the CnvFastCatch command is too short in manual low speed mode, causing an exception in the planning of the compensation segment in the instruction.	Reduce the conveyor speed, or add the motion distance of the CnvFastCatch instruction.
0x281D	Conveyor tracking action speed exceeded 250 mm/s in manual low speed mode	The conveyor speed is too high in manual mode.	Reduce the conveyor speed.
0x2820	Robot enters interference zone 0	Robot enters interference zone 0	Disable the interference zone 0, and move the robot out of interference zone 0.
0x2821	Robot enters interference zone 1	Robot enters interference zone 1	Disable the interference zone 1, and move the robot out of interference zone 1.
0x2822	Robot enters interference zone 2	Robot enters interference zone 2	Disable the interference zone 2, and move the robot out of interference zone 2.
0x2823	Robot enters interference zone 3	Robot enters interference zone 3	Disable the interference zone 3, and move the robot out of interference zone 3.
0x2824	Robot enters interference zone 4	Robot enters interference zone 4	Disable the interference zone 4, and move the robot out of interference zone 4.
0x2825	Robot enters interference zone 5	Robot enters interference zone 5	Disable the interference zone 5, and move the robot out of interference zone 5.
0x2826	Robot enters interference zone 6	Robot enters interference zone 6	Disable the interference zone 6, and move the robot out of interference zone 6.
0x2827	Robot enters interference zone 7	Robot enters interference zone 7	Disable the interference zone 7, and move the robot out of interference zone 7.

Error code	Description	Cause	Solution
0x2828	Robot enters interference zone 8	Robot enters interference zone 8	Disable the interference zone 8, and move the robot out of interference zone 8.
0x2829	Robot enters interference zone 9	Robot enters interference zone 9	Disable the interference zone 9, and move the robot out of interference zone 9.
0x282A	Robot enters interference zone 10	Robot enters interference zone 10	Disable the interference zone 10, and move the robot out of interference zone 10.
0x282B	Robot enters interference zone 11	Robot enters interference zone 11	Disable the interference zone 11, and move the robot out of interference zone 11.
0x282C	Robot enters interference zone 12	Robot enters interference zone 12	Disable the interference zone 12, and move the robot out of interference zone 12.
0x282D	Robot enters interference zone 13	Robot enters interference zone 13	Disable the interference zone 13, and move the robot out of interference zone 13.
0x282E	Robot enters interference zone 14	Robot enters interference zone 14	Disable the interference zone 14, and move the robot out of interference zone 14.
0x282F	Robot enters interference zone 15	Robot enters interference zone 15	Disable the interference zone 15, and move the robot out of interference zone 15.
0x2901	Invalid curve starting point	The current point is too far from the starting point in the curve instruction.	Move the robotic arm to the starting point first.
0x2902	Curve data transmission error	Internal error	Contact the manufacturer.
0x2903	Insufficient curve data space	DSP curve data storage failed for internal reason.	Save error information and contact the manufacturer.
0x2904	Insufficient queue space for speed constraints	Insufficient queue space in DSP for speed constraints.	Contact the manufacturer.

Error code	Description	Cause	Solution
0x2905	Invalid curve starting point due to too small angle	Current point of the robot cannot be the starting point of the curve instruction.	Move the robotic arm to the starting point first.
0x2906	Invalid curve starting point due to conflicting arm type	Current point of the robot cannot be the starting point of the curve instruction.	Move the robotic arm to the starting point first.
0x2907	External axis movement not allowed during free curve execution	The external axis movement is not allowed during free curve execution.	The external axis movement is not allowed during free curve execution.
0x2908	Curve trajectory deviation exceeds tolerance	Local curve distortion causes deviation.	Adjust local path point constraints to make pose changes as uniform as possible, avoiding concentrated pose changes.
0x2A01	Soft float at singular position	The position compensated by Cartesian soft float is in the singular position.	Avoid enabling Cartesian soft float near singular position.
0x2A02	Soft float Cartesian compensation position exceeded limit	The driving distance of the robot is too large.	Increase the value of Cartesian compensation position variable or reduce the distance of soft float Cartesian motion of robot.
0x2A03	Soft float Cartesian compensation speed exceeded limit	The robot motion speed is too large.	Reduce the speed at which the robot is pushed in the Cartesian direction.
0x2A04	Soft float Cartesian compensation acceleration exceeded limit	The robot motion acceleration is too large.	Reduce the acceleration at which the robot is pushed in the Cartesian direction.
0x2A05	Soft float joint compensation angle exceeded limit	The motion angle of robot joint is too large.	Reduce the motion angle of robot joint.
0x2A06	Soft float joint compensation angular speed exceeded limit	The angular speed at which the robot is pushed is too large.	Reduce the angular speed of the robot.
0x2A07	Soft float joint compensation angular acceleration exceeded limit	The angular acceleration at which the robot is pushed is too large.	Reduce the angular acceleration of the robot.

Error code	Description	Cause	Solution
0x2A08	Soft float joint pulse compensation value exceeded limit	The motion angle of the robot joint is too large, resulting in excessive compensation pulse.	Reduce the motion angle of robot joint.
0x2A09	Soft float joint pulse compensation speed exceeded limit	The angular speed of the robot is too large, resulting in excessive compensation pulse speed.	Reduce the angular speed of the robot.
0x2A0A	Soft float joint pulse compensation acceleration exceeded limit	The angular acceleration of the robot is too large, resulting in excessive compensation pulse angular speed.	Reduce the angular acceleration of the robot.
0x2A0B	Soft float state machine error	Soft float status was incorrectly set.	Reset the soft float function.
0x2A0C	Soft float stop joint compensation angle exceeded limit	The joint angle of the robot is too large when the robot stops.	Restart the soft float function.
0x2A0D	Soft float stop joint compensation angular speed exceeded limit	The joint angular speed of the robot is too large when the robot stops.	Restart the soft float function.
0x2A0E	Soft float stop joint compensation angular acceleration exceeded limit	The joint angular acceleration of the robot is too large when the robot stops.	Restart the soft float function.
0x2A11	Error transmitting soft float enable channel parameters	Error transmitting soft float enable channel parameters	Retransmit soft float enable channel parameters.
0x2A12	Error transmitting soft float disable channel parameters	Error transmitting soft float disable channel parameters	Retransmit soft float disable channel parameter.
0x2A13	Error transmitting soft float track channel parameters	Error transmitting soft float track channel parameters	Retransmit soft float track channel parameters.

Error code	Description	Cause	Solution
0x2A14	Error transmitting channel 1 parameters on the soft float interface	Error transmitting channel 1 parameters on the soft float interface	Retransmit channel 1 parameters on the soft float interface.
0x2A15	Error transmitting channel 2 parameters on the soft float interface	Error transmitting channel 2 parameters on the soft float interface	Retransmit channel 2 parameters on the soft float interface.
0x2A16	Error transmitting soft float Cartesian configuration channel parameters	Error transmitting soft float Cartesian configuration channel parameters	Retransmit soft float Cartesian configuration channel parameters.
0x2A17	Error transmitting soft float joint configuration channel parameters	Error transmitting soft float joint configuration channel parameters	Retransmit soft float joint configuration channel parameters.
0x2A18	Error transmitting soft float blocked channel parameters	Error transmitting soft float blocked channel parameters	Retransmit soft float blocked channel parameters.
0x2A19	Error transmitting soft float blocked channel parameters of whether soft float is complete.	Error transmitting soft float blocked channel parameters of whether soft float is complete.	Switch on and off the soft float-related instructions again.
0x2A1A	Soft float stop joint pulse compensation value exceeded limit	The joint pulse is too large when the robot stops.	Restart the soft float function.
0x2A1B	Soft float stop joint pulse compensation speed exceeded limit	The joint pulse speed is too large when the robot stops.	Restart the soft float function.
0x2A1C	Soft float stop joint pulse compensation acceleration exceeded limit	The joint pulse acceleration is too large when the robot stops.	Restart the soft float function.
0x2A1D	The soft float function cannot be enabled when the tracking process is enabled.	The soft float function and tracking process function are mutually exclusive.	Disable the tracking process and then enable the soft float function.

Error code	Description	Cause	Solution
0x2A1E	The soft float function and the independent axis function are mutually exclusive.	The independent axis function is enabled.	Disable the independent axis function and then enable the soft float function.
0x2A1F	The Soft float function cannot be enabled when the optimal trajectory function is enabled.	The soft float function and the optimal trajectory function are mutually exclusive.	Disable the optimal trajectory function and then enable the optimal trajectory function.
0x2A21	The optimal trajectory function cannot be enabled when the soft float function is enabled.	The soft float function and the optimal trajectory function are mutually exclusive.	Disable the soft float function and then enable the optimal trajectory function.
0x2A22	Soft float Jacobian inverse solution error	Soft float Jacobian inverse solution error	Restart the program.
0x2A23	Reference tool number changed after the soft float function is enabled.	After the soft float function is enabled, the tool number cannot be changed.	Do not change the tool number after the soft float function is enabled.
0x2A24	Reference wobj number changed after the soft float function is enabled.	After the soft float function is enabled, the wobj number cannot be changed.	Do not change the wobj number after the soft float function is enabled.
0x2A25	The robot does not move before the soft float function is enabled.	The robot does not move before the soft float function is enabled.	Move the robot before enabling the soft float function.
0x2A26	When the soft float function is enabled, the actual position of the robot exceeds the limit value of the joint.	When the soft float function is enabled, the actual position of the robot exceeds the limit value of the joint.	Jog the robot out of the joint limit position in the teaching mode.
0x2A27	Soft float function not supported by ceiling-mounted robots	Soft float function not supported by ceiling-mounted robots	Enable the soft float function after turning off the ceiling-mount settings.
0x2A28	The use of guide rails and external axes of the positioner is not allowed in manual mode.	The use of guide rails and external axes of the positioner is not allowed in manual mode.	The use of guide rails and external axes of the positioner is not allowed in manual mode.

Error code	Description	Cause	Solution
0x2A29	Soft float heartbeat function false alarm, causing soft float to close	A false alarm for soft float heartbeat function is triggered, causing soft float to close.	Contact the manufacturer.
0x2B01	Emergency stop signal transmission error	The emergency stop signal check result is incorrect.	If this occurs frequently, contact the manufacturer.
0x2B02	Robot stop planning calculation error	The robot stop planning calculation is incorrect.	Contact the manufacturer.
0x2B03	Stop signal transmission error	The stop signal check result is incorrect.	If this occurs frequently, contact the manufacturer.
0x2B04	Collision signal transmission error	The collision signal check result is incorrect.	If this occurs frequently, contact the manufacturer.
0x2B06	Unintended motion after arriving at stop position of original trajectory	Unintended motion after arriving at stop position of original trajectory	If this occurs frequently, contact the manufacturer.
0x2B07	Planning calculation timeout triggering joint stop	Planning calculation timeout triggering joint stop	If this occurs frequently, contact the manufacturer.
0x2B08	Incorrect motion instruction count received in cache	The number of motion instructions received in cache is incorrect.	Contact the manufacturer.
0x2BB0	Mechanical lock switching not allowed due to active independent axis	The mechanical lock switching is not allowed because an active independent axis is detected.	Switch the active independent axis to normal axis before switching the mechanical lock.
0x2BB1	Axis lock mode error: Axle is enabled.	Axis lock mode error: Axle is enabled.	Ensure that the axis is not enabled and try again.
0x2BB2	Failed to lock axis	Internal error	Contact the manufacturer.
0x2C01	One-drive-many vision function parameter error	One-drive-many vision function parameter error	Contact the manufacturer.

Error code	Description	Cause	Solution
0x2C02	One-drive-many vision primary cache full	One-drive-many vision primary cache full	Contact the manufacturer.
0x2C03	Slave encoder value abnormal in one-drive-many vision	Slave encoder value abnormal in one-drive-many vision	Check whether the EtherCAT connection is correct, ensure to clear the master EtherCAT alarm first, then clear the slave alarm
0x2C11	6-axis zero point calibration: collision detection threshold below 100	6-axis zero point calibration: collision detection threshold below 100	Adjust the collision detection threshold to 100 or above.
0x2C12	6-axis zero point calibration: torque sensor value limit exceeded	6-axis zero point calibration: torque sensor value limit exceeded	Check the torque sensor condition to see whether it is under normal force.
0x3000	Multiple fieldbuses active simultaneously	Multiple fieldbuses active simultaneously	Keep only one fieldbus active.
0x3001	EtherNet/IP connection actively disconnected by one party.	EtherNet/IP client or server actively disconnected.	Re-initiate the EtherNet/IP connection.
0x3002	EtherNet/IP disconnected due to network timeout	Network communication on EtherNet/IP connection does not work.	Check whether the network cable is properly plugged in or has poor contact.
0x3003	EtherCAT disconnected from master	Loose EtherCAT cable connection, EtherCAT master failure, or robot system failure.	Check whether the network cable is plugged in properly or has poor contact, check the EtherCAT master, or contact the manufacturer.
0x3004	Modbus TCP disconnected due to network timeout	Network communication on Modbus TCP connection does not work.	Check whether the network cable is properly plugged in or has poor contact.

Error code	Description	Cause	Solution
0x3005	PROFINET expansion card missing	The activated PROFINET expansion card has lost communication with the controller.	Check in the following order: 1. Check that the PROFINET expansion card is securely connected to the card slot. 2. Check that the NS indicator light on the front panel of the PROFINET expansion card is solid green or flashing green. 3. Check that the PROFINET expansion card can be activated after the controller is powered on again. If the problem persists, replace the PROFINET expansion card.
0x3032	EtherCAT (fieldbus) communication synchronization failed	The synchronization signal is not generated due to hardware errors.	Contact the manufacturer.
0x3033	EtherCAT (fieldbus) communication IRQ loss exceeds the limit.	1. The data frame has been lost or discarded at an upstream station. 2. The performance of the host station is poor, the jitter of the IRQ exceeds the set value (H0E-22) * communication cycle.	1. Check the CPU usage of the master. 2. Reduce the communication time. 3. Check whether link loss occurs on the upstream slave.
0x3034	EtherCAT (fieldbus) EEPROM loading error	During program start-up, the first 8 bytes of data in the EEPROM were wrong, causing EtherCAT slave to fail to start.	Contact the manufacturer to re-burn the XML file.
0x3035	EtherCAT (fieldbus) initialization error.	EtherCAT (fieldbus) initialization error.	Hardware failure, please contact the manufacturer.
0x3036	EtherCAT (fieldbus) state switching error	Bad state switching due to incorrect operation of the master or human error.	Contact the manufacturer.

Error code	Description	Cause	Solution
0x3037	DC not enabled for EtherCAT slave	In DC mode, there is no synchronization signal causing abnormal movement due to master fault or improper master operation.	Contact the manufacturer.
0x3038	EtherCAT (fieldbus) PDO overlimit	EtherCAT (fieldbus) PDO overlimit	Check whether the number of PDOs configured for the master exceeds the limit.
0x3039	EtherCAT (fieldbus) link missing	The physical connection of the data link is unstable or the process data is lost due to plug-in/plug-out of the network cable.	Check whether the network cable is connected properly and whether the application site suffers from strong vibration.
0x303A	The EtherCAT (fieldbus) connection has link interference	The data is lost due to EMC interference, poor quality of the network cable, or improper connection.	Check whether proper grounding is performed and rectify EMC measures. Check whether the network cable used is provided by Inovance and whether the network cable is reliable.
0x303B	EtherCAT (fieldbus) data forward error	The upstream station detects that the data frame has been corrupted, leading to a data transfer error.	Check the upstream station to locate the fault cause.
0x303C	EtherCAT (fieldbus) received no data	1. The data frame has been lost or discarded at an upstream station. 2. The performance of the host station is poor, the jitter of the IRQ exceeds the set value (H0E-22) * communication cycle.	1. Check the CPU usage of the master. 2. Reduce the communication time. 3. Check whether link loss occurs on the upstream slave.
0x303D	EtherCAT (fieldbus) mailbox configuration error (preop)	1. The master station is configured improperly. 2. The slave XML file is incorrect.	1. Check the master eni file. 2. Check the slave xml file.

Error code	Description	Cause	Solution
0x303E	EtherCAT (fieldbus) SM2 configuration error	1. The master station is configured improperly. 2. The slave XML file is incorrect.	1. Check the master eni file. 2. Check the slave xml file.
0x303F	EtherCAT (fieldbus) SM3 configuration error	1. The master station is configured improperly. 2. The slave XML file is incorrect.	1. Check the master eni file. 2. Check the slave xml file.
0x3040	Illegal MAC address of PROFINET expansion card	The MAC address of the PN expansion card was not burned, or an illegal MAC address was detected.	Burn a unique MAC address for the PN expansion card.
0x3041	PROFINET expansion card has no network connection.	PROFINET expansion card is not connected to the master.	Check the cable between the PROFINET expansion card and the master.
0x3042	Wrong configuration parameters of PROFINET expansion card	Configuration parameters of PROFINET expansion card are not correctly set.	Check the configuration parameters of the PROFINET expansion card.
0x3043	PROFINET expansion card disconnected from master	PROFINET expansion card is disconnected from master.	Check the cable between the PROFINET expansion card and the master.
0x3044	PROFINET expansion card chip not detected	PROFINET expansion card chip not detected	Reinstall the PROFINET expansion card or restart the controller.
0x3045	Master shutdown indicated in PROFINET expansion card	It is detected that the IOPS state in the PNIO data frame is bad, indicating that the data frame is invalid and the master is stopped.	Check if the PROFINET master is in the STOP state, and if it is in the STOP state, switch it to the RUN state.
0x3046	PROFINET expansion card name does not exist.	Device name of the PROFINET expansion card was not detected.	Assign a device name to the PROFINET expansion cards through configuration software.

Error code	Description	Cause	Solution
0x3047	PDO length of the PROFINET expansion card is inconsistent with the configuration.	Inobus data frame length verification error.	Check that the set length of the data area of the Inobus standard frame matches the actual length.
0x3048	PROFINET expansion card Inobus CRC error	Inobus CRC error	Eliminate Inobus link interference.
0x3049	The master and slave data of the PROFINET expansion card are inconsistent in length.	The length of the PN bus data configured on the host controller of the robot is inconsistent with the data length configured on the PLC.	Modify the bus communication data length at the robot or PLC end to ensure consistency between the two ends.
0x3050	EtherCAT (fieldbus) watchdog configuration error	The master station is configured improperly.	Contact the manufacturer.
0x3051	EtherCAT (fieldbus) sync signal lost	1. The DC start time in register 0x990 and the DC active time in register 0x981 configured in the master are less than the local system time of the slave. 2. The DC startup time in the 0x990 register and the DC active time in the 0x981 register of the master settings are too large, exceeding the local system time of the slave by 17.2s; 3. The sync signal pulse width in the 0x982 register is 0.	Contact the manufacturer.
0x3052	EtherCAT (fieldbus) PHY initialization configuration failed	1. The ESC is not working properly before reading the PHY ID 2. The PHY chip is damaged. 3. The data is disturbed. 4. The model configured is different from the	Replace the servo drive. Contact Inovance for maintenance.

Error code	Description	Cause	Solution
		actual model of the PHY.	
0x3053	EEPROM sync signal pulse width length abnormal	1. The master committed an incorrect operation while writing EEPROM configuration data. 2. The ESI file is abnormal.	Reset the ESI file using a parameter or re-program the ESI file.
0x3100	Fail to save configuration file	The system is busy or there is a problem with the file system.	1. Try to save again. 2. Contact the manufacturer.
0x3101	Fail to Load the DSP0 Firmware	DSP0 firmware error or startup abnormality	1. Restart the robot. 2. Contact the manufacturer.
0x3102	Fail to Load the EtherCAT slave Xml File	Xml file error or startup exception	1. Restart the robot. 2. Contact the manufacturer.
0x3110	CANopen: CANopen slave offline	The CANopen slave is in offline status.	1. Check the CAN network connection. 2. Check and eliminate CAN network interference.
0x3111	CANopen: Unknown status of CANopen slave	The CANopen master status is abnormal.	1. Restart the robot. 2. Contact the manufacturer.
0x3112	CANopen: Unknown configuration error	The JSON file error or parsing exception occurs.	1. Restart the robot. 2. Contact the manufacturer.
0x3113	CANopen: Configuration file missing	JSON file is missing, or the path is incorrect.	1. Restart the robot. 2. Contact the manufacturer.
0x3114	CANopen: Invalid configuration file	JSON file is invalid or incorrect.	1. Update the configuration file. 2. Contact the manufacturer.
0x3115	CANopen: Empty slave list in the configuration file	CANopen configuration has no	Update the configuration file.

Error code	Description	Cause	Solution
		slave or configuration failed.	
0x3116	CANopen: Empty SDO configuration in the configuration file	JSON file generation failed or error	Update the configuration file.
0x3117	CANopen: Empty PDO mapping configuration in the configuration file	JSON file generation failed or error	Update the configuration file.
0x3118	CANopen: Memory initialization failed	The memory usage or operational load of the robot is too high.	1. Reduce memory usage or operational load. 2. Contact the manufacturer.
0x3119	CANopen: Protocol stack initialization failed	JSON file error or protocol stack operation failed	1. Update the configuration file. 2. Restart the robot.
0x311A	CANopen: Synchronization configuration error	The CANopen master is abnormal.	1. Restart the robot. 2. Contact the manufacturer.
0x311B	CANopen: Heartbeat producer initialization error	The CANopen master is abnormal.	1. Restart the robot. 2. Contact the manufacturer.
0x311C	CANopen: SDO initialization error	The CANopen master is abnormal.	1. Restart the robot. 2. Contact the manufacturer.
0x311D	CANopen: Heartbeat consumer initialization error	The CANopen master is abnormal.	1. Restart the robot. 2. Contact the manufacturer.
0x311E	CANopen: Online SDO error	Online SDO client generation or transmission failed	1. Check the CAN network connection. 2. Restart the robot.
0x311F	CANopen: SDO configuration error in initializing slave	Failed to write CANopen slave configuration information.	1. Check the CAN network connection. 2. Update the configuration file. 3. Restart the robot.
0x3120	CANopen: SDO busy	Online SDO client is currently unavailable.	Retry later.
0x3121	CANopen: SDO internal error	Unknown	Unknown

Error code	Description	Cause	Solution
0x3122	CANopen: Emergency message	An emergency message is received from CANopen slave.	1. Check for anomalies in the slave operational state. 2. Check and eliminate CAN network interference.
0x3123	CANopen: Error setting INITIALIZATION status	Unknown	Unknown
0x3124	CANopen: Error setting PRE_OPERATIONAL status	Unknown	Unknown
0x3125	CANopen: Error setting OPERATIONAL status	Unknown	Unknown
0x3126	CANopen: Error setting STOPPED status	Unknown	Unknown
0x3127	CANopen: NMT RESET execution error	NMT reset frame transmission failed.	1. Check the CAN network connection. 2. Check and eliminate CAN network interference. 3. Restart the robot.
0x3128	CANopen: NMT START execution error	NMT start frame transmission failed.	Unknown
0x3129	CANopen: NMT STOP execution error	Unknown	Unknown
0x313A	CANopen: Error switching to PRE_OPERATIONAL status	A CANopen master status switchover error occurs.	1. Restart the robot. 2. Contact the manufacturer.
0x313B	CANopen: Error setting OPERATIONAL status	Failed to reconnect slave.	1. Check the CAN network connection. 2. Check and eliminate CAN network interference. 3. Restart the robot.
0x3200	DeviceNet: Master initialization failed	Master initialization failed.	1. Check whether the CAN interface is properly enabled. 2. Check for duplicated MAC ID.
0x3201	DeviceNet: Master MAC ID duplicated	There is other device in the network with a conflicting MAC ID to the master.	Change the MAC ID of the conflicting device in the network or change the MAC ID of the master.

Error code	Description	Cause	Solution
0x3202	DeviceNet: Master CAN drive initialization failed	CAN drive initialization failed.	Check whether the CAN drive is normal.
0x3203	DeviceNet: Master CAN read failure	CAN drive read failed.	Check whether the CAN interface is properly enabled.
0x3204	DeviceNet: Master CAN write failure	CAN drive write failed.	Check whether the CAN interface is properly enabled.
0x3205	DeviceNet: Slave MAC ID occupied	The MAC ID set for the slave is already occupied.	Change the slave MAC ID to an unused one.
0x3206	DeviceNet: MAC ID unavailable	The set MAC ID exceeds limit.	Change to a valid MAC ID.
0x3207	DeviceNet: Slave input I/O data space allocation error	Protocol stack space allocation error	Troubleshoot the space allocation module.
0x3208	DeviceNet: Slave configured input I/O data too long	The input I/O data configured for slave is too long.	Reconfigure the input I/O data to a reasonable length.
0x3209	DeviceNet: Slave output I/O data allocation space error	Protocol stack space allocation error	Troubleshoot the space allocation module.
0x320A	DeviceNet: Slave configured output I/O data too long	The output I/O data configured for slave is too long.	Reconfigure the output I/O data to a reasonable length.
0x320B	DeviceNet: Slave configured MAC ID conflicts with master MAC ID	The MAC ID in slave settings conflicts with the master MAC ID.	Reconfigure the MAC ID of the slave.
0x320C	DeviceNet: Master transmit data pointer null	The master transmit data pointer is null.	Troubleshoot the data transmit module.
0x320D	DeviceNet: MAC ID unavailable	The set MAC ID exceeds limit.	Reconfigure a valid MAC ID.
0x320E	DeviceNet: Error in setting scan range for slave MAC ID	Error in setting the MAC ID for scanning slaves	Reconfigure the MAC ID range for scanning slaves.
0x320F	DeviceNet: Node error mask not cleared before scanning slaves	Node error mask not cleared before scanning slaves	Check the slave scanning module.

Error code	Description	Cause	Solution
0x3210	DeviceNet: An explicit message is currently being processed	An explicit message is currently in transmission.	Resend pending explicit message later.
0x3211	DeviceNet: Slave inactive. Cannot send explicit message.	The explicit message is sent while slave is not active.	Troubleshoot the slave active status.
0x3212	DeviceNet: Master already in slave scan status	Master executed slave scan action again while scanning slaves.	Abort the current pending slave scanning action and wait for the completion of the ongoing slave scanning.
0x3213	DeviceNet: Slave offline	The slave is offline.	Check the slave status and physical connection reliability.
0x3214	DeviceNet: Slave I/O connection timeout	The slave I/O connection timed out.	Check the slave status and physical connection reliability.
0x3215	DeviceNet: Slave configured output I/O data length mismatch with actual length	The configured length of the slave output data does not match the actual length.	Reconfigure the length of the slave output I/O data.
0x3216	DeviceNet: Slave configured input I/O data length mismatch with actual length	The configured length of the slave input data does not match the actual length.	Reconfigure the length of the slave input I/O data.
0x3217	DeviceNet: Slave configured vendor ID mismatch with actual value	The configured vendor ID of the slave does not match the actual value.	Configure the vendor ID of the slave to the actual value.
0x3218	DeviceNet: Configured slave type mismatch with actual value	The configured type of the slave does not match the actual value.	Configure the type of the slave to the actual value.
0x3219	DeviceNet: Slave configured product code mismatch actual value	The configured product code of the slave does not match the actual value.	Configure the product code of the slave to the actual value.
0x321A	DeviceNet: Slave CCV configuration value mismatch with actual value	The configured CCV of the slave does not match the actual value.	Configure the CCV of the slave to the actual value.

Error code	Description	Cause	Solution
0x321B	DeviceNet: Slave I/O data volume too large	The slave I/O data volume is too large.	Check the configuration of the slave I/O data length.
0x321C	DeviceNet: Configuration parameter parsing failed	The configuration file format is incorrect.	Import a correctly formatted configuration file.
0x3300	Failed to start EtherCAT module data interaction thread	Failed to start EtherCAT module data interaction thread	Reboot after resolving the error for recovery.
0x3301	Configured number of EtherCAT analog module ADs out of range	The configured number of EtherCAT analog module ADs is out of range.	Check the configured number of ADs.
0x3302	Configured number of EtherCAT analog module DAs out of range	The configured number of EtherCAT analog module DAs is out of range.	Check the configured number of DAs.
0x3303	EtherCAT master station configuration completed. Please reboot.	EtherCAT master station configuration completed. Please reboot.	Restart the controller.
0x3304	EtherCAT master configuration file parsing failed	EtherCAT master configuration file parsing failed	Try to reconfigure.
0x3305	GL20_RTU_ECT slave status error	GL20_RTU_ECT slave status error	Check whether the corresponding slave is faulty.
0x3306	EtherCAT I/O slave status error	EtherCAT I/O slave status error	Check whether the corresponding slave is faulty.
0x3307	EtherCAT AD slave status error	EtherCAT AD slave status error	Check whether the channel input value exceeds limit or the channel is disconnected.
0x3308	EtherCAT DA slave status error	EtherCAT DA slave status error	Check whether the wiring is incorrect or the external device impedance is too high.
0x3309	Excessive input-type PDOs configured in EtherCAT master	Excessive input-type PDOs configured in EtherCAT master	Check the number of PDOs on the slave, and configure fewer.
0x330A	Excessive output-type PDOs configured in EtherCAT master		Check the number of PDOs on the slave, and configure fewer.

Error code	Description	Cause	Solution
		Excessive output-type PDOs configured in EtherCAT master	
0x3311	EtherNet/IP transfer type or trigger method not supported	EtherNet/IP transfer type or trigger method not supported	Check transfer type and trigger method.
0x3312	EtherNet/IP connection ownership conflict - duplicate connection to target device	EtherNet/IP connection ownership conflict - duplicate connection to target device	Ensure the target device is not connected by other masters.
0x3313	EtherNet/IP connection size invalid	EtherNet/IP connection size invalid	Ensure the connection size is valid.
0x3314	EtherNet/IP device not configured. Configuration data not set for the device requiring configuration.	EtherNet/IP device not configured. Configuration data not set for the device requiring configuration.	Configure the EtherNet/IP correctly.
0x3315	Unsupported RPI of EtherNet/IP or issues with timeout multiplier coefficient and inhibit time	Unsupported RPI of EtherNet/IP or issues with timeout multiplier coefficient and inhibit time	Check whether the RPI and timeout multiplier coefficient and inhibit time are valid.
0x3316	EtherNet/IP RPI not accepted	EtherNet/IP RPI not accepted	Check whether the RPI is valid.
0x3317	EtherNet/IP local connection is full, the connection manager cannot support more connections	EtherNet/IP local connection is full, the connection manager cannot support more connections	Delete unnecessary connections.
0x3318	EtherNet/IP Vendor ID or Product Code mismatch with device	EtherNet/IP Vendor ID or Product Code mismatch with device	Check whether the Vendor ID or Product Code of EtherNet/IP matches the device.
0x3319	EtherNet/IP product type mismatch with device	EtherNet/IP product type mismatch with device	Check whether the EtherNet/IP product type matches the device.
0x331A		EtherNet/IP primary or secondary version	

Error code	Description	Cause	Solution
	EtherNet/IP primary or secondary version number mismatch with device	number mismatch with device	Check whether the EtherNet/IP primary or secondary version number matches the device.
0x331B	EtherNet/IP connection request failed due to no enabled connection	EtherNet/IP connection request failed due to no enabled connection	Check the connection configuration.
0x331C	EtherNet/IP target application cannot support more connections	EtherNet/IP target application cannot support more connections	Delete unnecessary connections.
0x331D	EtherNet/IP RPI less than inhibit time	The RPI of EtherNet/IP is less than the inhibit time.	Ensure the RPI is greater than or equal to the inhibit time.
0x331E	EtherNet/IP connection timeout	EtherNet/IP connection timeout	Redownload the configuration.
0x331F	Invalid segment path or segment value in EtherNet/IP path	Invalid segment path or segment value in EtherNet/IP path	Check the connection path.
0x3320	EtherNet/IP supplier-specific error	EtherNet/IP supplier-specific error	Contact the supplier.
0x3321	Unsupported transfer type in EtherNet/IP transfer type/trigger method parameters	Unsupported transfer type in EtherNet/IP transfer type/trigger method parameters	Check the transfer type.
0x3322	Unsupported trigger method in EtherNet/IP transfer type/trigger method parameters	Unsupported trigger method in EtherNet/IP transfer type/trigger method parameters	Check the trigger method.
0x3323	Unsupported request direction in EtherNet/IP transfer type/trigger method parameters	Unsupported request direction in EtherNet /IP transfer type/ trigger method parameters	Check the request direction in transfer type/trigger method parameters.
0x3324	EtherNet/IP O->T fixed/variable flag not supported	The EtherNet/IP O>T fixed/variable flag is not supported.	Check the O>T fixed/variable flag.

Error code	Description	Cause	Solution
0x3325	EtherNet/IP T->O fixed/variable flag not supported	The EtherNet/IP T>O fixed/variable flag is not supported.	Check the T>O fixed/variable flag.
0x3326	EtherNet/IP O->T priority not supported	The EtherNet/IP O>T priority is not supported.	Re-check the O>T priority.
0x3327	EtherNet/IP T->O priority not supported	The EtherNet/IP T>O priority is not supported.	Re-check the T>O priority.
0x3328	EtherNet/IP O->T connection type not supported	The EtherNet/IP O>T connection type is not supported.	Reconfigure the O>T connection type.
0x3329	EtherNet/IP T->O connection type not supported	The EtherNet/IP T>O connection type is not supported.	Reconfigure the T>O connection type.
0x332A	Invalid data area length	The data segment provided in the EtherNet/IP connection path parameters does not contain the requested configuration of required 16-bit word count for the application path.	Check the connection configuration.
0x332B	Unsupported size requested in EtherNet/IP O->T network connection parameters	The size requested in the O>T network connection parameters is not supported.	Reconfigure the size requested in the O>T network connection parameters.
0x332C	Unsupported size requested in EtherNet/IP T->O network connection parameters	Unsupported size requested in EtherNet/IP T>O network connection parameters	Reconfigure the size requested in the T>O network connection parameters.
0x332D	EtherNet/IP specified configuration application path mismatch with valid path	The EtherNet/IP specified configuration application path does not match the valid configuration application path.	Reconfigure a valid configuration application path.

Error code	Description	Cause	Solution
0x332E	EtherNet/IP specified consumption application path mismatch with valid path	The EtherNet/IP specified consumption application path does not match the valid consumer application path.	Reconfigure a valid consumption application path.
0x332F	EtherNet/IP specified production application path mismatch with valid path	The EtherNet/IP specified production application path does not match the valid production application path.	Reconfigure a valid production application path.
0x3330	EtherNet/IP specified configuration and/or consumption and/or production application path combinations inconsistent	The EtherNet/IP specified configuration and/or consumption and/or production application path combinations are inconsistent.	Reconfigure the configuration and/or consumption and/or production application path combinations.
0x3331	Information in EtherNet/IP data segment inconsistent with consumer data format	The information in the EtherNet/IP data segment is inconsistent with the consumer data format.	Reconfigure and ensure the information in the EtherNet/IP data segment is consistent with the consumer data format.
0x3332	Information in EtherNet/IP data segment inconsistent with producer data format	The information in the EtherNet/IP data segment is inconsistent with the producer data format.	Reconfigure and ensure the information in the EtherNet/IP data segment is consistent with the producer data format.
0x3333	Null Forward Open request not supported in EtherNet/IP target	Null Forward Open request is not supported in the EtherNet/IP target.	Reconfigure the Forward Open request in the EtherNet/IP target.
0x3334	EtherNet/IP connection timeout multiplier value reserved or resulting timeout value exceeded limit supported by device	The EtherNet/IP connection timeout multiplier value is reserved or the resulting timeout value exceeded the upper limit supported by the device.	Reconfigure the connection timeout multiplier value.

Error code	Description	Cause	Solution
0x3335	EtherNet/IP connection size mismatch with existing multicast connection	EtherNet/IP connection size mismatch with existing multicast connection	Check the connection configuration.
0x3336	EtherNet/IP fixed/variable connection type mismatch with existing multicast connection	EtherNet/IP fixed/ variable connection type mismatch with existing multicast connection	Reconfigure the EtherNet/IP fixed/ variable connection type.
0x3337	EtherNet/IP fixed/variable connection priority mismatch with existing multicast connection	EtherNet/IP fixed/ variable connection priority mismatch with existing multicast connection	Reconfigure the EtherNet/IP fixed/ variable connection priority.
0x3338	EtherNet/IP fixed/variable transfer type mismatch with existing multicast connection	EtherNet/IP fixed/ variable transfer type mismatch with existing multicast connection	Reconfigure the EtherNet/IP fixed/ variable transfer type.
0x3339	EtherNet/IP fixed/variable production trigger mismatch with existing multicast connection	EtherNet/IP fixed/ variable production trigger mismatch with existing multicast connection	Reconfigure the EtherNet/IP fixed/ variable production trigger type.
0x333A	EtherNet/IP fixed/variable production inhibit time mismatch with existing multicast connection	EtherNet/IP fixed/ variable production inhibit time mismatch with existing multicast connection	Reconfigure the EtherNet/IP fixed/ variable production inhibit time.
0x333B	EtherNet/IP duplicate connection attempt to active session	The EtherNet/IP device is attempting to reconnect to a target that is already connected.	Waiting for the connection result.
0x333C	EtherNet/IP master failed to send data	EtherNet/IP communication error	Check whether the communication between master and slave is normal.
0x333D	EtherNet/IP master failed to receive data	EtherNet/IP communication error	Check whether the communication between master and slave is normal.

Error code	Description	Cause	Solution
0x333E	EtherNet/IP protocol stack startup failed	EtherNet/IP protocol stack status error	1. Restart the protocol stack. 2. Check the connection status of the dynamic network port. If the network port is loose or not connected, connect the port properly and restart for it to take effect. 3. To clear the alarm, save and disable the EtherNet/IP slave switch.
0x333F	Connection start failed	Connection configuration error	Check the connection configuration.
0x3340	Offline of target slave connected to master	The target slave connected to the master has gone offline.	Check whether the slave switch is On and the link is in normal operation.
0x3341	Network port declaration failed	Network port declaration failed	Reissue configuration.
0x3342	Configured slave IP conflicted with local master IP	Slave IP cannot be the same as the master network port IP	Fill in the correct slave IP.
0x3350	File read and write size exceeds 40 MB	File read and write size exceeds 40 MB	Stop writing oversized file.
0x3351	File read and write size exceeds 50 MB	File read and write size exceeds 50 MB	Stop writing oversized file.
0x3352	EMMC remaining memory less than 25%	EMMC remaining memory less than 25%	Check EMMC memory, delete some program files and some user files appropriately.
0x3353	EMMC remaining memory less than 5%	EMMC remaining memory less than 5%	Check EMMC memory, delete some program files and some user files appropriately.
0x4A00	The event list in the event mechanism is full.	The host controller does not read the events in the event list in time.	Read the event list in time.
0x4A01	In the event mechanism, when several events sent by the controller to the host controller are compared with the same events sent back by	The communication between the controller and host controller is incorrect.	Check whether the communication between the controller and host controller is normal.

Error code	Description	Cause	Solution
	the host computer, the event information is inconsistent.		
0x4A02	The range of event IDs in the event mechanism exceeds the limit.	The initialization array in the event mechanism was not properly filled, an internal error.	Save the error message on the system diagnosis page and contact the manufacturer.
0x4A10	One-drive-many vision: Master bus configuration updated; Restart required	Update the parameters of one-drive-many vision.	Restart.
0x4A11	One-drive-many vision: EtherCAT online slave mismatch with configuration	The EtherCAT communication is disconnected.	Check whether the EtherCAT channel is connected properly.
0x4A12	One-drive-many vision: Slave TCP connection disconnected	TCP communication connection is abnormal.	1. Check whether the Ethernet port network cable is connected normally. 2. Check for any anomaly in the local area network.
0x4A13	One-drive-many vision: TCP visual data cache queue full	Vision data transfer load is high.	1. Reduce the conveyor speed. 2. Decrease the number of workobjects on the conveyor.
0x4A14	One-drive-many vision: Monitoring cache queue full	Vision data transfer load is high.	1. Reduce the conveyor speed. 2. Decrease the number of workobjects on the conveyor.
0x4A15	One-drive-many vision: Slave device index value error	1. The index value is occupied. 2. The index value is invalid.	Use the correct slave device index value.
0x4A16	One-drive-many vision: Master server exception	Master device vision data server exception	Check whether the master device server is properly enabled
0x4A17	One-drive-many vision: Data processing error	Workobject pixel coordinate and conveyor coordinate calibration matrix are incorrect.	Check whether the calibration matrix is correct.

Error code	Description	Cause	Solution
0x4A18	One-drive-many vision: Shared memory vision data cache full	Vision data transfer load is high.	Check whether the motion module is normal. 2. Decrease the number of workobjects on the conveyor (motion module is normal).
0x4A19	One-drive-many vision: Slave connections not fully connected	Not all connections for the slaves have been established; the master runs the one-drive-many vision related API.	Ensure that all slaves are successfully connected to the master.
0x4A1A	One-drive-many vision: TCP vision data verification error	TCP data transmission error	Check whether the local area network is interfered.
0x4A1B	One-drive-many vision: Slave EtherCAT-(IN) connection status abnormal	EtherCAT-IN connection is disconnected.	Check whether the EtherCAT connection is abnormal.
0x4A1C	One-drive-many vision: Slave EtherCAT-(OUT) connection status abnormal	EtherCAT-OUT connection is disconnected.	Check whether the EtherCAT connection is abnormal.
0x4A1D	One-drive-many vision: Slave EtherCAT-(IN)-(OUT) connection status abnormal	EtherCAT-IN-OUT connection is disconnected.	Check whether the EtherCAT connection is abnormal.
0x4A1E	One-drive-many vision: Slave ESC status abnormal (master EtherCAT connection normal)	The EtherCAT slave status is abnormal.	Check whether the EtherCAT connection is abnormal.
0x4A1F	One-drive-many vision: Configure d/Online slave quantity mismatch	The number of configured slaves does not match the number of online slaves.	Check the configuration of one-drive-many vision, fix the error and restart the controller.
0x5001	J1 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.
0x5002	J1 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x5003	J2 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.

Error code	Description	Cause	Solution
0x5004	J2 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x5005	J3 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.
0x5006	J3 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x5007	J4 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.
0x5008	J4 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x5009	J5 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.
0x500A	J5 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x500B	J6 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.
0x500C	J6 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x500D	J7 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.
0x500E	J7 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x500F	J8 axis torque overlimit warning	The actual maximum current exceeds the limit for warning.	Check whether the speed or acceleration is too large.

Error code	Description	Cause	Solution
0x5010	J8 axis average load rate overlimit warning	The average load rate exceeds the limit for warning.	Check whether speed and acceleration are too large. Troubleshoot the brake, mechanical parts and drive.
0x5011	J1 axis servo warning	Warning occurs on the servo of J1 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5012	J2 axis servo warning	Warning occurs on the servo of J2 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5013	J3 axis servo warning	Warning occurs on the servo of J3 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5014	J4 axis servo warning	Warning occurs on the servo of J4 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5015	J5 axis servo warning	Warning occurs on the servo of J5 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5016	J6 axis servo warning	Warning occurs on the servo of J6 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5017	J7 axis servo warning	Warning occurs on the servo of J7 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5018	J8 axis servo warning	Warning occurs on the servo of J8 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5019	J9 axis servo warning	Warning occurs on the servo of J9 axis.	View the servo parameter H0B-45 and handle the problem according to the user guide.
0x5020	The number of vision data points of tracking process exceeds 50, the excessive points will be ignored.	The number of vision data points is out of range.	Limit the number of vision data points to 50 or fewer.

Error code	Description	Cause	Solution
0x5021	J1 axis motor/reducer overloaded.	Motor/reducer temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5022	J1 axis encoder overheated	Encoder temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5023	J1 axis motor/reducer overloaded	The steady-state predicted temperature of the motor/reducer is high, exceeding the warning threshold.	1. Check whether the environment temperature is set correctly. 2. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 3. Reduce the duty cycle.
0x5041	J2 axis motor/reducer overheated	Motor/reducer temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5042	J2 axis encoder overheated	Encoder temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle.

Error code	Description	Cause	Solution
			3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5043	J2 axis motor/reducer overloaded	The steady-state predicted temperature of the motor/reducer is high, exceeding the warning threshold.	1. Check whether the environment temperature is set correctly. 2. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 3. Reduce the duty cycle.
0x5061	J3 axis motor/reducer overheated	Motor/reducer temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5062	J3 axis encoder overheated	Encoder temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5063	J3 axis motor/reducer overloaded	The steady-state predicted temperature of the motor/reducer is high, exceeding the warning threshold.	1. Check whether the environment temperature is set correctly. 2. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 3. Reduce the duty cycle.

Error code	Description	Cause	Solution
0x5081	J4 axis motor/reducer overheated	Motor/reducer temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5082	J4 axis encoder overheated	Encoder temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x5083	J4 axis motor/reducer overloaded	The steady-state predicted temperature of the motor/reducer is high, exceeding the warning threshold.	1. Check that the ambient temperature is set correctly. 2. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 3. Reduce the duty cycle.
0x50A1	J5 axis motor/reducer overheated	Motor/reducer temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x50A2	J5 axis encoder overheated	Encoder temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.

Error code	Description	Cause	Solution
0x50A3	J5 axis motor/reducer overloaded	The steady-state predicted temperature of the motor/reducer is high, exceeding the warning threshold.	1. Check whether the environment temperature is set correctly. 2. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 3. Reduce the duty cycle.
0x50C1	J6 axis motor/reducer overheated	Motor/reducer temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x50C2	J6 axis encoder overheated	Encoder temperature is too high, exceeding warning threshold.	1. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 2. Reduce the duty cycle. 3. Check whether the ambient temperature of the robot is too high and reduce the temperature if necessary.
0x50C3	J6 axis motor/reducer overloaded	The steady-state predicted temperature of the motor/reducer is high, exceeding the warning threshold.	1. Check whether the environment temperature is set correctly. 2. Check whether the speed, acceleration, and load values are too large, and reduce the motion speed, acceleration, or load if necessary. 3. Reduce the duty cycle.
0x50D1	Wrong object type for visual recognition	The object type of the sent visual data is not within the range [0,15].	Modify the object type number sent by vision to make it within the range [0,15].

Error code	Description	Cause	Solution
0x50D2	Vision data waiting timeout	No returned data is received for a long period of time after vision triggering signals are sent, and the vision processing cycle is greater than the photographing interval.	1. Check whether the vision trigger signal is delivered successfully. 2. If the vision trigger signal is delivered successfully every time, check whether the camera will take pictures normally every time. 3. The processing time of vision software is too long, or the delay time of data transmission is too long.
0x50D3	One-drive-many vision: Shared address 2 full	The shared address 2 of one-drive-many vision is full.	Check the TCP connection status of the slave.
0x50D4	One-drive-many vision: Missed object data cache full	The shared address 2 of one-drive-many vision is full.	Check the TCP connection status of the slave.
0x50E1	Lookahead error	Lookahead error	Save the error message on the system diagnostics page and contact the manufacturer.
0x50E2	Adaptive speed planning verification error	Adaptive speed planning verification error	Save the error message on the system diagnostics page and contact the manufacturer.
0x50E3	General speed planning verification error	General speed planning verification error	Save the error message on the system diagnostics page and contact the manufacturer.
0x50E4	Trajectory time too long	The time of a single trajectory exceeds 1,000 seconds.	It does not affect operation, but may cause unexpected problems. Increase the speed and acceleration to reduce the execution time of a single instruction.
0x50E5	No smooth curve at a fly point	Position and motion parameters constrain the smooth length.	Normal work is not affected, but cycle time can be optimized.
0x50E6	Stop time too long	Stop time exceeded 500 milliseconds	Normal work is not affected, but be aware that the robot cannot be operated again before it is completely stopped.
0x50E7	The load mass setting is too small when the optimal trajectory mode is turned on, the robot will move at	The load mass setting is too small when the	Check that the load parameters are set properly.

Error code	Description	Cause	Solution
	low speed. Please confirm whether the load setting is correct.	optimal trajectory mode is turned on.	
0x50EE	EtherCAT communication feedback error	The speed is abnormal when the robot coasts to stop.	Save the error message on the system diagnostics page and contact the manufacturer.
0x50F8	Real time task execution time too long	Real time task execution timeout	Export the diagnostic information and contact the manufacturer.
0x5101	Robot enters interference zone 0	Robot enters interference zone 0	Disable the interference zone 0, and move the robot out of interference zone 0.
0x5102	Robot enters interference zone 1	Robot enters interference zone 1	Disable the interference zone 1, and move the robot out of interference zone 1.
0x5103	Robot enters interference zone 2	Robot enters interference zone 2	Disable the interference zone 2, and move the robot out of interference zone 2.
0x5104	Robot enters interference zone 3	Robot enters interference zone 3	Disable the interference zone 3, and move the robot out of interference zone 3.
0x5105	Robot enters interference zone 4	Robot enters interference zone 4	Disable the interference zone 4, and move the robot out of interference zone 4.
0x5106	Robot enters interference zone 5	Robot enters interference zone 5	Disable the interference zone 5, and move the robot out of interference zone 5.
0x5107	Robot enters interference zone 6	Robot enters interference zone 6	Disable the interference zone 6, and move the robot out of interference zone 6.
0x5108	Robot enters interference zone 7	Robot enters interference zone 7	Disable the interference zone 7, and move the robot out of interference zone 7.
0x5109	Robot enters interference zone 8	Robot enters interference zone 8	Disable the interference zone 8, and move the robot out of interference zone 8.

Error code	Description	Cause	Solution
0x510A	Robot enters interference zone 9	Robot enters interference zone 9	Disable the interference zone 9, and move the robot out of interference zone 9.
0x510B	Robot enters interference zone 10	Robot enters interference zone 10	Disable the interference zone 10, and move the robot out of interference zone 10.
0x510C	Robot enters interference zone 11	Robot enters interference zone 11	Disable the interference zone 11, and move the robot out of interference zone 11.
0x510D	Robot enters interference zone 12	Robot enters interference zone 12	Disable the interference zone 12, and move the robot out of interference zone 12.
0x510E	Robot enters interference zone 13	Robot enters interference zone 13	Disable the interference zone 13, and move the robot out of interference zone 13.
0x510F	Robot enters interference zone 14	Robot enters interference zone 14	Disable the interference zone 14, and move the robot out of interference zone 14.
0x5110	Robot enters interference zone 15	Robot enters interference zone 15	Disable the interference zone 15, and move the robot out of interference zone 15.
0x6000	Robot initialization parameter error	Robot initialization parameters are illegal.	Reconfigure robot initialization parameters according to diagnostic prompts.
0x6001	Incorrect initialization status	Robot initialization failed	Reinitialize the robot according to diagnostic prompts.
0x6002	Mechanical unit initialization parameter error	Mechanical unit initialization parameters are illegal.	Reinitialize the mechanical unit initialization parameters according to diagnostic prompts.
0x6003	External axis initialization parameter error	External axis initialization parameters are illegal.	Reinitialize the external axis initialization parameters according to diagnostic prompts.
0x6004	Incorrect mechanical unit or external axis count for initialization	Incorrect mechanical unit or external axis count for initialization	Reconfigure the number of mechanical units or external axes according to diagnostic prompts.
0x6010	Illegal position points	The passed in point parameters are illegal.	Check if the Euler angle value of the point exceeds 180 degrees.

Error code	Description	Cause	Solution
0x6011	Illegal tool parameters	The passed in tool parameters are illegal.	1. Check that the input tool installation position Euler angle is correct. 2. Check that the load parameters are legal.
0x6012	Illegal wobj parameters	The passed in wobj parameters are illegal.	1. Check that the input work object installation position Euler angle is correct. 2. Check that the fixing properties match the mechanical unit.
0x6013	Illegal load parameters	The passed in load parameters are illegal.	Check if there is a negative value of mass inertia in the input load parameters.
0x6014	Illegal joint position	The passed in joint position is illegal.	Check if the input joint position exceeds the limit.
0x6016	The active tool and workobject parameters do not match (kinematics).	The active tool and the workobject have the same RobHold parameter.	1. Switch the active tool and workobject matching the RobHold parameter. 2. Modify the RobHold parameter of the active tool and workobject to be different.
0x6017	Illegal pose parameter	The passed in pose parameters are illegal.	Check if the Euler angle value of the point exceeds 180 degrees.
0x6018	Pose deviation calculation type flag error	The flag bit of the pose deviation calculation function is incorrect.	System error, please contact the manufacturer.
0x6030	Wrong world frame type	The world frame type passed in is incorrect when converting the world frame to a reference frame.	System error, please contact the manufacturer.
0x6031	Wrong mechanical unit type	The mechanical unit type passed in is incorrect when converting the world frame to a reference frame.	System error, please contact the manufacturer.

Error code	Description	Cause	Solution
0x6032	Wrong reference frame type	The reference frame type passed in is incorrect when converting the reference frame type to world frame.	System error, please contact the manufacturer.
0x6033	Wrong mechanical unit type	The mechanical unit type passed in is incorrect when converting the reference frame to world frame.	System error, please contact the manufacturer.
0x6034	The mechanical unit associated with the workobject is not calibrated.	The mechanical unit associated with the workobject is not calibrated.	Calibrate the mechanical unit associated with the workobject.
0x6050	Tool or wobj parameter error	The RobHold parameter is the same for both the tool and the workobject currently in use.	Ensure that the RobHold parameter is set to true for only one of tool and workobject.
0x6051	End parameter calculation error	The RobHold parameter is the same for both the tool and the workobject currently in use.	Ensure that the RobHold parameter is set to true for only one of tool and workobject.
0x6052	Error getting external reference frame	The RobHold parameter is the same for both the tool and the workobject currently in use.	Ensure that the RobHold parameter is set to true for only one of tool and workobject.
0x6053	Wobj frame conversion error	The RobHold parameter is the same for both the tool and the workobject currently in use.	Ensure that the RobHold parameter is set to true for only one of tool and workobject.
0x6054	Reference frame conversion error	The RobHold parameter is the same for both the tool and the workobject currently in use.	Ensure that the RobHold parameter is set to true for only one of tool and workobject.

Error code	Description	Cause	Solution
0x6060	Tool calibration error	Calibration calculation errors caused by non-standard tool calibration points or other reasons	1. Check that the calibration points comply with the calibration rules. 2. Check that the robot parameter initialization is correct.
0x6061	Guide rail-robot calibration error	Calibration calculation errors caused by non-standard guide rail calibration points or other reasons	Check that the calibration points comply with the calibration rules.
0x6062	Positioner calibration error	Calibration calculation errors caused by non-standard position calibration points or other reasons.	1. Check that the calibration points comply with the calibration rules. 2. Check that the positioner calibration sequence is correct.
0x6063	User frame calibration error	Calibration calculation errors caused by non-standard user frame calibration points or other reasons.	Check that the calibration points comply with the calibration rules.
0x6064	Improper tool calibration points	Improper tool calibration points	Re-select the calibration points having significant difference in orientation.
0x6065	Calibration points too close	Calibration points too close	Re-select the calibration points.
0x6066	Calibration points collinear	Calibration points collinear	Re-select the calibration points.
0x6067	Excessive discrepancy between dual-arm parameters, resulting in deviations in target joint angles during inverse calculation	Excessive discrepancy between dual-arm parameters, resulting in deviations in target joint angles during inverse calculation	Modify the arm parameters of the point.
0x6070	Same calibration points input	Same calibration points input	Reselect calibration points.
0x6071	In TCP mode, points relative to flange cannot be converted to wobj points.	In TCP mode, points relative to flange cannot be converted to wobj points.	Get a point again.

Error code	Description	Cause	Solution
0x6080	Error in inverse solution of target position in orientation calibration.	The target position for orientation calibration is singular or unreachable.	Check whether the target position for orientation calibration is a singular position.
0x6081	Singular pose present in the orientation calibration path	Orientation calibration causes the robot to go through singular pose.	Adjust the original points so that the robot does not go through singular pose during the orientation calibration process.
0x6090	Incorrect arm type parameter	The passed in arm type parameter is incorrect.	Check that the arm type parameter configuration corresponding to the point is correct.
0x6092	Singular or unreachable position	The points are at singular or unreachable positions.	Check whether the input points are at singular or unreachable positions, and modify the points if necessary.
0x6094	SCARA singularity	SCARA elbow singularity	Adjust points to avoid singularity.
0x6096	Shoulder singularity	Shoulder singularity	Adjust points to avoid singularity.
0x6097	Elbow singularity	Elbow singularity	Adjust points to avoid singularity.
0x6098	Wrist singularity	Wrist singularity	Adjust points to avoid singularity.
0x7030	Curve path angle too small	Position or orientation in the free curve path has sharp turning.	Modify the points in curve path to avoid sharp turning positions or orientations.
0x7031	Excessive spacing between trajectory points	Position or orientation spacing exceeds the specification.	Adjust the spacing between trajectory points or add intermediate points.
0x7032	Illegal number of curve points	The number of curve points input in the curve instruction is less than 4 or more than 500.	Adjust the number of curve points.
0x7033	No valid data within the curve group	No valid curve instruction within the curve group instruction.	Modify curve group instruction.

Error code	Description	Cause	Solution
0x7034	Points with too small spacing in curve	Repetitive or small spacing of input points on the curve results in the inability to construct the curve.	Remove duplicate or too close points.
0x7035	Excessive pose variation caused by Euler degeneracy	When the absolute value of Euler angle B approaches 90°, excessive fluctuation in A/C angles configuration leads to excessive pose spacing.	Avoid degenerate positions or manually adjust A/C values to prevent excessive spacing in curve point pose.
0x7038	Joints move too large	Excessive joint motion between adjacent points in the path.	Check that the arm parameters are set correctly or select appropriate SlewMode.
0x7039	Joint value overlimit	A point in the curve path exceeds the joint angle limit in the set arm parameters.	Modify the point position, modify the point arm parameters, select SlewMode, depending on the situation.
0x7040	Conflict state	Internal error	Contact the manufacturer.
0x7041	Conflict symbol	Internal error	Contact the manufacturer.
0x7042	Conflict resume state	Internal error	Contact the manufacturer.
0x7043	Conflict line number	Internal error	Contact the manufacturer.
0x7050	Too many I/Os bound to the same point on the curve	The number of I/Os bound to the same or similar point exceeds the limit.	Reduce or adjust the number of I/Os.
0x7051	Insufficient effective points on the curve.	Insufficient effective points on the curve.	Add curve points.
0x7052	Curve too long	The total length of the curve exceeds the specification.	Execute the curve by multiple instructions.
0x7053	I/O not bound to the point of curve	I/O is bound to a point outside the curve.	Modify the I/O number.

Error code	Description	Cause	Solution
0x7060	Positioner coordination not supported by free curve	The wobj frame is not fixed.	Use the free curve instruction in a fixed wobj frame.
0x8001	No network device	The FPGA module is not functioning properly.	Contact the manufacturer.
0x8002	No master	Failed to request EtherCAT master	Restart the controller. If the problem persists, it is a hardware device error, contact the manufacturer.
0x8003	Invalid domain	Failed to apply for EtherCAT master domain resource	Restart the controller. If the problem persists, it is a hardware device error, contact the manufacturer.
0x8004	Slave not found	The slave could not be found when configuring it.	Restart the controller or contact the manufacturer to check the EtherCAT slave device.
0x8005	Invalid process data	Error configuring slave PDO	Restart the controller or contact the manufacturer to check the EtherCAT slave device.
0x8006	Invalid service data	Error configuring slave SDO	Restart the controller or contact the manufacturer to check the EtherCAT slave device.
0x8007	Invalid entry object	Error configuring slave SDO entry	Restart the controller or contact the manufacturer to check the EtherCAT slave device.
0x8008	Domain memory address allocation error	Failed to apply for EtherCAT master domain memory	Restart the controller. If the problem persists, contact the manufacturer.
0x8009	Failed to activate master	Failed to apply for activation of EtherCAT master	Restart the controller. If the problem persists, contact the manufacturer.
0x800A	Service data common error	Length mismatch or slave not found while configuring slave SDO	Restart the controller. If the problem persists, contact the manufacturer to check the EtherCAT slave deice.
0x800B	Registration cycle callback error	Failed to create timed interrupt task	Restart the controller. If the problem persists, contact the manufacturer.
0x800C	Process communication configuration error	Error configuring PDO buffer	Restart the controller. If the problem persists, contact the manufacturer.

Error code	Description	Cause	Solution
0x800D	Module initialization error	EtherCAT Module resource initialization error	Restart the controller. If the problem persists, contact the manufacturer.
0x800E	Error parsing configuration	Error parsing the slave configuration	Check the secondary development configuration and reconfigure if necessary.
0x800F	Channel parameter configuration error	Failed to configure the interval between channel synchronization signals and interrupts	Restart the controller. If the problem persists, contact the manufacturer.
0x8010	Domain registration error	Domain registration failure detected	Restart the controller. If the problem persists, contact the manufacturer.
0x8011	Error creating timer	Failed to create timer due to system reasons	Restart the controller. If the problem persists, contact the manufacturer.
0x8012	Error starting timer	Failed to start timer due to system reasons	Restart the controller. If the problem persists, contact the manufacturer.
0x8013	EtherCAT communication cycle configuration error	EtherCAT communication cycle is not an integral number of 250us.	Check the secondary development configuration and reconfigure if necessary.
0x8014	EtherCAT version selection error	Wrong version of EtherCAT is used.	EtherCAT version error, contact the manufacturer.
0x8015	EtherCAT servo slave quantity error	The number of configured ECAT servo slaves is less than 1.	Check whether the configured number of EtherCAT servo slaves is correct.
0x8016	EtherCAT I/O slave quantity error	The number of configured EtherCAT I/O slaves is less than 0.	Check whether the configured number of EtherCAT I/O slaves is correct.
0x8017	EtherCAT I/O module quantity error	The number of configured EtherCAT I/O slaves is less than 1	Check whether the number of configured EtherCAT I/O slaves is correct.
0x8018	EtherCAT I/O type error	The EtherCAT I/O type is unknown.	Check the secondary development configuration and reconfigure if necessary.
0x8019	EtherCAT I/O not supported	The type of configured EtherCAT I/O is	

Error code	Description	Cause	Solution
		currently not supported.	Check the secondary development configuration and reconfigure if necessary.
0x801A	EtherCAT memory request error	Current memory request failed due to excessive system resource usage.	Restart the controller. If the problem persists, contact the manufacturer.
0x801B	EtherCAT alarm shared memory configuration error	EtherCAT alarm shared memory resource request failed.	Restart the controller. If the problem persists, contact the manufacturer.
0x801C	EtherCAT Servo operation mode configuration error	ECAT servo control mode is not CSP-8,CSV-9 or CST-10.	Check the secondary development configuration and reconfigure if necessary.
0x801D	EtherCAT register configuration error	Failed to access slave register	Check that the slave registers to be accessed are correct or allowed to be accessed.
0x801E	Mismatch between the number of configured EtherCAT I/Os and the number of online I/Os	The number of configured EtherCAT I/Os does not match the number of online I/Os.	Check the number of configured EtherCAT I/Os and the number of online I/Os.
0x801F	Mismatch between the number of configured EtherCAT servos and the number of online servos	The number of configured EtherCAT servos does not match the number of online servos.	Check the number of configured EtherCAT servos and the number of online servos.
0x8020	Configured EtherCAT servo supplier codes not supported	The slave device is not supported.	Check that all slave devices in all EtherCAT networks are supported.
0x8021	Mismatch between configured slave device ID and online slave device ID	The configured slave device ID do not match the online slave device ID.	Check whether the configured slave device ID matches the online slave device ID.
0x8022	FPGA received a non-EtherCAT frame	FPGA received a non-EtherCAT frame	Check whether the slave wiring is correct, clear and reboot after recovery.
0x8024	EtherCAT slave function exception (configured sequence does not match the actual sequence or invalid SDO exists)	The configured sequence does not match the actual one or invalid SDO exists.	Check whether the configured sequence of the slaves matches the actual sequence or the SDO is valid.

Error code	Description	Cause	Solution
0x8028	Error writing buffer	Failed to write buffer due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8029	Error writing start command	Failed to write start command error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x802A	Error reading status register	Failed to read status register due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x802B	Error reading data link status	Failed to read the data link status due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x802C	Error reading service data channel	Failed to read the service data channel due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x802D	Error reading service data length	Failed to read the service data length due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x802E	Service data length error	Service data length error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x802F	Service data reception error	Service data reception error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8030	Service data channel busy	Service data channel busy error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8031	Service data message error	Service data message error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8032	Communication error in reading process data	Error reading process data due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8033	Error reading process data length	Failed to read the process data length due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.

Error code	Description	Cause	Solution
0x8034	Process data length error	Failed to read the process data length due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8035	Process data reception error	Failed to receive process data due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8036	Error opening network device	Failed to open network device due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8037	Underlying communication error	The underlying communication control error is caused by a hardware error.	Restart the controller. If the problem persists, contact the manufacturer.
0x8038	Underlying communication error	Underlying communication read error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8039	Underlying communication error	Underlying communication write error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x803A	Error reading send time stamp	Failed to read send time stamp due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x803B	Error reading receive time stamp	Failed to read receive time stamp due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x803C	Error reading remaining process data	Failed to read the remaining process data due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x803D	Error reading application time stamp	Failed to read application time stamp due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x803E	Error opening fieldbus LED	Failed to open fieldbus LED due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.

Error code	Description	Cause	Solution
0x803F	Fieldbus LED IOCTRL error	Fieldbus LED IOCTRL error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8040	Invalid underlying hardware	The underlying hardware module 1 is invalid due to a hardware error.	Restart the controller. If the problem persists, contact the manufacturer.
0x8041	Invalid underlying hardware	The underlying hardware module 2 is invalid due to a hardware error.	Restart the controller. If the problem persists, contact the manufacturer.
0x8042	EtherCAT slave disconnected (slave offline/alias error)	EtherCAT slave is disconnected or the alias is incorrect.	Check the EtherCAT device/Alias.
0x8043	Non-EtherCAT slave device connected	A non-EtherCAT slave device is connected.	Check that the connected device meets the requirements.
0x8044	EtherCAT network port 0 not connected	The EtherCAT network port 0 is not connected.	Check the status of EtherCAT network port 0.
0x8045	EtherCAT network port 1 not connected	The EtherCAT network port 1 is not connected.	Check the status of EtherCAT network port 1.
0x8046	EtherCAT startup time setting error	EtherCAT startup time is incorrectly set due to a hardware error.	Restart the controller. If the problem persists, contact the manufacturer.
0x8047	EtherCAT slave status error	The read ECAT slave status word indicates that the status is abnormal, possibly due to mismatch with servo module.	Check the error codes to troubleshoot and restart the system, or upgrade the servo module to the matched version.
0x8048	Failed to open EOE virtual NIC device	System driver loading is not normal.	Check the system software version and restart the system.
0x8050	Slave IN/OUT reverse connection	The IN and OUT of external axis are connected in reverse.	Check the wiring of external axis.
0x805C	Toggle bit not changed		Re-initiate a SDO access, or contact the manufacturer.

Error code	Description	Cause	Solution
		The slave feeds back that the toggle bit is not changed.	
0x805D	SDO protocol timeout	SDO protocol timeout	Re-initiate a SDO access, or contact the manufacturer.
0x805E	Client/Server command specifier not valid or unknown	The slave feeds back that Client/Server command specifier is not valid or unknown.	Internal system error, please contact the manufacturer.
0x805F	Object inaccessible	The slave feeds back that the object is not accessible.	This operation is prohibited.
0x8060	Error reading an write-only object	The slave feeds back that an error occurs while trying to read a write-only object.	This operation is prohibited.
0x8061	Error writing an read-only object	The slave feeds back that an error occurs while trying to write a read-only object.	This operation is prohibited.
0x8062	Object does not exist in the object directory.	The slave feeds back that the object does not exist in the object directory.	Check that the object exists in the object dictionary.
0x8063	Object cannot be mapped into PDO.	The slave feeds back that the object cannot be mapped to the PDO.	Check that the object to be mapped is correct.
0x8064	Length of object to be mapped exceeds PDO length	The slave feeds back that the length of the object to be mapped exceeds the PDO length.	Check that the length of the object to be mapped is correct.
0x8065	Basic parameter incompatible	The slave feeds back that the base parameters are incompatible.	Check that the basic parameters of the slave are compatible.
0x8066	Device internal incompatibility	The slave feeds back that the device is	

Error code	Description	Cause	Solution
		internally incompatible.	Restart the controller and slave. If the problem persists, contact the manufacturer.
0x8067	Access failure due to a hardware error	The slave feeds back that the access failed due to hardware causes.	Restart the controller and slave. If the problem persists, contact the manufacturer.
0x8068	Service parameter length mismatch	The slave feeds back that the service parameter length mismatches.	Check that the length of the service parameter of the accessed slave is correct.
0x8069	Service parameter too long	The slave feeds back that the service parameter length is too long.	Check that the length of the service parameter of the accessed slave is correct.
0x806A	Service parameter too short	The slave feeds back that the service parameter length is too short.	Check that the length of the service parameter of the accessed slave is correct.
0x806B	Subindex does not exist.	The slave feeds back that the subindex does not exist.	Check that the object subindex exists.
0x806C	Parameter value out of range	The slave feeds back that the parameter value is out of range.	Check that the parameters are set correctly.
0x806D	Written parameter value too large	The slave feeds back that the written parameter value is too large.	Check that the parameters are set correctly.
0x806E	Written parameter value too small	The slave feeds back that the written parameter value is too small.	Check that the parameters are set correctly.
0x806F	Maximum value smaller than minimum value.	The slave feeds back that the maximum value is less than the minimum value.	Check that the set values are correct.

Error code	Description	Cause	Solution
0x8070	Error transferring or storing data	The slave feeds back that the data failed to be transferred or stored.	Restart the controller and slave. If the problem persists, contact the manufacturer.
0x8071	Error storing data due to local control	The slave feeds back that the data failed to be stored due to local control.	Restart the controller and slave. If the problem persists, contact the manufacturer.
0x8072	Error storing data due to device status	The slave feeds back that the data failed to be stored due to device status.	Restart the controller and slave. If the problem persists, contact the manufacturer.
0x8073	Object dictionary dynamic generation failure or object dictionary not found	The slave feeds back that the object dictionary dynamic generation fails or no object dictionary is present.	Check that the object dictionary exists.
0x8079	IR-Link initialization error	Failed to initialize IR-LINK due to IR-Link configuration or hardware connection error.	Check the IR-Link configuration or hardware connection.
0x807A	IR-Link communication cycle configuration error	The IR-Link communication cycle is not an integral number of 250us.	Check the IR-Link communication cycle configuration.
0x807B	IR-Link version selection configuration error	Wrong version of IR-Link is used.	Contact the manufacturer.
0x807C	IR-Link servo slave quantity configuration error	The number of configured IR-Link servos is less than 0.	Check the number of configured IR-Link servos.
0x807D	IR-Link slave quantity configuration error	The number of configured IR-Link slaves is less than 1.	Check the number of configured IR-Link slaves.
0x807E	IR-Link module quantity configuration error	The number of configured IR-Link modules is less than 1.	Check the number of configured IR-Link modules.

Error code	Description	Cause	Solution
0x807F	IR-Link type configuration error	The type of configured IR-Link I/O is unrecognized.	Check the type of configured IR-Link I/O.
0x8080	IR-Link configuration not supported	IR-Link configuration is not supported.	Check the IR-Link configuration.
0x8081	IR-Link memory request configuration error	Current memory request failed due to excessive system resource usage.	Restart the controller. If the problem persists, contact the manufacturer.
0x8082	IR-Link alarm shared memory configuration error	IR-Link alarm shared memory resource request failed	Restart the controller. If the problem persists, contact the manufacturer.
0x8083	IR-Link slave operation mode configuration error	IR-Link operation mode is not MODE-8.	Check the IR-Link operation mode.
0x8084	IR-Link register configuration error	Failed to access slave register	Check that the slave registers to be accessed are correct or allowed to be accessed.
0x8085	Mismatch between the number of configured IR-Link I/Os and the number of online I/Os	The number of configured IR-Link I/Os does not match the number of online I/Os.	Check the number of configured IR-Link I/Os and the number of online I/Os.
0x8086	Mismatch between the number of configured IR-Link slaves and the number of online slaves	The number of configured IR-Link slaves does not match the number of online slaves.	Check the number of configured IR-Link slaves and the number of online slaves.
0x8087	IR-Link servo supplier codes not supported	The IR-Link servo supplier codes are not supported.	Check the IR-Link configuration.
0x8090	Error writing buffer	Failed to write buffer due to hardware error.	Restart the controller. If the problem persists, contact the manufacturer.
0x8091	Error reading service data channel	Failed to read the service data channel due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8092	Error reading service data length	Failed to read the service data length due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.

Error code	Description	Cause	Solution
0x8093	Service data length error	Service data length error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8094	Service data reception error	Service data reception error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8095	Service data channel busy	Service data channel busy error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8096	Service data message error	Service data message error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8097	Communication error in reading process data	Error reading process data due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8098	Error reading process data length	Failed to read the process data length due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x8099	Process data length error	Process data length error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x809A	Process data reception error	Failed to receive process data due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x809B	Error opening network device	Failed to open network device due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x809C	GPMC IR-Link read error	GPMC IR-Link read error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x809D	GPMC IR-Link write error	GPMC IR-Link write error due to hardware error	Restart the controller. If the problem persists, contact the manufacturer.
0x809E	IR-Link slave disconnected	IR-Link slave is disconnected.	Check the status of IR-Link device.
0x809F	Non-IR-Link slave device connection error	A non-IR-Link slave device is connected.	Check that the connected device meets the requirements.

Error code	Description	Cause	Solution
0x80A0	IR-Link port 0 not connected	The IR-Link port 0 is not connected.	Check the connection of IR-Link port 0.
0x80A1	IR-Link port 1 not connected	The IR-Link port 1 is not connected.	Check the connection of IR-Link port 1.
0x80A2	IR-Link startup time setting error	IR-Link startup time is incorrectly set due to a hardware error.	Restart the controller. If the problem persists, contact the manufacturer.
0x8142	EtherCAT slave 1 disconnected	The EtherCAT slave 1 is disconnected.	Check the EtherCAT device.
0x819E	IR-Link slave 1 disconnected	The IR-Link slave 1 is disconnected.	Check the connection status of IR-Link device.
0x8242	EtherCAT slave 2 disconnected	The EtherCAT slave 2 is disconnected.	Check the EtherCAT device.
0x829E	IR-Link slave 2 disconnected	The IR-Link slave 2 is disconnected.	Check the connection status of IR-Link device.
0x8342	EtherCAT slave 3 disconnected	The EtherCAT slave 3 is disconnected.	Check the EtherCAT device.
0x839E	IR-Link slave 3 disconnected	The IR-Link slave 3 is disconnected.	Check the connection status of IR-Link device.
0x8442	EtherCAT slave 4 disconnected	The EtherCAT slave 4 is disconnected.	Check the EtherCAT device.
0x849E	IR-Link slave 4 disconnected	The IR-Link slave 4 is disconnected.	Check the connection status of IR-Link device.
0x8542	EtherCAT slave 5 disconnected	The EtherCAT slave 5 is disconnected.	Check the EtherCAT device.
0x859E	IR-Link slave 5 disconnected	The IR-Link slave 5 is disconnected.	Check the connection status of IR-Link device.
0x8642	EtherCAT slave 6 disconnected	The EtherCAT slave 6 is disconnected.	Check the EtherCAT device.
0x869E	IR-Link slave 6 disconnected	The IR-Link slave 6 is disconnected.	Check the connection status of IR-Link device.
0x8742	EtherCAT slave 7 disconnected	The EtherCAT slave 7 is disconnected.	Check the EtherCAT device.

Error code	Description	Cause	Solution
0x879E	IR-Link slave 7 disconnected	The IR-Link slave 7 is disconnected.	Check the connection status of IR-Link device.
0x8842	EtherCAT slave 8 disconnected	The EtherCAT slave 8 is disconnected.	Check the EtherCAT device.
0x889E	IR-Link slave 8 disconnected	The IR-Link slave 8 is disconnected.	Check the connection status of IR-Link device.
0x8942	EtherCAT slave 9 disconnected	The EtherCAT slave 9 is disconnected.	Check the EtherCAT device.
0x899E	IR-Link slave 9 disconnected	The IR-Link slave 9 is disconnected.	Check the connection status of IR-Link device.
0x8A42	EtherCAT slave 10 disconnected	The EtherCAT slave 10 is disconnected.	Check the EtherCAT device.
0x8A9E	IR-Link slave 10 disconnected	The IR-Link slave 10 is disconnected.	Check the connection status of IR-Link device.
0x8B42	EtherCAT slave 11 disconnected	The EtherCAT slave 11 is disconnected.	Check the EtherCAT device.
0x8B9E	IR-Link slave 11 disconnected	The IR-Link slave 11 is disconnected.	Check the connection status of IR-Link device.
0x8C42	EtherCAT slave 12 disconnected	The EtherCAT slave 12 is disconnected.	Check the EtherCAT device.
0x8C9E	IR-Link slave 12 disconnected	The IR-Link slave 12 is disconnected.	Check the connection status of IR-Link device.
0x8D42	EtherCAT slave 13 disconnected	The EtherCAT slave 13 is disconnected.	Check the EtherCAT device.
0x8D9E	IR-Link slave 13 disconnected	The IR-Link slave 13 is disconnected.	Check the connection status of IR-Link device.
0x8E42	EtherCAT slave 14 disconnected	The EtherCAT slave 14 is disconnected.	Check the EtherCAT device.
0x8E9E	IR-Link slave 14 disconnected	The IR-Link slave 14 is disconnected.	Check the connection status of IR-Link device.
0x8F42	EtherCAT slave 15 disconnected	The EtherCAT slave 15 is disconnected.	Check the EtherCAT device.
0x8F9E	IR-Link slave 15 disconnected	The IR-Link slave 15 is disconnected.	Check the connection status of IR-Link device.

Error code	Description	Cause	Solution
0x9016	J1 exceeds Group 1 speed limit	J1 exceeds Group 1 speed limit	Clear the alarm.
0x9017	J2 exceeds Group 1 speed limit	J2 exceeds Group 1 speed limit	Clear the alarm.
0x9018	J3 exceeds Group 1 speed limit	J3 exceeds Group 1 speed limit	Clear the alarm.
0x9019	J4 exceeds Group 1 speed limit	J4 exceeds Group 1 speed limit	Clear the alarm.
0x901A	J5 exceeds Group 1 speed limit	J5 exceeds Group 1 speed limit	Clear the alarm.
0x901B	J6 exceeds Group 1 speed limit	J6 exceeds Group 1 speed limit	Clear the alarm.
0x901C	J1 exceeds Group 2 speed limit	J1 exceeds Group 2 speed limit	Clear the alarm.
0x901D	J2 exceeds Group 2 speed limit	J2 exceeds Group 2 speed limit	Clear the alarm.
0x901E	J3 exceeds Group 2 speed limit	J3 exceeds Group 2 speed limit	Clear the alarm.
0x901F	J4 exceeds Group 2 speed limit	J4 exceeds Group 2 speed limit	Clear the alarm.
0x9020	J5 exceeds Group 2 speed limit	J5 exceeds Group 2 speed limit	Clear the alarm.
0x9021	J6 exceeds Group 2 speed limit	J6 exceeds Group 2 speed limit	Clear the alarm.
0x9022	J1 exceeds Group 3 speed limit	J1 exceeds Group 3 speed limit	Clear the alarm.
0x9023	J2 exceeds Group 3 speed limit	J2 exceeds Group 3 speed limit	Clear the alarm.
0x9024	J3 exceeds Group 3 speed limit	J3 exceeds Group 3 speed limit	Clear the alarm.
0x9025	J4 exceeds Group 3 speed limit	J4 exceeds Group 3 speed limit	Clear the alarm.
0x9026	J5 exceeds Group 3 speed limit	J5 exceeds Group 3 speed limit	Clear the alarm.

Error code	Description	Cause	Solution
0x9027	J6 exceeds Group 3 speed limit	J6 exceeds Group 3 speed limit	Clear the alarm.
0x9028	J1 exceeds Group 4 speed limit	J1 exceeds Group 4 speed limit	Clear the alarm.
0x9029	J2 exceeds Group 4 speed limit	J2 exceeds Group 4 speed limit	Clear the alarm.
0x902A	J3 exceeds Group 4 speed limit	J3 exceeds Group 4 speed limit	Clear the alarm.
0x902B	J4 exceeds Group 4 speed limit	J4 exceeds Group 4 speed limit	Clear the alarm.
0x902C	J5 exceeds Group 4 speed limit	J5 exceeds Group 4 speed limit	Clear the alarm.
0x902D	J6 exceeds Group 4 speed limit	J6 exceeds Group 4 speed limit	Clear the alarm.
0x902E	J1 exceeds Group 5 speed limit	J1 exceeds Group 5 speed limit	Clear the alarm.
0x902F	J2 exceeds Group 5 speed limit	J2 exceeds Group 5 speed limit	Clear the alarm.
0x9030	J3 exceeds Group 5 speed limit	J3 exceeds Group 5 speed limit	Clear the alarm.
0x9031	J4 exceeds Group 5 speed limit	J4 exceeds Group 5 speed limit	Clear the alarm.
0x9032	J5 exceeds Group 5 speed limit	J5 exceeds Group 5 speed limit	Clear the alarm.
0x9033	J6 exceeds Group 5 speed limit	J6 exceeds Group 5 speed limit	Clear the alarm.
0x9034	J1 exceeds Group 6 speed limit	J1 exceeds Group 6 speed limit	Clear the alarm.
0x9035	J2 exceeds Group 6 speed limit	J2 exceeds Group 6 speed limit	Clear the alarm.
0x9036	J3 exceeds Group 6 speed limit	J3 exceeds Group 6 speed limit	Clear the alarm.
0x9037	J4 exceeds Group 6 speed limit	J4 exceeds Group 6 speed limit	Clear the alarm.

Error code	Description	Cause	Solution
0x9038	J5 exceeds Group 6 speed limit	J5 exceeds Group 6 speed limit	Clear the alarm.
0x9039	J6 exceeds Group 6 speed limit	J6 exceeds Group 6 speed limit	Clear the alarm.
0x903A	J1 exceeds Group 7 speed limit	J1 exceeds Group 7 speed limit	Clear the alarm.
0x903B	J2 exceeds Group 7 speed limit	J2 exceeds Group 7 speed limit	Clear the alarm.
0x903C	J3 exceeds Group 7 speed limit	J3 exceeds Group 7 speed limit	Clear the alarm.
0x903D	J4 exceeds Group 7 speed limit	J4 exceeds Group 7 speed limit	Clear the alarm.
0x903E	J5 exceeds Group 7 speed limit	J5 exceeds Group 7 speed limit	Clear the alarm.
0x903F	J6 exceeds Group 7 speed limit	J6 exceeds Group 7 speed limit	Clear the alarm.
0x9040	J1 exceeds Group 8 speed limit	J1 exceeds Group 8 speed limit	Clear the alarm.
0x9041	J2 exceeds Group 8 speed limit	J2 exceeds Group 8 speed limit	Clear the alarm.
0x9042	J3 exceeds Group 8 speed limit	J3 exceeds Group 8 speed limit	Clear the alarm.
0x9043	J4 exceeds Group 8 speed limit	J4 exceeds Group 8 speed limit	Clear the alarm.
0x9044	J5 exceeds Group 8 speed limit	J5 exceeds Group 8 speed limit	Clear the alarm.
0x9045	J6 exceeds Group 8 speed limit	J6 exceeds Group 8 speed limit	Clear the alarm.
0x9046	J1 exceeds Group 1 position limit	J1 exceeds Group 1 position limit	Close the joint position monitoring function or deactivate Group 1, and move the robot to a safe position.
0x9047	J2 exceeds Group 1 position limit	J2 exceeds Group 1 position limit	Close the joint position monitoring function or deactivate Group 1, and move the robot to a safe position.

Error code	Description	Cause	Solution
0x9048	J3 exceeds Group 1 position limit	J3 exceeds Group 1 position limit	Close the joint position monitoring function or deactivate Group 1, and move the robot to a safe position.
0x9049	J4 exceeds Group 1 position limit	J4 exceeds Group 1 position limit	Close the joint position monitoring function or deactivate Group 1, and move the robot to a safe position.
0x904A	J5 exceeds Group 1 position limit	J5 exceeds Group 1 position limit	Close the joint position monitoring function or deactivate Group 1, and move the robot to a safe position.
0x904B	J6 exceeds Group 1 position limit	J6 exceeds Group 1 position limit	Close the joint position monitoring function or deactivate Group 1, and move the robot to a safe position.
0x904C	J1 exceeds Group 2 position limit	J1 exceeds Group 2 position limit	Close the joint position monitoring function or deactivate Group 2, and move the robot to a safe position.
0x904D	J2 exceeds Group 2 position limit	J2 exceeds Group 2 position limit	Close the joint position monitoring function or deactivate Group 2, and move the robot to a safe position.
0x904E	J3 exceeds Group 2 position limit	J3 exceeds Group 2 position limit	Close the joint position monitoring function or deactivate Group 2, and move the robot to a safe position.
0x904F	J4 exceeds Group 2 position limit	J4 exceeds Group 2 position limit	Close the joint position monitoring function or deactivate Group 2, and move the robot to a safe position.
0x9050	J5 exceeds Group 2 position limit	J5 exceeds Group 2 position limit	Close the joint position monitoring function or deactivate Group 2, and move the robot to a safe position.
0x9051	J6 exceeds Group 2 position limit	J6 exceeds Group 2 position limit	Close the joint position monitoring function or deactivate Group 2, and move the robot to a safe position.
0x9052	J1 exceeds Group 3 position limit	J1 exceeds Group 3 position limit	Close the joint position monitoring function or deactivate Group 3, and move the robot to a safe position.
0x9053	J2 exceeds Group 3 position limit	J2 exceeds Group 3 position limit	Close the joint position monitoring function or deactivate Group 3, and move the robot to a safe position.

Error code	Description	Cause	Solution
0x9054	J3 exceeds Group 3 position limit	J3 exceeds Group 3 position limit	Close the joint position monitoring function or deactivate Group 3, and move the robot to a safe position.
0x9055	J4 exceeds Group 3 position limit	J4 exceeds Group 3 position limit	Close the joint position monitoring function or deactivate Group 3, and move the robot to a safe position.
0x9056	J5 exceeds Group 3 position limit	J5 exceeds Group 3 position limit	Close the joint position monitoring function or deactivate Group 3, and move the robot to a safe position.
0x9057	J6 exceeds Group 3 position limit	J6 exceeds Group 3 position limit	Close the joint position monitoring function or deactivate Group 3, and move the robot to a safe position.
0x9058	J1 exceeds Group 4 position limit	J1 exceeds Group 4 position limit	Close the joint position monitoring function or deactivate Group 4, and move the robot to a safe position.
0x9059	J2 exceeds Group 4 position limit	J2 exceeds Group 4 position limit	Close the joint position monitoring function or deactivate Group 4, and move the robot to a safe position.
0x905A	J3 exceeds Group 4 position limit	J3 exceeds Group 4 position limit	Close the joint position monitoring function or deactivate Group 4, and move the robot to a safe position.
0x905B	J4 exceeds Group 4 position limit	J4 exceeds Group 4 position limit	Close the joint position monitoring function or deactivate Group 4, and move the robot to a safe position.
0x905C	J5 exceeds Group 4 position limit	J5 exceeds Group 4 position limit	Close the joint position monitoring function or deactivate Group 4, and move the robot to a safe position.
0x905D	J6 exceeds Group 4 position limit	J6 exceeds Group 4 position limit	Close the joint position monitoring function or deactivate Group 4, and move the robot to a safe position.
0x905E	J1 exceeds Group 5 position limit	J1 exceeds Group 5 position limit	Close the joint position monitoring function or deactivate Group 5, and move the robot to a safe position.
0x905F	J2 exceeds Group 5 position limit	J2 exceeds Group 5 position limit	Close the joint position monitoring function or deactivate Group 5, and move the robot to a safe position.

Error code	Description	Cause	Solution
0x9060	J3 exceeds Group 5 position limit	J3 exceeds Group 5 position limit	Close the joint position monitoring function or deactivate Group 5, and move the robot to a safe position.
0x9061	J4 exceeds Group 5 position limit	J4 exceeds Group 5 position limit	Close the joint position monitoring function or deactivate Group 5, and move the robot to a safe position.
0x9062	J5 exceeds Group 5 position limit	J5 exceeds Group 5 position limit	Close the joint position monitoring function or deactivate Group 5, and move the robot to a safe position.
0x9063	J6 exceeds Group 5 position limit	J6 exceeds Group 5 position limit	Close the joint position monitoring function or deactivate Group 5, and move the robot to a safe position.
0x9064	J1 exceeds Group 6 position limit	J1 exceeds Group 6 position limit	Close the joint position monitoring function or deactivate Group 6, and move the robot to a safe position.
0x9065	J2 exceeds Group 6 position limit	J2 exceeds Group 6 position limit	Close the joint position monitoring function or deactivate Group 6, and move the robot to a safe position.
0x9066	J3 exceeds Group 6 position limit	J3 exceeds Group 6 position limit	Close the joint position monitoring function or deactivate Group 6, and move the robot to a safe position.
0x9067	J4 exceeds Group 6 position limit	J4 exceeds Group 6 position limit	Close the joint position monitoring function or deactivate Group 6, and move the robot to a safe position.
0x9068	J5 exceeds Group 6 position limit	J5 exceeds Group 6 position limit	Close the joint position monitoring function or deactivate Group 6, and move the robot to a safe position.
0x9069	J6 exceeds Group 6 position limit	J6 exceeds Group 6 position limit	Close the joint position monitoring function or deactivate Group 6, and move the robot to a safe position.
0x906A	J1 exceeds Group 7 position limit	J1 exceeds Group 7 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.
0x906B	J2 exceeds Group 7 position limit	J2 exceeds Group 7 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.

Error code	Description	Cause	Solution
0x906C	J3 exceeds Group 7 position limit	J3 exceeds Group 7 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.
0x906D	J4 exceeds Group 7 position limit	J4 exceeds Group 7 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.
0x906E	J5 exceeds Group 7 position limit	J5 exceeds Group 7 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.
0x906F	J6 exceeds Group 7 position limit	J6 exceeds Group 7 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.
0x9070	J1 exceeds Group 8 position limit	J1 exceeds Group 8 position limit	Close the joint position monitoring function or deactivate Group 8, and move the robot to a safe position.
0x9071	J2 exceeds Group 8 position limit	J2 exceeds Group 8 position limit	Close the joint position monitoring function or deactivate Group 8, and move the robot to a safe position.
0x9072	J3 exceeds Group 8 position limit	J3 exceeds Group 8 position limit	Close the joint position monitoring function or deactivate Group 7, and move the robot to a safe position.
0x9073	J4 exceeds Group 8 position limit	J4 exceeds Group 8 position limit	Close the joint position monitoring function or deactivate Group 8, and move the robot to a safe position.
0x9074	J5 exceeds Group 8 position limit	J5 exceeds Group 8 position limit	Close the joint position monitoring function or deactivate Group 8, and move the robot to a safe position.
0x9075	J6 exceeds Group 8 position limit	J6 exceeds Group 8 position limit	Close the joint position monitoring function or deactivate Group 8, and move the robot to a safe position.
0x9077	Overspeed in manual mode	The TCP speed of the robot in manual mode exceeds 250 mm/s.	Clear the alarm.
0x9078	TCP speed exceeds Group 1 limit	The TCP speed of the robot exceeds the Group 1 limit.	Clear the alarm.

Error code	Description	Cause	Solution
0x9079	TCP speed exceeds Group 2 limit	The TCP speed of the robot exceeds the Group 2 limit.	Clear the alarm.
0x907A	TCP speed exceeds Group 3 limit	The TCP speed of the robot exceeds the Group 3 limit.	Clear the alarm.
0x907B	TCP speed exceeds Group 4 limit	The TCP speed of the robot exceeds the Group 4 limit.	Clear the alarm.
0x907C	TCP speed exceeds Group 5 limit	The TCP speed of the robot exceeds the Group 5 limit.	Clear the alarm.
0x907D	TCP speed exceeds Group 6 limit	The TCP speed of the robot exceeds the Group 6 limit.	Clear the alarm.
0x907E	TCP speed exceeds Group 7 limit	The TCP speed of the robot exceeds the Group 7 limit.	Clear the alarm.
0x907F	TCP speed exceeds Group 8 limit	The TCP speed of the robot exceeds the Group 8 limit.	Clear the alarm.
0x9080	Robot enters interference zone 1	The robot enters the interference zone 1.	Close the TCP position monitoring function or deactivate the interference zone 1.
0x9081	Robot enters interference zone 2	The robot enters the interference zone 2.	Close the TCP position monitoring function or deactivate the interference zone 2.
0x9082	Robot enters interference zone 3	The robot enters the interference zone 3.	Close the TCP position monitoring function or deactivate the interference zone 3.
0x9083	Robot enters interference zone 4	The robot enters the interference zone 4.	Close the TCP position monitoring function or deactivate the interference zone 4.
0x9084	Robot enters interference zone 5	The robot enters the interference zone 5.	Close the TCP position monitoring function or deactivate the interference zone 5.

Error code	Description	Cause	Solution
0x9085	Robot enters interference zone 6	The robot enters the interference zone 6.	Close the TCP position monitoring function or deactivate the interference zone 6.
0x9086	Robot enters interference zone 7	The robot enters the interference zone 7.	Close the TCP position monitoring function or deactivate the interference zone 7.
0x9087	Robot enters interference zone 8	The robot enters the interference zone 8.	Close the TCP position monitoring function or deactivate the interference zone 8.
0x9088	Robot enters interference zone 9	The robot enters the interference zone 9.	Close the TCP position monitoring function or deactivate the interference zone 9.
0x9089	Robot enters interference zone 10	The robot enters the interference zone 10.	Close the TCP position monitoring function or deactivate the interference zone 10.
0x908A	Robot enters interference zone 11	The robot enters the interference zone 11.	Close the TCP position monitoring function or deactivate the interference zone 11.
0x908B	Robot enters interference zone 12	The robot enters the interference zone 12.	Close the TCP position monitoring function or deactivate the interference zone 12.
0x908C	Robot enters interference zone 13	The robot enters the interference zone 13.	Close the TCP position monitoring function or deactivate the interference zone 13.
0x908D	Robot enters interference zone 14	The robot enters the interference zone 14.	Close the TCP position monitoring function or deactivate the interference zone 14.
0x908E	Robot enters interference zone 15	The robot enters the interference zone 15.	Close the TCP position monitoring function or deactivate the interference zone 15.
0x908F	Robot enters interference zone 16	The robot enters the interference zone 16.	Close the TCP position monitoring function or deactivate the interference zone 16.
0x9090	J1 position check error for master chip	J1 position check error for master chip	Contact the manufacturer.
0x9091	J2 position check error for master chip	J2 position check error for master chip	Contact the manufacturer.

Error code	Description	Cause	Solution
0x9092	J3 position check error for master chip	J3 position check error for master chip	Contact the manufacturer.
0x9093	J4 position check error for master chip	J4 position check error for master chip	Contact the manufacturer.
0x9094	J5 position check error for master chip	J5 position check error for master chip	Contact the manufacturer.
0x9095	J6 position check error for master chip	J6 position check error for master chip	Contact the manufacturer.
0x9096	J1 position check error for slave chip	J1 position check error for slave chip	Contact the manufacturer.
0x9097	J2 position check error for slave chip	J2 position check error for slave chip	Contact the manufacturer.
0x9098	J3 position check error for slave chip	J3 position check error for slave chip	Contact the manufacturer.
0x9099	J4 position check error for slave chip	J4 position check error for slave chip	Contact the manufacturer.
0x909A	J5 position check error for slave chip	J5 position check error for slave chip	Contact the manufacturer.
0x909B	J6 position check error for slave chip	J6 position check error for slave chip	Contact the manufacturer.
0x909C	Category 1 emergency stop time too long	The Category 1 emergency stop exceeds the limit.	1. Set the delay for Category 1 emergency stop to a larger value. 2. Contact the manufacturer.
0x909D	STO stop time too long	The STO stop time exceeds the limit.	1. Set the delay for Category 0 emergency stop to a larger value. 2. Contact the manufacturer.
0x909E	J1 CRC failed for master chip data frame	J1 CRC failed for master chip data frame	Contact the manufacturer.
0x909F	J2 CRC failed for master chip data frame	J2 CRC failed for master chip data frame	Contact the manufacturer.
0x90A0	J3 CRC failed for master chip data frame	J3 CRC failed for master chip data frame	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90A1	J4 CRC failed for master chip data frame	J4 CRC failed for master chip data frame	Contact the manufacturer.
0x90A2	J5 CRC failed for master chip data frame	J5 CRC failed for master chip data frame	Contact the manufacturer.
0x90A3	J6 CRC failed for master chip data frame	J6 CRC failed for master chip data frame	Contact the manufacturer.
0x90A4	J1 CRC failed for master chip calculated data frame	J1 CRC failed for master chip calculated data frame.	Contact the manufacturer.
0x90A5	J2 CRC failed for master chip calculated data frame	J2 CRC failed for master chip calculated data frame.	Contact the manufacturer.
0x90A6	J3 CRC failed for master chip calculated data frame	J3 CRC failed for master chip calculated data frame.	Contact the manufacturer.
0x90A7	J4 CRC failed for master chip calculated data frame	J4 CRC failed for master chip calculated data frame.	Contact the manufacturer.
0x90A8	J5 CRC failed for master chip calculated data frame	J5 CRC failed for master chip calculated data frame.	Contact the manufacturer.
0x90A9	J6 CRC failed for master chip calculated data frame	J6 CRC failed for master chip calculated data frame.	Contact the manufacturer.
0x90AA	J1 CRC failed for slave chip data frame	J1 CRC failed for slave chip data frame	Contact the manufacturer.
0x90AB	J2 CRC failed for slave chip data frame	J2 CRC failed for slave chip data frame	Contact the manufacturer.
0x90AC	J3 CRC failed for slave chip data frame	J3 CRC failed for slave chip data frame	Contact the manufacturer.
0x90AD	J4 CRC failed for slave chip data frame	J4 CRC failed for slave chip data frame	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90AE	J5 CRC failed for slave chip data frame	J5 CRC failed for slave chip data frame	Contact the manufacturer.
0x90AF	J6 CRC failed for slave chip data frame	J6 CRC failed for slave chip data frame	Contact the manufacturer.
0x90B0	J1 CRC failed for slave chip calculated data frame	J1 CRC failed for slave chip calculated data frame.	Contact the manufacturer.
0x90B1	J2 CRC failed for slave chip calculated data frame	J2 CRC failed for slave chip calculated data frame.	Contact the manufacturer.
0x90B2	J3 CRC failed for slave chip calculated data frame	J3 CRC failed for slave chip calculated data frame.	Contact the manufacturer.
0x90B3	J4 CRC failed for slave chip calculated data frame	J4 CRC failed for slave chip calculated data frame.	Contact the manufacturer.
0x90B4	J5 CRC failed for slave chip calculated data frame	J5 CRC failed for slave chip calculated data frame.	Contact the manufacturer.
0x90B5	J6 CRC failed for slave chip calculated data frame	J6 CRC failed for slave chip calculated data frame.	Contact the manufacturer.
0x90B6	J1 SN code fluctuates in master chip data frame	J1 SN code fluctuates in master chip data frame	Contact the manufacturer.
0x90B7	J2 SN code fluctuates in master chip data frame	J2 SN code fluctuates in master chip data frame	Contact the manufacturer.
0x90B8	J3 SN code fluctuates in master chip data frame	J3 SN code fluctuates in master chip data frame	Contact the manufacturer.
0x90B9	J4 SN code fluctuates in master chip data frame	J4 SN code fluctuates in master chip data frame	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90BA	J5 SN code fluctuates in master chip data frame	J5 SN code fluctuates in master chip data frame	Contact the manufacturer.
0x90BB	J6 SN code fluctuates in master chip data frame	J6 SN code fluctuates in master chip data frame	Contact the manufacturer.
0x90BC	J1 SN code fluctuates in master chip calculated data frame	J1 SN code fluctuates in master chip calculated data frame.	Contact the manufacturer.
0x90BD	J2 SN code fluctuates in master chip calculated data frame	J2 SN code fluctuates in master chip calculated data frame.	Contact the manufacturer.
0x90BE	J3 SN code fluctuates in master chip calculated data frame	J3 SN code fluctuates in master chip calculated data frame.	Contact the manufacturer.
0x90BF	J4 SN code fluctuates in master chip calculated data frame	J4 SN code fluctuates in master chip calculated data frame.	Contact the manufacturer.
0x90C0	J5 SN code fluctuates in master chip calculated data frame	J5 SN code fluctuates in master chip calculated data frame.	Contact the manufacturer.
0x90C1	J6 SN code fluctuates in master chip calculated data frame	J6 SN code fluctuates in master chip calculated data frame.	Contact the manufacturer.
0x90C2	J1 SN code fluctuates in slave chip data frame	J1 SN code fluctuates in slave chip data frame	Contact the manufacturer.
0x90C3	J2 SN code fluctuates in slave chip data frame	J2 SN code fluctuates in slave chip data frame	Contact the manufacturer.
0x90C4	J3 SN code fluctuates in slave chip data frame	J3 SN code fluctuates in slave chip data frame	Contact the manufacturer.
0x90C5	J4 SN code fluctuates in slave chip data frame	J4 SN code fluctuates in slave chip data frame	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90C6	J5 SN code fluctuates in slave chip data frame	J5 SN code fluctuates in slave chip data frame	Contact the manufacturer.
0x90C7	J6 SN code fluctuates in slave chip data frame	J6 SN code fluctuates in slave chip data frame	Contact the manufacturer.
0x90C8	J1 SN code fluctuates in slave chip calculated data frame	J1 SN code fluctuates in slave chip calculated data frame.	Contact the manufacturer.
0x90C9	J2 SN code fluctuates in slave chip calculated data frame	J2 SN code fluctuates in slave chip calculated data frame.	Contact the manufacturer.
0x90CA	J3 SN code fluctuates in slave chip calculated data frame	J3 SN code fluctuates in slave chip calculated data frame.	Contact the manufacturer.
0x90CB	J4 SN code fluctuates in slave chip calculated data frame	J4 SN code fluctuates in slave chip calculated data frame.	Contact the manufacturer.
0x90CC	J5 SN code fluctuates in slave chip calculated data frame	J5 SN code fluctuates in slave chip calculated data frame.	Contact the manufacturer.
0x90CD	J6 SN code fluctuates in slave chip calculated data frame	J6 SN code fluctuates in slave chip calculated data frame.	Contact the manufacturer.
0x90CE	J1 multi-turn value in master chip overflows	J1 multi-turn value in master chip overflows	Contact the manufacturer.
0x90CF	J2 multi-turn value in master chip overflows	J2 multi-turn value in master chip overflows	Contact the manufacturer.
0x90D0	J3 multi-turn value in master chip overflows	J3 multi-turn value in master chip overflows	Contact the manufacturer.
0x90D1	J4 multi-turn value in master chip overflows	J4 multi-turn value in master chip overflows	Contact the manufacturer.
0x90D2	J5 multi-turn value in master chip overflows	J5 multi-turn value in master chip overflows	Contact the manufacturer.
0x90D3	J6 multi-turn value in master chip overflows	J6 multi-turn value in master chip overflows	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90D4	J1 estimated multi-turn value in master chip overflows	J1 estimated multi-turn value in master chip overflows	Contact the manufacturer.
0x90D5	J2 estimated multi-turn value in master chip overflows	J2 estimated multi-turn value in master chip overflows	Contact the manufacturer.
0x90D6	J3 estimated multi-turn value in master chip overflows	J3 estimated multi-turn value in master chip overflows	Contact the manufacturer.
0x90D7	J4 estimated multi-turn value in master chip overflows	J4 estimated multi-turn value in master chip overflows	Contact the manufacturer.
0x90D8	J5 estimated multi-turn value in master chip overflows	J5 estimated multi-turn value in master chip overflows	Contact the manufacturer.
0x90D9	J6 estimated multi-turn value in master chip overflows	J6 estimated multi-turn value in master chip overflows	Contact the manufacturer.
0x90DA	J1 multi-turn value in slave chip overflows	J1 multi-turn value in slave chip overflows	Contact the manufacturer.
0x90DB	J2 multi-turn value in slave chip overflows	J2 multi-turn value in slave chip overflows	Contact the manufacturer.
0x90DC	J3 multi-turn value in slave chip overflows	J3 multi-turn value in slave chip overflows	Contact the manufacturer.
0x90DD	J4 multi-turn value in slave chip overflows	J4 multi-turn value in slave chip overflows	Contact the manufacturer.
0x90DE	J5 multi-turn value in slave chip overflows	J5 multi-turn value in slave chip overflows	Contact the manufacturer.
0x90DF	J6 multi-turn value in slave chip overflows	J6 multi-turn value in slave chip overflows	Contact the manufacturer.
0x90E0	J1 estimated multi-turn value in slave chip overflows	J1 estimated multi-turn value in slave chip overflows	Contact the manufacturer.
0x90E1	J2 estimated multi-turn value in slave chip overflows	J2 estimated multi-turn value in slave chip overflows	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90E2	J3 estimated multi-turn value in slave chip overflows	J3 estimated multi-turn value in slave chip overflows	Contact the manufacturer.
0x90E3	J4 estimated multi-turn value in slave chip overflows	J4 estimated multi-turn value in slave chip overflows	Contact the manufacturer.
0x90E4	J5 estimated multi-turn value in slave chip overflows	J5 estimated multi-turn value in slave chip overflows	Contact the manufacturer.
0x90E5	J6 estimated multi-turn value in slave chip overflows	J6 estimated multi-turn value in slave chip overflows	Contact the manufacturer.
0x90E6	Joint position state abnormal	The joint position state is checked inconsistent between master and slave chips.	Contact the manufacturer.
0x90E7	Joint speed state abnormal	The joint speed state is checked inconsistent between master and slave chips.	Contact the manufacturer.
0x90E8	TCP speed state abnormal	The TCP speed state is checked inconsistent between master and slave chips.	Contact the manufacturer.
0x90E9	Low-speed safety function state abnormal	The low-speed state is checked inconsistent between master and slave chips.	Contact the manufacturer.
0x90EA	TCP position monitoring function state abnormal	The TCP position state is checked inconsistent between master and slave chips.	Contact the manufacturer.
0x90EB	Category 1 emergency stop state abnormal	The emergency stop state is checked inconsistent between master and slave chips.	Contact the manufacturer.

Error code	Description	Cause	Solution
0x90EC	Running state abnormal	The running state is checked inconsistent between master and slave chips.	Contact the manufacturer.
0x90ED	System initialization failed	System initialization failed	Contact the manufacturer.
0x90EE	Abnormal J1 in master chip data frame	Abnormal J1 in master chip data frame	Contact the manufacturer.
0x90EF	Abnormal J2 in master chip data frame	Abnormal J2 in master chip data frame	Contact the manufacturer.
0x90F0	Abnormal J3 in master chip data frame	Abnormal J3 in master chip data frame	Contact the manufacturer.
0x90F1	Abnormal J4 in master chip data frame	Abnormal J4 in master chip data frame	Contact the manufacturer.
0x90F2	Abnormal J5 in master chip data frame	Abnormal J5 in master chip data frame	Contact the manufacturer.
0x90F3	Abnormal J6 in master chip data frame	Abnormal J6 in master chip data frame	Contact the manufacturer.
0x90F4	Abnormal J1 in slave chip data frame	Abnormal J1 in slave chip data frame	Contact the manufacturer.
0x90F5	Abnormal J2 in slave chip data frame	Abnormal J2 in slave chip data frame	Contact the manufacturer.
0x90F6	Abnormal J3 in slave chip data frame	Abnormal J3 in slave chip data frame	Contact the manufacturer.
0x90F7	Abnormal J4 in slave chip data frame	Abnormal J4 in slave chip data frame	Contact the manufacturer.
0x90F8	Abnormal J5 in slave chip data frame	Abnormal J5 in slave chip data frame	Contact the manufacturer.
0x90F9	Abnormal J6 in slave chip data frame	Abnormal J6 in slave chip data frame	Contact the manufacturer.
0x90FA	Abnormal J1 in slave chip calculated data frame	Abnormal J1 in slave chip calculated data frame	Contact the manufacturer.
0x90FB	Abnormal J2 in slave chip calculated data frame		Contact the manufacturer.

Error code	Description	Cause	Solution
		Abnormal J2 in slave chip calculated data frame	
0x90FC	Abnormal J3 in slave chip calculated data frame	Abnormal J3 in slave chip calculated data frame	Contact the manufacturer.
0x90FD	Abnormal J4 in slave chip calculated data frame	Abnormal J4 in slave chip calculated data frame	Contact the manufacturer.
0x90FE	Abnormal J5 in slave chip calculated data frame	Abnormal J5 in slave chip calculated data frame	Contact the manufacturer.
0x90FF	Abnormal J6 in slave chip calculated data frame	Abnormal J6 in slave chip calculated data frame	Contact the manufacturer.
0x9100	Abnormal J1 in master chip calculated data frame	Abnormal J1 in master chip calculated data frame	Contact the manufacturer.
0x9101	Abnormal J2 in master chip calculated data frame	Abnormal J2 in master chip calculated data frame	Contact the manufacturer.
0x9102	Abnormal J3 in master chip calculated data frame	Abnormal J3 in master chip calculated data frame	Contact the manufacturer.
0x9103	Abnormal J4 in master chip calculated data frame	Abnormal J4 in master chip calculated data frame	Contact the manufacturer.
0x9104	Abnormal J5 in master chip calculated data frame	Abnormal J5 in master chip calculated data frame	Contact the manufacturer.
0x9105	Abnormal J6 in master chip calculated data frame	Abnormal J6 in master chip calculated data frame	Contact the manufacturer.
0x9106	Master chip triggers Category 0 stop	Master chip triggers Category 0 stop	Clear the alarm.
0x9107	Slave chip triggers Category 0 stop	Slave chip triggers Category 0 stop	Clear the alarm.

Error code	Description	Cause	Solution
0x9200	Batch point modification communication data error	Batch point modification communication data error	Clear the alarm.
0x9201	Batch point modification initialization error	Batch point modification initialization error	Clear the alarm.
0x9202	Error reading point file for batch point modification	Error reading point file for batch point modification	Clear the alarm.
0x9203	Error modifying point cache for batch point modification, please restart the controller.	Error modifying point cache for batch point modification, please restart the controller.	Restart the controller. If the problem persists, contact the manufacturer.
0x9204	Error modifying point file for batch point modification, please restart the controller.	Error modifying point file for batch point modification, please restart the controller.	Restart the controller. If the problem persists, contact the manufacturer.
0x9301	MCUA failed to read EEPROM	Communication error between chip and EEPROM	Contact the manufacturer.
0x9302	MCUB failed to read EEPROM	Communication error between chip and EEPROM	Contact the manufacturer.
0x9303	MCUA failed to write EEPROM	Communication error between chip and EEPROM	Contact the manufacturer.
0x9304	MCUB failed to write EEPROM	Communication error between chip and EEPROM	Contact the manufacturer.
0x9305	MCUA has a DMA transmission error	Communication error between chip and EEPROM	Contact the manufacturer.
0x9306	MCUB has a DMA transmission error	Communication error between chip and EEPROM	Contact the manufacturer.

Error code	Description	Cause	Solution
0x9307	MCUB discharge voltage collection failed	Discharge voltage abnormal	Contact the manufacturer.
0x9308	MCUA 3.3 V abnormal	The power supply voltage of the safety controller is abnormal.	Check the power supply voltage.
0x9309	MCUB 3.3 V abnormal	The power supply voltage of the safety controller is abnormal.	Check the power supply voltage.
0x930A	MCUA board voltage abnormal	The board voltage of safety controller is abnormal.	Check the power supply voltage.
0x930B	MCUB board voltage abnormal	The board voltage of safety controller is abnormal.	Check the power supply voltage.
0x930C	CRC check failed during MCUA initialization	EEPROM parameter in MCUA is abnormal.	Contact the manufacturer.
0x930D	CRC check failed during MCUB initialization	EEPROM parameter in MCUB is abnormal.	Contact the manufacturer.
0x930E	CRC check failed during MCUA mutual check	EEPROM parameter in MCUA is abnormal.	Contact the manufacturer.
0x930F	CRC check failed during MCUB mutual check	EEPROM parameter in MCUB is abnormal.	Contact the manufacturer.
0x9310	MCUA chip self-test failed	The chip is damaged.	Contact the manufacturer.
0x9311	MCUB chip self-test failed	The chip is damaged.	Contact the manufacturer.
0x9312	MCUA failed to parse mailbox data of the host controller	Communication error	Contact the manufacturer.
0x9313	MCUA failed to process mailbox data of the host controller	Communication error	Contact the manufacturer.
0x9314	MCUA failed to parse MCUB mailbox data	Communication error	Contact the manufacturer.
0x9315	MCUA failed to process MCUB mailbox data	Communication error	Contact the manufacturer.
0x9316	MCUB failed to parse MCUA mailbox data	Communication error	Contact the manufacturer.

Error code	Description	Cause	Solution
0x9317	MCUB failed to process MCUA mailbox data	Communication error	Contact the manufacturer.
0x9318	MCUA detects disconnection from MCUB	Communication error	Contact the manufacturer.
0x9319	MCUA detects disconnection from FPGA	Communication error	Contact the manufacturer.
0x931A	MCUA failed to compare DIs	DI abnormal	Contact the manufacturer.
0x931B	MCUB failed to compare DIs	DI abnormal	Contact the manufacturer.
0x931C	MCUA timed out while waiting for a message from MCUB	Communication error	Contact the manufacturer.
0x931D	MCUA interrupt execution timeout	Communication error	Contact the manufacturer.
0x931E	MCUB interrupt execution timeout	Communication error	Contact the manufacturer.
0x931F	MCUA timing abnormal	Communication error	Contact the manufacturer.
0x9320	MCUB timing abnormal	Communication error	Contact the manufacturer.
0x9321	MCUA failed to compare DOs	The DO is abnormal.	Contact the manufacturer.
0x9322	MCUB failed to compare DOs	The DO is abnormal.	Contact the manufacturer.
0x9323	MCUA parameter initialization failed	Parameter saving error	Contact the manufacturer.
0x9324	MCUB parameter initialization failed	Parameter saving error	Contact the manufacturer.
0x9325	MCUA failed to save parameters	Parameter saving error	Contact the manufacturer.
0x9326	MCUB failed to save parameters	Parameter saving error	Contact the manufacturer.
0x9327	MCUA output pin read-back failed	Pin read-back error	Contact the manufacturer.
0x9328	MCUB output pin read-back failed	Pin read-back error	Contact the manufacturer.
0x9329	DI comparison failed for three-position enable	The DI inputs are inconsistent.	Ensure simultaneous DI inputs.

Error code	Description	Cause	Solution
0x932A	Clock self-test failed	The chip or external clock source is abnormal.	Contact the manufacturer.
0x932B	CPU self-test failed	Chip exception	Contact the manufacturer.
0x932C	RAM self-test failed	Chip exception	Contact the manufacturer.
0x932D	Flash self-test failed	Chip exception	Contact the manufacturer.
0x932E	MCUA triggers safety door	The safety door properties have been configured and a DI input is received.	Change the safety parameter DI configuration properties or remove the DI input
0x932F	MCUA triggers an emergency stop	The emergency stop properties have been configured and a DI input is received.	Change the safety parameter DI configuration properties or remove the DI input
0x9330	MCUB triggers safety door	The safety door properties have been configured and a DI input is received.	Change the safety parameter DI configuration properties or remove the DI input
0x9331	MCUB triggers an emergency stop	The emergency stop properties have been configured and a DI input is received.	Change the safety parameter DI configuration properties or remove the DI input
0x9332	MCUA parameter read-back failed	Safety parameter saving error	Contact the manufacturer.
0x9333	MCUB parameter read-back failed	Safety parameter saving error	Contact the manufacturer.
0x9334	Safety parameters initialized, reboot the system	The safety parameters are initialized.	Restart the controller.
0x9345	Main chip of the safety module failed to read the parameter version number	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9346	Slave chip of the safety module failed to read the parameter version number	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.

Error code	Description	Cause	Solution
0x9347	Main chip of the safety module failed to read the parameter length	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9348	Slave chip of the safety module failed to read the parameter length	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9349	CRC write error on the main chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x934A	CRC write error on the slave chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x934B	Length check error on the main chip of the safety module during program update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x934C	Length check error on the slave chip of the safety module during program update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x934D	Parameter version number write error on the main chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x934E	Parameter version number write error on the slave chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x934F	Length info write error on the main chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.

Error code	Description	Cause	Solution
0x9350	Length info write error on the slave chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9351	Parameter error on the main chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9352	Parameter error on the slave chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9353	Parameter write error on the main chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9354	Parameter write error on the slave chip of the safety module during software update	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9355	Incompatible version parameters detected in the main chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9356	Incompatible version parameters detected in the slave chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9361	CRC error detected while writing safety parameters to the main chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9362	CRC error detected while writing safety parameters to the slave chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.

Error code	Description	Cause	Solution
0x9363	Error writing safety parameters during the initialization phase of the main chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9364	Error writing safety parameters during the initialization phase of the slave chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9365	Error writing flag bit during the initialization phase of the main chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9366	Error writing flag bit during the initialization phase of the slave chip of the safety module	Software update caused a safety parameter compatibility issue.	Contact the manufacturer.
0x9500	Failed to issue robot body parameters	The communication between A40i and MCU is abnormal.	Check the communication status between A40i and MCU.
0x9501	MCU alarm clearance failed	The communication between A40i and MCU is abnormal.	Check the communication status between A40i and MCU.
0x9502	No MCU board detected	MCU is loose or has been removed.	Check if the MCU has poor contact.
0x9503	Communication between MCU and FPGA disconnected	The communication between MCU and FPGA is disconnected.	Check the MCU communication status.
0x9504	Failed to obtain MCU version	The communication between A40i and MCU is abnormal.	Check the MCU communication status.
0x9505	Safety MCU and controller version mismatch	Safety MCU and controller version mismatch	Reflash the safety MCU version or controller version.
0xE001	Normal operation	Normal operation	No action is required.
0xE002	Firmware loading failed	Unable to get firmware from SD card	Check whether it is in test mode, check the SD card content.

Error code	Description	Cause	Solution
0xE003	Firmware loading failed	Unable to get the correct firmware from Flash	Re-upgrade the system.
0xE004	Firmware loading failed	FPGA failed to reset	Restart the controller. If the problem persists, contact the manufacturer.
0xE005	Firmware loading failed	FPGA transmission error	Restart the controller. If the problem persists, contact the manufacturer.
0xE006	Firmware loading failed	Handshake with FPGA failed	Restart the controller. If the problem persists, contact the manufacturer.
0xE007	Control channel 1 running properly	Control channel 1 running properly	No action is required.
0xE008	Failed to allocate memory to control channel 1	No enough memory	Restart the controller. If the problem persists, contact the manufacturer.
0xE009	Firmware loading failed	Firmware not found or information not available	Restart the controller. If the problem persists, contact the manufacturer.
0xE00A	Firmware loading failed	Firmware not found or information not available	Restart the controller. If the problem persists, contact the manufacturer.
0xE00B	Control channel 1 firmware length out of range	Control channel 1 firmware length out of range	Restart the controller. If the problem persists, contact the manufacturer.
0xE00C	Firmware loading failed	Unable to communicate with FPGA	Restart the controller. If the problem persists, contact the manufacturer.
0xE00D	Failed to reset control channel 1	Failed to reset control channel 1	Restart the controller. If the problem persists, contact the manufacturer.
0xE00E	SPI communication failed	Failed to send start word	Restart the controller. If the problem persists, contact the manufacturer.
0xE00F	SPI communication failed	POS action failed	Restart the controller. If the problem persists, contact the manufacturer.
0xE010	Failed to regulate communication rate of channel 1	Failed to regulate communication rate of channel 1	Restart the controller. If the problem persists, contact the manufacturer.

Error code	Description	Cause	Solution
0xE011	Control channel 1 data loading timeout	Control channel 1 data loading timeout	Restart the controller. If the problem persists, contact the manufacturer.
0xE012	Control channel 1 running response is abnormal.	Control channel 1 running response is abnormal.	Restart the controller. If the problem persists, contact the manufacturer.
0xE013	Control channel 0 running properly	Control channel 0 running properly	No action is required.
0xE014	Failed to allocate memory to control channel 0	No enough memory	Restart the controller. If the problem persists, contact the manufacturer.
0xE015	Firmware loading failed	Firmware not found or information not available	Restart the controller. If the problem persists, contact the manufacturer.
0xE016	Firmware loading failed	Firmware not found or information not available	Restart the controller. If the problem persists, contact the manufacturer.
0xE017	Control channel 0 firmware length out of range	Control channel 0 firmware length out of range	Restart the controller. If the problem persists, contact the manufacturer.
0xE018	Firmware loading failed	Unable to communicate with FPGA	Restart the controller. If the problem persists, contact the manufacturer.
0xE019	Failed to reset control channel 0	Failed to reset control channel 0	Restart the controller. If the problem persists, contact the manufacturer.
0xE01A	SPI communication failed	Failed to send start word	Restart the controller. If the problem persists, contact the manufacturer.
0xE01B	SPI communication failed	POS action failed	Restart the controller. If the problem persists, contact the manufacturer.
0xE01C	Failed to regulate communication rate of channel 0	Failed to regulate communication rate of channel 0	Restart the controller. If the problem persists, contact the manufacturer.
0xE01D	Control channel 0 data loading timeout	Control channel 0 data loading timeout	Restart the controller. If the problem persists, contact the manufacturer.
0xE01E	Control channel 0 running response is abnormal.	Control channel 0 running response is abnormal.	Restart the controller. If the problem persists, contact the manufacturer.

Error code	Description	Cause	Solution
0xE101	Error loading controller parameters	Error loading controller parameters	Contact the manufacturer.
0xE102	Error loading robot model parameters	Error loading robot model parameters	Import the parameters of the corresponding model.
0xE103	Error loading machine parameter patch	Error loading machine parameter patch	Import the parameters of the corresponding model.
0xE104	The machine parameter version and software version are incompatible.	The machine parameter version and software version are incompatible.	Import machine parameters compatible with the software.
0xE105	Error writing servo parameter	Error writing servo parameter	Contact the manufacturer.
0xE107	Servo parameters updated automatically, please reboot the controller.	Servo parameters updated automatically, please reboot the controller.	Restart the controller.
0xE109	The controller software version is incompatible with the manipulator parameter version.	The controller software version is incompatible with the manipulator parameter version.	Turn off the universality switch, reprogram or upgrade the system.
0xE10A	The controller parameters are inconsistent with the manipulator parameters.	The controller parameters are inconsistent with the manipulator parameters.	Switch control to the teach pendant or InoRobotLab and enable universality configuration.
0xE10B	The power of the controller does not match that of the manipulator.	The power of the controller does not match that of the manipulator.	Replace the controller or manipulator.
0xE10D	Version information mismatch, use software that matches the controller version	The version of the teach pendant or InoRobotLab does not match the version of the controller.	Use a teach pendant or InoRobotLab that matches the version of the controller.
0x00010001	Invalid parameter while setting data		
0x00010002	Invalid parameter while getting data		

Error code	Description	Cause	Solution
0x00010003	Project name already exists.		
0x00010004	The path of the project to be loaded does not exist.		
0x00010005	Program file already exists.		
0x00010006	Invalid IP address or port		
0x00010007	Device offline		
0x00010008	Device not enabled		
0x00010009	Failed to set line number		
0x0001000a	Failed to start run		
0x0001000b	Failed to read run status		
0x0001000c	Failed to stop run		
0x0001000d	Failed to pause		
0x0001000e	Failed to set mode		
0x00010011	Command undefined		
0x00010013	Failed to grant system control		
0x00010014	Download file under non-manual mode		
0x00010015	Decoding in progress		
0x00010016	The directory already exists.		
0x00010017	Main program is not matched while start run.		
0x00010018	Single axis movement not allowed in auto mode		
0x00010019	Failed to set speed		

Error code	Description	Cause	Solution
0x0001001a	Failed to stop motion		
0x0001001b	Operation not allowed in auto mode		
0x0001001c	Operation not allowed in non-stop mode		
0x0001001d	Operation not allowed when cursor line is in the subroutine		

19012798A00

Copyright © Shenzhen Inovance Technology Co., Ltd.

Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park,
Guanlan Street, Longhua New District,
Shenzhen 518000, P.R. China
Tel: (0755) 2979 9595 Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No.52, Tian E Dang Road, Wuzhong District,
Suzhou 215104, P.R. China
Tel: (0512) 6637 6666 Fax: (0512) 6285 6720