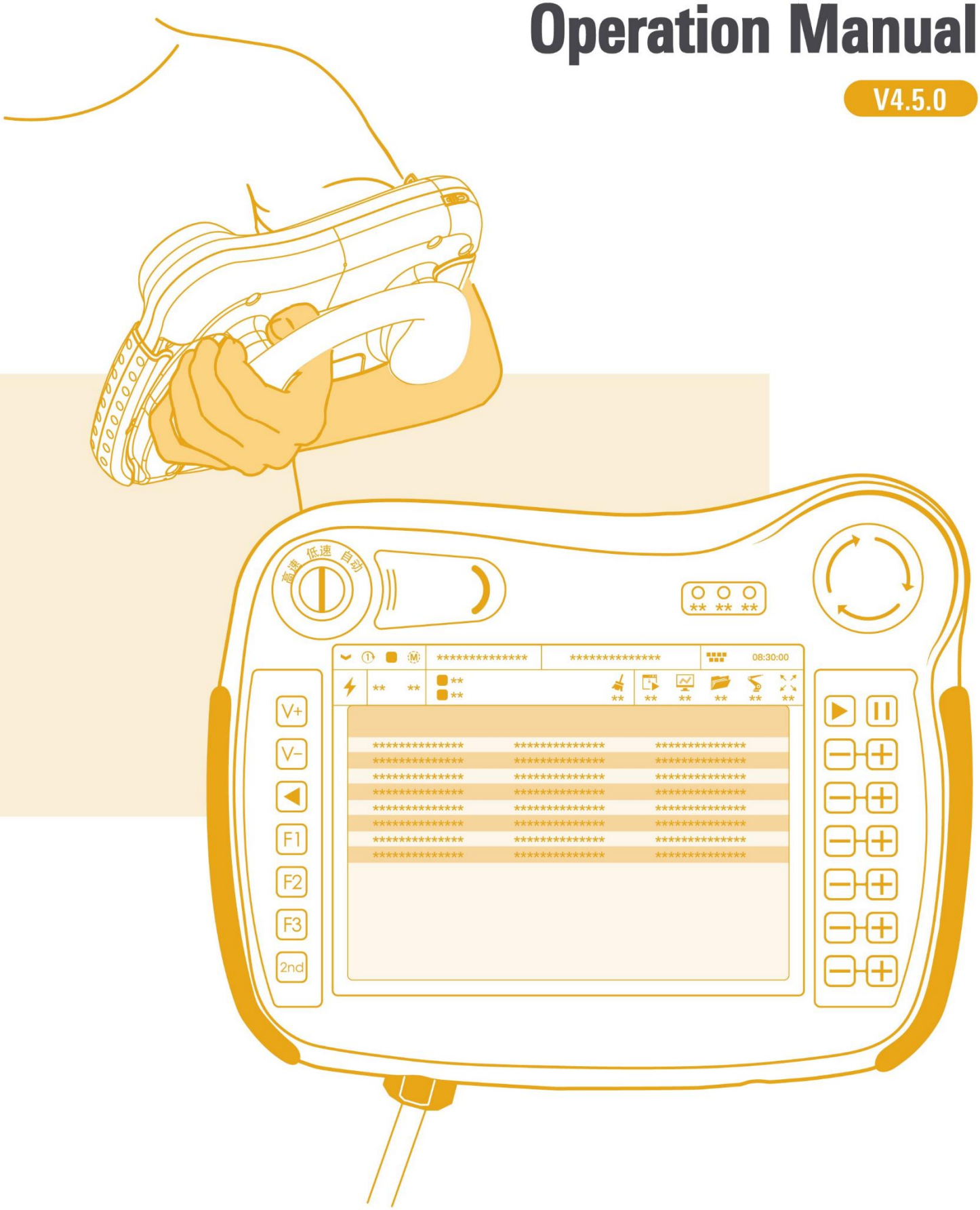
PEITIAN ROBOTICS

AIR-TP Teach Pendant Operation Manual

V4.5.0



Foreword

About this manual

This manual introduces how to use the AIR-TP teach pendant to operate the industrial robot system based on the AIR type industrial robot.

Prerequisites

safety instructions of the product carefully. Users must understand the safety knowledge and basic operation knowledge before using the teach pendant.

Please read the following documents when necessary:

- "ARL Programming Manual"
- "XX type industrial robot manipulator manual v
- "XX type control cabinet manual "

Target groups

- Operators
- Product technicians
- Technical service personnel
- Robot teachers

Meaning of common signs

The signs and their meanings in this manual are detailed in Table 1.

Table 1 Signs used in this manual

Sign	Meaning
Danger	Failure to follow the instructions may result in an accident causing the severe or fatal injury or the great losses of property.
Warning	Failure to follow the instructions may resulting in moderate injuries or minor injuries, or only material damage may occur.
Caution	Prompt for the environmental conditions and important things or shortcuts you shall pay attention to

Sign	Meaning
Prompt	Prompt for additional literature and instructions for additional information or more detailed operating instructions

Manual description

The contents of this manual are subject to supplementation and modification. Please visit "Download Center" on the website regularly to obtain the latest version of this manual in a timely manner.

Website URL: http://robot.peitian.com/

See Table 2 for manual related information.

Table 2 Related information of this manual

Iterm	Illustrate
Manual name	*AIR-TP teach pendant operation manual*
Manual number	UM-P05070000001-001
Manual version	V4.5.0
Software version	2.6.5

Revision history

The revision history contains the instructions for each document update. The latest version of the document contains updates to all previous versions of the document.

Table 3 Signs used in this manual

Version	Publication date	Modification description
V4.1.1	2019.12.24	The corresponding software version is upgraded from 2.5.5 to 2.6.1
V4.1.2	2020.06.30	The corresponding software version is upgraded from 2.6.1 to 2.6.2
V4.3.0	2020.10.30	The corresponding software version is upgraded from 2.6.2 to 2.6.3
V4.4.0	2021.03.15	The corresponding software version is upgraded from 2.6.3 to 2.6.4
V4.4.1	2022.01.11	Added "User Security DO Application Scenario "
V4.5.0	2022.03.31	The corresponding software version is upgraded from 2.6.4 to 2.6.5

Symbol convention

See Table 4 for the symbols and conventions used in the document.

Table 4 Symbol conventions

Format	Meaning
<>	Button names are indicated with angle brackets '<>', such as 'Click the <Yes> button'.
[]	The square brackets '[]' indicate the names of windows, menus, and data tables, such as 'pop up the [New User] window'.
/	Multiple-level menus are separated by '/'. For example, 'File/New/Folder' represents the menu item 'Folder' under the sub-menu 'New' under the menu 'File'.

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1 Safety precautions

The robot owner and operator must be responsible for their own safety. Petian Robotics Co., Ltd. is not responsible for the safety of the robot. The user must pay attention to the use of safety equipment when using the robot and must abide by the safety provisions.

1.1 Use environment

Robot could not be used in below environments:

- Burning environment
- Potential explosive environment
- Radio interference environment
- In water or other liquids

1.2 Safety operating procedures

Teaching and manual operation of the robot

- Please do not operate the teach pendant and operation panel with gloves
- Use lower speed multiplier to jog the robot for better controllability.
- The movement trend of the robot should be considered before pressing the jog button on the teach pendant.
- It is necessary to pre-consider the movement trajectory of the robot so as to avoid interference.
- The area around the robot must be clean and free of oil, water and impurities.

2 Overview of the teach pendant

2.1 Overview

The Robot Teach Pendant (AIR-TP) is a handheld device for operating and controlling the robot. The weight of the AIR-TP Teach Pendant is 1.2kg. It can be used by hand or placed flat on the desktop. It is usually placed directly above the control cabinet when stored (reference Figure 2-1) or hang on the side of the control cabinet.

Figure 2-1 Where and how to place the robot teach pendant

If the teach pendant is placed incorrectly, the teach pendant may fall or be damaged.

Normally, the teach pendant is operated in a handheld mode. Users who are accustomed to right-handed operation need to hold the teach pendant with their left hand, and then use the right hand to operate the buttons and touch screen on the teach pendant. The recommended holding method is shown in Figure 2-2.

Figure 2-2 The correct posture of holding the teach pendant

2.2 Label description

The position of the nameplate and matching label of the teach pendant is shown in Figure 2-3.

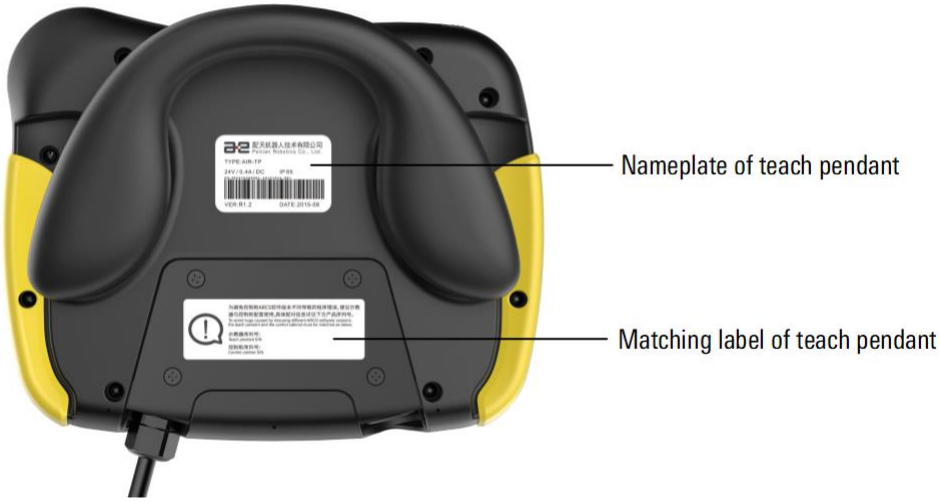


Figure 2-3 The position of the nameplate and matching label of the teach pendant

2.2.1 Nameplate of Teach Pendant

Please refer to Figure 2-4 for the contents of the nameplate of the teach pendant, which contains the product model, version number, production date and other information. The serial number of the teach pendant will be printed on the nameplate when the product is shipped.

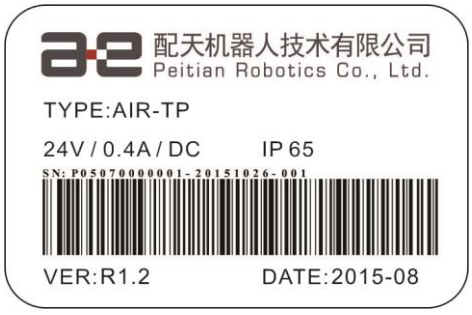


Figure 2-4 The location of the nameplate of the teach pendant and the matching label

2.2.2 Teach Pendant pairing label

Please refer to Figure 2-5 for the contents of the matching label of the teach pendant, please confirm:

- The serial number of the teach pendant in Figure 2-5 is consistent with the serial number on the nameplate of the teach pendant;
- The serial number of the control cabinet in Figure 2-5 is consistent with the serial number on the nameplate of the connected control cabinet.

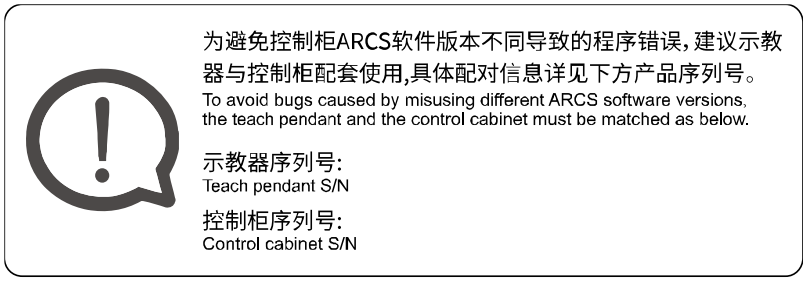


Figure 2-5 The position of the nameplate of the teach pendant and the matching label

2.3 Composition

The position of the components of the teach pendant is shown in Figure 2-6, and the description of the corresponding components of the teach pendant is shown in Table 2-1.

(a) Front view

(b) Top view

(c) Right side view
Figure 2-6 Contents of the components of the teach pendant

Table 2-1 Description of the components of the teach pendant

No.	Name	Description
1	Mode switch key	Manual high speed, manual low speed, automatic three modes
2	USB interface protection cover	Protect the USB interface
3	Indicator light	Indicate power, operation and error status
4	Emergency stop button	Press the emergency stop button, the robot stops moving; after the robot stops moving, turn the button clockwise and manually clear the error alarm to release the emergency stop state and return to the normal state
5	Control key	Run the program and manually control the movement of the mechanical unit (Each manipulator, positioner, conveyor belt, etc. configured in the system can be used as a mechanical unit).
6	Function keys	Provide shortcut keys for some functions
7	Display (touch screen)	HMI operating area
8	Enable key	For specific usage, please refer to Chapter 2.3.2.
9	Multi-grip handle	Hand-held part, refer to Figure 2-2 for holding posture
10	Teach pendant connection cable	The cable has been connected at the factory, no user connection is required, and the default connection is on the left.
11	Stylus	Used to tap the touch screen

Next, the use of several commonly used components will be described in detail.

2.3.1 Mode switch key

Refer to Figure 2-7 for the three modes of the mode switch key on the upper left of the front of the robot teach pendant.

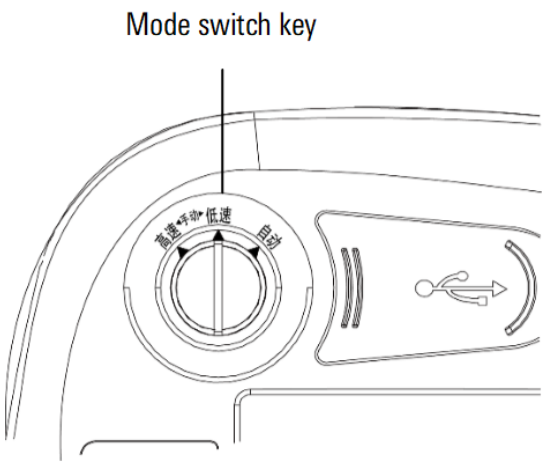


Figure 2-7 Mode switch key

Figure 2-8 Running status bar

The mode switch determines the mode status by turning the key. It is located at the upper left of the teach pendant. The main function is to switch the mode. There are three main modes provided (refer to Table 2-2).

Table 2-2 Mode switch key description

Name	Description	function
Manual high speed mode	Turn the key to the left to switch to manual high-speed mode, and the control mode icon status in the "running status bar" of the teach pendant (refer to Figure 2-8) is "Ⓜ"	For detailed functions, please refer to Chapter 4.1.4
Manual low speed mode	Turn the key to the middle to switch to manual low speed mode, and the control mode icon status in the "running status bar" of the teach pendant is "Ⓜ"	
Automatic mode	Turn the key to the right to switch to automatic mode, the status of the control mode icon in the "operation status bar" of the teach pendant is "Ⓐ"	

Caution

Two keys for operating mode switching are usually provided. Please keep them properly to avoid losing them.

2.3.2 Enable button

The enable buttons can be installed on the left or right sides of the rear housing of the teach pendant. The default installation is on the right side when leaving the factory, as shown in Figure 2-6.

Steps for usage:

Step1.When the enable key is fully released, the natural state is the first key position, and the robot is not enabled and cannot be operated.

Step2.Gently buckle the enable key (located on the right side of the teach pendant in Figure 2-9) to make it stay in the second key position, and the robot is then enabled (a "click" sound is heard). At the same time, the lightning icon in status bar is displayed as " " (highlighted), the "Run" indicator of the control cabinet turns on, and then manual operation can be carried out (you need to keep pressing the enable key).

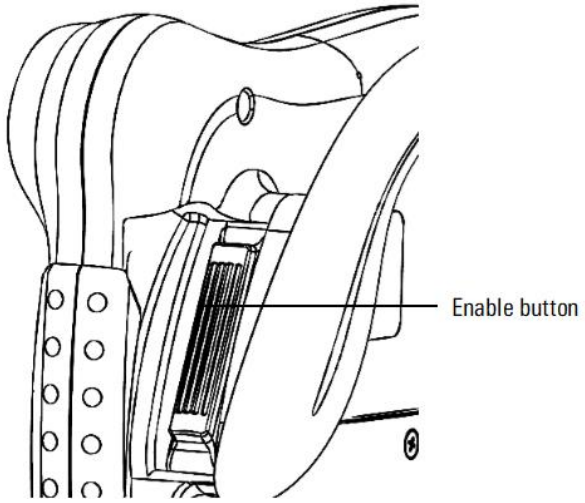


Figure 2-9 Teach pendant enable button

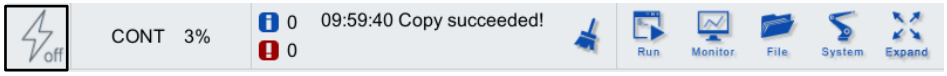


Figure 2-10 Enable status bar

Step3.Continue to press down firmly. At this time, it is the third key position. The robot is enabled (a "click" sound is heard), and the lightning icon in the enable status bar (see Figure 2-10) is displayed as " " (gray). The "Run" indicator light of the control cabinet goes out.

Step4.When the enable key is in the second key position, release the key to return to the first key position, the robot is disabled, and the lightning icon in the enable status bar (see Figure 2-10) is displayed as " " (gray).

2.3.3 Control keys

There are two ways to operate the robot manually, please refer to Chapter 4.10.1:

- Single-axis mode operation: Each axis can run forward or reverse independently.
- Cartesian mode operation: TCP (Tool Center Point, robot end execution point) moves forward or backward along the axis of the coordinate system.
- Tool mode The user can control the TCP of the manipulator to move linearly along the positive or negative direction of the X/Y/Z axis of the tool coordinate system, and can also control the TCP of the manipulator to rotate around the X/Y/Z axis of the tool coordinate system.

Refer to Figure 2-11 for the contents of the operation control keys when running the robot manually. The corresponding functions and meanings of each key (in single-axis mode and Cartesian mode) are shown in Table 2-3. "System sidebar (axis indication)" is related Please refer to Chapter 4.13 for instructions.

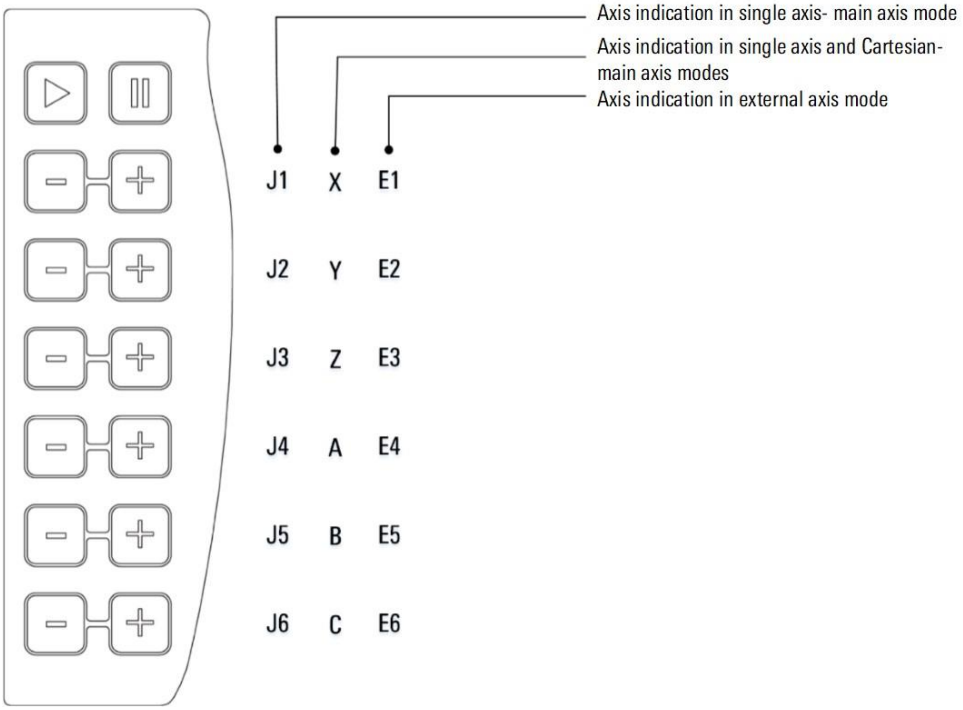


Figure 2-11 Teach pendant control keys

Table 2-3 Operating instructions for teach pendant control keys

Sign	Single axis mode	Cartesian mode	Tool mode
	Start running program operation		
	Pause program operation		
	Control a certain axis of the manipulator to move forward	Control the TCP point of the manipulator to move in the positive direction of the X axis, Y axis, or Z axis, and also control the TCP point of the manipulator to rotate around the Z axis, Y axis or X axis	Control the TCP point of the manipulator to move along the positive direction of the X, Y, or Z axis of the tool coordinate system, and also control the TCP point of the manipulator to rotate around the Z, Y or X axis of the tool coordinate system
	Control a certain axis of the manipulator for negative movement	Control the TCP point of the manipulator to move in the negative direction of the X axis, Y axis, or Z axis, and also control the TCP point of the manipulator to rotate around the Z axis, Y axis or X axis	Control the TCP point of the manipulator to move along the X axis, Y axis, or the negative direction of the Z axis of the tool coordinate system, and also control the TCP point of the manipulator to rotate around the Z axis, Y axis or X axis of the tool coordinate system

2.3.4 Function keys

Please refer to Chapter 8.3.2 for the configuration and usage of all buttons on the left side of the front of the teach pendant.

2.3.5 Emergency stop button

The emergency stop button is located at the upper right corner of the front of the teach pendant, as shown in Figure 2-12. The emergency stop button is when an emergency occurs, the user can quickly press this button to achieve protection.

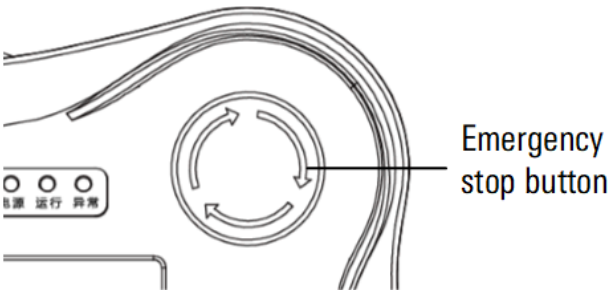


Figure 2-12 Emergency stop button of teach pendant

Steps for usage:

Step1.In case of emergency, press the emergency stop button, the robot will stop moving, and the "message bar" of the teach pendant displays the relevant alarm information of "Teach pendant emergency stop button is pressed", refer to Figure 2-13. The "Alarm" indicator of the teach pendant turns red.

Figure 2-13 Teach pendant "message bar" alarm

Step2.After the robot movement stops, turn the button clockwise to release the emergency stop state, the emergency stop button pops up, click the " " icon in the message bar of the teach pendant to manually clear the relevant alarms, and the "alarm" indicator of the teach pendant goes out, Return to normal state.

2.3.6 Indicator

The indicator light is located on the upper right side of the front of the robot teach pendant. Refer to Figure 2-6 for specific locations. There are three indicators: power supply, operation and alarm. The meanings and functions of each are shown in Table 2-4.

Table 2-4 Teach pendant indicator light description

Sign	Description
Power supply	After the teach pendant is activated, the white light is on
Run	During manual or automatic operation, the green light is on
Error	When there is an alarm, the red light is on

2.3.7 Stylus

It is recommended to connect the stylus to the teach pendant through a cord to prevent loss. The position of the cord hole is shown in Figure 2-14.

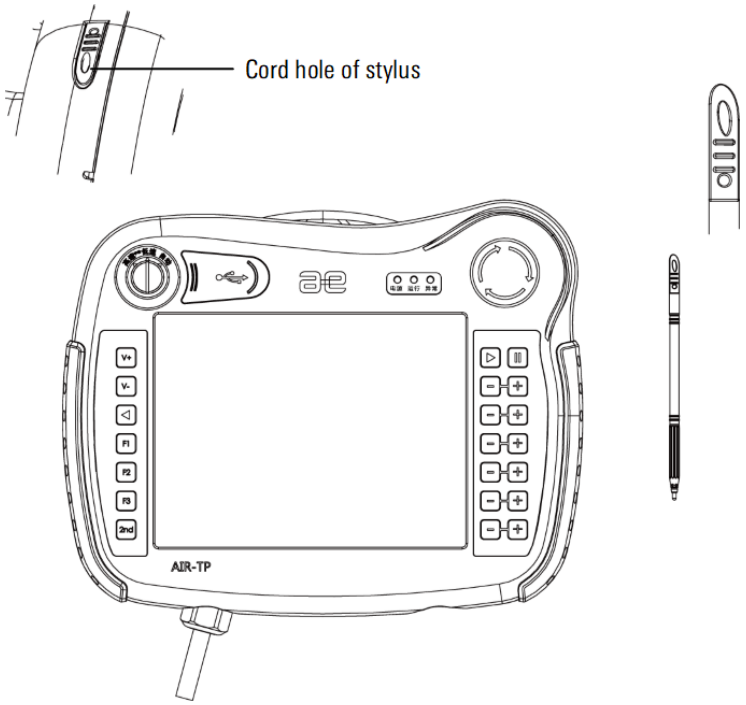


Figure 2-14 AIR-TP Teach pendant stylus

2.4 Connect the control cabinet

For the connection between the teach pendant and controls of different models, please refer to "XX Control Cabinet Manual".

Caution

Incorrect connection may cause the teach pendant to be unusable or damaged.

3 Login Interface

3.1 Login permission

When started for the first time, you must log in with the teacher permission, as shown in Figure 3-1.

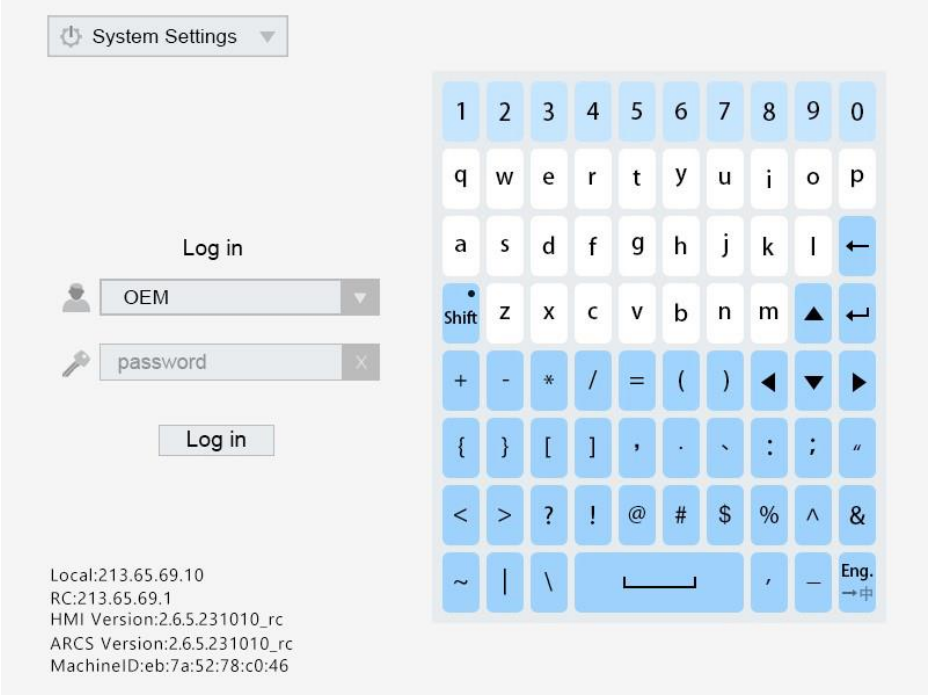


Figure 3-1 HMI login interface

Teacher permission:

You can write the robot operating programs, and modify some parameters. The initial login password is "PEACE".

Operator permissions:

You can view the robot's position parameters and operating conditions, without program/parameter modification permissions. The initial login password is "LOVE".

Prompt

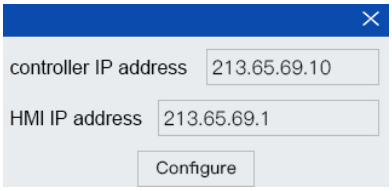
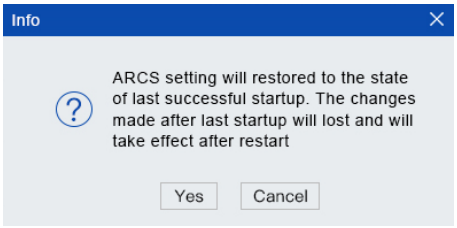
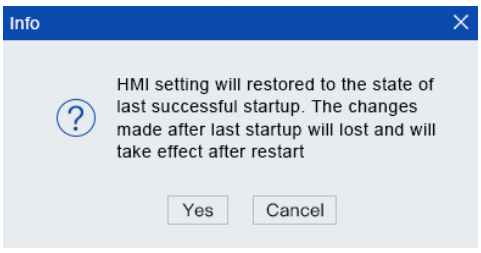
For other related login passwords, please contact our after-sales personnel.

3.2 Login interface related settings

Click <System Settings> button at the top left shown in Figure 3-1, and a drop-down list will pop up, as shown in Figure 3-2. You can perform operations such as "System Upgrade", "Import Authorization" and "Configure IP". Please refer to Table 3-1 for related descriptions.

Figure 3-2 <Settings> list of login interface

Table 3-1 Description of "Settings" on the login interface

Name	Description
System Upgrade	The "system upgrade" method here is the same as the "version update" method in Chapter8.6.2, you can directly refer to it
Authorized guide	The "import authorization" method here is the same as the "authorization import" method in Chapter 8.6.6, you can directly refer to it
Configure IP	Click the "System Settings > Configure IP" option in Figure 3-3, and the dialog box shown in Figure 3-3 will pop up, in which you can view, configure or change the IP addresses of HMI and ARCS.  Figure 3-3 "Configure IP" pop-up window
Restore ARCS	Click on the [Settings/Restore ARCS] option in Figure 3-2, a prompt box will pop up as shown in Figure 3-4, click <Yes>, and the control cabinet configuration will be restored to the state of the last successful startup. Any modifications made after the last power-on will be lost.  Figure 3-4 [Restore ARCS] Pop-up Window
Restore HMI	Click on the [Settings/Restore HMI] option in Figure 3-2, a prompt box will pop up as shown in Figure 3-5, click <Yes>, and the configuration of the teach pendant will be restored to the state of the last successful startup. Any modifications made after the last power-on will be lost.  Figure 3-5 [Restore HMI] Pop-up Window

3.3 Login interface information

The information (see Figure 3-6) displayed in the bottom left corner in Figure 3-1 includes HMI version number, machine code, etc. More detailed information can be found in "System Information", please refer to Section 8.6.1.

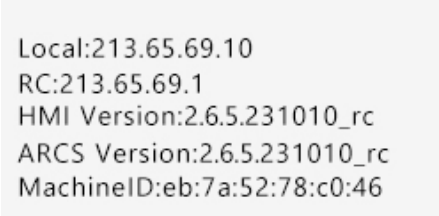


Figure 3-6 " Configure IP" window

4 Main Interface

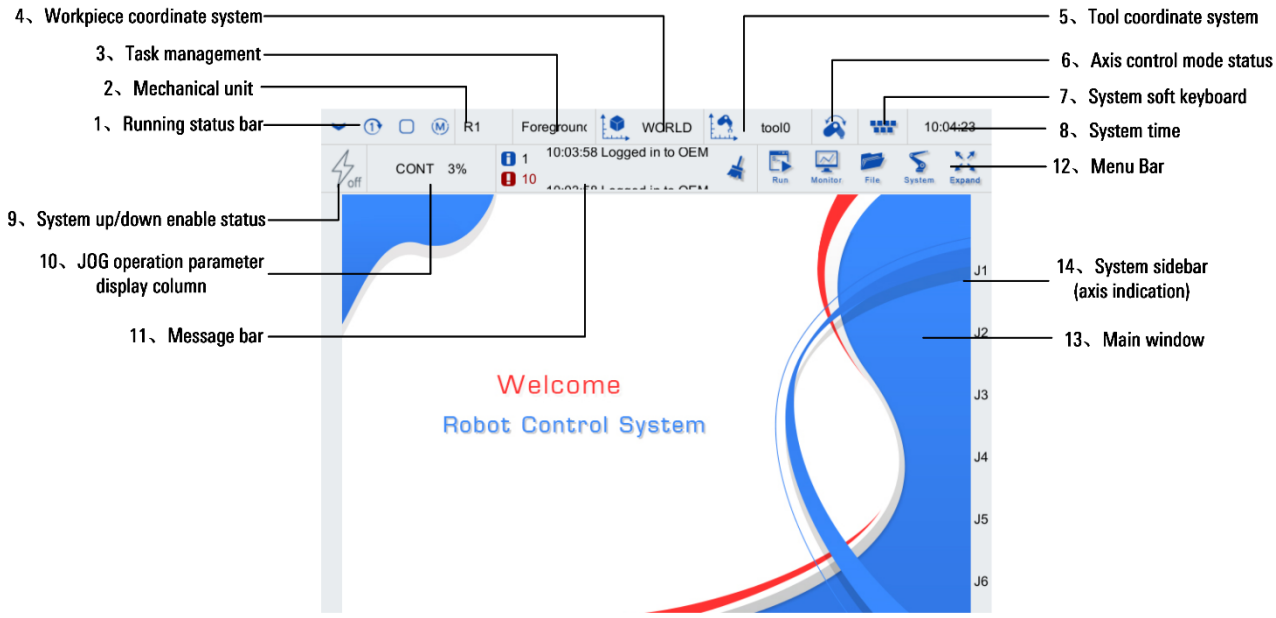


Figure 4-1 Division of function zones on main interface

Table 4-1 Description of function zones on main interface

No.	Name	Description
1	Running status bar	To display the current system running status. For details, please refer to Section 4.1
2	Mechanical unit	To display the name channel switching of mechanical unit in the current channel. For details, please refer to Section 4.2
3	Task management	Display and set the current task, please refer to Chapter 4.3 for details
4	Workobject coordinate system	Display the current workobject coordinate system, please refer to Chapter 4.4 for details
5	Tool coordinate system	Display the current tool coordinate system, please refer to chapter 4.5 for details
6	Axis control mode status	Display the current axis control mode, please refer to Chapter 4.6 for details
7	System soft keyboard	To display and set the system time. For details, please refer to Section 4.7
8	System time	To display and set the system time. For details, please refer to Section 4.8
9	System enable/disable status	System enable/disable status display icon when manual, system enable/disable button when automatic. For details, please refer to Section 4.9
10	JOG operation parameter display column	To set and display the running parameters of the current JOG. For details, please refer to Section 4.10
11	Message bar	To scroll to display the latest system message, being the entry of the system message interface. For details, please refer to Section 4.11
12	Menu bar	To provide various function options. For details, please refer to Section 4.12
13	Main window	Display zone of function interface, please refer to Section 4.12

No.	Name	Description
14	System sidebar (axis indication)	The contents of the axis indication correspond to the function buttons on the right side of the teach pendant. For details, please refer to Section 4.13

4.1 Running status bar

The contents of the running status bar is shown in Figure 4-2, which mainly contains 4 types, representing "Continuous Mode Status", "Cycle Mode Status", "Program Running Status", and "Control Mode" from front to back.

Figure 4-2 Running status bar

4.1.1 Continuous mode status

"Continuous mode status" includes 3 types, as shown in Table 4-2. For switching between different statuses, please refer to Section 5.1.

Table 4-2 Description of 3 types of "Continuous Mode Status"

Icon	Meaning
	The program is in continuous running status
	The program is in single step running status
	The program is in segment debugging running status

4.1.2 Cyclic mode status

"Cyclic mode status" includes 2 types, as shown in.Table4-3. For switching between different statuses, please refer to Section 5.1.

Table4-3 Description of 2 types of "Cyclic Mode Status"

Icon	Meaning
	The program is in cyclic running status
	The program is in single running status

4.1.3 Program running status

"Program running status" includes 4 types, as shown in Table4-4. For "Loading" and "Stop" of the program, please refer to Section 5.1 and Section 5.2. For "Pause" and "Run" of the program, please refer to Section 2.3.3.

Table4-4 Description of 4 types of "Program Running Status"

Icon	Meaning
	The program is in unloaded status
	The program is in stop status
	The program is in pause status

Icon	Meaning
	The program is in running status

4.1.4 Control mode

"Control mode" includes 3 types, as shown in Table4-5. For switching between different modes, please refer to Section 2.3.1.

Table4-5 Description of 3 types of "Control Mode"

Icon	Meaning	Description
	Manual high-speed control mode (T2)	It is used for test running. The teach pendant will run at programmed speed in this mode
	Manual low speed control mode (T1)	It is used for test running and teaching. PTP movement speed limit is 10%, and CP movement speed limit is 250mm/s
	utomatic control mode (AUT)	It is used for running. The teach pendant will run at programmed speed in this mode

4.2 Mechanical unit

When there are multiple mechanical units(Each manipulator, positioner, conveyor belt, etc. configured in the system can be used as a mechanical unit), it is used to switch the mechanical unit currently manually controlled by the controller (refer to Figure 4-3 and Figure 4-4). For the specific setting method, please refer to the "Multi-machine Linkage Operation Manual".

Figure 4-3 Display position of channel mechanical unit name

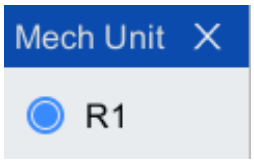


Figure 4-4 "Mechanical unit" selection interface

4.3 Channel task management

Front-end tasks support loading any program, while back-end tasks only support loading programs that do not contain motion instructions, refer to Figure 4-5 and Figure 4-6. (For example, the background task can be used to load and run programs including logic operations, TCP/IP communication and serial communication, and to calculate the variable data or external equipment required by the foreground task for communication).

Figure 4-5 Task management

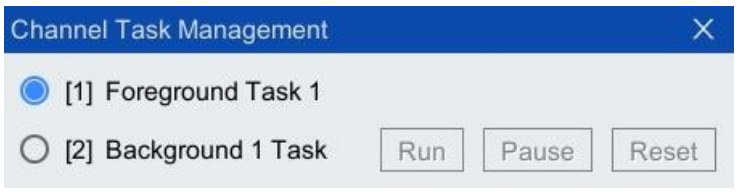


Figure 4-6 "Task Management"Select interface

Caution

- The serial number of the foreground task corresponds to the serial number of the channel, for example: foreground task 1 corresponds to the mechanical unit in channel 1, and foreground task 2 corresponds to the mechanical unit in channel 2. However, when the use command is used, the created mechanical unit can be arbitrarily selected in a foreground task, thereby releasing the one-to-one binding relationship between the serial number of the foreground task and the serial number of the channel.
- In automatic mode, pausing, starting, and resetting of the foreground channels are operations performed on all foreground channels, without affecting the background channels. Starting, pausing, and resetting of the background channels are operations performed only on the current background channel, without affecting the foreground channels.
- In manual mode, you can set the front-end channel to start or pause through the parameter 'START_CHANNEL_T1T2' in the interface [System/Parameter Configuration/Global]. When the parameter value is [CurChannel], it means that only the current front-end channel task will be started in manual mode; when the parameter value is 'All Channels', it means that all front-end channel tasks will be started in manual mode.
- Alarm clear is to clear the alarms of all channels.

4.4 Workobject coordinate system

Select and display the workpiece coordinate system selected by the user in the current JOG mode (refer to Figure 4-7 and Figure 4-8, BASE[0] is selected), and the method of selecting the coordinate system can refer to Chapter 4.10.4.

Figure 4-7 Workobject coordinate system display position

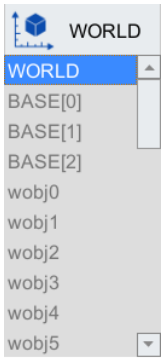


Figure 4-8 Workpiece coordinate system display position selection

4.5 Tool coordinate system

Select and display the tool coordinate system selected by the user in the current JOG mode (refer to Figure 4-9 and Figure 4-10, FLANGE is selected). For the method of selecting the tool coordinate system, refer to chapter 4.10.3.

Figure 4-9 Tool coordinate system display position

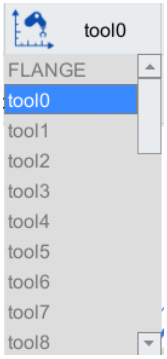


Figure 4-10 Tool coordinate system position selection

4.6 Axis control mode status

Select and display the currently selected axis control mode (refer to Figure 4-11, Figure 4-12 and Table 4-6). For the method of selecting the axis control mode, please refer to Chapter 4.10.1.

Figure 4-11 Axis control mode status display position

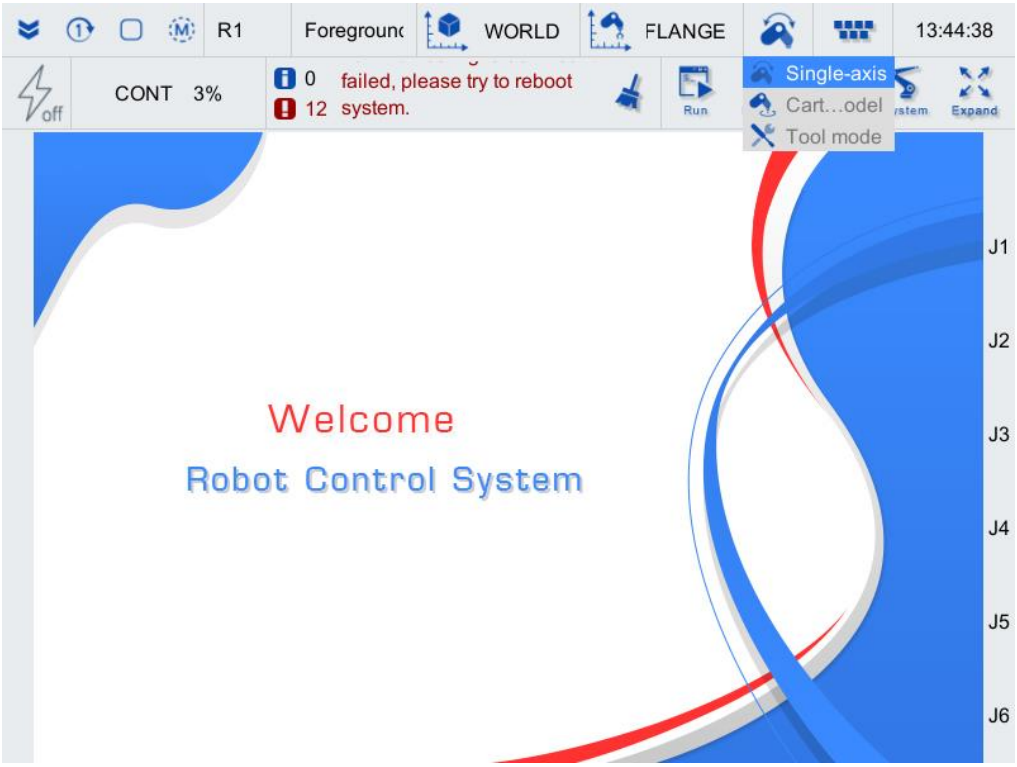


Figure 4-12 Axis control mode state position selection

Table 4-6 Introduction to 3 states of "Axis Control Mode State"

Icon	Meaning
	The currently selected axis control mode is single axis mode
	The currently selected axis control mode is Cartesian mode
	The currently selected axis control mode is tool mode

4.7 System soft keyboard

Select " " icon shown in Figure 4-13 in the menu area on main interface to display or hide the system soft keyboard (see Figure 4-14), or click any editable box to call out the system soft keyboard.

Figure 4-13 The location of the system soft keyboard

Figure 4-14 System soft keyboard

4.8 System time

Click " 14:15:44 " icon in the top right corner on main interface to pop up "Time Setting" dialog box in Figure 4-15, displaying the specific date and time. You can set the date and time using "+" and "-" buttons on the left and right of the number.

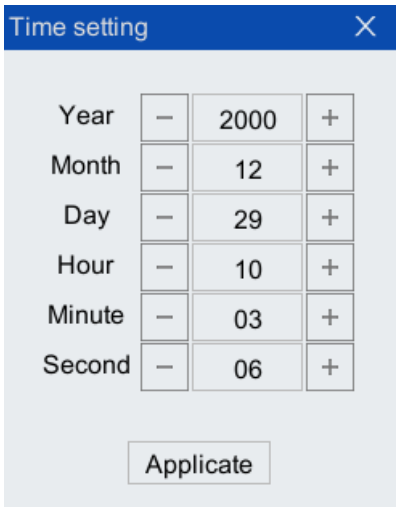


Figure 4-15 Time setting dialog box

4.9 System enable/disable

"System Enable/Disable" includes 2 statuses, as shown in Table 4-7.

Table 4-7 Description of 2 statuses of "System Enable/Disable"

Icon	Meaning
(brightness)	The system is in the enabled status
(grey)	The system is in the disabled status

For enable/disable method in manual mode, please refer to Section 2.3.1 and Section 2.3.2.

In auto mode, click the flash icon in the enable status bar (see Figure 2-10), the status will be switched from " " (grey) to " " (high brightness), indicating that the enable is successful.

4.10 JOG running settings

Click " CONT 3% " icon in the upper left corner on main interface to pop up "JOG" running parameter setting dialog box, as shown in Figure 4-16. It mainly includes the settings of axis control mode, speed, step, tool, coordinate system and other related parameters.

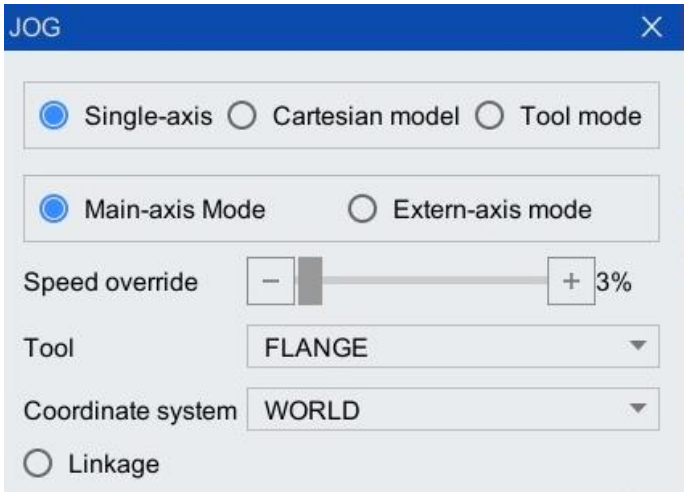


Figure 4-16 JOG running settings interface

4.10.1 Axis control mode

The user can select multiple axis control modes when controlling the manipulator. Refer to Figure 4-17. For details, refer to Table 4-8.

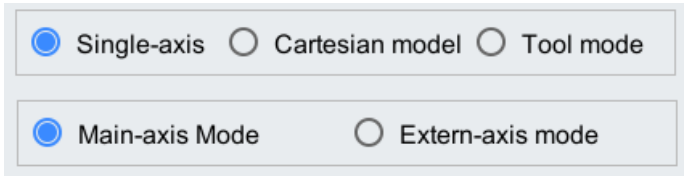
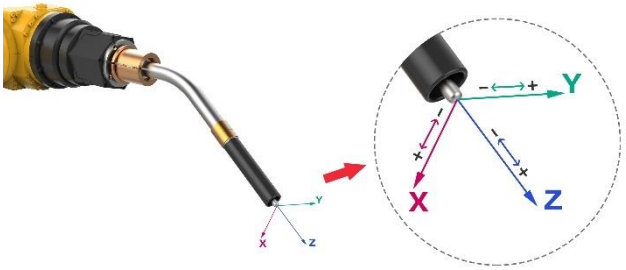


Figure 4-17 Axis control mode options

Table 4-8 Description of axis control modes

Options	Description	Remarks
Single-axis mode	The user can control each rotation axis of the manipulator to move in a positive or negative direction In this mode, the "axis control mode status" icon at the top of the main interface of the teach pendant is displayed as " "	Can only choose one of three

Options	Description	Remarks
Cartesian mode	The user can control each rotary axis of the manipulator to move in a positive or negative direction. In this mode, the "axis control mode status" icon at the top of the main interface of the teach pendant is displayed as " "	
Tool mode	The user can control the TCP of the manipulator to move linearly along the positive or negative direction of the X/Y/Z axis of the tool coordinate system, and can also control the TCP of the manipulator to rotate around the X/Y/Z axis of the tool coordinate system In this mode, the "axis control mode status" icon at the top of the main interface of the teach pendant is displayed as " "  Figure 4-18 The positive and negative directions of each axis of the tool coordinate system	
Main-axis mode	The user can control the 1~6 axis movement of the manipulator	Can only choose one of two
External-axis mode	The user can control the extended 1~6 axis movement of the manipulator	

Prompt

When JOG is in Cartesian mode or tool mode, the posture will continue to rotate, but the A, B, and C of the real-time position interface may not change continuously. This is caused by the way of expressing Euler angles and is a normal phenomenon.

4.10.2 Speed override

The speed override of the manipulator can be adjusted in Figure 4-19, and can also be adjusted by the "V+" and "V−" buttons on the left side of the teach pendant (this method does not affect the use of the <+> and <-> buttons on the left and right sides of the speed override bar Key to adjust the speed).

Figure 4-19 Speed setting

- The adjustment effect of clicking the "V+" and "V−" buttons is: micro speed-low speed -1%-5%-100% (where: 1%-5% is changed in 1% increments, and 5%-100% is changed in 5 % Is incremental change).
- The adjustment effect of long pressing the "V+" and "V−" buttons: the speed continuously increases/decreases.

Micro-speed and low-speed performance

Table 4-9 Micro-speed and low-speed performance

Operating mode	Speed override performance
The program runs	In T1, T2, AUTO mode, all run at 1% speed

Operating mode	Speed override performance
JOG operation	T1: Low speed—0.5DEG/MM; Slight speed—0.1DEG/MM (speed override for stepping action is 1%)
	T2: No action
	AUTO: No action

Speed override performance when operating mode switching

Table 4-10 Speed override performance when operating mode switching

Operation mode switching method	Speed override performance
T1->T2	Speed multiplier reduced to 3%
T2->T1	Speed magnification unchanged
T1->AUTO	Speed magnification unchanged
AUTO->T1	The speed multiplier will decrease by 3%.

4.10.3 Tool

The tool coordinate system selection interface is shown in Figure 4-20, which can implement the coordinate system selection of the current tool. The flange coordinate system is the default tool coordinate system defined by the system. The coordinate system data of other tools are customized by the user. For the custom method, please refer to Section 5.5.1.

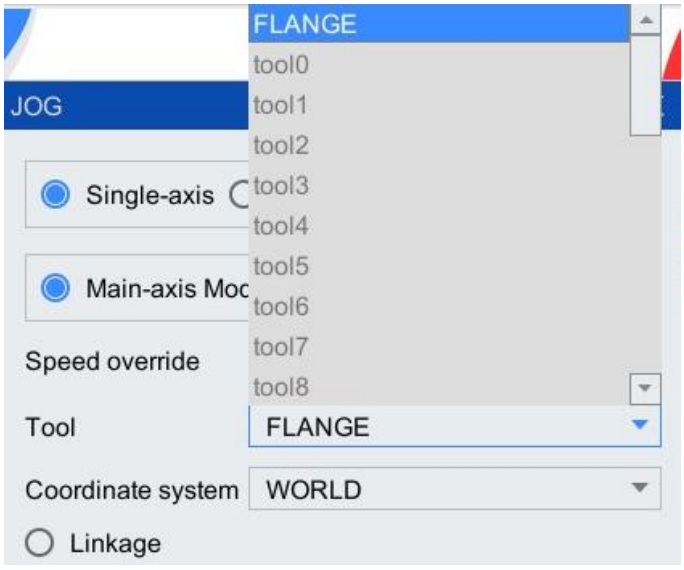
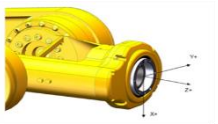


Figure 4-20 Tool coordinate system selection interface

Table 4-11 Tool description

Name	Meaning	Definition
FLANGE Flange coordinate system		■ The flange coordinate system is the axis coordinate system of the 6th axis ■ The origin is at the center of the flange surface, the X-axis and Y-axis rotate with the 6-axis rotation, and the Z-axis is perpendicular to the flange surface upward

Name	Meaning	Definition
tool Tool coordinate system		■ Its origin is the tool center point (TCP, Tool Centre Point) ■ The sixth axis of the robot is connected to the working point of the end effector. The movement trajectory programmed by the user is actually the trajectory of this point ■ Unless otherwise specified, the coordinates of TCP are relative to the workobject coordinate system ■ The specific coordinate system can be customized by the user, but must meet the right-hand rule

4.10.4 Coordinate system

The coordinate system is used to select the coordinate system referenced by the current manual control. The manual reference coordinate system selection page is shown in Figure 4-21. For detailed description of each coordinate system, please refer to Table 4-12. The user can also customize the coordinate system. Chapter 5.5.1.

Figure 4-21 Manual reference coordinate system selection interface

Table 4-12 Coordinate system description

Name	Figure example	Description	
WORLD World coordinate system		■ Also called absolute coordinate system, it is an invariable Cartesian coordinate system with reference to the earth, and is the origin coordinate system of the robot coordinate system and the workobject coordinate system ■ When the manipulator is configured with an external moving axis for overall movement, the absolute coordinate system position does not change with the manipulator ■ The absolute coordinate system is generally customized by the user. In the default configuration, the world coordinate system is located at the foot of the robot to describe the position of the mechanical unit	
BASE Base coordinate system		■ Also called robot coordinate system, the inherent coordinate system on the robot body ■ Fixed at the feet of the robot, using the world coordinate system as the reference datum,	One channel can be configured with three mechanical units at most, corresponding to three base coordinate systems Base[0]\[1]\[2], Base[0] is

Name	Figure example	Description	
		which can be used to illustrate the position of the robot	the base coordinate system of robot, Base[1]\[2] is the base coordinate system of position machine/conveyor/base axis.If the latter two mechanical units are configured, the user can select Base[1]\[2]
wobj Workobject coordinate system		■ The coordinate system used to describe the position of the workobject, taking the world coordinate system as the reference datum. In the default configuration, it coincides with the world coordinate system ■ The workobject coordinate system is also the user's programming coordinate system, and the coordinates of the teaching point stored by the user are the coordinate values in this coordinate system ■ The workobject coordinate system can be specified by the user in the world coordinate system according to the programming convenience	

4.10.5 Other

The "Linkage" and "JOG collision detection" in the "JOG" operating parameter setting dialog box (refer to Figure 4-22) are not currently supported.

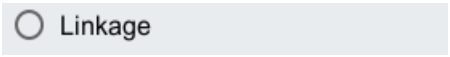


Figure 4-22 Other option settings

4.11 Message bar

The "Message Bar" on main interface of the teach pendant is shown in Figure 4-23. For details, please refer to Table 4-13.

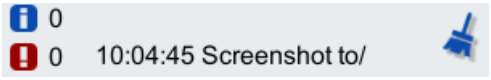
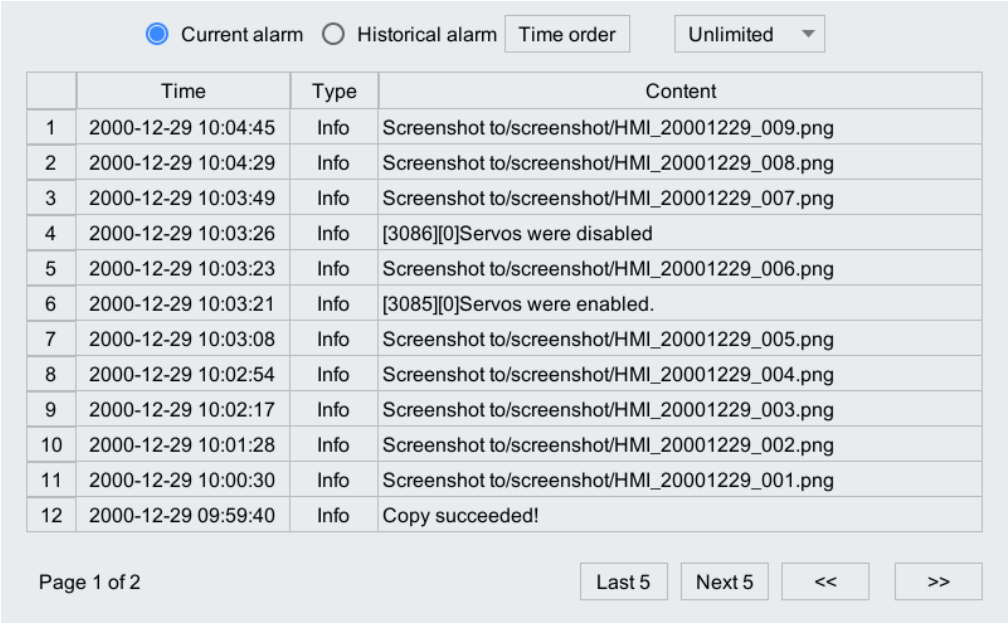


Figure 4-23 Message bar



	Time	Type	Content
1	2000-12-29 10:04:45	Info	Screenshot to/screenshot/HMI_20001229_009.png
2	2000-12-29 10:04:29	Info	Screenshot to/screenshot/HMI_20001229_008.png
3	2000-12-29 10:03:49	Info	Screenshot to/screenshot/HMI_20001229_007.png
4	2000-12-29 10:03:26	Info	[3086][0]Servos were disabled
5	2000-12-29 10:03:23	Info	Screenshot to/screenshot/HMI_20001229_006.png
6	2000-12-29 10:03:21	Info	[3085][0]Servos were enabled.
7	2000-12-29 10:03:08	Info	Screenshot to/screenshot/HMI_20001229_005.png
8	2000-12-29 10:02:54	Info	Screenshot to/screenshot/HMI_20001229_004.png
9	2000-12-29 10:02:17	Info	Screenshot to/screenshot/HMI_20001229_003.png
10	2000-12-29 10:01:28	Info	Screenshot to/screenshot/HMI_20001229_002.png
11	2000-12-29 10:00:30	Info	Screenshot to/screenshot/HMI_20001229_001.png
12	2000-12-29 09:59:40	Info	Copy succeeded!

Figure 4-24 Message list

Table 4-13 Description of system message

Icon	Description
0	Warning type messages and quantity
0	Error type messages and quantity
10:04:45 Screenshot to/	Current message, displaying the latest message, including time and content. Clicking the button can display or hide the message list (see Figure 4-24)
	Clear warning button to clear all current warnings

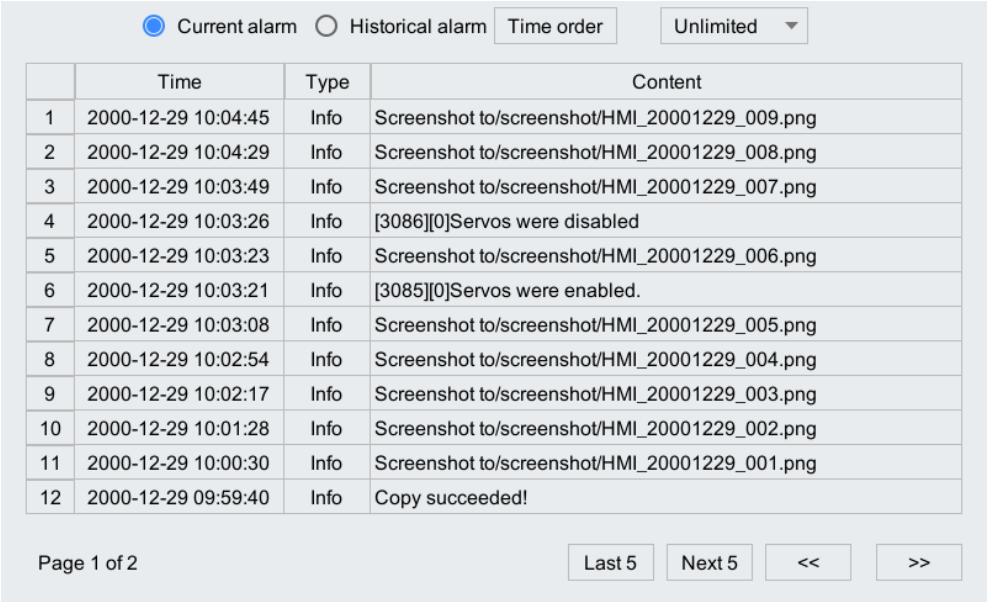
The message list (see Figure 4-24) includes options such as message category, time sequence, message type and message content. For relevant description, please refer to Table 4-14.

Table 4-14 Description of message list

Name	Description
Message category	It is used to select whether the displayed content is "Current Warning" or "Historical Warning". For details, please refer to Section 4.11.1
Time sequence/set time	When displayed as current warning: You can change the time sequence of the warning display. When displayed as historical warning: You can set the start/end time of the warning display. For details, please refer to Section 4.11.2
Message type	Through the setting, you can select the warning type to be displayed. For details, please refer to Section 4.11.3
Message content	It displays the specific contents of the warning. For details, please refer to Section 4.11.4
Page turning button	You can page up and down with "Previous" and "Next"

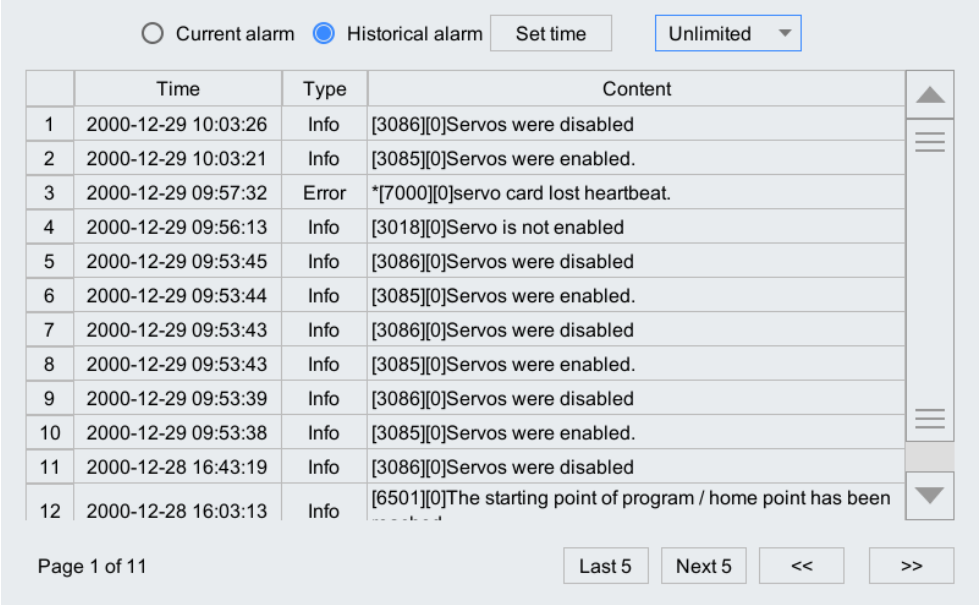
4.11.1 Message category

The message categories are divided into "Current alarm" and "Historical alarm", as shown in Figure 4-25 and Figure 4-26. The user can choose it according to the needs.



	Time	Type	Content
1	2000-12-29 10:04:45	Info	Screenshot to/screenshot/HMI_20001229_009.png
2	2000-12-29 10:04:29	Info	Screenshot to/screenshot/HMI_20001229_008.png
3	2000-12-29 10:03:49	Info	Screenshot to/screenshot/HMI_20001229_007.png
4	2000-12-29 10:03:26	Info	[3086][0]Servos were disabled
5	2000-12-29 10:03:23	Info	Screenshot to/screenshot/HMI_20001229_006.png
6	2000-12-29 10:03:21	Info	[3085][0]Servos were enabled.
7	2000-12-29 10:03:08	Info	Screenshot to/screenshot/HMI_20001229_005.png
8	2000-12-29 10:02:54	Info	Screenshot to/screenshot/HMI_20001229_004.png
9	2000-12-29 10:02:17	Info	Screenshot to/screenshot/HMI_20001229_003.png
10	2000-12-29 10:01:28	Info	Screenshot to/screenshot/HMI_20001229_002.png
11	2000-12-29 10:00:30	Info	Screenshot to/screenshot/HMI_20001229_001.png
12	2000-12-29 09:59:40	Info	Copy succeeded!

Figure 4-25 Current alarm



	Time	Type	Content
1	2000-12-29 10:03:26	Info	[3086][0]Servos were disabled
2	2000-12-29 10:03:21	Info	[3085][0]Servos were enabled.
3	2000-12-29 09:57:32	Error	*[7000][0]servo card lost heartbeat.
4	2000-12-29 09:56:13	Info	[3018][0]Servo is not enabled
5	2000-12-29 09:53:45	Info	[3086][0]Servos were disabled
6	2000-12-29 09:53:44	Info	[3085][0]Servos were enabled.
7	2000-12-29 09:53:43	Info	[3086][0]Servos were disabled
8	2000-12-29 09:53:43	Info	[3085][0]Servos were enabled.
9	2000-12-29 09:53:39	Info	[3086][0]Servos were disabled
10	2000-12-29 09:53:38	Info	[3085][0]Servos were enabled.
11	2000-12-28 16:43:19	Info	[3086][0]Servos were disabled
12	2000-12-28 16:03:13	Info	[6501][0]The starting point of program / home point has been

Figure 4-26 Historical alarm

4.11.2 Time sequence/set time

When displayed as "Current alarm", click <Time order> button to change the time sequence of the warning display.

When displayed as "Historical alarm", The "Time Sort" button is switched to the <Set Time> button. Click the button to pop up "Set the start time" window in Figure 4-27. You can set the start time for the warning display.

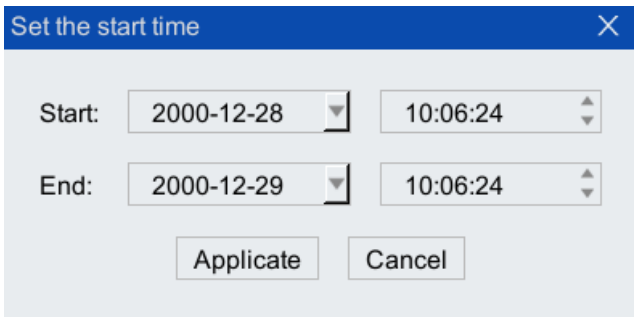


Figure 4-27 "Set start time" dialog box

4.11.3 Message type

"Message Type" is divided into 4 types: Unlimited, Info, Warning and Error (see Figure 4-28). The user can choose the type of message they want to view according to the needs.

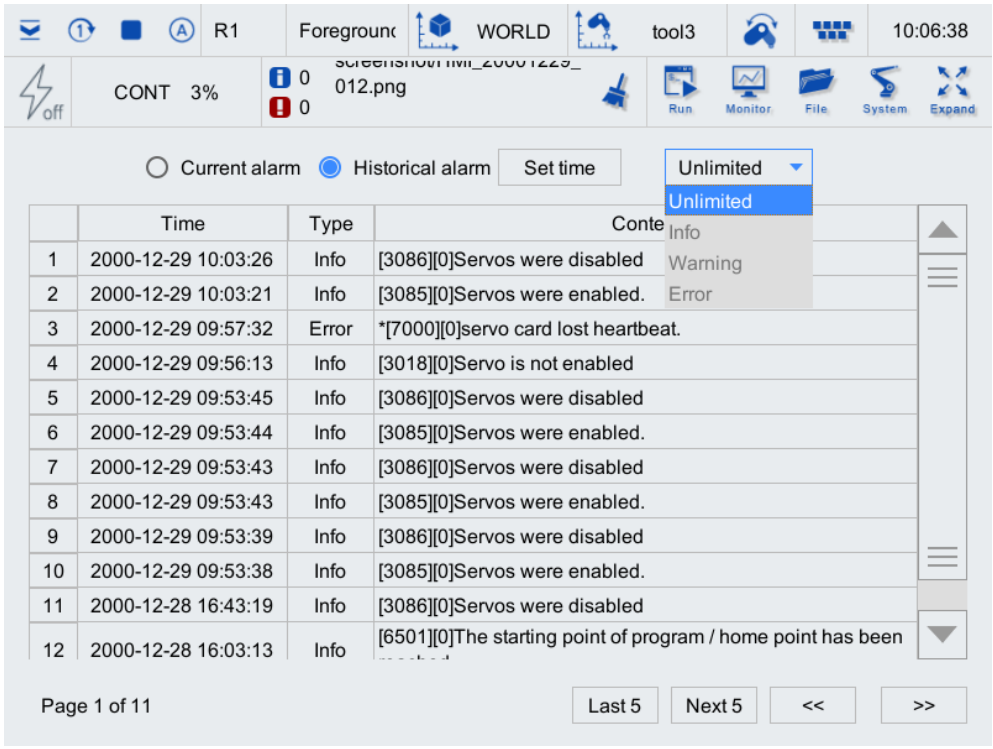


Figure 4-28 "Message Type" list

4.11.4 Message content

"Content" mainly includes the generation time of message, type of message, and content of message, as shown in Figure 4-29. It should be noted that when the content of some messages is incomplete or there are some types of "error" messages, you can try to click on the content of the line where they are located to obtain the method to eliminate the warning in the pop-up "Alarm Details" dialog box. Here the 11th warning is taken as an example. When clicking on the warning content of the line where it is located, "Alarm Details" will pop up, as shown in Figure 4-30 and Figure 4-31.

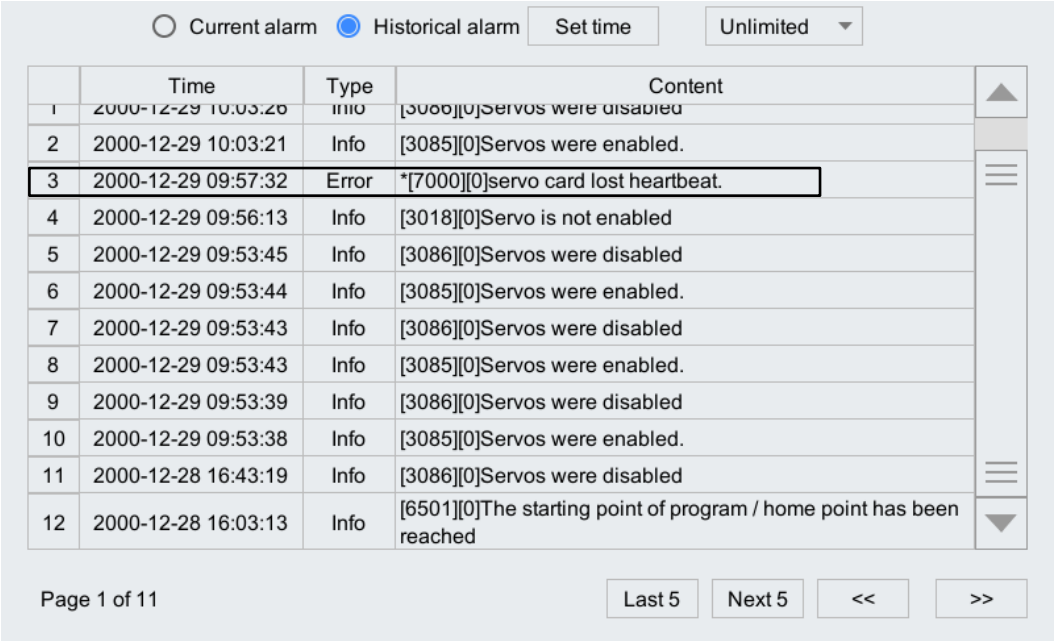


Figure 4-29 "Message Content" interface

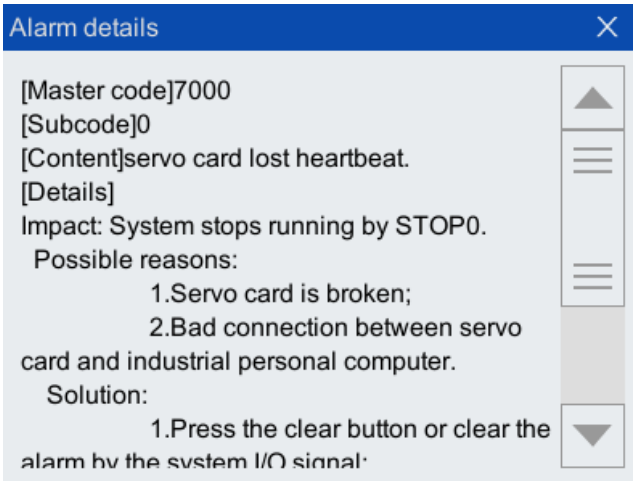


Figure 4-30 Alarm details for "Main Code" 7000

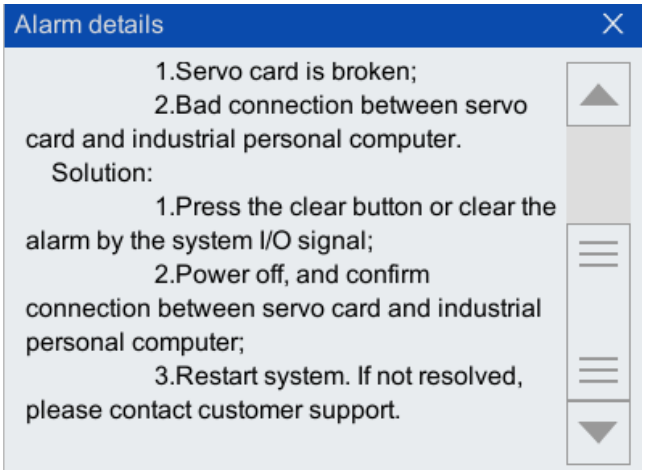


Figure 4-31 The detailed information of the alarm with the "Master Code" 7000

4.12 Menuarea

The menu area is shown in Figure 4-32. The description of each option in the menu area is shown in Table 4-15.

Figure 4-32 Menu area

Table 4-15 Description of menu area

Menu	Description
Run	Open the window or dialog box related to the robot operation. For details, please refer to Section 5.
Monitor	Open the real-time position and IO status window or dialog box. For details, please refer to Section 6.
File	Perform file management and program editing related operations. For details, please refer to Section 6.5
System	Open a window or dialog box related to system settings. For details, please refer to Section 7.3.5
Expand	Not currently supported, please refer to Section 9

4.13 System sidebar (axis indication)

The "System Sidebar" system can be displayed or hidden through "Appearance and Personalization Settings" of the "system". For the specific setting method, please refer to Section 8.3.6.

The right side of "System Sidebar" is the axis indication, which corresponds to the control button functions on the right side of the teach pendant, as shown in Figure 4-33.

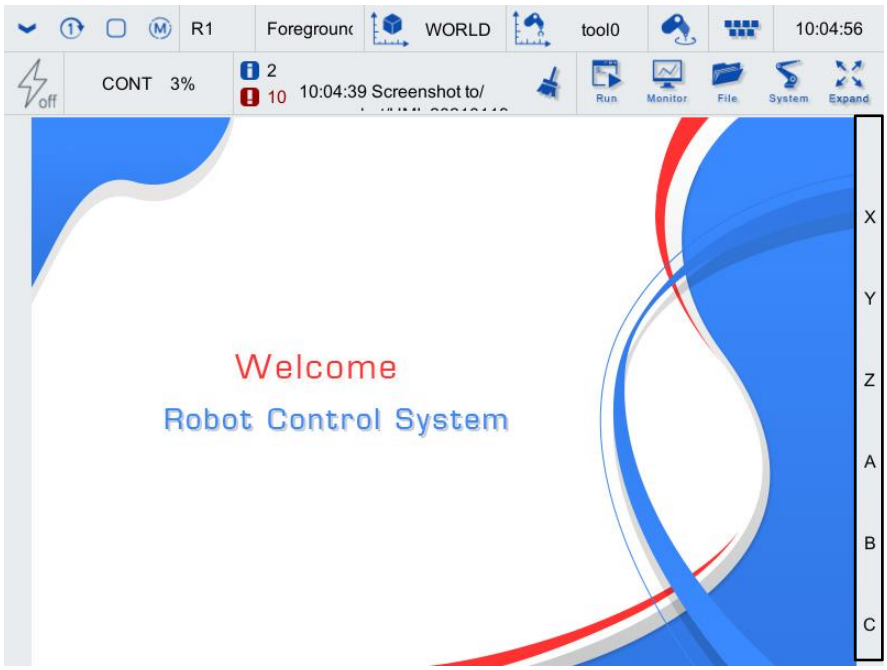


Figure 4-33 "System Sidebar" right axis indication in "Cartesian Mode"

5 Running

The expanded view of "Run Menu" is shown in Figure 5-1. The entry of "Run Menu" is shown in Figure 5-2. The contents of parts in "Run Menu" are described below.

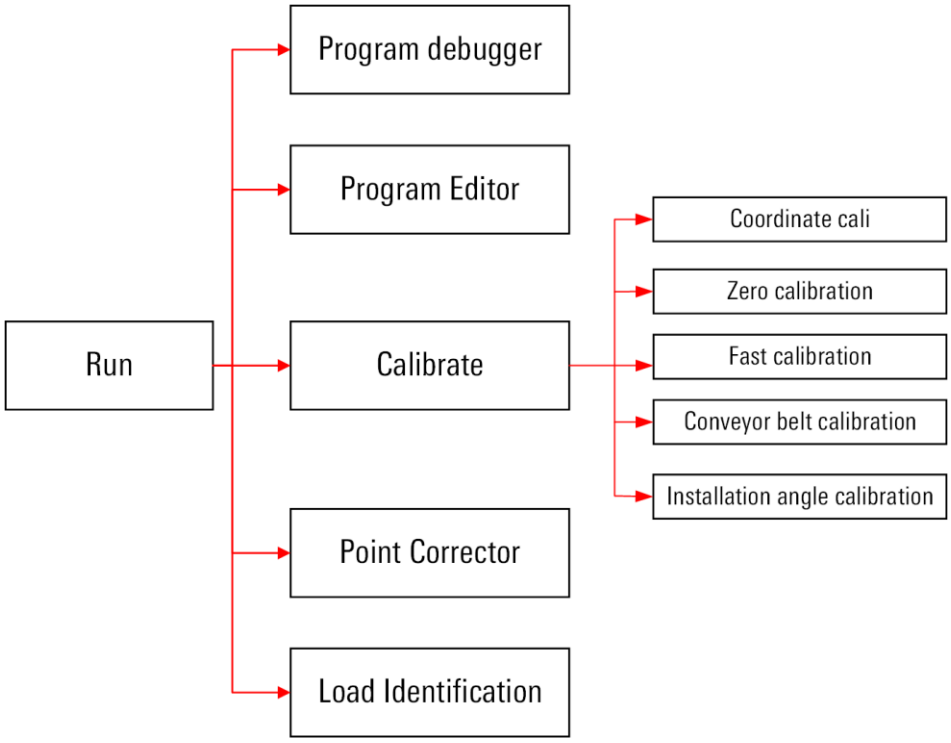


Figure 5-1 Expanded view of "Running Menu"

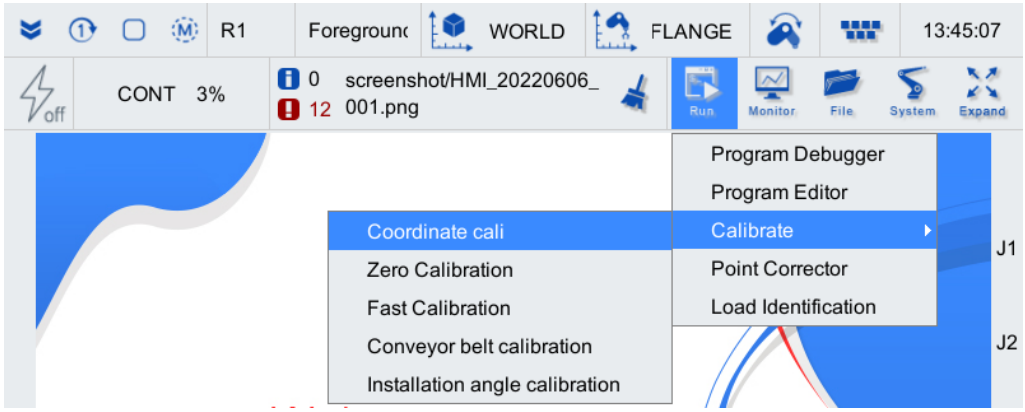


Figure 5-2 "Running Menu" interface

5.1 Program debugger

On the main interface of the teach pendant, click "Run > Program Debugger" option to enter the loaded program or empty "Program Debugger" interface, refer to Figure 5-3.

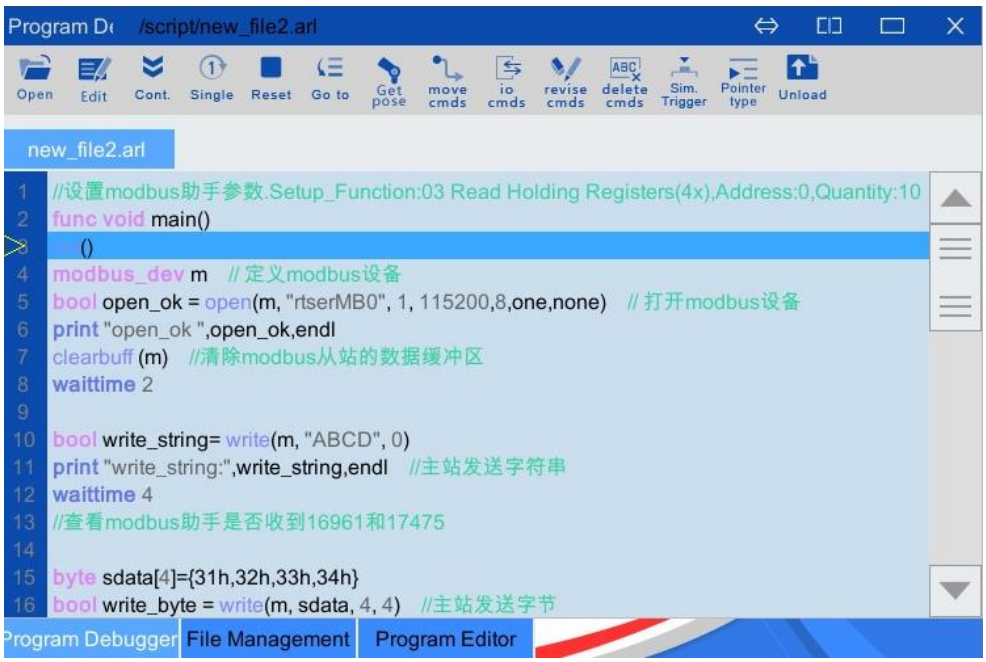
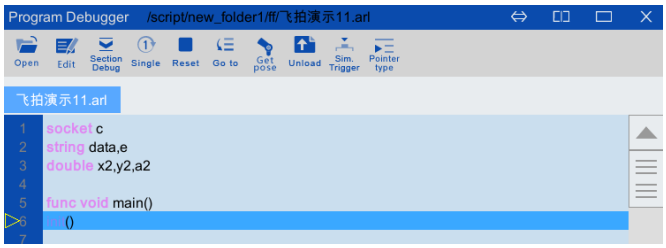
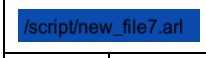


Figure 5-3 "Program Debugger" Interface

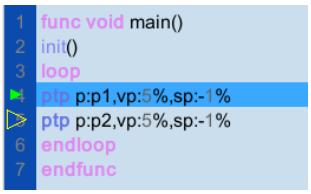
For details about function on "Tool Bar" of the program debugger, please refer to Table 5-1.

Table 5-1 Description of "Tool Bar" of program debugger

<table>
<tr><th>Icon</th><th>Name</th><th colspan="2">Function</th></tr>
<tr><td> </td><td>Open</td><td colspan="2">Load any ARL program in "File Manager". After loaded successfully, open the program in the program debugger and display "Program Pointer" yellow (hollow) triangle symbol, as shown in Figure5-4; if failed to load, the error program will be opened in the program editor and the first error line will be highlighted.
 
Figure5-4 Program is loaded into "Program Debugger Interface"</td></tr>
<tr><td colspan="2">  </td><td colspan="2">Display of the path of the loaded arl file</td></tr>
<tr><td rowspan="3"> </td><td rowspan="3">Continuous mode</td><td> </td><td>Each time the start button is pressed, the program will execute an instruction, which may be a non-moving statement. In this mode, "Continuous Mode" icon in "Running Status Bar" on main interface of the teach pendant will be " "</td></tr>
<tr><td> </td><td>Each time the start button is pressed, the program will run continuously until the user presses the pause button or the program execution is completed. In this mode, "Continuous Mode" icon in "Running Status Bar" on main interface of the teach pendant will be " "</td></tr>
<tr><td> </td><td>Each time the start button is pressed, the program will execute until the next movement trajectory is completed. In this mode, "Continuous Mode" icon in "Running Status Bar" on main interface of the teach pendant will be " "</td></tr>
</table>

<table>
<tr><td>Icon</td><td>Name</td><td colspan="2">Function</td></tr>
<tr><td rowspan="2"> </td><td rowspan="2">Cyclic mode</td><td> </td><td>The program runs for a single time. In this mode, "Cyclic Mode" icon in "Running Status Bar" on main interface of the teach pendant will be " "</td></tr>
<tr><td> </td><td>The program runs cyclically. In this mode, "Cycle Mode" icon in "Running Status Bar" on main interface of the teach pendant will be " "</td></tr>
<tr><td> </td><td>Reset</td><td colspan="2">The program will be reset immediately after clicking "Reset" button; it can be reset only when the program is paused.</td></tr>
<tr><td> </td><td>Skip</td><td colspan="2">Click the [Jump] button to bring up the [Program Debugger Settings] interface as shown in Figure5-6. The six-axis robot only supports two types of jump methods: lin and ptp. Click <Yes> to jump the program pointer to the current line of the cursor.

Figure5-5 [Program Debugger Settings] interface</td></tr>
<tr><td> </td><td>Get location</td><td colspan="2">When the ARL program containing motion instructions is successfully loaded, and the program is in a paused state, select a line of motion instructions with the cursor and click "Get Position" to obtain the current pose information of the robot. And write the pose information into the point position of the motion instruction, when the motion instruction is reached, the target point pose will change

Automatic mode does not allow location acquisition.</td></tr>
<tr><td> </td><td>Unload</td><td colspan="2">Unload the loaded program. Click the <Uninstall> button to uninstall the currently loaded program</td></tr>
<tr><td> </td><td>Analog trigger</td><td colspan="2">If the program is executing and ended at "waituntil" statement, click <Analog Trigger> button, and then the program will meet the conditions of waituntil statement and continue to execute downward; "Analog Trigger" can only be performed in manual mode.</td></tr>
<tr><td> </td><td>Pointer type</td><td>Tracking pointers include two types of pointers: "motion pointer" and "program pointer", as shown in Figure5-6 and Figure5-7.
"Motion pointer" points to the line where the movement instruction is located during program running. At this time, the pointer will be a green (solid) triangle symbol. When returning to the home point or stopping, the pointer will be a red (solid) triangle symbol
"Program Pointer" points to the line where the program is located and is a yellow (hollow)</td><td>Select to track "Motion pointer". During program running, the instruction line to which "Motion pointer" points will be highlighted, as shown in Figure5-8.
 
Figure5-8 Tracking "Motion pointer"</td></tr>
</table>

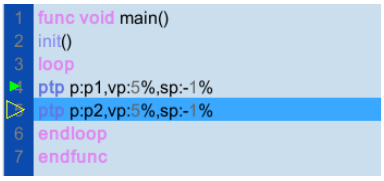
<table>
<tr><th>Icon</th><th>Name</th><th>Function</th></tr>
<tr><td></td><td></td><td>triangle symbol.
 

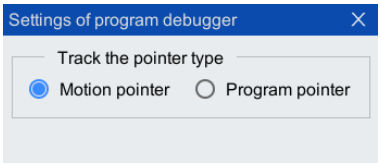
Figure5-6 Tracking pointer type
 

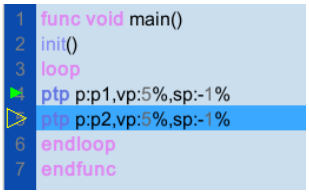
Figure5-7 Tracking pointer type selection window</td><td>Select to track "Program Pointer". During program running, the instruction line to which "Program Pointer" points will be highlighted, as shown in Figure5-9.
 

Figure5-9 Track "Program Pointer"</td></tr>
<tr><td>
</td><td>Movement instructions</td><td colspan="2">Click the [Motion Instruction] button to insert a motion instruction at the current cursor position.
The insertion conditions are as follows:
■ Only allow insertion below the selected line, the selected line cannot be blank or a comment line.
■ First, the user needs to execute to the inside of this function, and then specify the insertion below a certain instruction.
■ "func, endfunc, if, else, elseif, endif, while, endwhile, for, endfor, waituntil, continue, break, goto, return, trigger, import, use" Functions cannot be inserted below these functions.
Caution</td></tr>
<tr><td>
</td><td>I/O functions</td><td colspan="2">Click the [I/O Functions] button to insert an I/O function at the current cursor position.
The insertion conditions are as follows:
■ Only allow insertion below the selected line, the selected line cannot be blank or a comment line.
■ First, the user needs to execute to the inside of this function, and then specify the insertion below a certain instruction with "func, endfunc, if, else, elseif, endif, while, endwhile, for, endfor, waituntil, continue, break, goto, return, trigger, import, use". Functions are not allowed to be inserted below these functions.
Caution</td></tr>
<tr><td>
</td><td>Modify instruction</td><td colspan="2">Click the 'Modify Instruction' button to modify the motion instructions and IO functions of the current cursor line in real time.
Caution
Instructions are not allowed to be modified during program execution.</td></tr>
</table>

Icon	Name	Function
	Delete instruction	Click the [Delete Instruction] button to delete the instruction in the current line of the cursor. Caution Functions that cannot be deleted include print, trigger, etc.

Caution During the running of the program, insertion, deletion, and modification of instructions and functions are not allowed.

5.2 Program Editor

On the main interface of the teach pendant, click "Run > Program Editor" option to enter the "Program Editor" interface as shown in Figure 5-10. Refer to Table 5-2 for detailed description of each function on the "Toolbar" of the program editor.

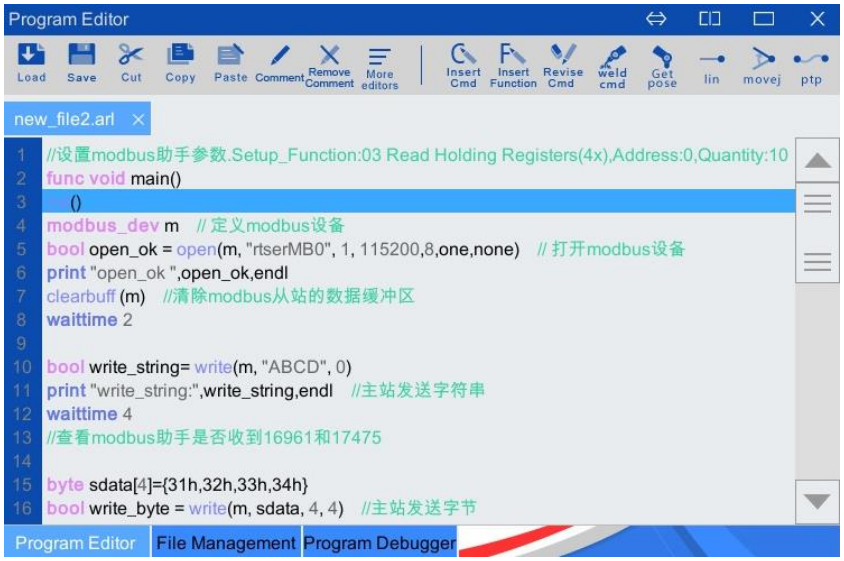
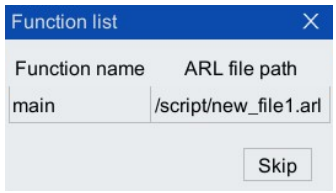


Figure 5-10 Program editor interface

Table 5-2 Description of program editor "Toolbar"

Icon	Name	Function
	Load	Load the current program file into the program debugger
	Save	Save a program file
	Cut	Cut the selected text

<table>
<tr><td>Icon</td><td>Name</td><td colspan="3">Function</td></tr>
<tr><td> </td><td>Copy</td><td colspan="3">Copy the selected text</td></tr>
<tr><td> </td><td>Paste</td><td colspan="3">Paste the selected text to the current cursor position</td></tr>
<tr><td> </td><td>Comment</td><td colspan="3">Click <Comment>` button to comment out the current line with "//"</td></tr>
<tr><td> </td><td>Remove Comment</td><td colspan="3">Cancel the original comment</td></tr>
<tr><td rowspan="11"> </td><td>Open</td><td colspan="3">Open the program file</td></tr>
<tr><td>Save as</td><td colspan="3">Save a program file as another</td></tr>
<tr><td rowspan="6">Query</td><td rowspan="6">Click "Query" button for operations such as find and replace</td><td>"Find" input box</td><td>Enter the character you want to find</td></tr>
<tr><td>"Replace with" input box</td><td>Enter the characters to replace with</td></tr>
<tr><td><Find Behind> button</td><td>Query backward from the current position</td></tr>
<tr><td><Replace> button</td><td>Perform one-by-one replacement</td></tr>
<tr><td><Close> button</td><td>Close the query interface</td></tr>
<tr><td><Replace All> button</td><td>Perform all replacements</td></tr>
<tr><td>Function list</td><td colspan="3">Clicking on [Function List] will display the interface as shown in Figure 5-11. The interface displays the list of sub-functions called by the current ARL program. Double-clicking on any sub-function in the list will open the corresponding ARL program file in the program editor and jump to the line of the sub-function.
Support viewing the following three sub-functions:
■ Sub-functions under the same ARL program
■ Subfunctions in the ARL program under the same path
■ Subfunctions in ARL programs under different paths
 
Figure 5-11 [Function List]Interface</td></tr>
<tr><td>Back</td><td colspan="3">Cancel the last operation</td></tr>
<tr><td>Advance</td><td colspan="3">Restore the last operation</td></tr>
<tr><td>Alignment</td><td colspan="3">Align the code to the left when writing.</td></tr>
<tr><td> </td><td>Insert Cmd</td><td colspan="3">Quickly add the instruction to the program file. For details, please refer to Section 5.2</td></tr>
<tr><td> </td><td>Insert function</td><td colspan="3">Quickly add the function to the program file. For details, please refer to Section 5.4</td></tr>
</table>

Icon	Name	Function
	Revise Cmd	Open the auxiliary programming interface and modify the instruction content in the line where the cursor is located
	Weld instruction	Arc welding function package related instructions
	Get pose	In the program editor, select a motion instruction by placing the cursor on a specific line and clicking on "Get pose". This will retrieve the current pose information of the robot and write it into the position of that motion instruction.
	"Lin" instruction	Quickly insert "lin" instruction. For details, please refer to Section 5.3.1.3.
	"movej" instruction	Quickly insert "movej" instruction. For details, please refer to Section 5.3.1.1.
	"PTP" instruction	Quickly insert "PTP" instruction. For details, please refer to Section 5.3.1.2.

5.3 Insert instruction

Through the auxiliary programming system, the user can complete the teaching of robot operations or write ARL programs more quickly.

Click <Insert> button in the toolbar of the program editor to pop up a menu of instruction to be inserted, including logic control, process control, movement instructions, etc. For details, please refer to the instruction menu shown in Figure 5-12.

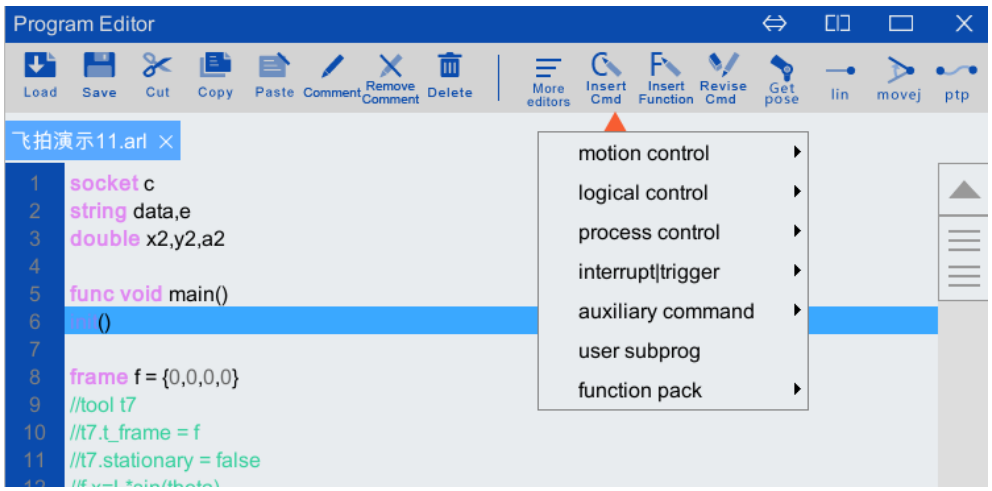


Figure 5-12 Insert instruction interface

The auxiliary programming table for each instruction is briefly described below. For more details about instruction writing, please refer to "ARL Programming Manual".

5.3.1 Movement instruction

See Table 5-3 for the list of motion instructions.

Table 5-3 Motion instruction list

Instruction name	Meaning	Remarks
movej	Moving axis	-

Instruction name		Meaning	Remarks
ptp		Point to point	-
lin		Linear motion	-
cir		Circular motion	-
startweave		Turn on overlay track	-
endweave		End superimpose trajectory	-
ccir		Continuous circular motion	-
Combination instruction	use	Designated program mechanical unit	"Combination instruction" is used in special scenarios such as multi-machine linkage. For detailed usage, please refer to the company's "Multi-machine linkage user manual"
	gmove	Multi-machine linkage	
Conveyor belt	waitwobj	Waiting for work object	For the specific usage of "conveyor belt" related instructions, please refer to our company's "Conveyor Belt Tracking Manual"
	dropwobj	Release work object	
	actunit	Activate mechanical unit	
	deactunit	Release mechanical unit	
Soft move	startcastfloat	Open Cartesian space soft move	For the specific usage of "soft move" related instructions, please refer to our company's "soft move user manual"
	startjointfloat	Open axis space soft move	
	endfloat	End soft move	
Trajectory compensation	startcompen	Turn on trajectory compensation	-
	endcompen	End trajectory compensation	-
	compen	Trajectory compensation	-

5.3.1.1 movej (Move axis)

Instruction introduction:

The movej instruction is used to move the robot axis or external axis to a specified position.

Insert steps:

Step1.Click " " icon in the toolbar of the program editor to pop up "movej" instruction box, as shown in Figure 5-13.

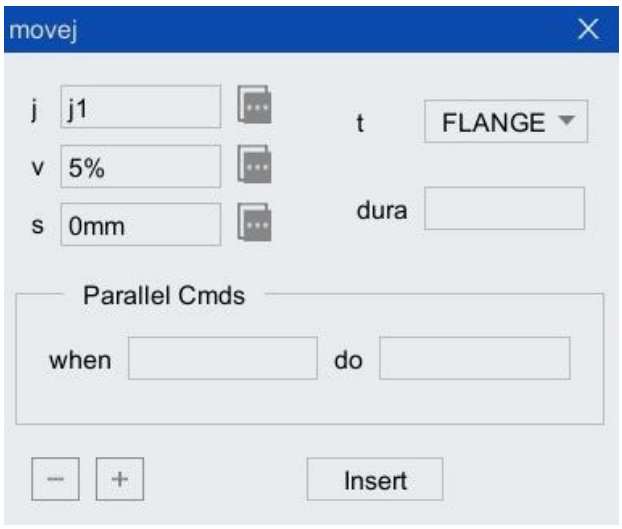


Figure 5-13 "movej" instruction box

Step2.Click <...> button after the axis position variable j to pop up "j variable" display box in Figure 5-14, which displays the current position information of the robot body axis(J1-J6) and the external axis (EJ1-EJ6). The position is displayed but cannot be modified. Click <Yes> button, and then the current position information can be obtained automatically after the instruction is inserted; if you want to modify it, you must complete the modification through "Revise Cmd" or "Get pose" in the toolbar of the program editor.

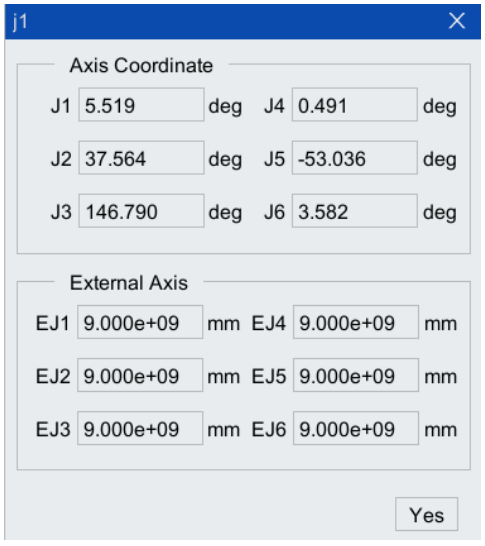


Figure 5-14 "j" variable display box

Step3.Click <Yes> button shown in Figure 5-15 to pop up "Are you need to create the variable j1" dialog box, and click <Yes> button.

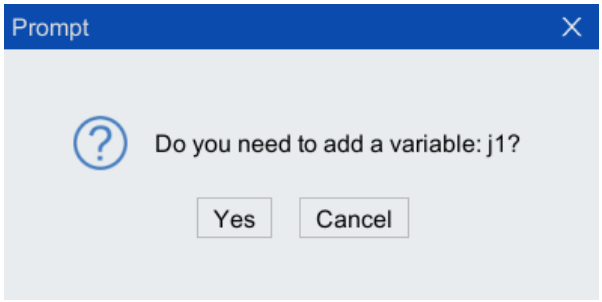


Figure 5-15 "Are you sure to create the variable j1" dialog box

Step4.For the speed parameter v, you can enter the value directly in the edit box to complete the speed percentage setting. You can also click <...> button to modify the specific velocity value in "v" variable setting box, as shown in Figure 5-16.

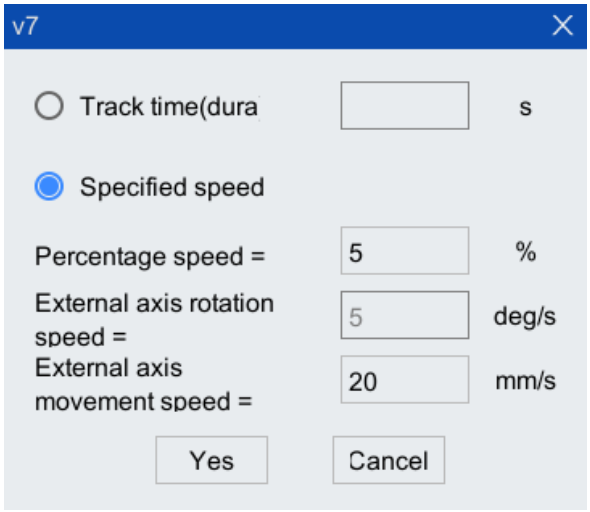


Figure 5-16 "v" variablesetting box

Step5.Click <Yes> to open [Prompt] box of "Create Variable v 4" as shown in Figure 5-17, and click <Yes> to create variable.

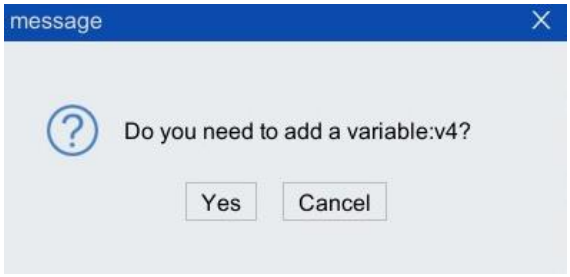


Figure 5-17 "Are you sure to create the variable v4" dialog box

Step6.For the slip parameter s, you can enter the value directly in the edit box to complete the slip percentage setting. You can also click <...> button to modify the specific slip value in "s" variable setting box, as shown in Figure 5-18.

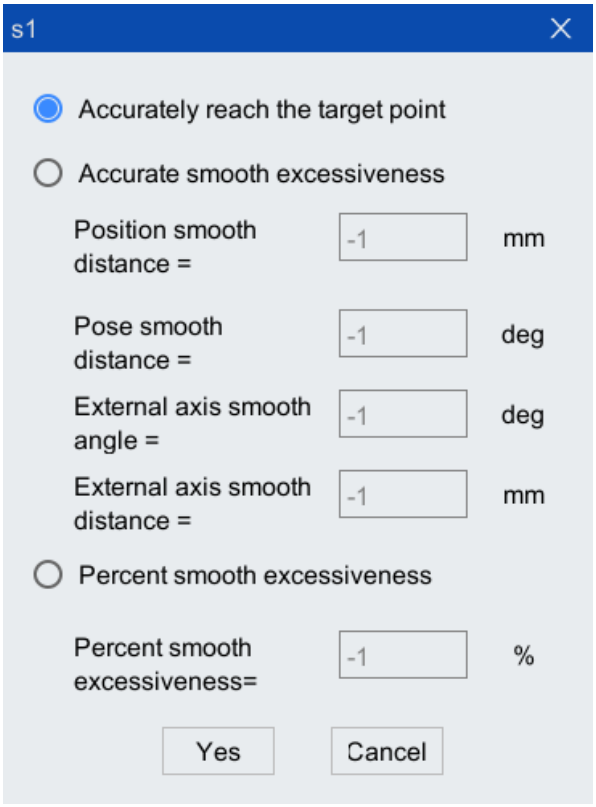


Figure 5-18 "s" variable setting box

Step7.Click <Yes> to open [Prompt] box of "Create Variable s 4" as shown in Figure 5-19, and click <Yes> to create variable.

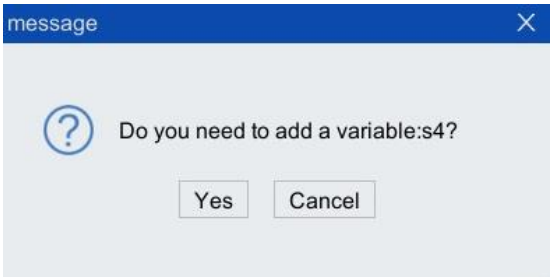


Figure 5-19 [Prompt] box for "Create Variable s 4"

Step8.The text box behind the trajectory time dura is read-only. The displayed data needs to be set in the "v" variable configuration interface as shown in Figure 5-16. After modification, click the <Yes> button.

Step9.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step10.Click the <Insert > button in Figure 5-16, and the instruction is inserted successfully.

Step11.Instructions generally use the speed value and smoothing value of the previous sentence, so when inserting a point, you can just click <Insert Instruction> to quickly insert the point.

Prompt

For details about "movej" instruction, please refer to "ARL Programming Manual".

5.3.1.2 PTP (Point to point)

Instruction introduction:

The point-to-point (PTP) movement instruction is used to quickly move the robot from one point to another without requiring the shape of the trajectory of the TCP. All axes can reach the target point simultaneously.

Insert steps:

Step1.Click " ptp " icon in the toolbar of the program editor to pop up "PTP" instruction box, as shown in Figure 5-20.

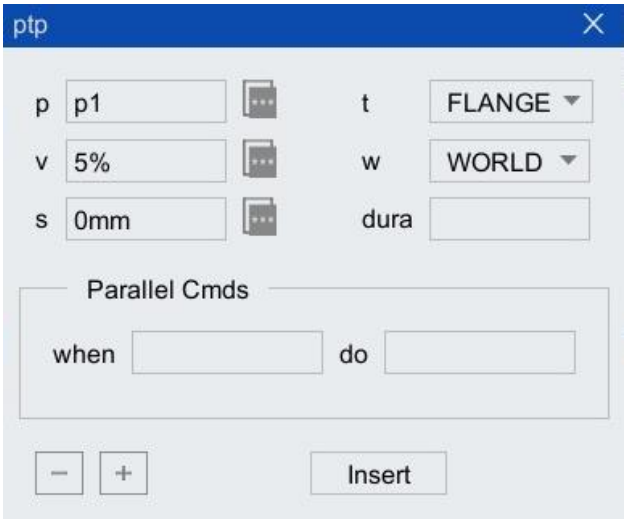


Figure 5-20 "PTP" instruction box

Step2.Click <...> button after the position variable p to pop up "p" variable display box in Figure 5-21, which displays the position information of the current TCP of the robot body relative to the workobject coordinate system and the current position information of the external axis. The position is displayed but cannot be modified. Click <Yes> button, and then the current position information can be obtained automatically after the instruction is inserted.

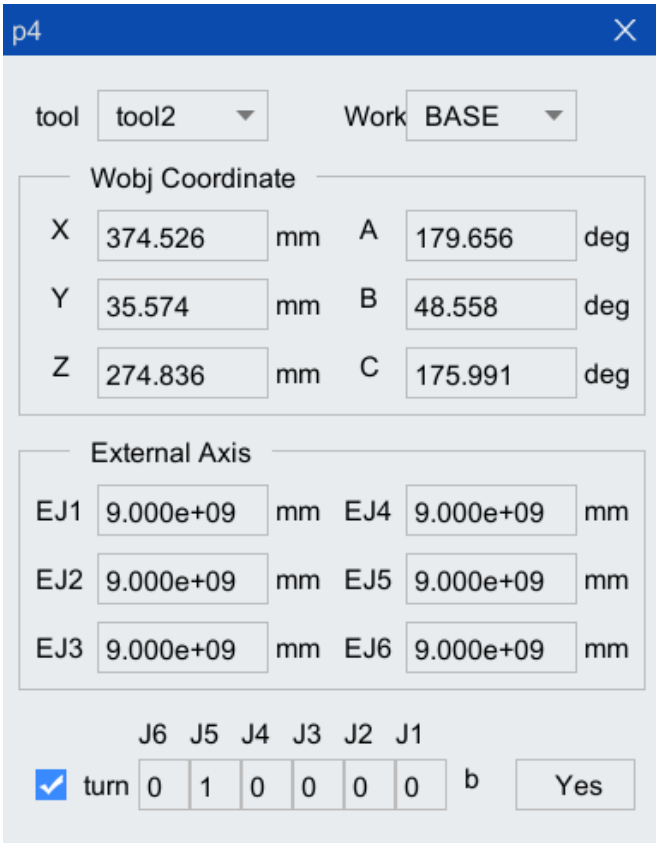


Figure 5-21 "p" variable display box

Step3.Click <Yes> button in Figure 5-21 to pop up "Do you sure to create the variable p1" dialog box, as shown in Figure 5-22. Click <Yes> button, variable creation completed.

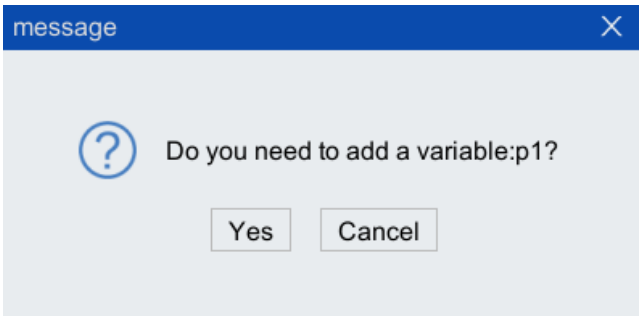


Figure 5-22 "Do you need to create the variable j1" dialog box

Step4.Figure 5-21 As shown in, you can re-select the tool/workobject coordinate system, or select or cancel the turn value. After clicking <Yes> button, the parameters t and w in the PTP instruction box will display the currently selected tool or workobject coordinate system (see Figure 5-23); if you want to modify it, you must complete the modification through "Revise Cmd" or "Get pose" in the toolbar of the program editor.

Figure 5-23 "t/w variable" display box

> Prompt
>
> After canceling the turn value, the robot does not care about the number of turns of the 4th and 6th axis during automatic movement, and the beat may be faster, but the 4th and 6th axis may differ from the teaching position by an integer number of revolutions. If there is no winding interference problem, it can be cancelled.

Step5.To modify the parameters v and s, refer to the "movej" instruction.

Step6.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step7.Click the <Insert> button in Figure 5-23, and the instruction is inserted successfully.

Step8.Instructions generally use the speed value and smoothing value of the previous sentence, so when inserting a point, you can just click <Insert > to quickly insert the point.

> Prompt
>
> For details about "PTP" instruction, please refer to "ARL Programming Manual".

5.3.1.3 lin (Linear motion)

Instruction introduction:

The lin linear movement instruction is used to move the TCP of the robot along a straight path to the target point pose; the position movement is synchronized with the posture rotation.

Insert steps:

Step1.Click "lin" icon in the toolbar of the program editor to pop up "lin" instruction box, as shown in Figure 5-24.

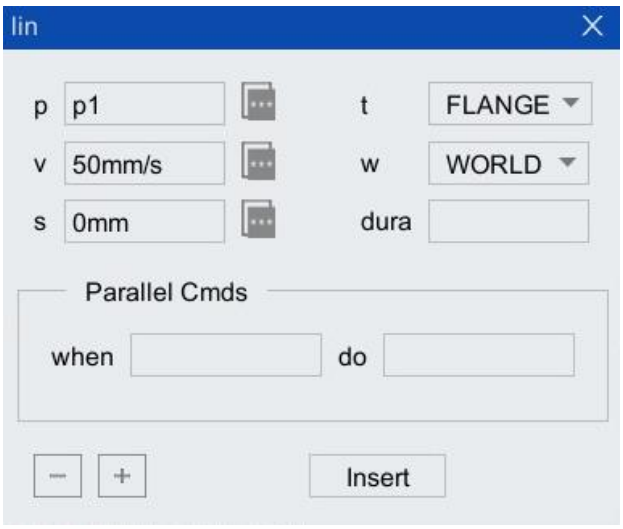


Figure 5-24 "lin" Instruction configuration interface

Step2.For the view and modification of the target point p, please refer to the modification method of the target point p in "PTP" instruction.

Step3.For the modification of the parameters v, s and dura, please refer to the modification of the corresponding parameters in "movej" instruction.

Step4.For the modification of the parameters t and w, please refer to the modification of the corresponding parameters in "PTP" instruction.

Step5.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step6.Click the <Insert> button in Figure 5-24, and the instruction is inserted successfully.

Step7.Instructions generally use the speed value and smoothing value of the previous sentence, so when inserting a point, you can just click <Insert> to quickly insert the point.

Prompt

For details about "lin" instruction, please refer to "ARL Programming Manual".

5.3.1.4 cir (Arc movement)

Instruction introduction:

The cir circular movement instruction is used to move the TCP of the robot along the circular path to the target point; the translation movement is synchronized with the rotation movement.

Insert steps:

Step1.Click "Insert Cmd > Motion instruction > cir" option in the toolbar of "Program editor", and the "cir" instruction configuration interface as shown in Figure 5-25 will pop up.

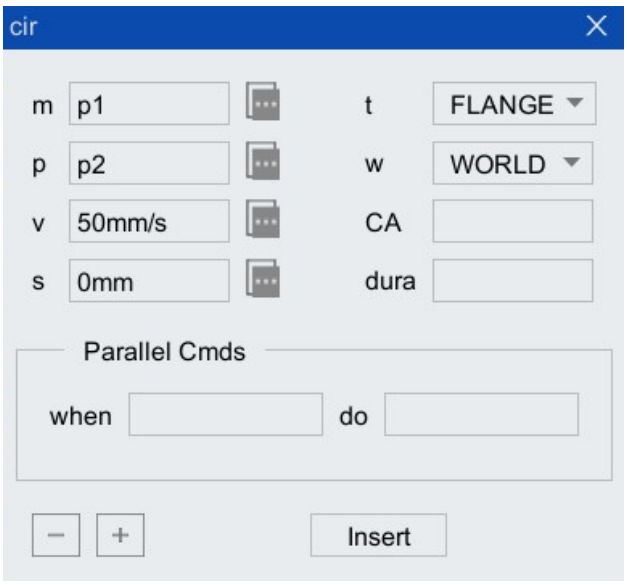


Figure 5-25 "cir" Instruction configuration interface

Step2.For the view and modification of the auxiliary point m and the target point p, please refer to the modification method of the target point p in "lin" instruction.

Step3.For the modification of the parameters v, s, t and w, please refer to the modification of the corresponding parameters in "lin" instruction. It is worth noting that there is a certain difference between the parameter v and movej, which is mainly reflected in the fact that in addition to using %, cir can also choose the speed in mm/s.

Step4.If the auxiliary points and target points are available, you do not need to set the parameter CA. If you do not directly specify the target point, you can enter the central angle in the edit box behind CA. At this time, the target point is only used to determine the circular geometry together with the auxiliary points, but not a real target point.

Step5.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step6.Click the <Insert> button in Figure 5-25, and the instruction is inserted successfully.

Prompt

For details about "cir" instruction, please refer to "ARL Programming Manual".

5.3.1.5 spl (Spline motion)

Instruction introduction:

The spl instruction makes the robot pass through the teaching point smoothly without stopping.

Insert steps:

Step1.Click the [Insert Cmd/Motion Instruction/spl] option in the [Program Editor] toolbar, and the [spl] instruction configuration interface as shown in Figure 5-26 will pop up.

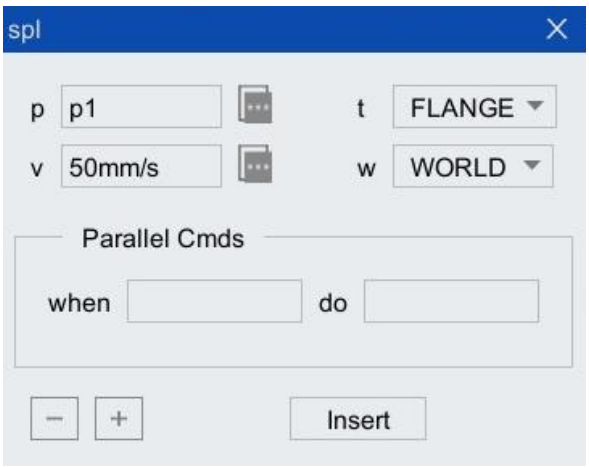


Figure 5-26 [spl] instruction configuration interface

Step2.Refer to the modification method of target point p in the 'lin' instruction for viewing and modifying target point p.

Step3.The modification method of parameters v, t, and w refers to the modification method of the corresponding parameters in the 'lin' instruction. It is worth noting that there is a certain difference between parameter v and movej, mainly reflected in the fact that spl can choose the speed unit in mm/s in addition to using %.

Step4.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step5.Click the <Insert> button in Figure 5-31, and the instruction is inserted successfully.

Prompt

For details about "spl" instruction, please refer to "ARL Programming Manual".

5.3.1.6 startweave (Turn on superimpose trajectory)

Instruction introduction:

The startweave instruction is used to turn on the superimpose trajectory.

Insert steps:

Step1.Click "Insert Cmd > Motion instruction > startweave" option in the program editor toolbar, and the "startweave" instruction configuration interface as shown in Figure 5-27.

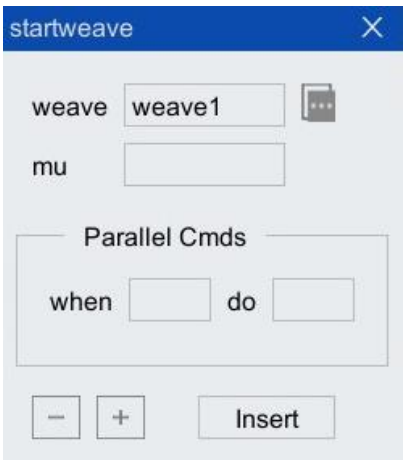


Figure 5-27 "Startweave" instruction configuration interface

Step2.Click the <...> button behind the variable weave to open the "weave" variable configuration interface as shown in Figure 5-28. Modify the specific parameter values according to actual needs. After the modification is completed, click the <Yes> button.

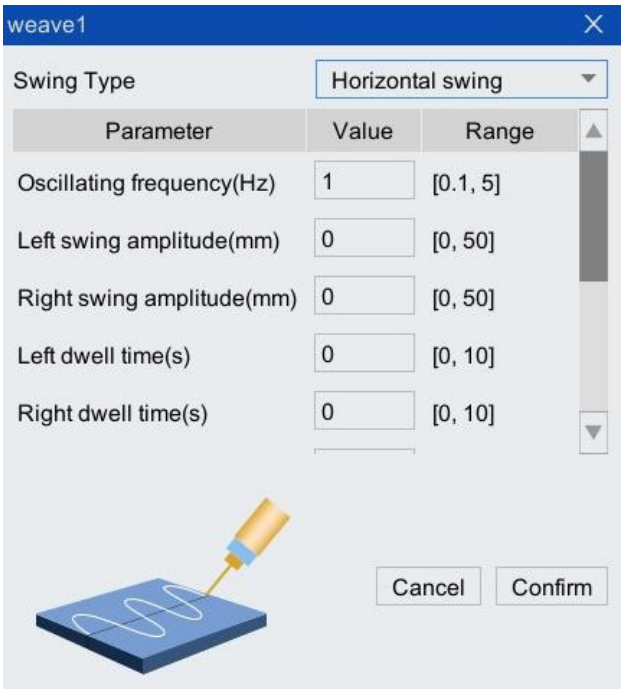


Figure 5-28 "Weave" variable configuration interface

Step3.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step4.Click the <Insert> button in Figure 5-27, and the instruction is inserted successfully.

Prompt

Please refer to "ARL Programming Manual" for parameter description and detailed usage of startweave instruction.

5.3.1.7 endweave (End superimpose trajectory)

Instruction introduction:

The endweave instruction is used to end the superimposed trajectory.

Insert steps:

Step1.Click "Insert Cmd > Motion instruction> endweave" option in the program editor toolbar, and the "endweave" instruction configuration interface as shown in Figure 5-29 will pop up.

Figure 5-29 "endweave" instruction configuration interface

Step2.Click the <Insert > button in Figure 5-29, the instruction is inserted successfully.

Prompt

Click the <Insert> button in Figure 5 24, the instruction is inserted successfully.

5.3.1.8 ccir (Continuous arc)

Instruction introduction:

In the cir instruction, the user needs to teach the two positions of the passing point and the end point. In the ccir instruction, only one point needs to be taught, but two or more ccir instructions need to be taught continuously to successfully construct an arc. Refer to "ARL Programming Manual" for detailed construction rules.

Compared with the cir instruction, the ccir instruction has the following characteristics:

- The speed can be specified individually at the passing point and end point of the arc motion.
- Logic instructions can be taught between the passing point and the end point. (However, the logic instructions that can be taught are limited.)

Caution

- When the following situations occur, the arc cannot be created, and the system reports "[12002][0] illegal arc plane".
- When the number of arc points created is less than 3, the arc cannot be formed.
- When the 3 points on the created arc form a straight line, the arc cannot be created.
- When consecutive identical points appear in the ccir instruction, an arc cannot be created.

Insert steps:

Step1.Click "Insert Cmd > Motion instruction > ccir" option in the toolbar of "Program editor", and the "ccir" instruction configuration interface as shown in Figure 5-30 will pop up.

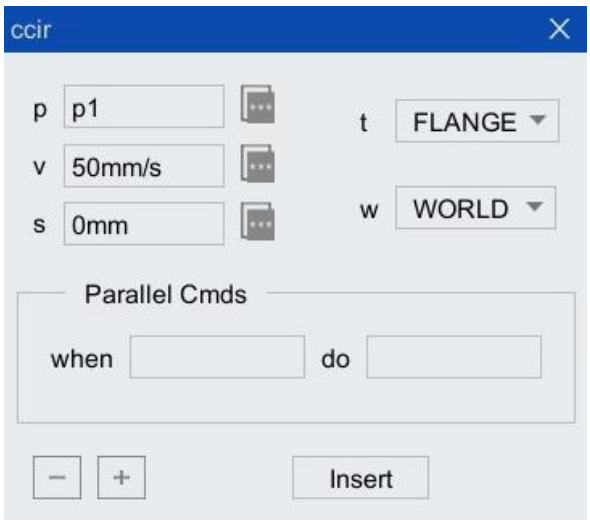


Figure 5-30 "ccir" Instruction configuration interface

Step2.To view and modify the target point p, please refer to the modification method of the target point p in the "PTP" instruction.

Step3.The speed parameter v can be directly entered in the text box at the back to complete the setting of the speed size percentage; you can also click the back <...> button to configure the variable in the [v] shown in Figure 5-31 To modify the specific speed value in the interface, click the <Yes> button after modification. There is a certain difference between the parameter v and movej, which is mainly reflected in the fact that in addition to using %, ccir can also choose the speed in mm/s.

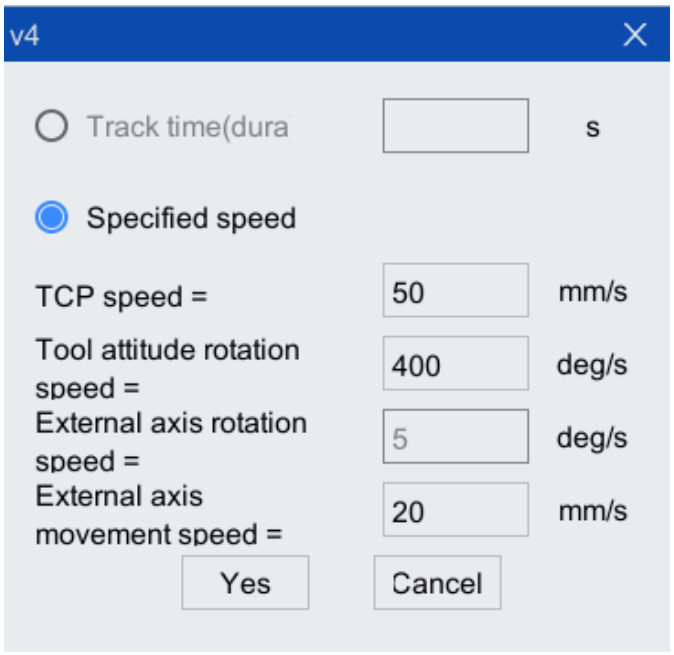


Figure 5-31 The "v" variable configuration interface

Step4.For the modification method of parameter s, refer to the modification method of the corresponding parameter in the "movej" instruction.

Step5.For the modification method of the parameters t and w, refer to the modification method of the corresponding parameter in the "PTP" instruction.

Step6.(Optional) When you need to process some actions in parallel, you need to enter parameters in [Expression] and [Action]. Click "+" to add a set of expressions and actions, and click "−" to delete a set of expressions and actions.

Step7.Click the <Insert> button in Figure 5-30, and the instruction is inserted successfully.

> Prompt
>
> For the parameter description and detailed usage of ccir instruction, please refer to "ARL Programming Manual".

5.3.1.9 Trajectory compensation

startcompen (Start trajectory compensation)

Instruction introduction

The startcompen instruction is used to turn on the tool compensation function.

Insert step

Step1.Click "Insert Cmd > Motion instruction > Tool compensation > startcompen" option in the tool bar of the program editor, and the [startcompen] instruction configuration interface as shown in Figure 5-32 will pop up.

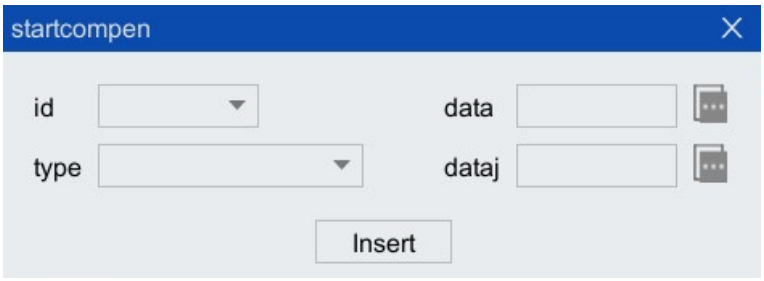


Figure 5-32 [Startcompen] instruction configuration interface

Step2.Configure the 'id' as the id of the compen instruction to be called, and configure the 'type' as the coordinate system used as a reference for the trajectory compensation.

Step3.Click the <...> button on the right side of date to pop up the parameter configuration interface for [data], as shown in Figure 5-33. This parameter represents the maximum speed, acceleration, jerk, and angular velocity, angular acceleration and angular jerk of the robot for tool compensation. After setting according to actual needs, click the <Yes> button.

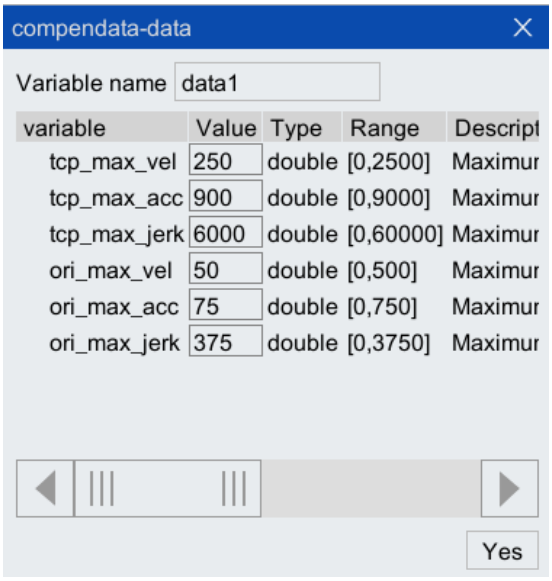


Figure 5-33 [Data] parameter configuration interface

Step4.Click the <...> button on the right side of dataj to pop up the parameter configuration interface of [dataj] as shown in Figure 5-34. This parameter represents the maximum speed, acceleration, and jerk of the robot for tool compensation. After setting it according to actual needs, click the <Yes> button.

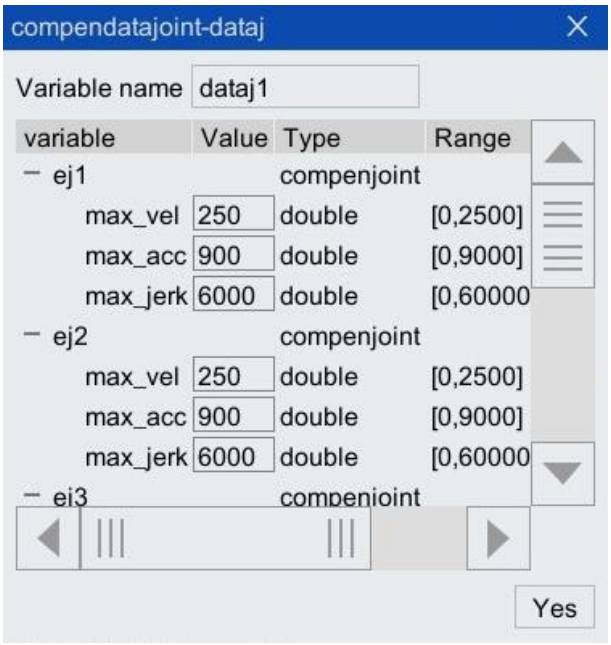


Figure 5-34 [Dataj] parameter configuration interface

Step5.Click the <Insert> button, the instruction is inserted successfully.

Prompt

Please refer to "ARL Programming Manual" for parameter description and detailed usage of startcompen instruction.

endcompen (End trajectory compensation)

Instruction introduction

The endcompen instruction is used to close the tool compensation function.

Insert step

Step1.Click "Insert instruction > Motion instruction > Tool compensation > endcompen" option in the program editor toolbar, and the [endcompen] instruction configuration interface as shown in Figure 5-35 will pop up.

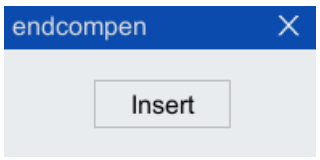


Figure 5-35 [Endcompen] instruction configuration interface

Step2.Click the <Insert> button, the instruction is inserted successfully.

Prompt

Please refer to "ARL Programming Manual" for the parameter description and detailed usage of endcompen instruction.

compen (Trajectory compensation)

Instruction introduction

The compen instruction is used to compensate the pose of the tool in real time.

Insert step

Step1.Click "Insert Cmd > Motion Instruction > Tool Compensation > compen" in the toolbar of the program editor, and the [compen] instruction configuration interface as shown in Figure 5-36 will pop up.

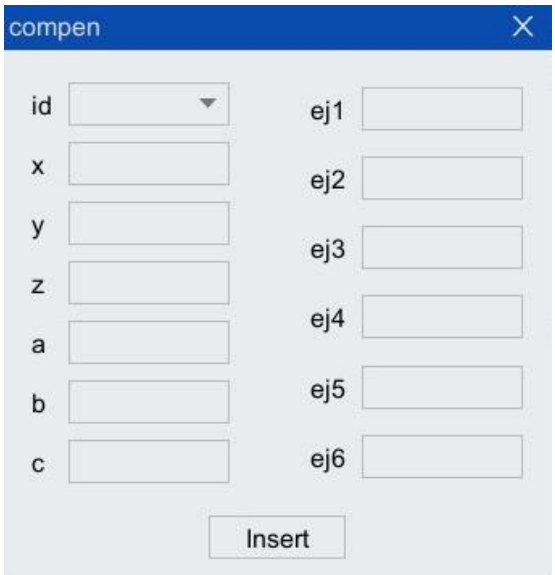


Figure 5-36 "Compen" Instruction configuration interface

Step2.Enter the compen instruction number to be matched with startcompen in 'id'; enter the required compensation amounts for each direction in 'x, y, z, a, b, c', in millimeters.

Step3.Click the <Insert> button, the instruction is inserted successfully.

Prompt

Please refer to "ARL Programming Manual" for parameter description and detailed usage of compen instruction.

5.3.2 Logic control

See Table 5-4 for the list of logic control instructions.

Table 5-4 List of logic control instructions

Name	Meaning
If	Conditional instruction
while	while loop
for	for loop
break	Out of the loop
continue	Continue to the next cycle
switch	Conditional branch
goto	Jump
returtn	Function returns
loop	Infinite loop
repeat	repeat loop
compact if	Compact conditional instruction

Instruction introduction:

Logic control instructions include "if" conditional branch, "while" loop, etc. When inserting one of the logic control instructions, the auxiliary programming will provide the program frame of the instruction.

Insert steps:

The "if" instruction is taken as an example to describe the steps of inserting the logic control instructions, and "if" is a conditional execution statement.

Step1.Place the cursor on any blank line in the program file.

Step2.Click "Insert Cmd > Logic control > if" option in the program editor toolbar, and the program frame of the if instruction is inserted. Please refer to Figure 5-37.

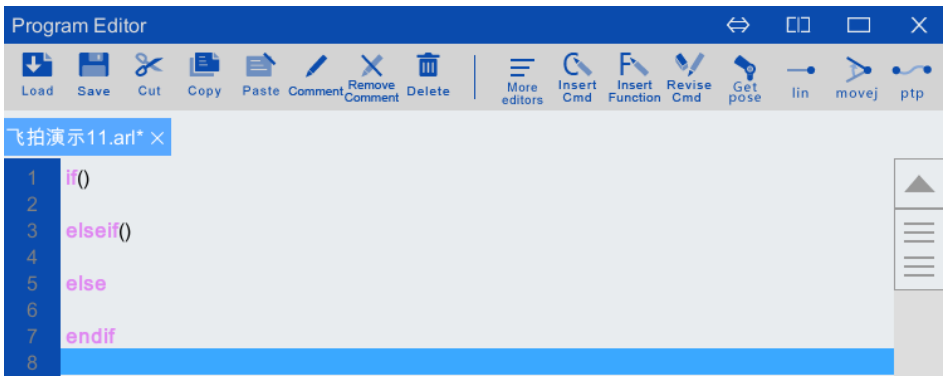


Figure 5-37 Contents of the program frame with the "if" instruction inserted

Step3.The system will calculate the value of the bool type expression after if from top to bottom, until a certain expression is true, then execute the instruction between this "if" and the next "elseif"or "else", and jump after execution continue execution to endif. The number of "elseif" is not limited, and there may be no "elseif" and/or "else" part.

> Prompt
>
> For the operation method of all instructions in logic control, please refer to "ARL Programming Manual".

5.3.3 Process control

Refer to Table 5-5 for the list of process control instructions.

Table 5-5 List of process control instructions

Name	Meaning
waittime	Delayed wait
waituntil	Condition wait
exit	Exit the program
pause	Pause
restart	Restart program
stopmove	Stop current movement
startmove	Restart a stopped movement

5.3.3.1 waittime (Delay waiting)

Instruction introduction:

The waittime instruction is used to delay waiting for a period of time.

Insert steps:

Step1.Click "Insert Cmd>process control> waittime" option in the toolbar of the program editor to pop up "waittime" instruction box, as shown in Figure 5-38.

Figure 5-38 "waittime" instruction box

Step2.Click the edit box behind the parameter "time" and enter the waiting time.

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about "waittime" instruction, please refer to "ARL Programming Manual".

5.3.3.2 waituntil (Condition wait)

Instruction introduction:

The waituntil instruction is used to wait until an event occurs.

Insert steps:

Step1.Click "Insert Cmd> Process Control> waituntil" option in the toolbar of the program editor to pop up "waituntil" instruction box, as shown in Figure 5-39.

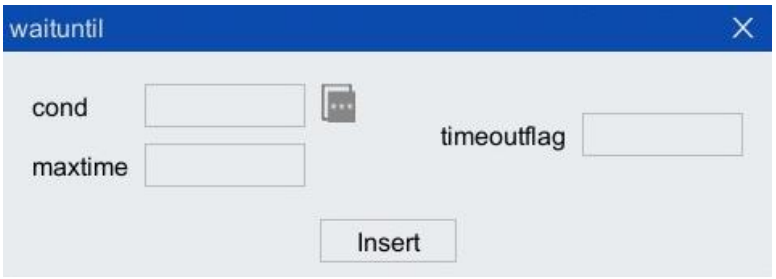


Figure 5-39 "waituntil" instruction configuration interface

Step2.Click the " " after the parameter cond to pop up the configuration interface shown in Figure 5-40. Configure the conditions for the specified program to wait, and click <Yes> after the configuration is completed.

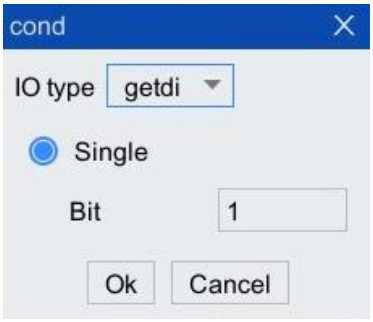


Figure 5-40 [cond]configuration interface

Step3.Click on the text box after the parameter 'maxtime' and enter the maximum waiting time. This parameter can be omitted based on actual needs.

Step4.If the parameter maxtime is set, click the edit box behind the parameter timeoutflag, enter a boolean variable expression.

Step5.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about "waituntil" instruction, please refer to "ARL Programming Manual".

5.3.3.3 exit (Exit the program)

Instruction introduction:

The exit instruction is used to exit the program execution. Even if the cyclic running mode is set, the program execution will be exited when an exit instruction is encountered, without restarting the program. If you want to restart the program after exiting, please use the restart instruction (please refer to Section5.3.3.5).

Insert steps:

Step1.Click "Insert Cmd> Process Control> exit" option in the toolbar of the program editor to pop up "exit" instruction interface, as shown in Figure 5-41.

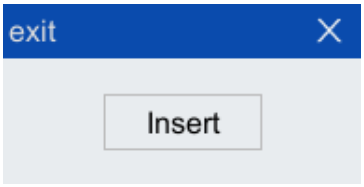


Figure 5-41 The "exit" instruction configuration interface

Step2.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about exit instruction, please refer to "ARL Programming Manual".

5.3.3.4 pause (Pause)

Instruction introduction:

The pause instruction is used to suspend the program execution. When the instruction is executed, the program will be in the pause status. At this time, the START button on the teach pendant must be pressed to run the program continuously.

Insert steps:

Step1.Click "Insert cmd> Process Control> pause" option in the toolbar of the program editor to pop up "pause" instruction interface, as shown in Figure 5-42.

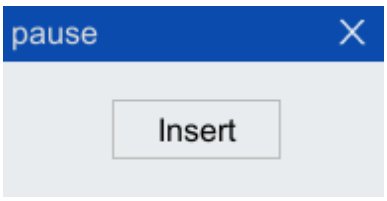


Figure 5-42 The "Pause" instruction configuration interface

Step2.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about "pause" instruction, please refer to "ARL Programming Manual".

5.3.3.5 restart (Restart the program)

Instruction introduction:

The restart instruction is used to restart the program. After executing the instruction, the program will reset and return to the main function entry for execution.

Insert steps:

Step1.Click "Insert Cmd> Process Control> restart" option in the toolbar of the program editor to pop up "restart" instruction interface, as shown in Figure 5-43.

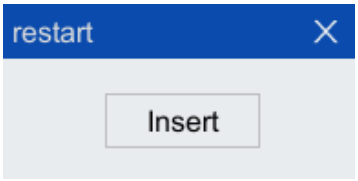


Figure 5-43 "Restart" instruction configuration interface

Step2.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about "restart" instruction, please refer to "ARL Programming Manual".

5.3.3.6 stopmove (Stop current movement)

Instruction introduction:

The stopmove instruction is used to suspend the execution of movement. The instruction is generally used in interrupt sub-functions. When the user wants a signal to come or an event to occur and the current movement is immediately decelerated and ended, you can declare an interrupt for the event in the program and execute the stopmove instruction in the interrupt processing sub-function. For example:

Interrupt sub-function:

```
func void zhongduan()

stopmove fast
```

waituntil getdi(6)

startmove true

endfunc

Main function:

func void main()

init()

interrupt 0,when:getdi(6),do:zhongduan()

Insertion steps:

Step1.Click "Insert Cmd> Process Control> stopmove" option in the toolbar of the program editor to pop up "stopmove" instruction interface, as shown in Figure 5-44.

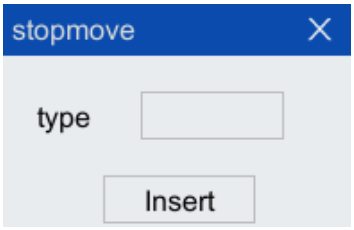


Figure 5-44 "Stopmove" instruction configuration interface

Step2.Click the edit box behind the parameter "type", and enter the stop type "general" or "fast" according to the actual needs.

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "stopmove" instruction, please refer to "ARL Programming Manual".

5.3.3.7 startmove (Restart a stopped motion)

Instruction introduction:

"startmove" restores the running execution. startmove is used together with stopmove to restore the movement instructions that are previously ended by stopmove.

Insertion steps:

Step1.Click "Insert Cmd> Process Control> startmove" option in the toolbar of the program editor to pop up "startmove" instruction interface, as shown in Figure 5-45.

Figure 5-45 "Startmove" instruction configuration interface

Step2.Click the edit box behind the parameter "skip", and enter the corresponding value according to the actual needs. The number behind "skip" indicates the number of trajectories to jump after restarting, which is calculated from the number of lines ended.

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "startmove" instruction, please refer to "ARL Programming Manual".

5.3.4 Interrupt trigger

Refer to Table 5-6 for the list of interrupt trigger instructions.

Table 5-6 List of interrupt trigger instructions

Name	Meaning
interrupt	Interrupt statement
enableint	Enable interrupt
disableint	Shield interrupt
delint	Delete interrupt
trigger	Trajectory trigger statement
timer	Timed interrupt

5.3.4.1 interrupt (Break statement)

Instruction introduction:

The interrupt instruction is used to declare an interrupt. If you want to execute a program when an asynchronous event occurs, you can use the interrupt declaration instruction. When the defined interrupt event occurs, the program will enter the interrupt sub-function defined in the interrupt declaration for execution.

Insertion steps:

Step1.Click "Insert Cmd> Interrupt Trigger> Interrupt" option in the toolbar of the program editor to pop up "interrupt" instruction interface, as shown in Figure 5-46.

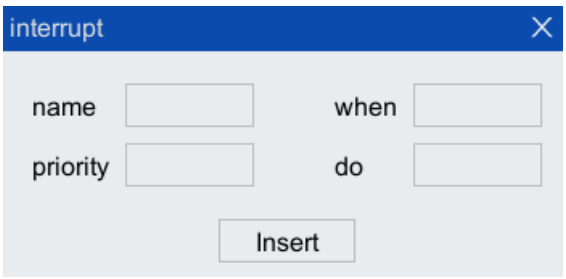


Figure 5-46 "Interrupt" instruction configuration interface

Step2.Click the edit box behind the parameter "name" and enter the interrupt name.

Step3.Click the edit box behind the parameter "priority" and enter the interrupt priority. The parameter can be defaulted. If it is default, the default priority will be 10.

Step4.Click the edit box behind the parameter "when", and enter the interrupt event.

Step5.Click the edit box behind the parameter "do", and enter the interrupt sub-function.

Step6.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about "interrupt" instruction, please refer to "ARL Programming Manual".

5.3.4.2 enableint (Enable interrupt)

Instruction introduction:

The enableint instruction is used to enable interrupts that are shielded previously.

Insertion steps:

Step1.Click "Insert Cmd> Interrupt Trigger> enableint" option in the toolbar of the program editor to pop up "enableint" instruction interface, as shown in Figure 5-47.

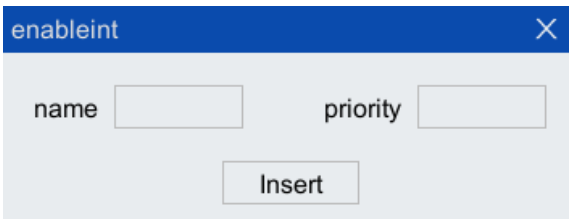


Figure 5-47 "enableint" instruction configuration interface

Step2.Click on the text box after the parameter 'name' and enter the name of the interrupt to be enabled.

Step3.Click on the text box after the parameter 'priority' and enter the priority level to enable a specific interrupt.

Step4.Click <Insert> button, and then the instruction is inserted successfully.

Prompt For details about enableint instruction, please refer to "ARL Programming Manual".

5.3.4.3 disableint (Mask interrupt)

Instruction introduction:

The disableint instruction is used to shield the interrupts that are declared previously.

Insertion steps:

For the insertion steps, please refer to "enableint" instruction.

5.3.4.4 delint (Remove interruption)

Instruction introduction:

The delint instruction is used to delete the interrupts that are declared previously.

Insertion steps:

For the insertion steps, please refer to "enableint" instruction.

5.3.4.5 trigger (Track trigger statement)

Instruction introduction:

The trigger instruction is used to declare a trigger. You can use the trigger function when you want to trigger a certain operation at a certain point on the trajectory. The format of the trigger declaration is basically identical with that of the interrupt declaration instruction, except that the trigger declaration must be written on the previous line of the movement instruction to be triggered.

Insertion steps:

Step1.Click "Insert Cmd> Interrupt Trigger> trigger" option in the toolbar of the program editor to pop up "trigger" instruction interface as shown in Figure 5-48.

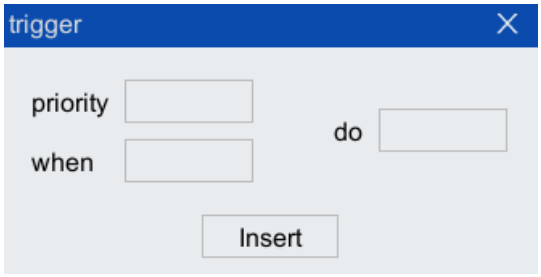


Figure 5-48 "Trigger" Instruction configuration interface

Step2.Click the edit box behind the parameter "priority", and enter the priority. The parameter can be defaulted.

Step3.Click the edit box behind the parameter "when", and enter the interrupt event.

Step4.Click the edit box behind the parameter "do", and enter the interrupt sub-function.

Step5.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about trigger instruction, please refer to "ARL Programming Manual".

5.3.4.6 timer (Timed interrupt)

Instruction introduction:

The timer instruction is a special interrupt instruction. It uses the clock as the interrupt source, which can be applied to the scenarios that need to implement an interrupt after a period of time or at regular intervals.

Insertion steps:

Step1.Click "Insert Cmd> Interrupt Trigger> timer" option in the toolbar of the program editor to pop up "timer" instruction interface, as shown in Figure 5-49.

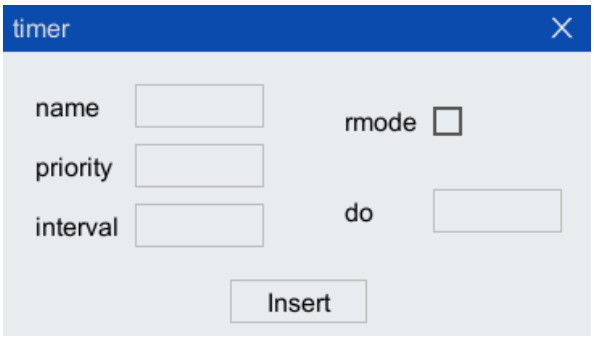


Figure 5-49 "Timer" instruction configuration interface

Step2.Click the edit box behind the parameter "name", and enter the interrupt name.

Step3.Click the edit box behind the parameter "priority", and enter the interrupt priority.

Step4.Click the edit box behind the parameter "interval", and enter the interrupt interval.

Step5.Click the box behind the parameter "rmode".

Step6.Click the edit box behind the parameter "do", and enter the interrupt sub-function.

Step7.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

Please refer to "ARL Programming Manual" for parameter description and detailed usage of timer instruction.

5.3.5 Auxiliary instructions

See Table 5-7 for the list of auxiliary instructions.

Table 5-7 List of auxiliary instructions

Name	Meaning
print	Printout
scan	Scan input

Name	Meaning
import	Import ARL module
nop	Add asynchronous teaching point instruction, see "Multi-move instructions" for details.
velset	Speed adjustment
accset	Acceleration adjustment
toolload	Tool load setting
toolswitch	Tool load switching
startdetect	Collision detection enable instruction, for detailed instructions, please refer to section 10.2.5.1
enddetect	Collision detection disable instruction, for detailed instructions, please refer to section 10.2.5.2

5.3.5.1 print (Printout)

Instruction introduction:

The print instruction is used to print the output to a certain position. You can use the function to print the value of one or more expressions to the HMI message bar, USB, a specified file, or a string. The instruction is mostly used for program debugging. The user can also use the function to output the logs.

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> Print" option in the toolbar of the program editor to pop up "print" instruction interface, as shown in Figure 5-50.

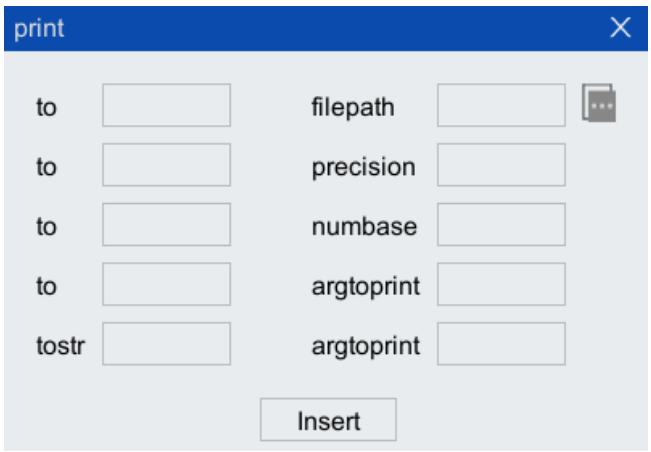


Figure 5-50 "Print" Instruction configuration interface

Step2.Click the corresponding parameter edit box according to the actual needs, and enter the parameter value.

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "print" instruction, please refer to "ARL Programming Manual".

5.3.5.2 scan (Scan input)

Instruction introduction:

The scan instruction is used to scan a string, and read a series of substrings separated by a delimiter into a series of variables according to their types.

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> scan" option in the toolbar of the program editor to pop up "scan" instruction interface, as shown in Figure 5-51.

Figure 5-51 "scan" instruction configuration interface

Step2.Click the edit box behind the parameter "from", and enter the defined string variable name.

Step3.Click the parameter "delimiter", and enter the delimiter.

Step4.Click the parameter "argtosave", and enter the name of the variable to which it is saved.

Step5.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "scan" instruction, please refer to "ARL Programming Manual".

5.3.5.3 import (Import ARL modules)

Instruction introduction:

The import instruction is used to import an ARL module.

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> import" option in the toolbar of the program editor to pop up "import" instruction interface, as shown in Figure 5-52.

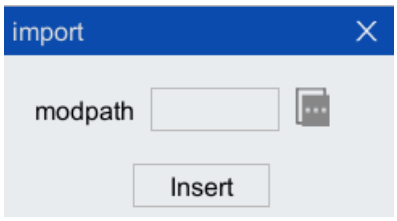


Figure 5-52 "import" instruction configuration interface

Step2.Click the edit box behind the parameter "modpath", and enter the arl file path to be imported.

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "import" instruction, please refer to "ARL Programming Manual".

5.3.5.4 velset (Speed adjustment)

Instruction introduction:

The velset instruction can be used to reduce or increase the programming planning speed of all subsequent movement instructions, and can also be used to set the max speed of the movement segment.

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> velset" option in the toolbar of the program editor to pop up "velset" instruction box, as shown in Figure 5-53.

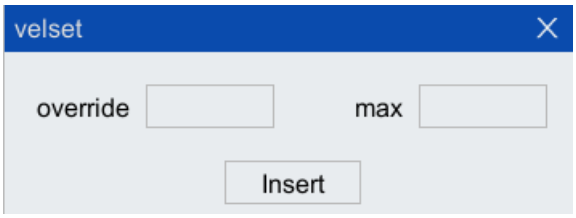


Figure 5-53 "velset" instruction configuration interface

Step2.Click the edit box behind the parameter "overside", and enter the speed percentage value.

Step3.Click the edit box behind the parameter "max", and enter the max TCP speed value for programming planning.

Step4.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "velset" instruction, please refer to "ARL Programming Manual".

5.3.5.5 accset (Acceleration adjustment)

Instruction introduction:

The accset instruction is used to adjust the acceleration and jerk of the robot's movement, and is often used when the robot is holding a fragile load. Low acceleration and deceleration are allowed. As a result, the robot's movement is more flexible.

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> accset" option in the toolbar of the program editor to pop up "accset" instruction interface, as shown in Figure 5-54.

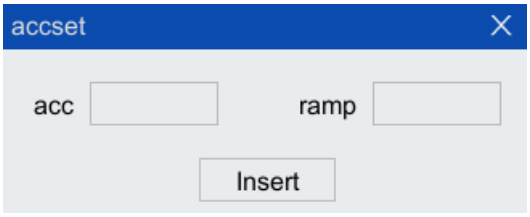


Figure 5-54 "accset" instruction configuration interface

Step2.Click the edit box behind the parameter "acc", and enter the percentage of actual acceleration relative to the max value.

Step3.Click the edit box behind the parameter "ramp", and enter the percentage of actual jerk relative to the max value.

Step4.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "accset" instruction, please refer to "ARL Programming Manual".

5.3.5.6 toolload (Tool load settings)

Instruction introduction:

The toolload instruction is used to set the load parameters when the program is running.

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> toolload" option in the toolbar of the program editor to pop up "toolload" instruction interface, as shown in Figure 5-55.

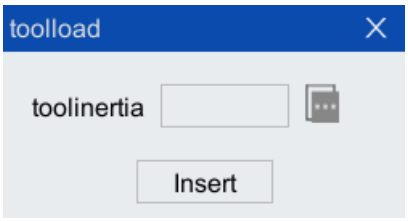


Figure 5-55 The "Toolload" instruction configuration interface

Step2.Click the <...> button on the right side to bring up the parameter configuration interface for [toolinertia], as shown in Figure 5-56. The variable m represents the tool mass, centroid_pos represents the centroid position, and inertia_tensor represents the inertia tensor. After setting according to actual needs, click the <Yes> button.

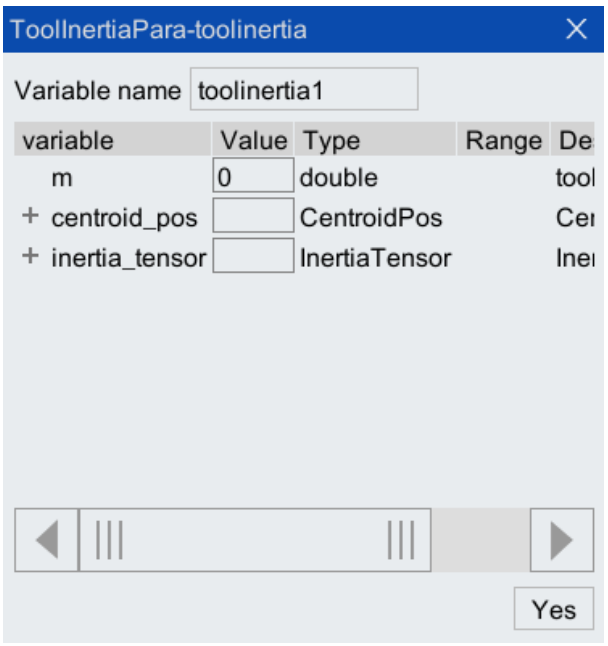


Figure 5-56 "Tool Load Inertia" parameter list

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "toolload" instruction, please refer to "ARL Programming Manual".

5.3.5.7 toolswitch (Tool load switching)

Instruction introduction:

The toolswitch instruction is used to switch the load serial number when the program is running. The inertia represented by the serial number can be modified and viewed in "System> Parameter Configuration> Global> TOOLINERTIA".

Insertion steps:

Step1.Click "Insert Cmd> auxiliary instruction> Tool Offset> toolswitch" option in the toolbar of the program editor to pop up "toolswitch" instruction interface, as shown in Figure 5-57.

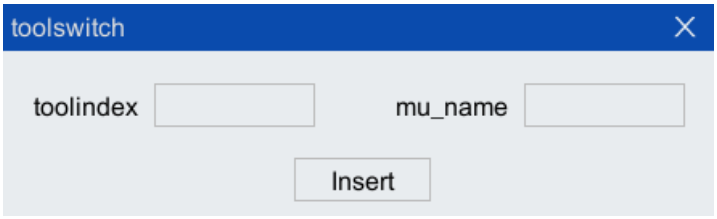


Figure 5-57 The "Toolswitch" instruction configuration interface

Step2.Enter the tool serial number (toolindex) and robot name (mu_name) in the pop-up toolswitch command configuration interface. The inertia represented by each serial number can be modified and viewed in "System> Parameter Configuration> Global> TOOLINERTIA".

Step3.Click <Insert> button, and then the instruction is inserted successfully.

Prompt

For details about "toolswitch" instruction, please refer to "ARL Programming Manual".

5.3.6 User subprogram

Instruction introduction:

The user subprogram function can insert a subprogram at any position in the main program.

When the program pointer is executed to the subprogram block, it will skip to the func function of the SubProg program. The structure of the subprogram will not be significantly different from that of the ordinary program, except that the main function may not be included. After the called function of the subprogram ends (that is, after execution to endfunc), the program pointer will return to the calling position. If you want to end the subprogram in advance, you can insert a return instruction in the place where you want to end. As a result, the subprogram's running will be ended in advance.

When the program pointer is executed to the above block, it will skip to the func function of the SubProg program. The structure of the subprogram will not be significantly different from that of the ordinary program, except that the main function may not be included.

Insertion steps:

Step1.In the main program (the program currently in use), position the cursor where you want to insert the subprogram.

Step2.Click "Insert Instruction> User Subprog" option in the toolbar of the program editor to pop up "Insert User Subprogram" interface, as shown in Figure 5-58. Click <Browse> button, find and highlight the folder where the subprogram to be inserted is located in the pop-up "Path Selection" dialog box, and click <Select> button, as shown in Figure 5-59.

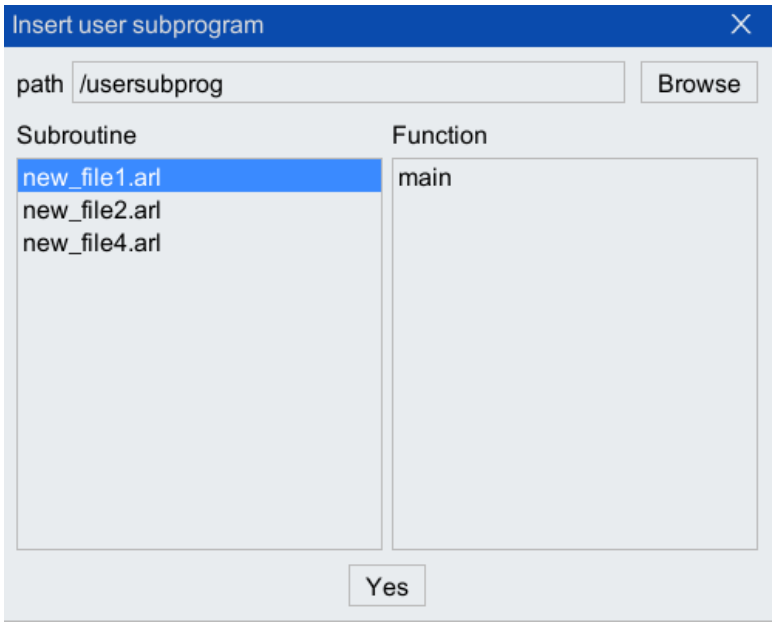


Figure 5-58 "Insert User Subprogram" interface

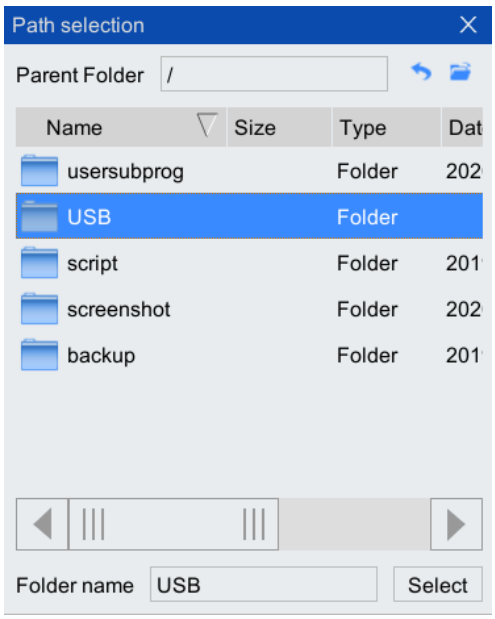


Figure 5-59 "Path selection" list box

Step3.The programs that can be inserted under the folder (the program contains the subprograms that can be inserted) will be displayed in "Insert User Subprogram" interface, as shown in Figure 5-60.

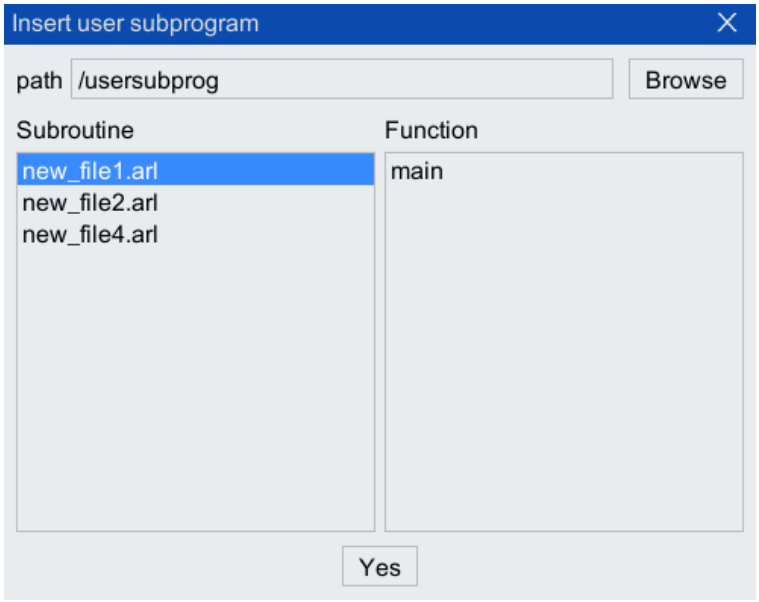


Figure 5-60 Subprogram is inserted along with its path

Step4.In "Subroutine" display box, click the program to which the subprogram belongs (EXT_CTRL_TESTluan + 0723.arl). At this time, "Function" display box will list all the subprograms contained in the selected program. Highlight the subprogram to be inserted and click <Yes> button.

Step5.If the subprogram (senddata) to be inserted is not in the same path as the main program, "The subprogram is not in the same path as the current program. Does it import the path?" dialog box will pop up, as shown in Figure 5-61. Click <Yes> button, and then the subprogram will be inserted into the main program along with its path, as shown in Figure 5-62.

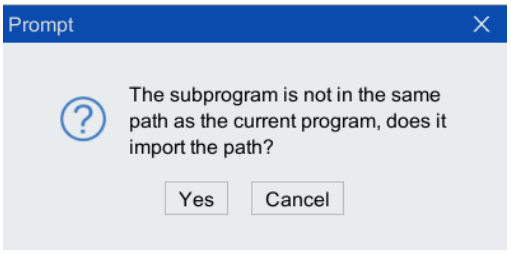


Figure 5-61 "Are you sure to Import Path" dialog box

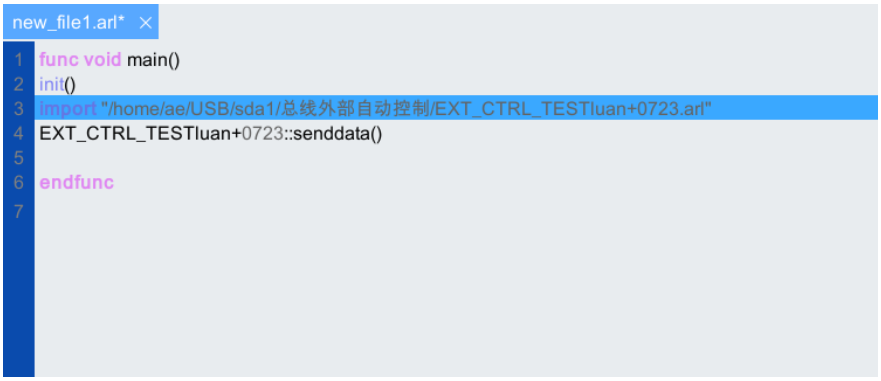


Figure 5-62 Subprogram is inserted along with its path (if it is not in the same path as the main program)

Step6.If the subprogram to be inserted is in the same path as the main program, highlight the subprogram to be inserted and click <Yes> button. Then the subprogram will be inserted into the main program, as shown in Figure 5-63.

Figure 5-63 Subprogram is inserted (if it is in the same path as the main program)

5.3.7 Function package

The related instructions for the functions of vision, arc welding, palletizing, bending and other functions in the "extended" list will only be displayed after the installation package is successfully installed. For specific usage, please refer to the instructions for each function package of our company.

5.4 Insert function

Please refer to the "ARL Programming Manual" of our company for the usage of all functions in the function menu.

5.5 Calibration

5.5.1 Coordinate system calibration

Select "Run> Coordinate System Measurement" option to enter "Coordinate System Measurement" interface, as shown in Figure 5-64. The coordinate system measurement includes "Tool Coordinate System Measurement", "Workobject Coordinate System Measurement" and "Base Coordinate System Measurement".

Caution

The workpiece coordinate system supports the creation of up to 200. The creation method is as follows: click [System/Parameter Configuration/Global/WOBJ_NUM (number of workpiece coordinate systems)] on the teach pendant main interface, and click <Edit> to configure the number of workpiece coordinate systems.

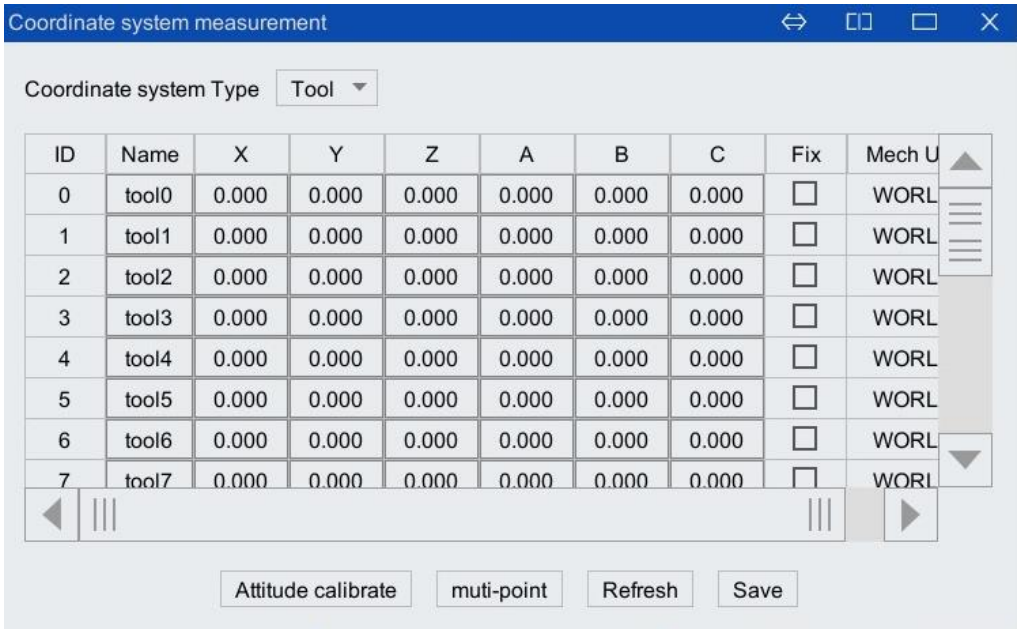


Figure 5-64 "Coordinate System Measurement" interface

5.5.1.1 Tool/workobject coordinate system

"Tool/workobject coordinate system measurement" has two methods: "input method" and "calibration method".

Input method

Tool coordinate system

You can set the tool coordinate system by inputting, as shown in Figure 5-65. The table shows the position of the origin of the tool coordinate system and the posture of the coordinate system.

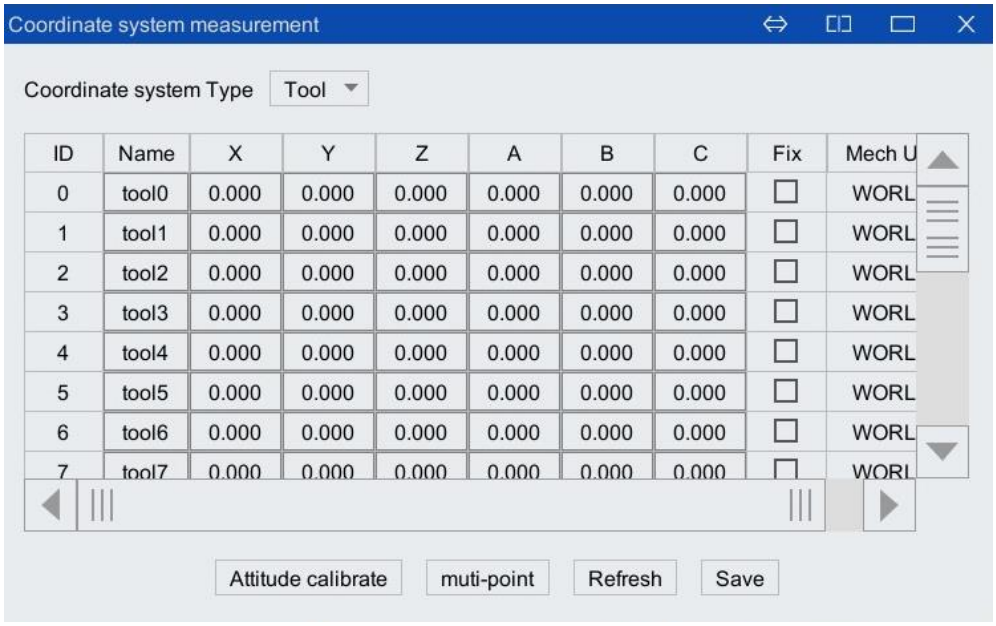


Figure 5-65 Interface of setting tool coordinate system by input method

Setting method:

Step1.Select "Tool Coordinate System" in "Coordinate System Type", as shown in Figure 5-65.

Step2.Click the cell in the line of "Tool Coordinate System" to be set, keep it editable, and modify X, Y, Z, A, B, C to the required values through the keypad.

Step3.Click <Save> button below to pop up "Saved Succeeded" dialog box in Figure 5-66, and then the setting will be completed.

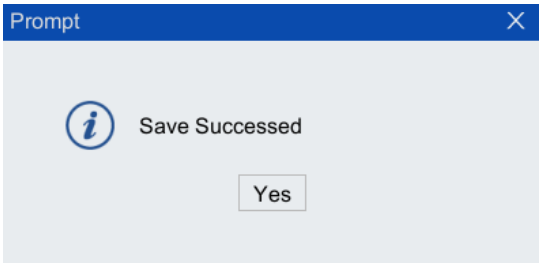


Figure 5-66 Save successful prompt box

Prompt

The "Input Method" can be used only when the specific values of the tool coordinate system X, Y, Z, A, B, C are known.

Step4.Set the workobject coordinate system by input, refer to Figure 5-67. The table in the figure shows the position of the origin of each workobject coordinate system and the posture of the coordinate system.

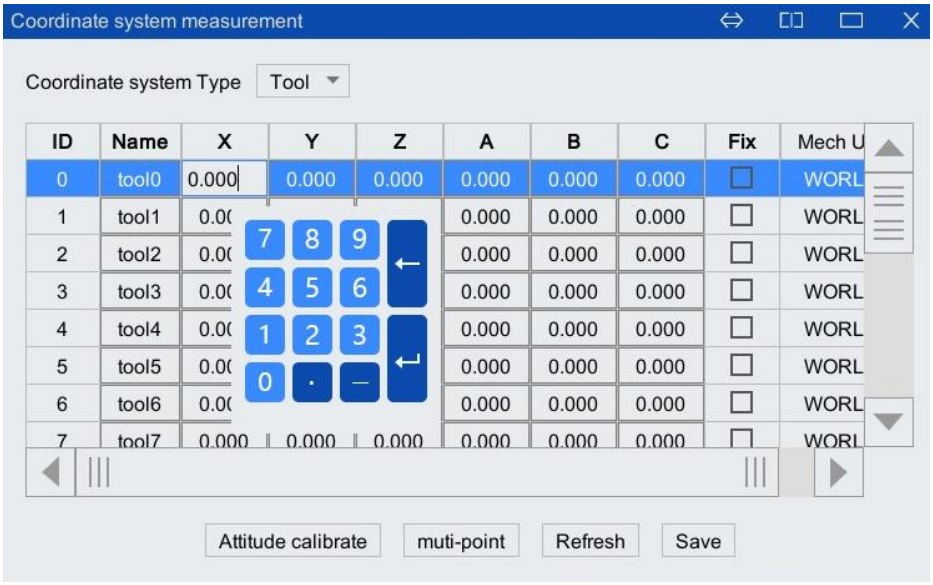


Figure 5-67 Input method setting workobject coordinate system page

Workobject coordinate system

Setting method:

Step1.Select "Workobject Coordinate System" in "Coordinate System Type", as shown in Figure 5-65.

Step2.Click the cell in the line of "Workobject Coordinate System" to be set, keep it editable, and modify X, Y, Z, A, B, C to the required values through the keypad.

Step3.Click <Save> button below to pop up "Save Succeeded" dialog box in Figure 5-68, and then the setting will be completed.

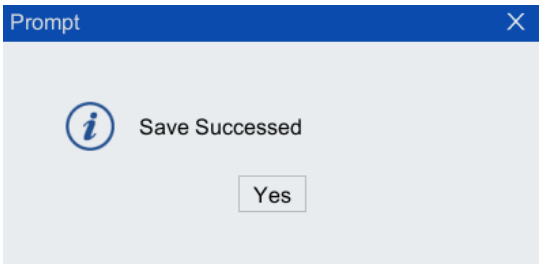


Figure 5-68 "Save Succeeded " dialog box

Prompt

The "Input Method" can be used only when the specific values of the workobject coordinate system X, Y, Z, A, B, C are known.

Calibration method

Mobile tool + fixed workobject

Our common tools are installed on the end flange, and the workobject is placed in a fixed position. For example, when we are grinding, we choose to install the grinding head or sandpaper on the end flange, and place the polished workobject on the grinding platform Above, this is the mobile tool + fixed workobject we defined. That is, when

calibrating the tool and workobject coordinate system, the "fixed" and "moving" option boxes in the [Coordinate System Measurement] interface are not checked.

Calibration method:

Step1.Select "Tool Coordinate System" for "Coordinate System Type" in Figure 5-65. Assuming that the name of the "Tool Coordinate System" to be calibrated is tool0, select the row where tool0 is located, and click the <Attitude calibrate> button below to enter Figure 5-69 shows the "multipoint method" calibration interface. In Figure 565, select "Tool Coordinate System" for [Coordinate System Type]. Assume that the name of the "Tool Coordinate System" to be calibrated is "tool0". Select the row where tool0 is located, click the <Attitude calibrate> button below, and enter the [Attitude Calibration] calibration interface is shown in Figure 5-69.

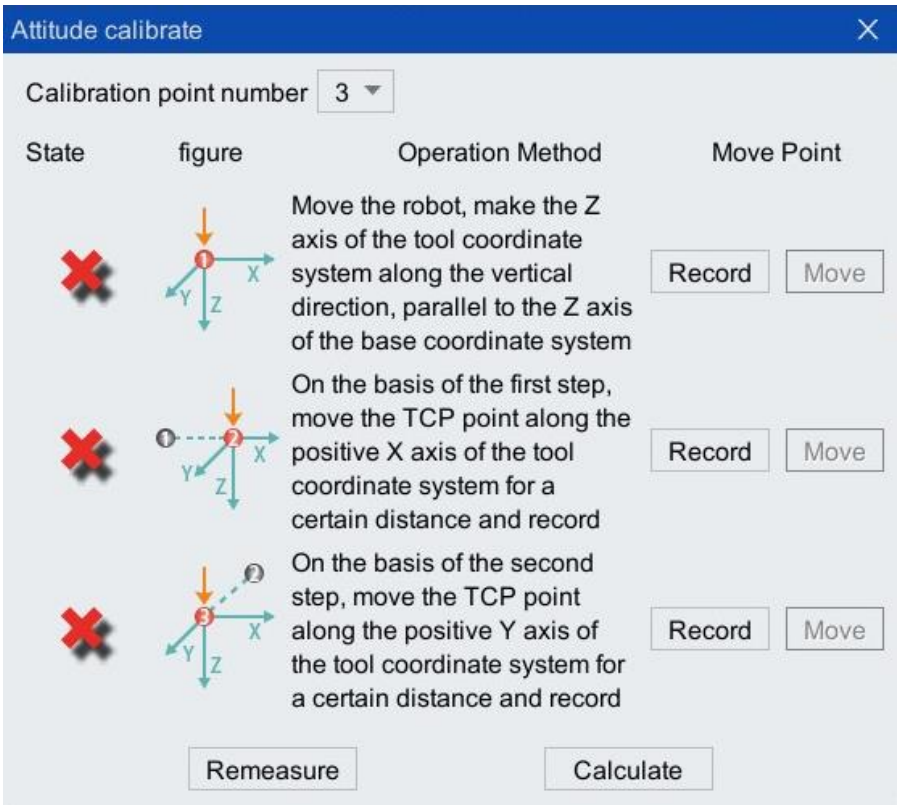


Figure 5-69 "Multi-point method" Calibration interface

Step2.Select the number of points to be calibrated from the [Calibration Points] list, here 3 points are taken as an example. Refer to Figure 5-70.

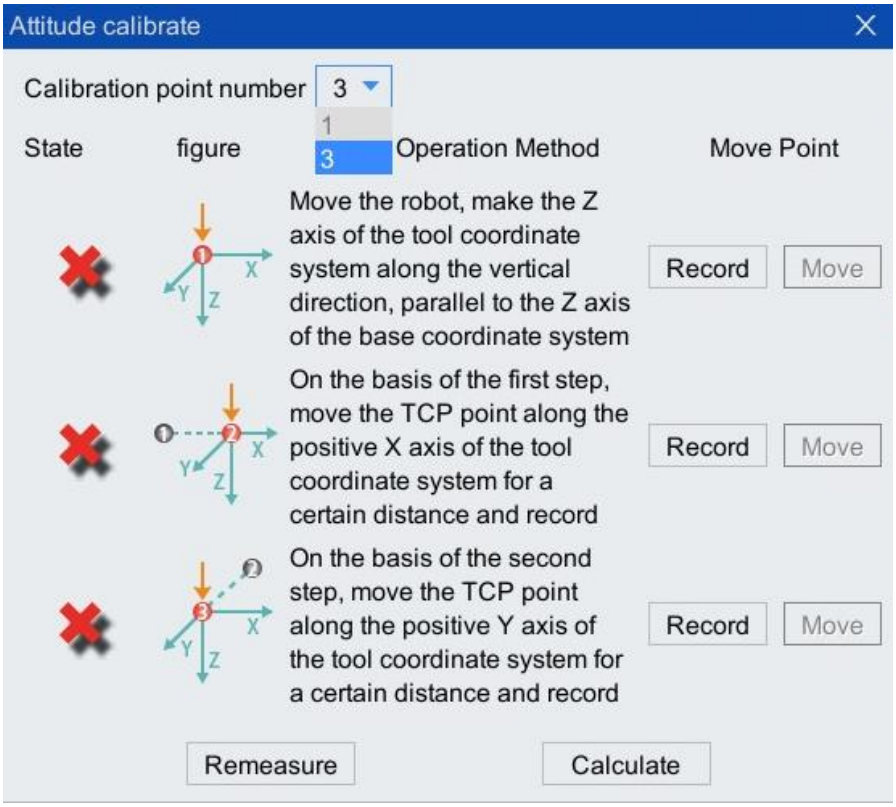


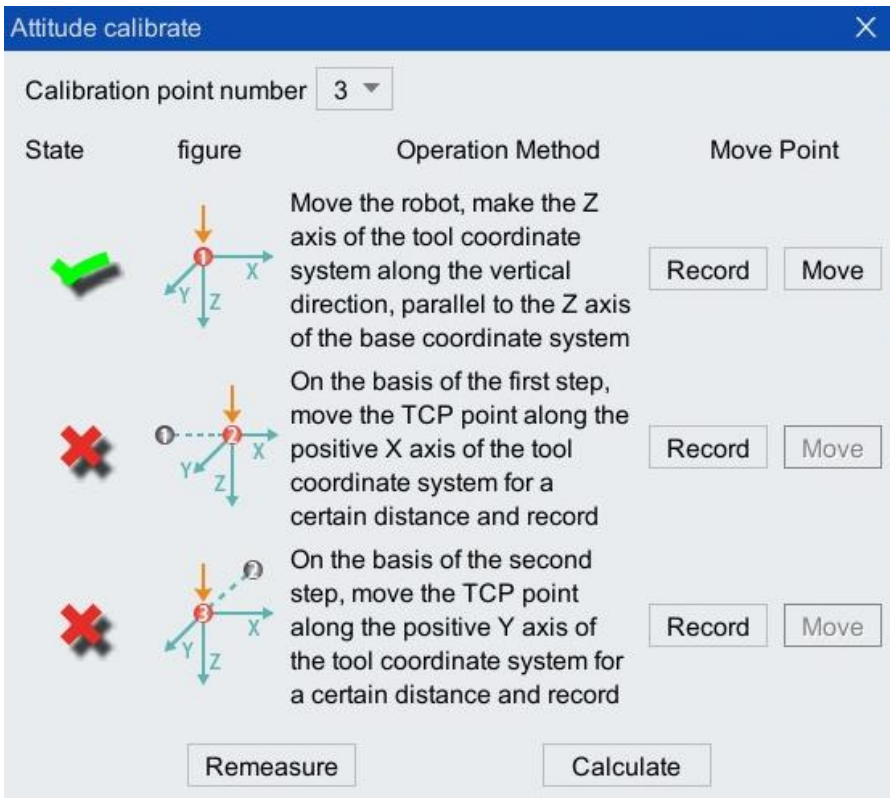
Figure 5-70 Calibration point selection

> Prompt
>
> The more points, the higher the accuracy of the tool coordinate system. For example, when using tools to calibrate the workobject coordinate system, base coordinate system, etc., the number of calibration points can be appropriately increased.

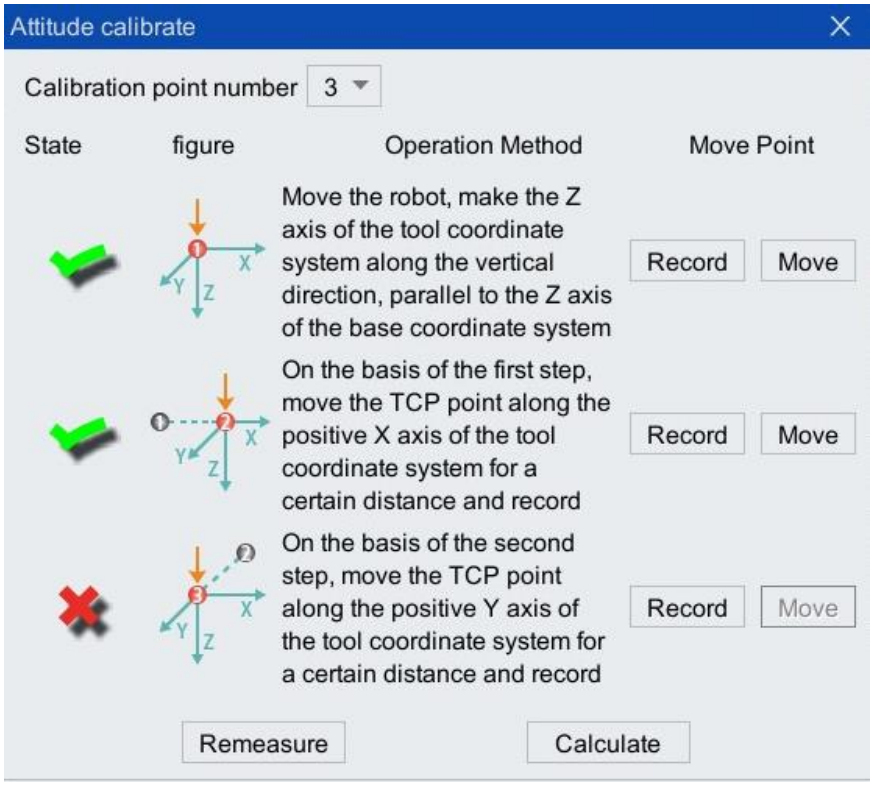
Step3.Then calibrate according to the operation instructions in the figure. After each point is successfully calibrated, the front status will change from X to √ (refer to Figure 5-71(a)-(c)), and when all calibrations are completed, the interface will be as shown in Figure 5-71(d). The button function description in the interface is shown in Table 5-8.

Table 5-8 "Multipoint Method" Calibration Interface button function introduction

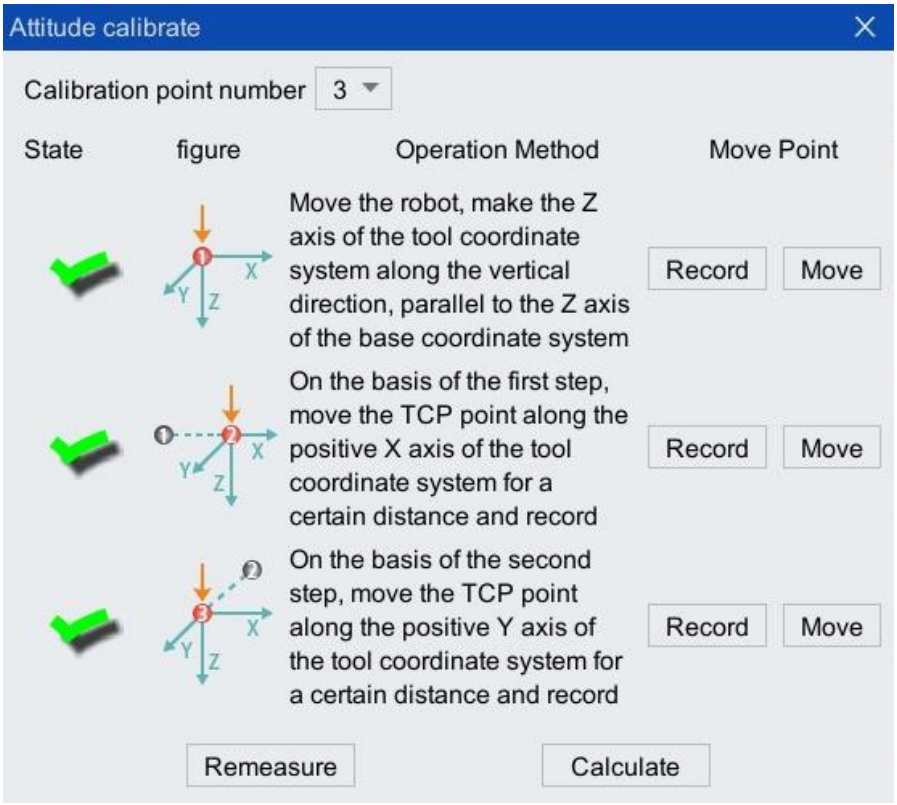
Icon	Function
Record	Record the point information you want to calibrate
Move	Move to the calibration record point. Used to verify the accuracy of calibration recording points
Remeasure	Clear the calibrated point information Note: After emptying, all √ in Figure 5-65 will be restored to X
Calculate	Calculate the calibration error, if it exceeds the error range, need to re-measure



(a) 1 point successfully calibrated



(b) 2 points successfully calibrated



(c) 3 points successfully calibrated
Figure 5-71 "3 point method" calibration process status change

Step4.After all the calibrations are successful, click the <Calculate> button at the bottom of Figure 5-65 to calculate the error. If it exceeds the error range, the "Calibration failed, please re-measure!" prompt box as shown in Figure 5-72 will pop up. Then you need to re-calibrate until the error is within the allowable range; if the error is within the allowable range, the "Calibration is successful, save?" prompt dialog box as shown in Figure 5-73 will pop up, click the <Yes> button, and the figure will pop up 5 The "Save successfully" prompt box shown in Figure 5-74 will complete the calibration.

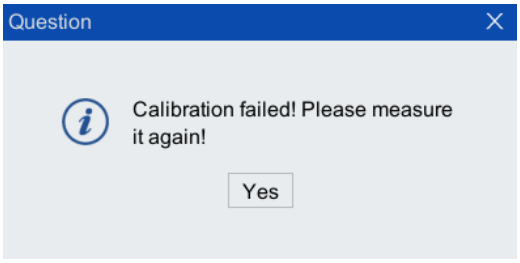


Figure 5-72 "Calibration failed, please measure it again!" prompt dialog box

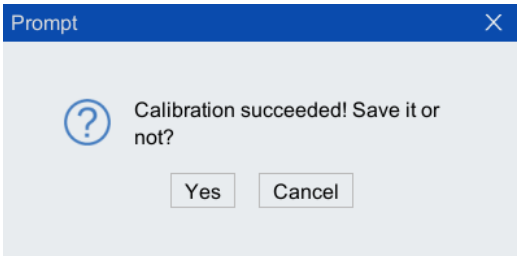


Figure 5-73 "Calibration succeeded, save it or not?" prompt dialog box

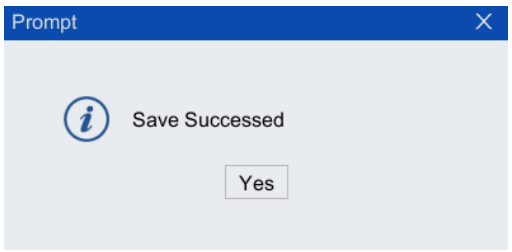


Figure 5-74 "Save successed" prompt dialog box

Step5.Select "Workobject Coordinate System" in [Coordinate System Type] in Figure 5-65. Assuming that the name of the "Workobject Coordinate System" to be calibrated is wobj0, click the mechanical unit box corresponding to the row of wobj0, and a drop-down list will pop up, as shown in Figure 5-75 , Choose either WORLD or R1. When WORLD is selected, it means that the workobject coordinate system is calibrated relative to the world coordinate system. When R1 is selected, it means that the workobject coordinate system is calibrated relative to the robot base coordinate system.

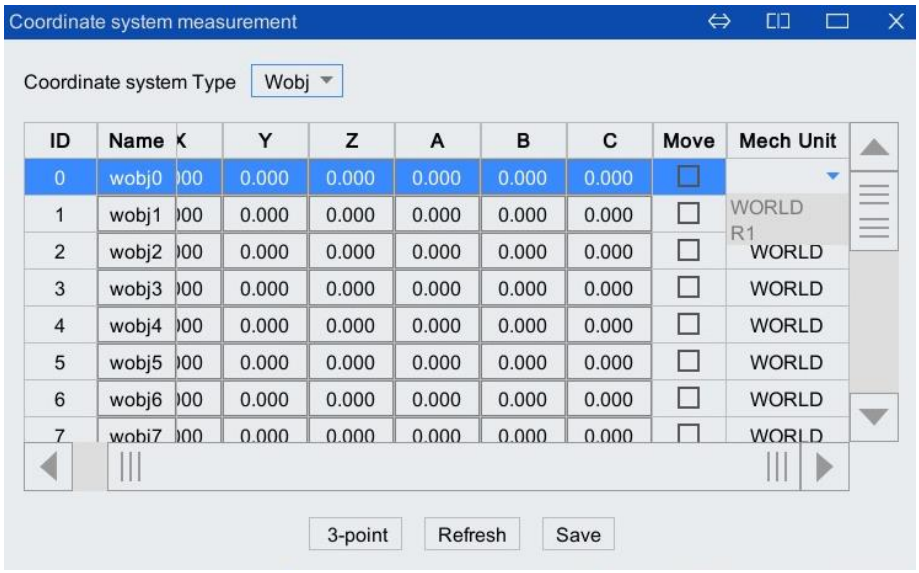


Figure 5-75 "Mechanical Unit" list

Step6.After selecting the row where wobj0 is located, click the <three-point method> button at the bottom left, and the [three-point method] calibration interface shown in Figure 5-76 will pop up. In the [Tool] list on the interface, select the tool coordinate system used to calibrate the workobject coordinate system (tool0 calibrated before).

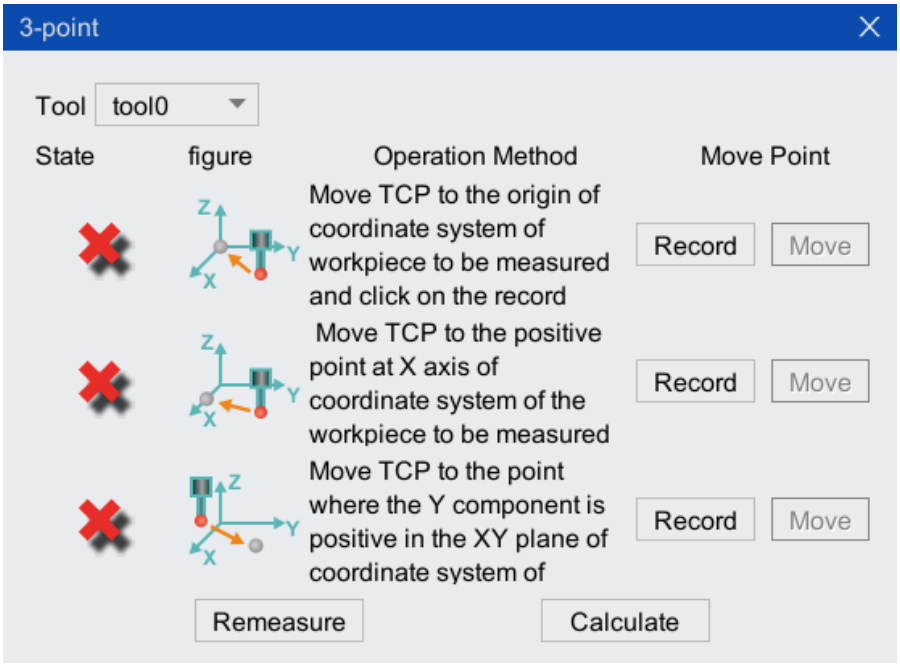
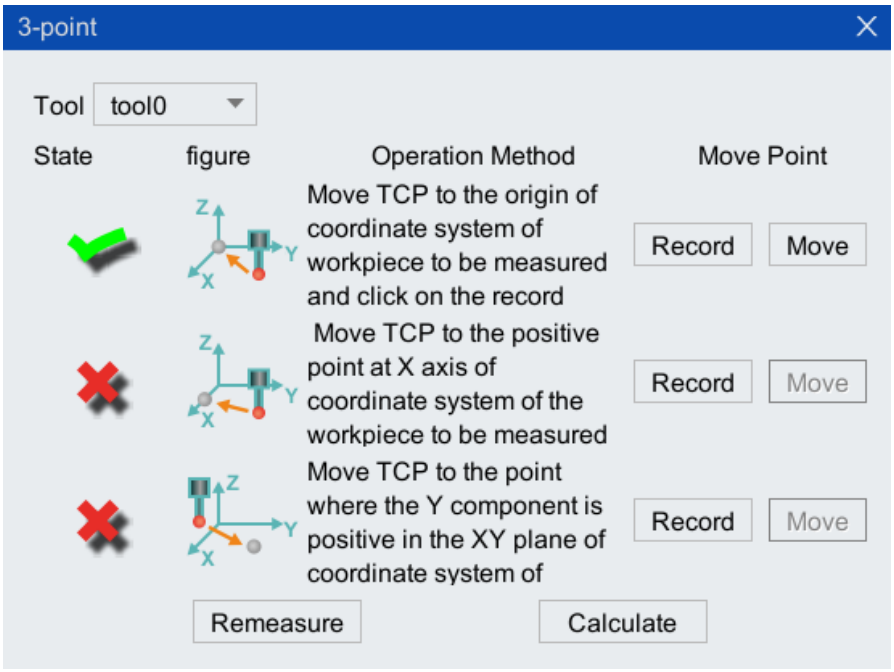
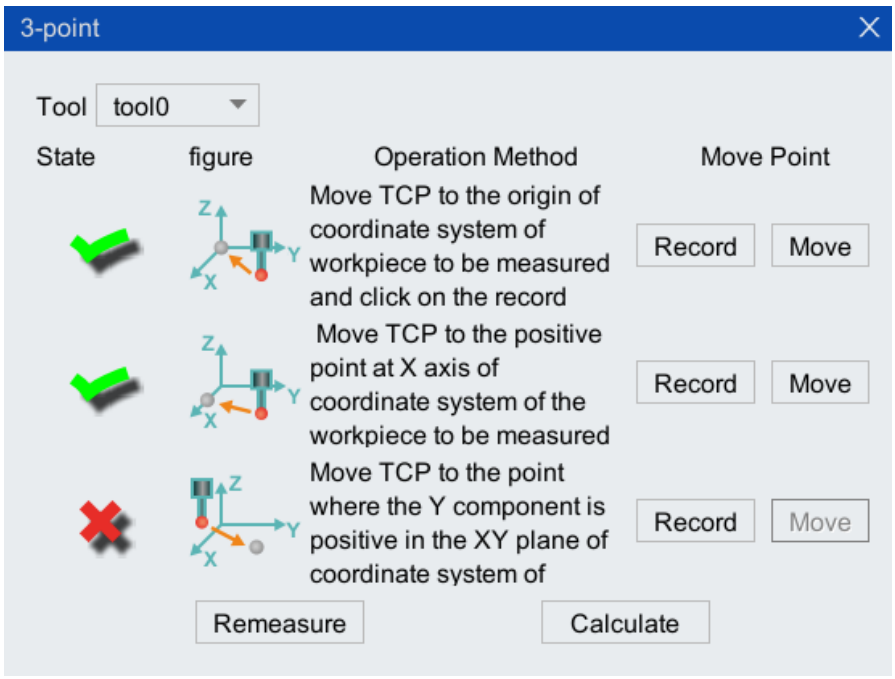


Figure 5-76 "Three-point method" calibration interface

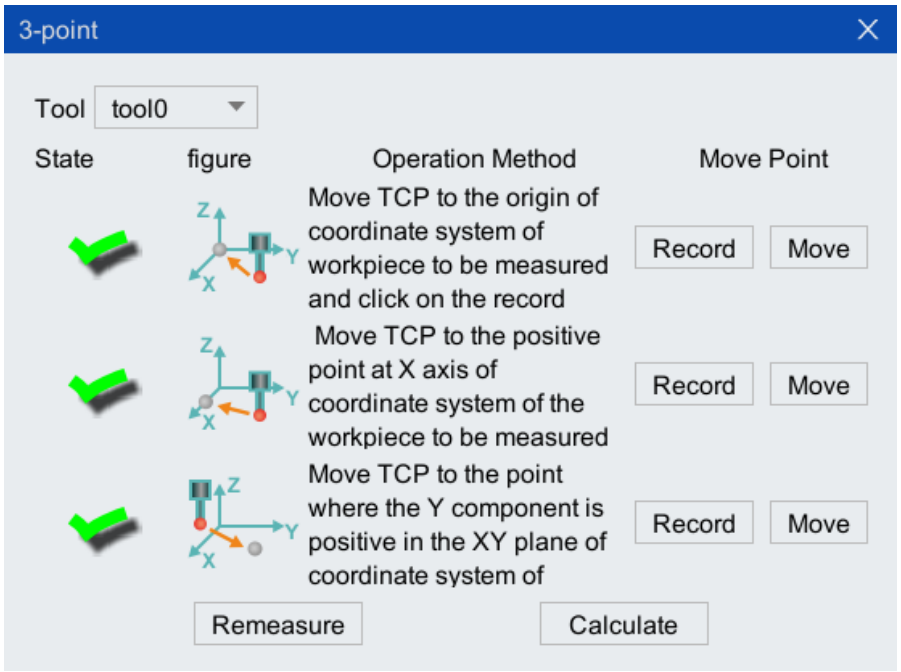
Step7.Next, calibrate according to the operation instructions in the figure. After each point is successfully calibrated, the front status will change from X to √ (refer to Figure 5-76(a)-(b)), and all calibrations are completed. As shown in Figure 5-77(c).



(a) 1 point successfully calibrated



(b) 2 point successfully calibrated



(c) 3 point successfully calibrated
Figure 5-77 "Three-point method" calibration process status change

Step8.Repeat step 4 to complete the calibration.

Moving workobject + fixed tool

In the robot use case, there is also the robot end flange clamping the workobject, and the tool is fixed to the specified position, which is defined as moving workobject + fixed tool, that is, external TCP. For example, the robot end flange holds the workobject, fixes the grinding wheel, and the robot moves the workobject to the grinding wheel for grinding. That is, when calibrating the tool and workobject coordinate system, both the "fixed" and "moving" option boxes in the "coordinate system calibration" interface must be checked.

Calibration steps:

Step1.If the coordinate system of the moving workobject to be calibrated is wobj1, check the <Move> button in the row where wobj1 is located, and √ is displayed after checking, as shown in Figure 5-78. Click the mechanical unit box corresponding to the row of wobj1, and a drop-down list will pop up, as shown in Figure 5-78. Optional WORLD or R1. When WORLD is selected, it means that the workobject coordinate system is calibrated relative to the world coordinate system. When R1 is selected, it means to calibrate the workobject coordinate system relative to the base coordinate system of the robot.

Step2.Select the row where wobj1 is located, and click the <multi-point method> button below, and the [multi-point method] calibration interface as shown in Figure 5-79 will pop up. The button function description in the interface is shown in Table 5-8.

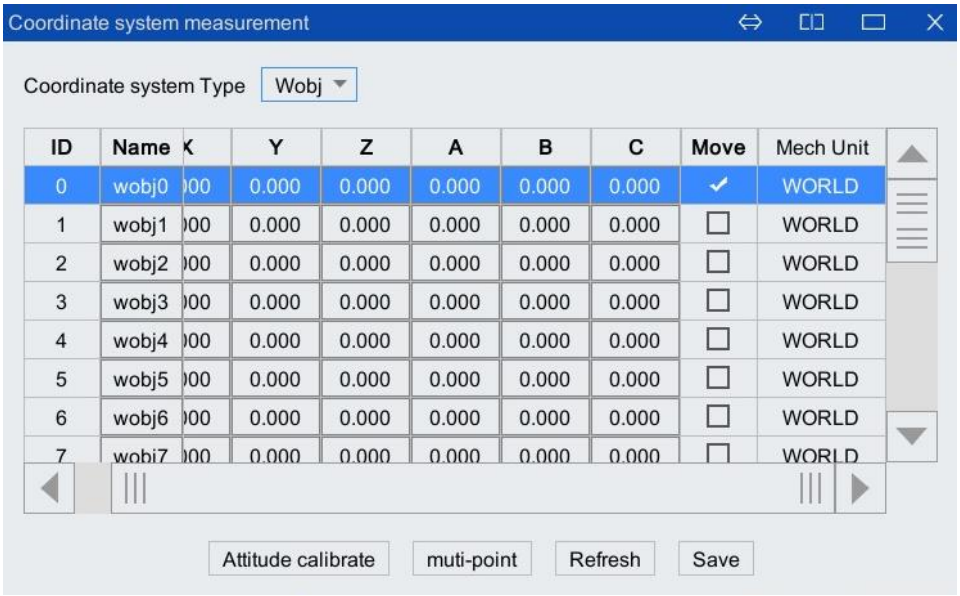


Figure 5-78 "Move Workobject Coordinate System" interface

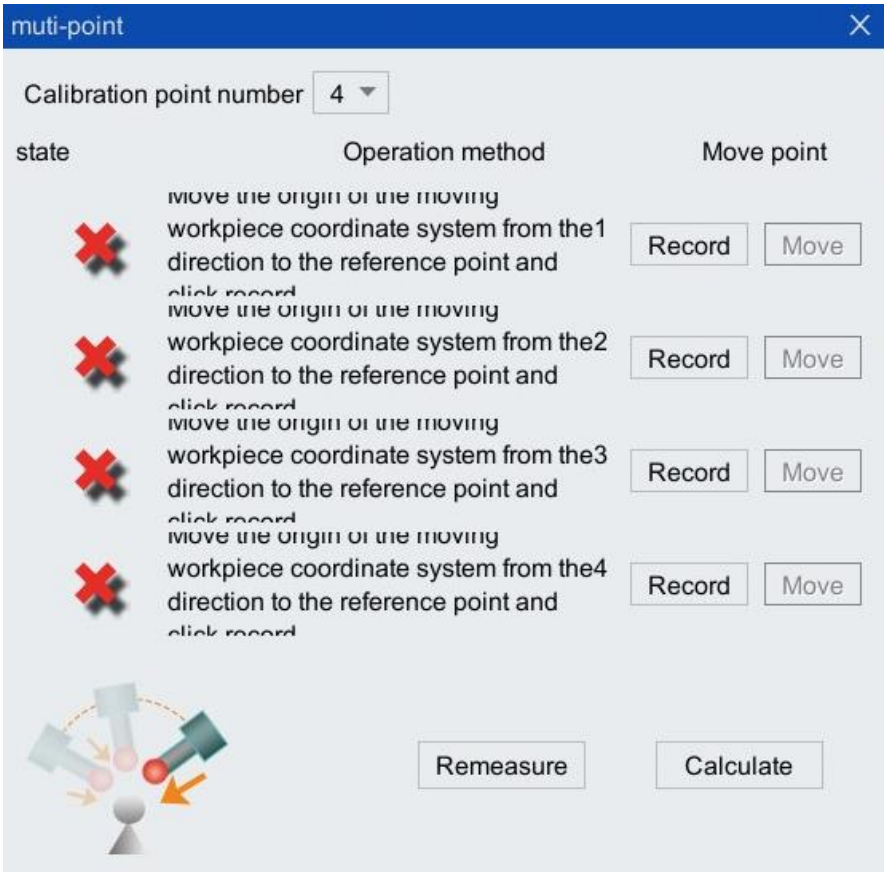


Figure 5-79 [Multi-point method] calibration interface

Step3.Select the number of points to be calibrated from the list of [Calibration points], here 4 points is taken as an example, refer to Figure 5-80.

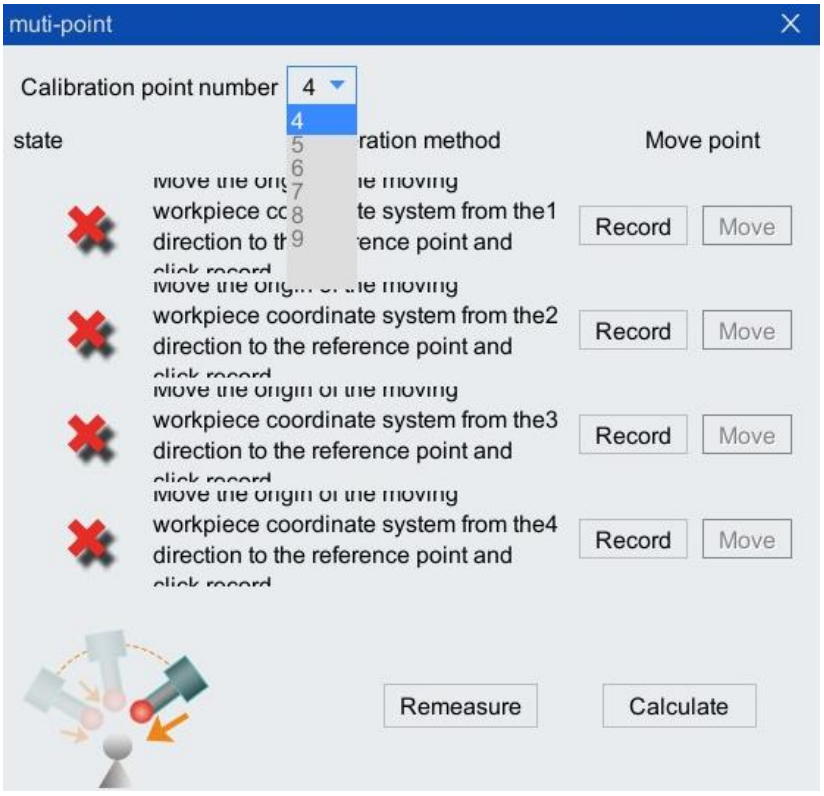
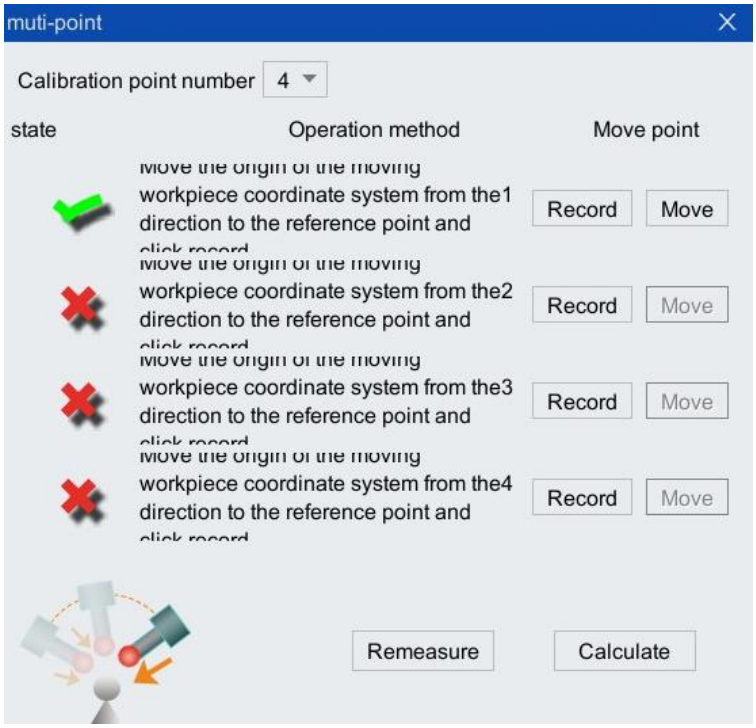
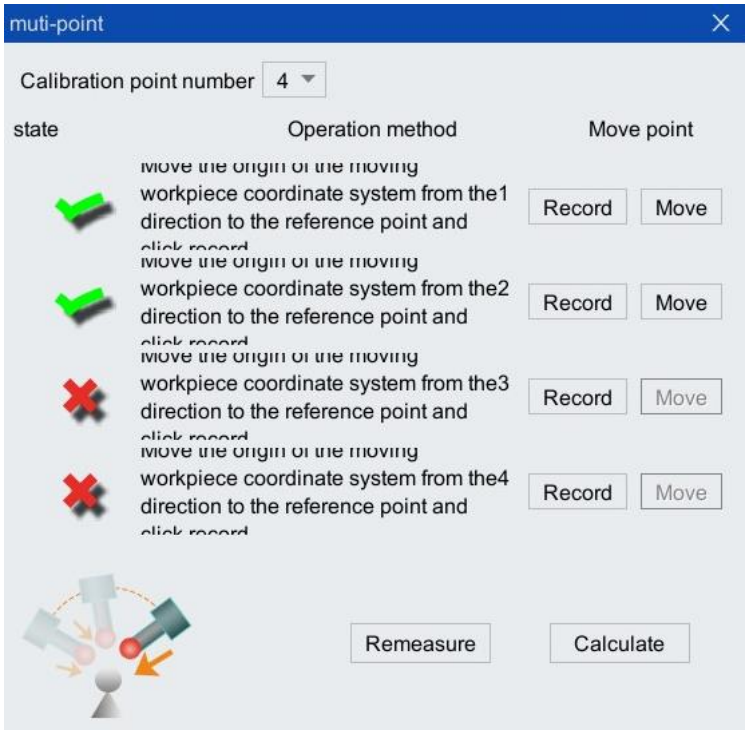


Figure 5-80 Calibration point selection

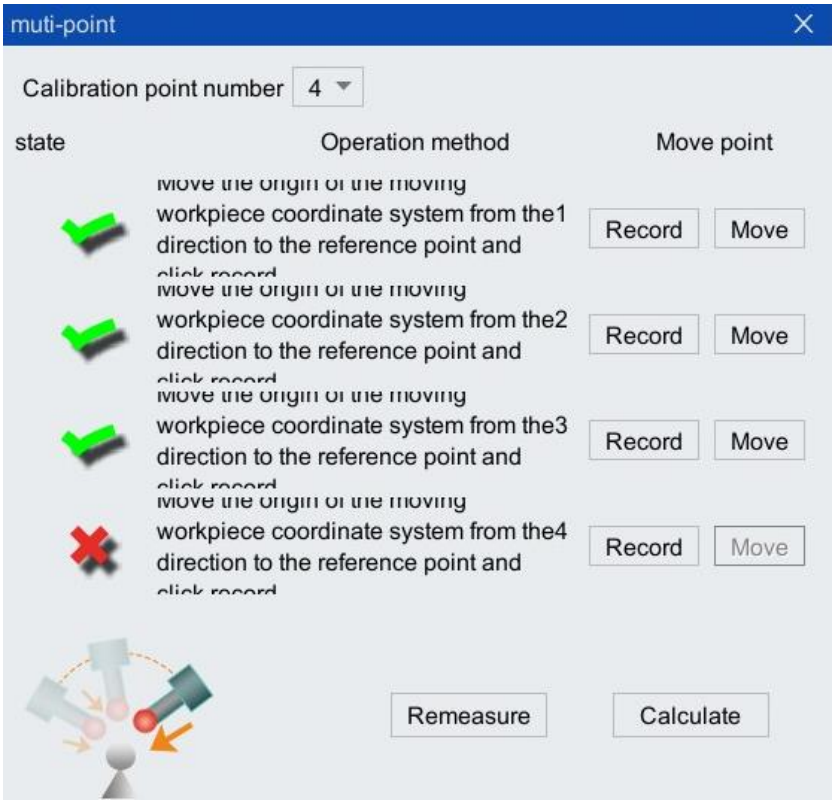
Step4.Next, calibrate according to the operation instructions in the figure. After each point is successfully calibrated, the front status will change from X to √ (refer to Figure 5-81(a)-(c)), and all calibrations are completed, the interface will be as shown in Figure 5-81 (d).



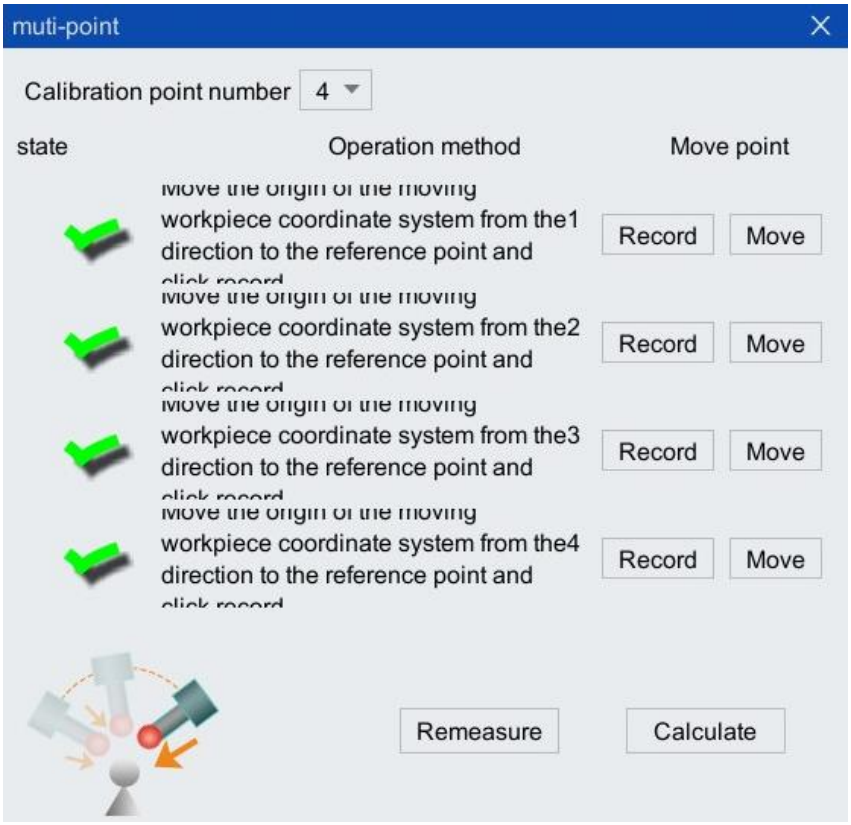
(a) 1 point successfully calibrated



(b) 2 point successfully calibrated



(c) 3 point successfully calibrated



(d) 4 point successfully calibrated
Figure 5-81 "Four point method" calibration process status change

Step5.After all calibrations are successful, click the <Calculate> button at the bottom of Figure 5-78 to calculate the error. If it exceeds the error range, the "Calibration failed, please re-measure!" prompt box as shown in Figure 5-

82 will pop up. Then you need to re-calibrate until the error is within the allowable range; if the error is within the allowable range, the "Calibration is successful, save it?" prompt dialog box as shown in Figure 5-83 will pop up, click the <Yes> button. The "Save Successful" prompt box as shown in Figure 5-84 pops up to complete the calibration.

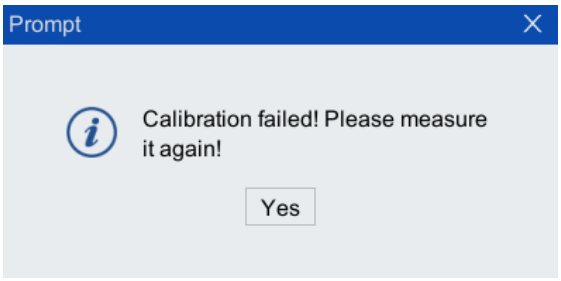


Figure 5-82 "Calibration failed, please measure it again!" prompt dialog box

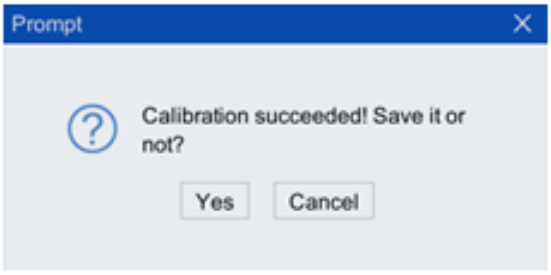


Figure 5-83 "Calibration succeed, save it or not?" prompt dialog box

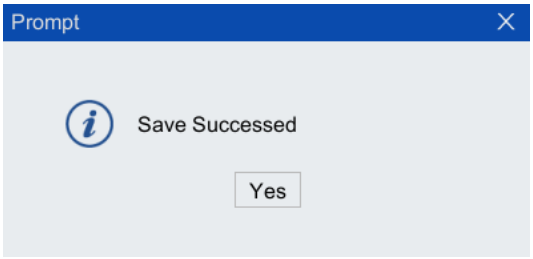


Figure 5-84 "Save successed" prompt dialog box

Step6."Type of Coordinate System" select "Tool Coordinate System", copy the values (X, Y, Z, A, B, C) in the calibrated workobject coordinate system wobj1 to the tool coordinate system tool1.

Step7.Assuming that the name of the "fixed tool coordinate system" to be calibrated is tool0, select the row where tool0 is located, check the "fixed" option in the row where tool0 is located, and then display √ , as shown in Figure 5-85.

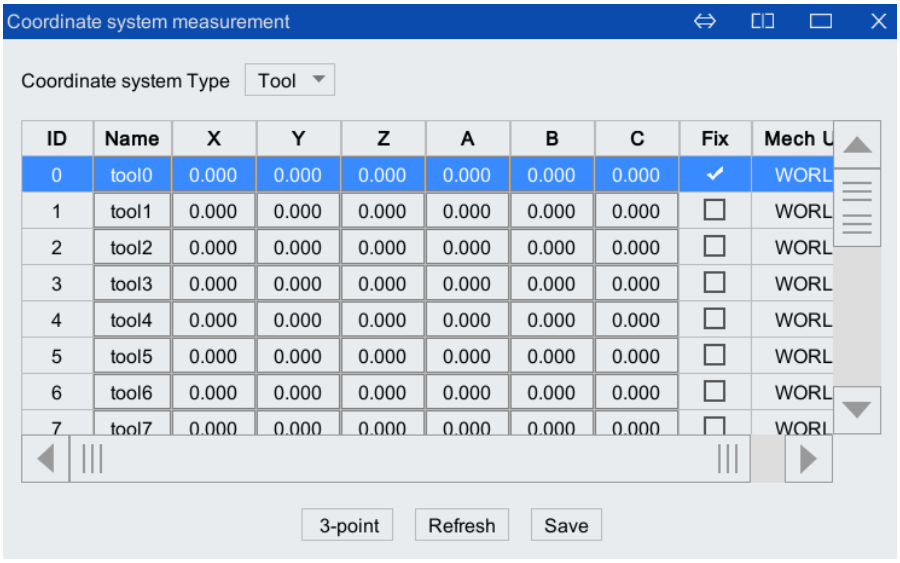


Figure 5-85 "Fixed Coordinate System" interface

Step8.Click the mechanical unit box corresponding to the row of tool0, and a drop-down list will pop up, as shown in Figure 5-86, where you can choose WORLD or R1. When WORLD is selected, it means the fixed tool coordinate system is calibrated relative to the world coordinate system; when R1 is selected, it means the fixed tool coordinate system is calibrated relative to the robot base coordinate system.

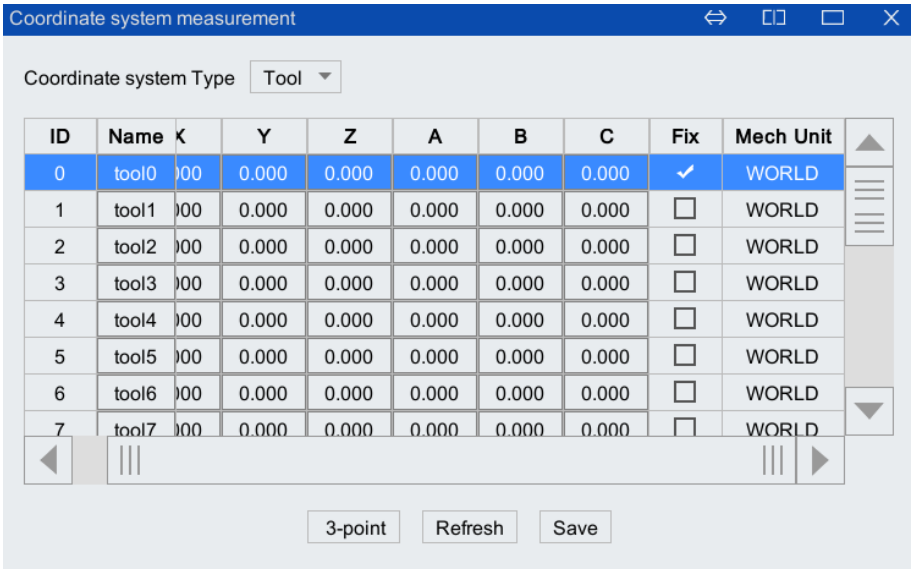


Figure 5-86 "Mechanical Unit" list

Step9.Select the row where tool0 is located, and click the <three-point method> button below to enter the [three-point method] calibration interface as shown in Figure 5-87. When calibrating the fixed tool coordinate system, it is necessary to install the tool used to calibrate the fixed tool coordinate system on the robot flange (define the coordinate system of this tool as tool1 that has been calibrated), and list it in the [Tool] list in Figure 5-87 , select tool1.

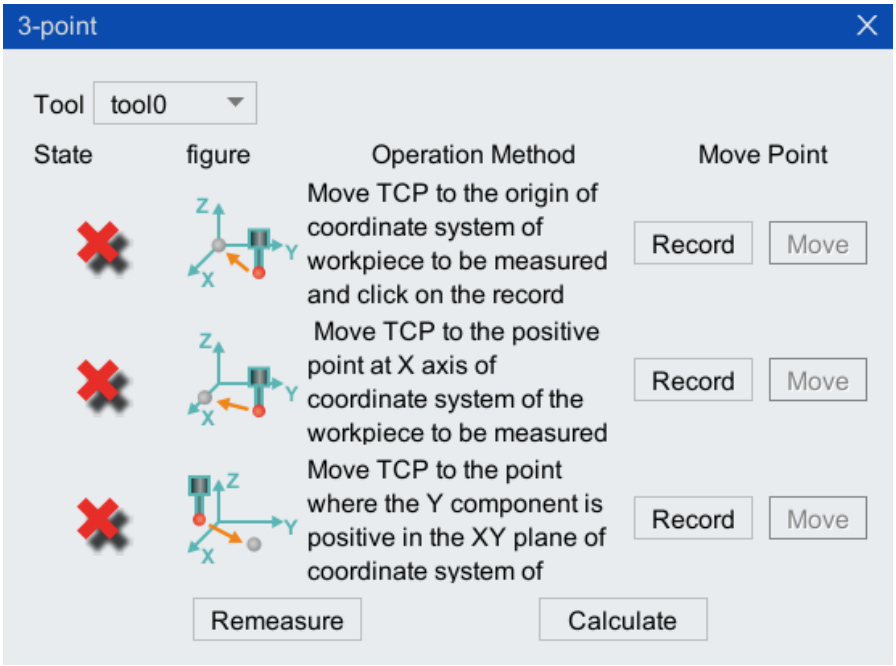
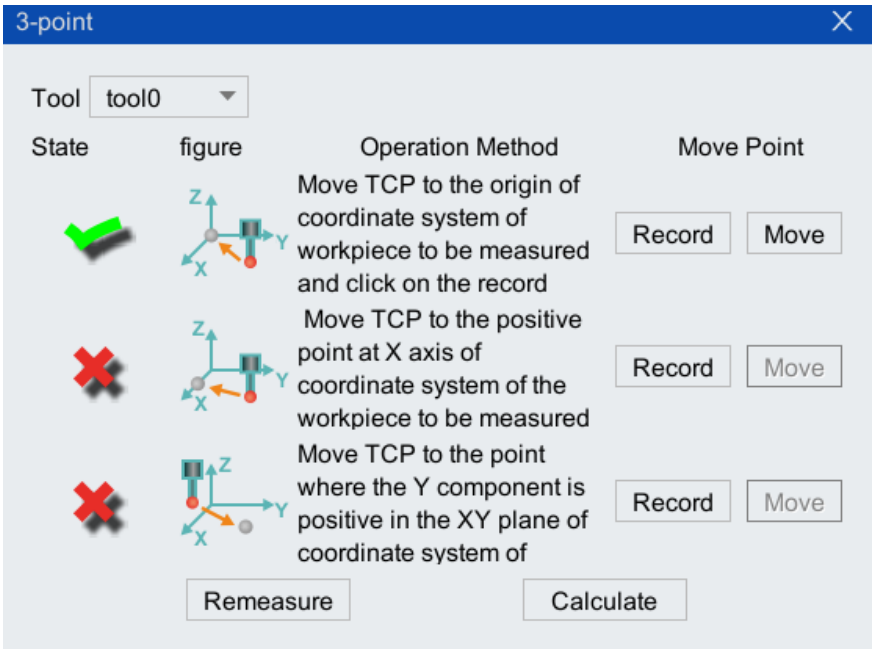
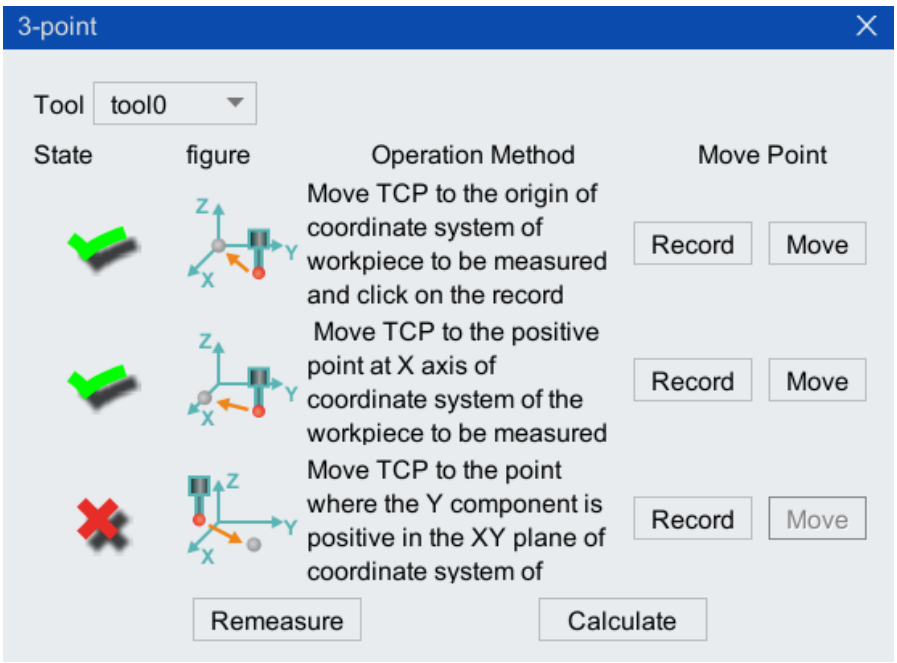


Figure 5-87 "Three-point method" Calibration interface

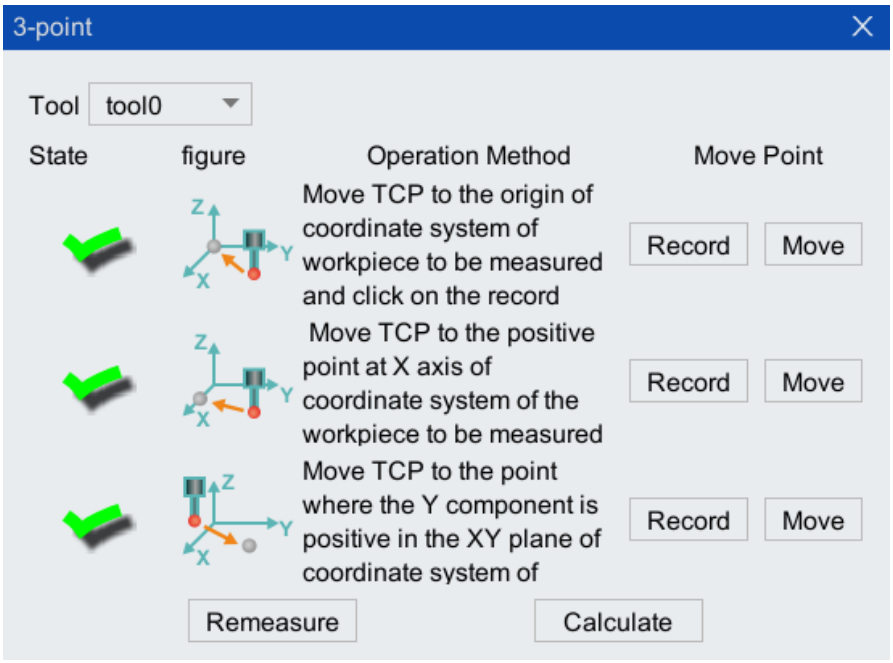
Step10.Next, calibrate according to the operation instructions in the figure. After each point is successfully calibrated, the front status will change from X to √ (refer to Figure 5-88(a)-(c)), and all calibrations are completed, the interface is shown in Figure 5-71(d).



(a) 1 point successfully calibrated



(b) 2 points were successfully calibrated



(c) 3 points were successfully calibrated
Figure 5-88 "Three-point method" calibration process status change

Step11.Repeat step 3 to complete the calibration.

5.5.1.2 Base coordinate system

Prompt

The base coordinate system is fixed on the robot base and coincides with the world coordinate system by default.

- When the user performs wall mounting and flip mounting, and wants to keep the world coordinate system Z axis still upward;
- When there are multiple mechanical units and want to specify the same world coordinate system together;

You need to calibrate the relationship between the base coordinate system and the world coordinate system.

"Base coordinate system calibration" has two methods: "input method" and "calibration method".

Input method

Set the base coordinate system by input, refer to Figure 5-89. The table in the figure shows the position of the origin of each base coordinate system and the posture of the coordinate system.

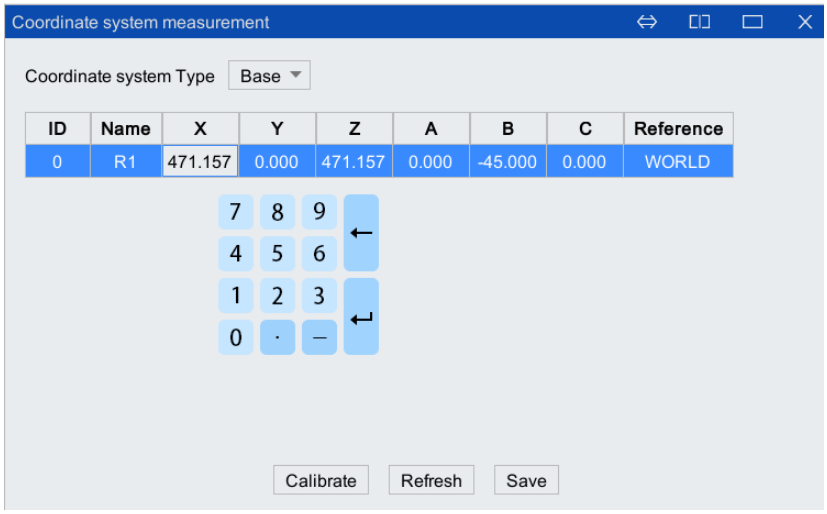


Figure 5-89 Input method setting base coordinate system page

Setting method:

Step1.Select "Base Coordinate System" in [Coordinate System Type] in Figure 5-89 above.

Step2.Click the cell in the row of the "base coordinate system" to be set to make it editable, and modify X, Y, Z, A, B, and C to the required values through the small keyboard.

Step3.Click the <Save> button below, the "Save Successful" prompt box as shown in Figure 5-90 will pop up, and the setting is complete.

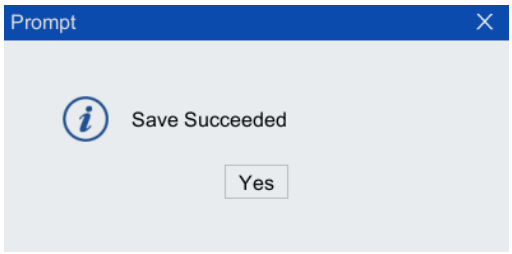


Figure 5-90 "Save successfully" prompt box

Prompt

The "input method" can only be used if the specific values of the base coordinate system X, Y, Z, A, B, and C are known.

Calibration method

Set the base coordinate system by calibration.

Calibration method:

Step1.Select "Base Coordinate System" in [Coordinate System Type] in Figure 5-89.

Step2.Assuming that the name of the "Base " to be calibrated is R1, after selecting the row where R1 is located, click the <Calibration> button at the bottom left, and the [Calibration] interface shown in Figure 5-91 will pop up, and the [reference mechanical unit] drop-down list on the interface It is used to select the reference coordinate system for calibrating the base coordinate system.

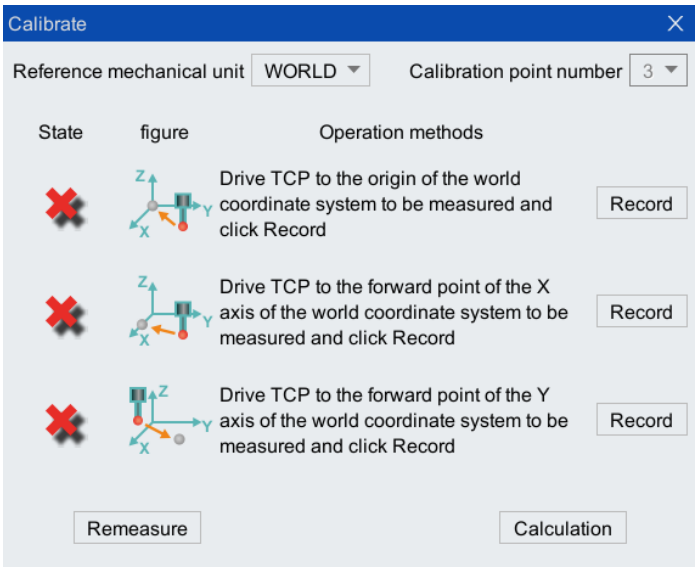
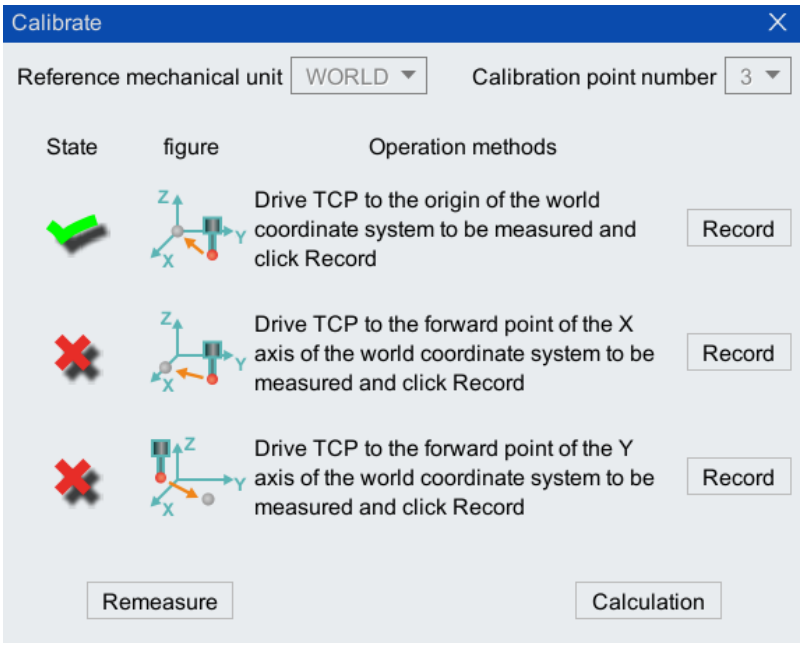
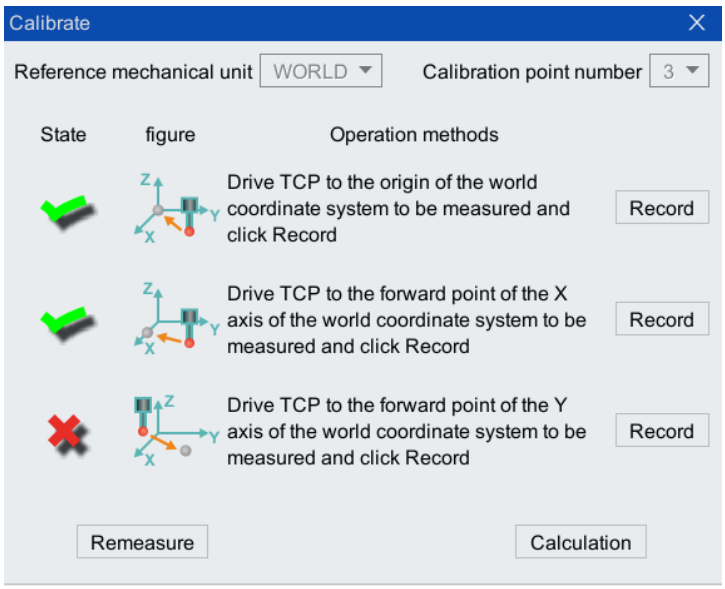


Figure 5-91 Select reference mechanical unit

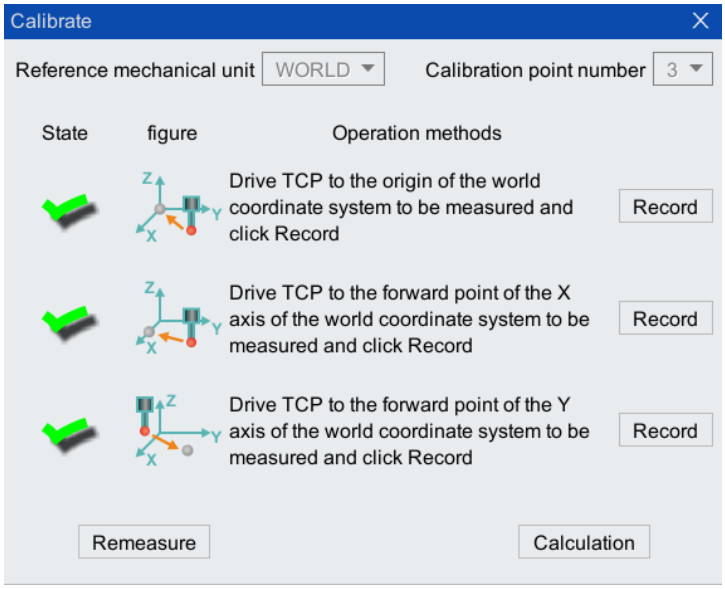
Step3.When [Reference Mechanical Unit] selects "World Coordinate System WORLD", you can calibrate according to the operation instructions in the figure. After each point is successfully calibrated, the front status will change from X to √ (refer to Figure 5-92 (a)-(b)), the interface of all calibration is shown in Figure 5-92(c).



(a) 1 point of successful calibration



(b) 2 point of successful calibration



(c) 3 point of successful calibration
Figure 5-92 State changes during calibration

Step4.After all the calibrations are successful, click the <Calculate> button at the bottom of Figure 5-92 to calculate the error. If it exceeds the error range, the "Calibration failed, please re-measure!" box as shown in Figure 5-93 will pop up, then you need Re-calibrate until the error is within the allowable range; if the error is within the allowable range, the "Calibration is successful, save it?" prompt dialog box as shown in Figure 5-94 will pop up, click the <Yes> button, and Figure 5-95 will pop up As shown in the "Save Successful" prompt box, the calibration is completed.

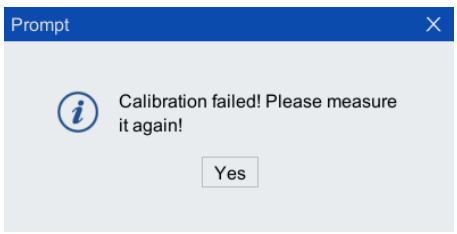


Figure 5-93 "Calibration failed, please re-measure!" prompt dialog box

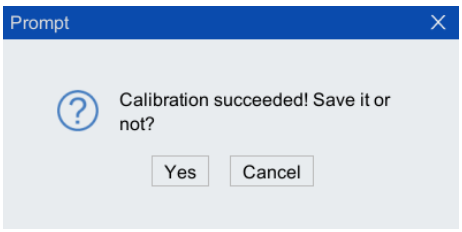


Figure 5-94 "Calibration is successful, save it?" prompt dialog box

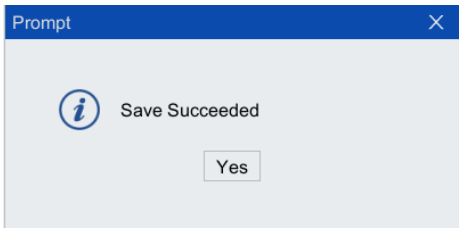


Figure 5-95 "Save successfully" prompt dialog box

5.5.2 Zero calibration

For details about "Zero Calibration", please refer to Table 5-9

Table 5-9 Description of calibration scenario

No.	Calibration scenario
1	Routine maintenance of the robot, such as replacing the encoder line battery, causes the encoder position analysis value to be lost
2	The manipulator has carried out a certain axis or overall disassembly
3	The manipulator collided during operation, causing the axis position information of the encoder to be different from the actual axis position
4	When there is a deviation between the zero position and the calibration slot position

For the specific method of zero calibration, please refer to " XX Industrial Robot System Quick Start Manual" of each model.

5.5.3 Fast calibration

"Fast Calibration" can record the current position in any pose. It should be noted that "Fast Calibration" can be performed only when the motor or reducer is faulty or damaged and needs to be replaced.

Calibration method:

Step1.The precondition for calibration is that the robot cannot move when the motor/reducer is faulty or damaged.

Step2.On the main interface of the teach pendant, click "Run > Calibration > Fast Calibration" option to enter the "Fast Calibration" interface shown in Figure 5-96. Click <Save Current Position> button, and then the system will record the robot's current axis position.

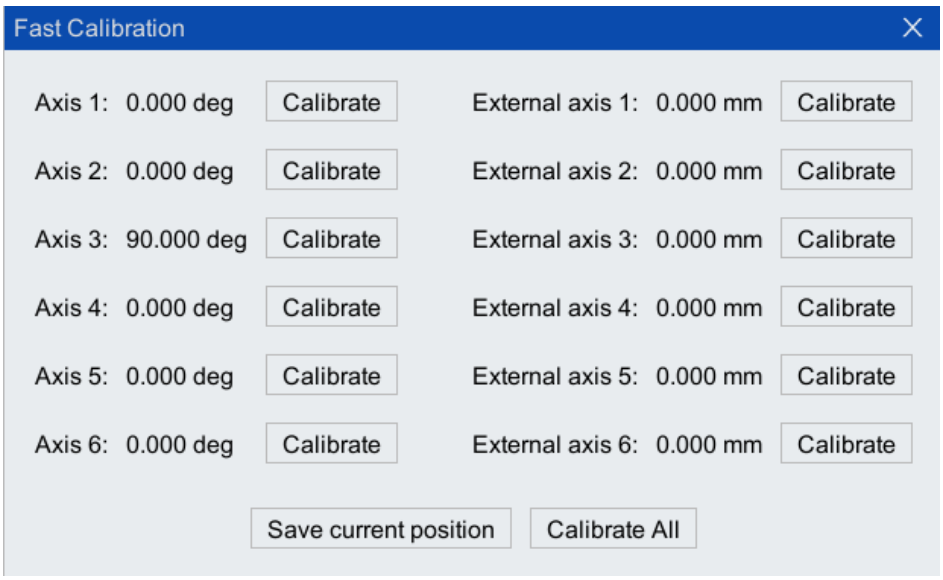


Figure 5-96 "Quick Calibration" Interface

Step3.Turn off the power, replace the motor/reducer (keep the shaft position still, no displacement), and restart the system.

Step4.Re-enter "Fast Calibration" interface in Figure 5-96, and click <Calibrate> button behind any axis or <Calibrate All> button below, and "Do you need to re-calibrate?" dialog box will pop up, as shown in Figure 5-97. Click <Yes> button, and "Message Bar" of the system will display "One axis or all axes are calibrated successfully", and the corresponding axis will be completed to the previously recorded position.

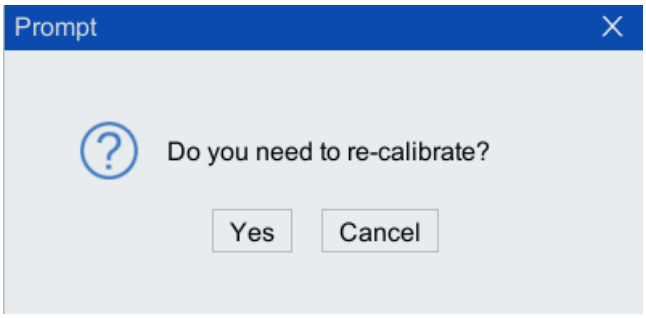


Figure 5-97 "Are you sure to recalibrate?" dialog box

5.5.4 Conveyor calibration

For the specific method of conveyor calibration, please refer to "Operation Instructions for Conveyor Tracking".

5.5.5 Installation angle calibration

When the robot is not installed horizontally (such as wall-mounted, flip-mounted), it is necessary to set the correct robot installation angle.

Configuration steps:

Step1.Click "Run>Calibration>Installation Angle Calibration" on the main interface of the teach pendant to enter the [Installation Angle Calibration] interface, as shown in Figure 5-98.

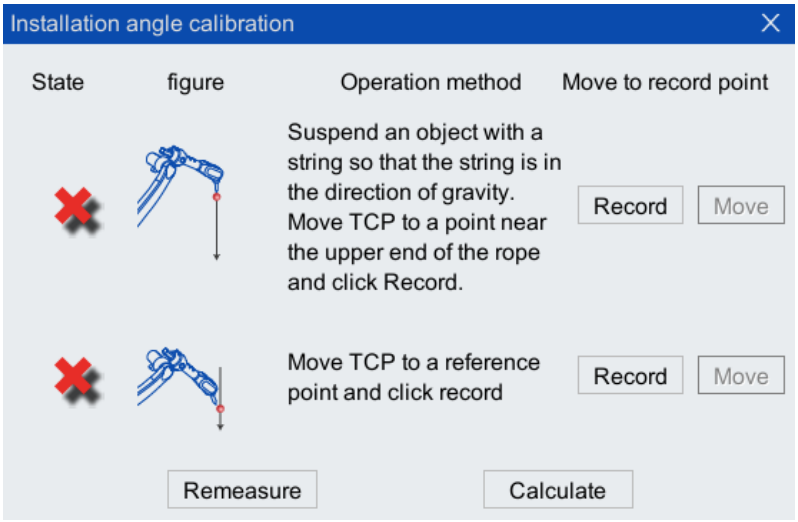


Figure 5-98 Installation angle calibration interface

Step2.Move the TCP to the reference point and click <Record>. Change ✗ to √ as shown in Figure 5-99.

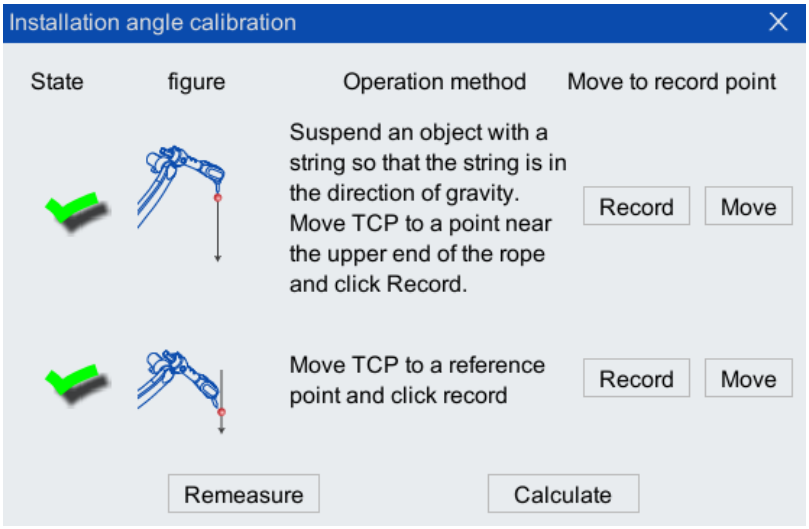


Figure 5-99 Successfully calibrated interface

Step3.The direction of gravity can be determined by the direction in which the rope naturally sags, so as to find directly below the reference point.

Step4.Move the TCP to any point 10cm away from the reference point, and click <Record>. Change ✗ to √.

Step5.After the teaching is completed, click <Calculate> to automatically calculate the robot installation angle.

Step6.On the main interface of the teach pendant, click "System>Parameter Configuration>Channel", click [+] in front of [GRAVITY_DIRECTION (gravity direction vector)], and you can view the calculation result of the installation angle in the expanded parameter value, as shown in Figure 5-100.

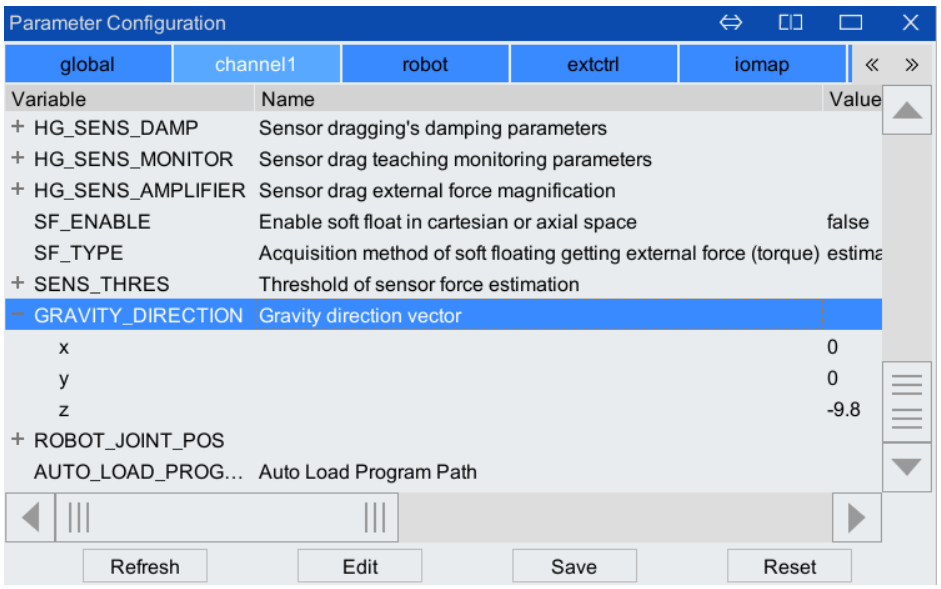


Figure 5-100 View channel parameter interface

5.6 Positioner calibration

The "Point Corrector" function can help correct points in the program.

Operation steps:

Step1.On the main interface of the teach pendant, click "Run > Point Corrector" option to enter the "Point Corrector" interface as shown in Figure 5-101.

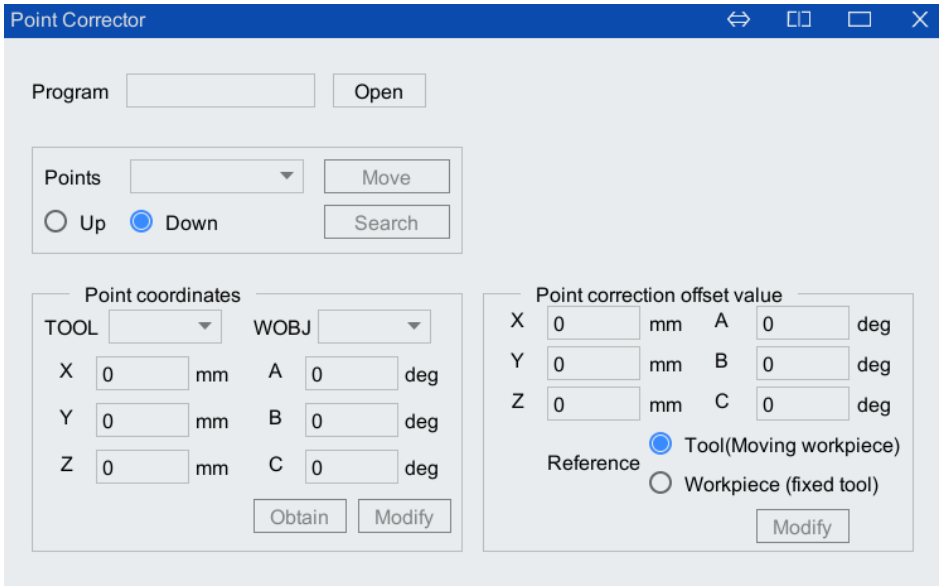


Figure 5-101 "Point Correction" Interface

Step2.Click the <Open> button above, and the "Select File" list box as shown in Figure 5-102 will pop up, select the file to be opened, and click the <Select> button. The program is opened in the "Program Editor" interface at the same time, its related information is also displayed in the "Point Corrector" interface, as shown in Figure 5-103.

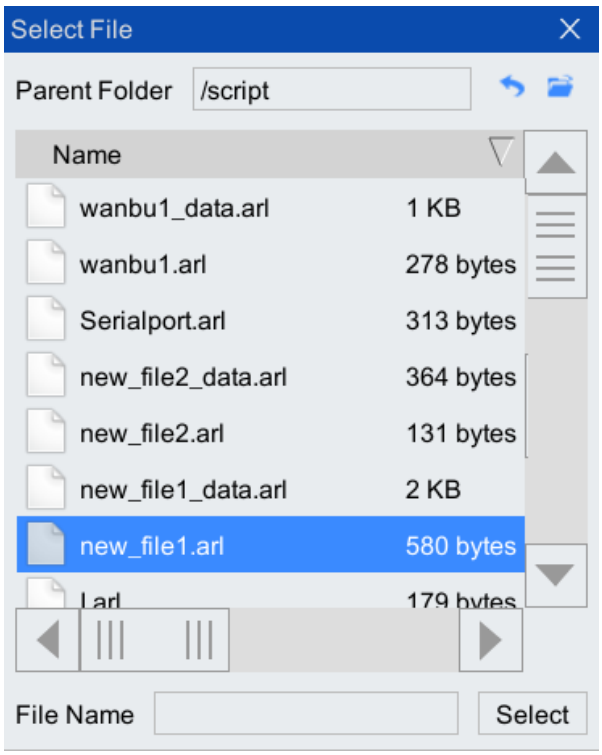


Figure 5-102 "select file" list box

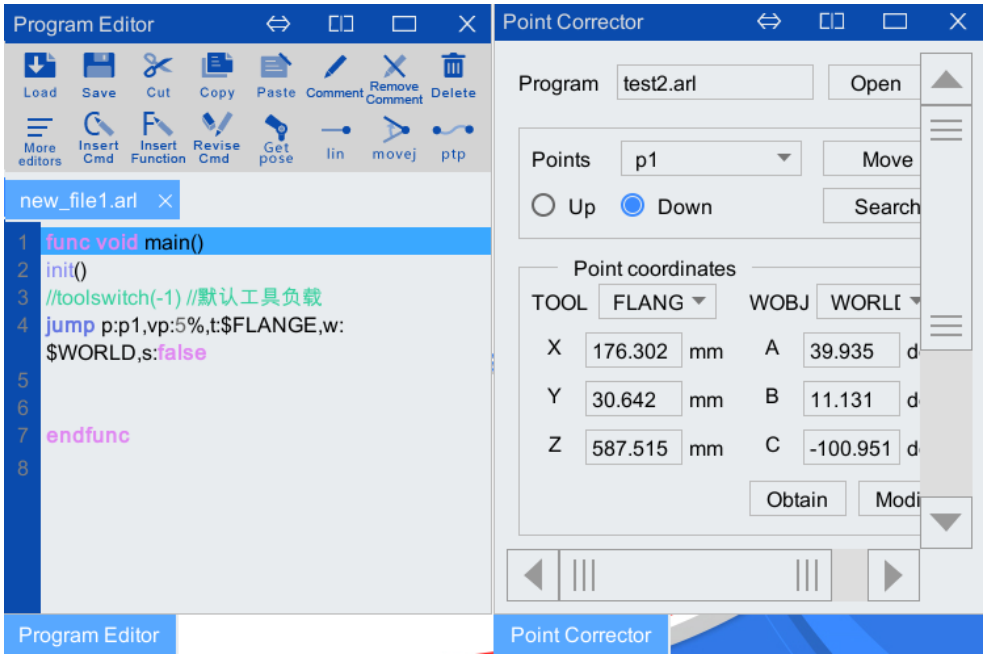


Figure 5-103 "point corrector" and "program editor" interface after opening the file

Step3.Click the drop-down box of "Point List" in Figure 5-104 to display all point data in the program. The <Up>, <Down> buttons and the <Search in Program> button are used together, meaning to search the selected point in the "points" from the current position in the program "up" or "down".

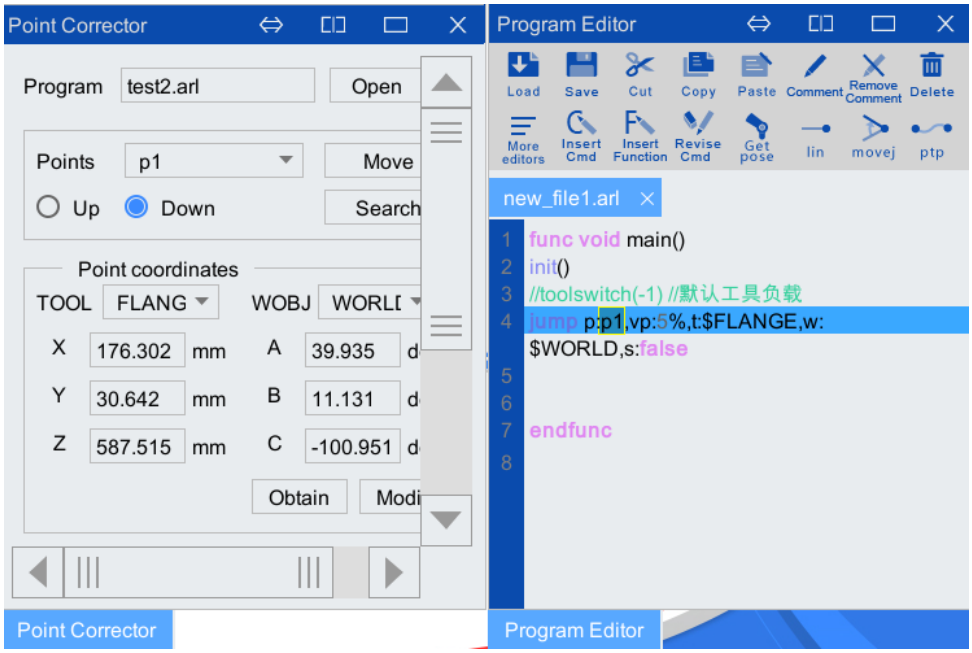


Figure 5-104 "Point List" Related button introduction

Step4.After opening the program in the "Point Corrector" interface, the "Point Coordinates" area box displays the "coordinate system" information and "pose" information of the current point selected in the "Points". You can directly change the "reference coordinate system" and "pose" data of the current point manually, and you can also use the <Get> button to record the current robot's pose data in the current point into the current point. Then click the <Yes> button to write the modified current point data into the data file.

Step5.You can also modify the current point data in the "Point Correction Offset Value" area box. Select the reference coordinate system of the current point offset. If the "Workobject (fixed tool)" option is checked, it means that the current point is offset relative to the workobject coordinate system. The offset value only supports the input of position data XYZ, as shown in Figure 5-105 shown.

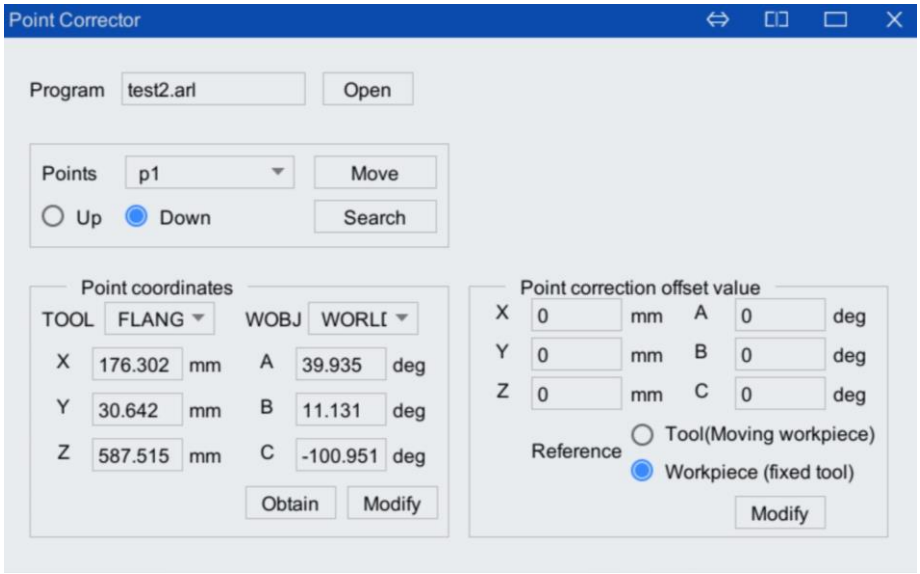


Figure 5-105 Modify the point coordinates through the "Point Correction Offset Value" area box

Step6.If the "Tool (Move Workobject)" option is checked, it means that the current point position is offset relative to the tool coordinate system. The offset value supports the input of pose data XYZABC. After manually inputting the

offset value, click the <Modify> button, and the data information of the current point in the point coordinate column will be modified according to the offset value. After modification, click the <Yes> button in the point coordinate column, and then you can write data files.

Prompt

For special conditions, such as grinding, a fixed tool is equivalent to a workobject, and a moving workobject is equivalent to a tool.

The "point corrector" function also supports the "one-key movement to this point" function.

Operation steps:

Step1.Select the point you want to move to in "Points" in Figure 5-105.

Step2.Then click the <Move> button, as shown in Figure 5-106, "The system will move to this point in manual override PTP mode. There may be interference during the movement, please pay attention!" "Prompt" box. After clicking <Yes>, the robot starts to move. At this time, the display of the <Move> button immediately changes to <Stop>. If there is interference during the movement, you can directly click the <Stop> button to stop the movement, and wait until the robot moves to the selection After the selected point, the <Stop> button returns to the <Movement> button.

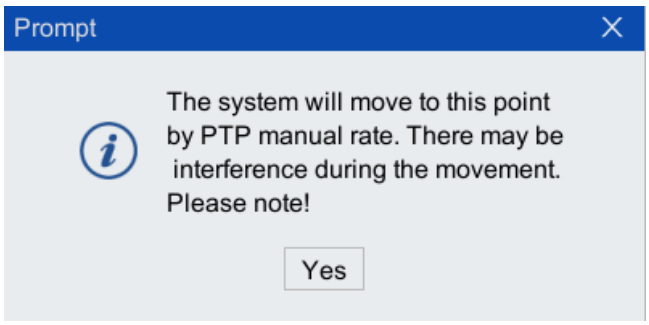


Figure 5-106 "Prompt" Box

5.7 Load setting function

5.7.1 Function introduction

The load setting function can automatically determine or manually input the tool mass, center of gravity position and inertia tensor, and save it to the tool inertia parameter. By selecting [Current effective load], the selected load can be applied to other functions.

The load identification time is about 2 minutes. The identification method is as follows:

Step1.Move the 3rd, 5th, and 6th axes first, with the speeds being 0.5%, 0.5%, and 2% respectively. In the initial state, axis 1 remains unchanged, axis 3 will be adjusted to the horizontal position of axis 3, and axes 4, 5, and 6 return to zero. From the initial state, the movement range of axis 3 is ±5°, axis 5 is ±60°, and the 6 axis is ±120°.

Step2.Then move the 4th, 5th, and 6th axes. Before formal identification, preview the trajectory at a low speed of 5%. After the formal identification starts, the identification speed is increased to 50%. The motion range of the 4th and 5th axes is ±50°, and the motion range of the 6th axis is ±90°.

5.7.2 How to use

Manually enter load parameters

The configuration steps are as follows:

Step1.Click "Run>Load identification" on the main interface of the teach pendant to enter the [Load Parameter Setting] interface as shown in Figure 5-107.

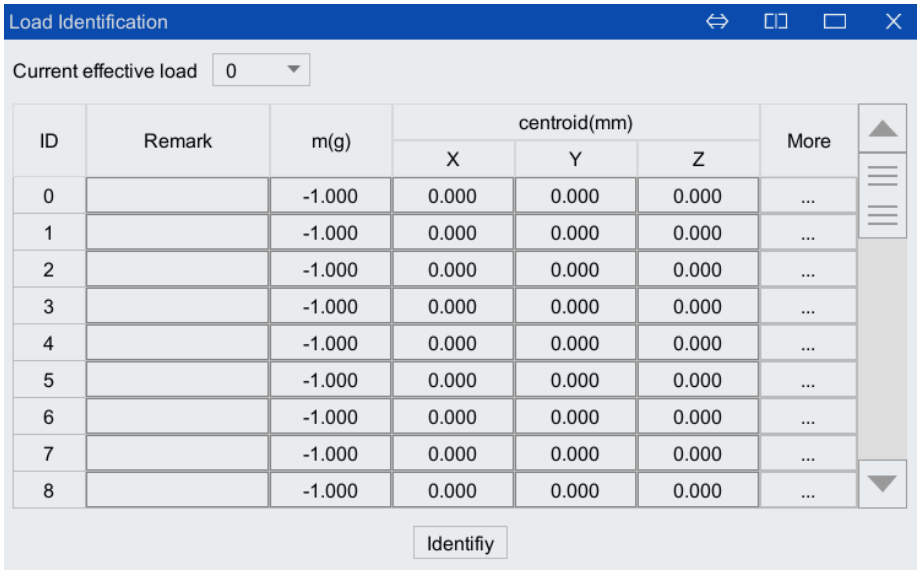


Figure 5-107 Load parameter setting interface

Step2.Select the load number to be input in the table on the interface. Manually fill in the mass, center of mass, and inertia tensors of the tool.

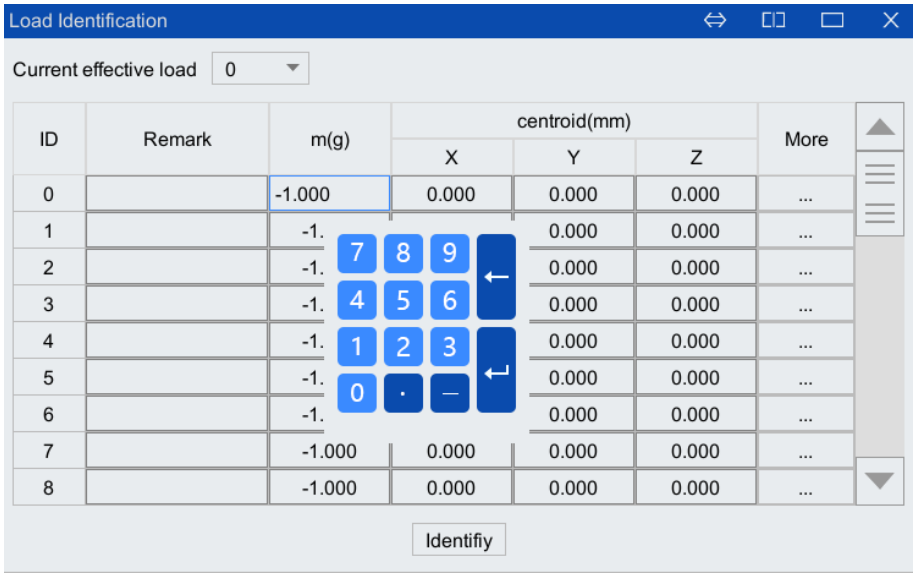


Figure 5-108 Manual input of load parameters interface

Caution

When the program is running, the system will give an alarm if the load parameters are illegal, and the alarm information will be "[3115] The currently selected load inertia parameter is invalid, and it has automatically switched to the default load DF_TOOL_INERTIA. If the actual load is used, please go to the "Load parameter setting" page. identify or switch loads". If it is found to be illegal in the soft float program and the collision detection program, it will give an alarm and cannot continue to run.

Automatic determination of load parameters

The configuration steps are as follows:

Step1.Install the load to be used on the robot.

Step2.Click "Run>Load Parameter Configuration" on the main interface of the teach pendant to enter the [Load Parameter Setting] interface as shown in Figure 5-109.

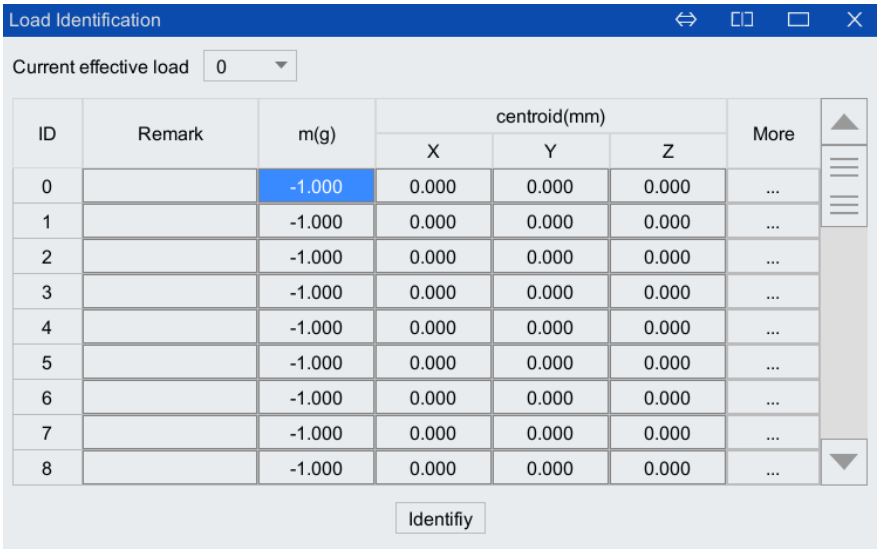


Figure 5-109 Load parameter setting interface

Step3.Click the <Identify> button to pop up the configuration interface as shown in Figure 5-110.

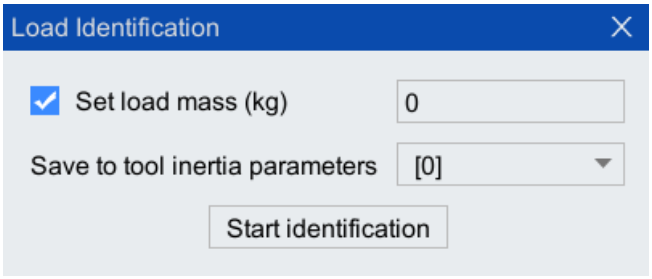


Figure 5-110 Load parameter identification configuration interface

Step4.If the user can accurately measure the load mass, you can check the checkbox in front of [Set Load Mass], and fill in the [Set Load Mass] and [Save to tool inertia parameters] of the load identification. If you do not need to configure it yourself, you can uncheck this option.

Step5.The prompt interface shown in Figure 5-111 will pop up, and the robot will automatically adjust to the reference position and start load identification. The entire identification process takes about two minutes, and no pause is allowed during this period. If an emergency stop is needed, please press the emergency stop button on the teach pendant.

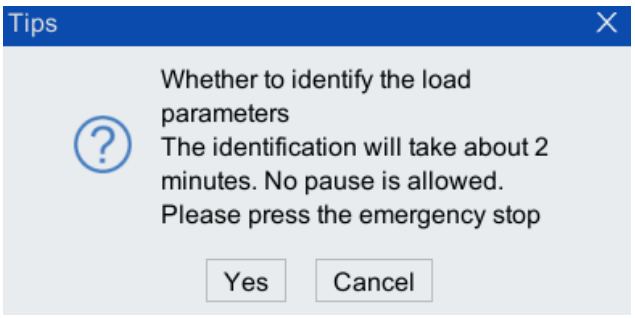


Figure 5-111 Prompt window

Step6.After successful identification, the interface shown in Figure 5-112 will pop up, click <Yes>.

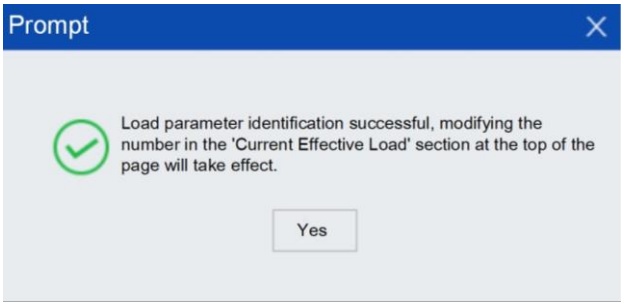


Figure 5-112 Prompt window

Step7.After the identification is completed, click the "System>Parameter Configuration>Global" option on the main interface of the teach pendant, and you can view the saved identification parameters in the [Tool inertia parameter].

Select current payload

Select the load number to be used in [Current Effective Load] (as shown in Figure 5-113), and close the interface. The currently active load parameter selected will be applied to the function configuration that requires this parameter.

If the load changes significantly when the program is running due to operations such as grabbing, placing, etc., you can switch the currently effective load through the toolswitch command.

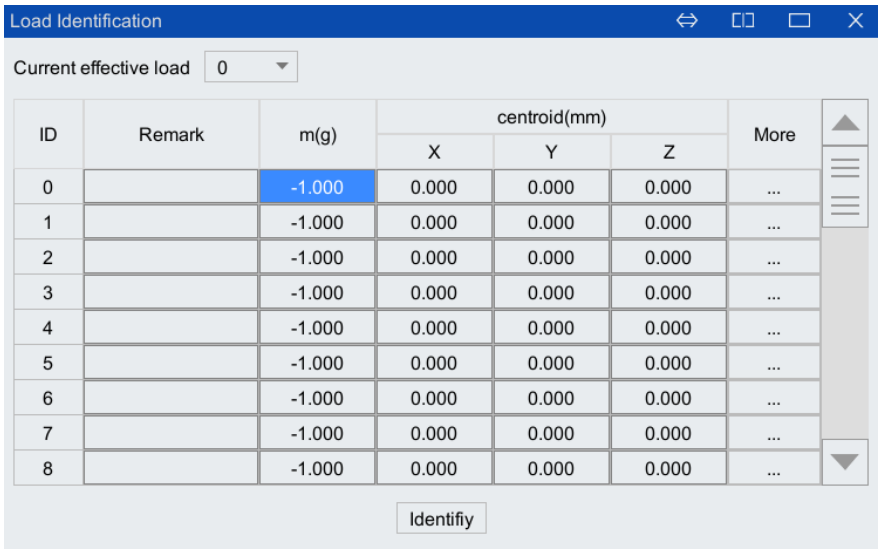


Figure 5-113 Configure current payload parameters

6 Monitoring

The expanded view of "Monitoring Menu" is shown in Figure 6-1. The entry of "Monitoring Menu" is shown in Figure 6-2. The contents of parts in "Monitoring Menu" are described below.

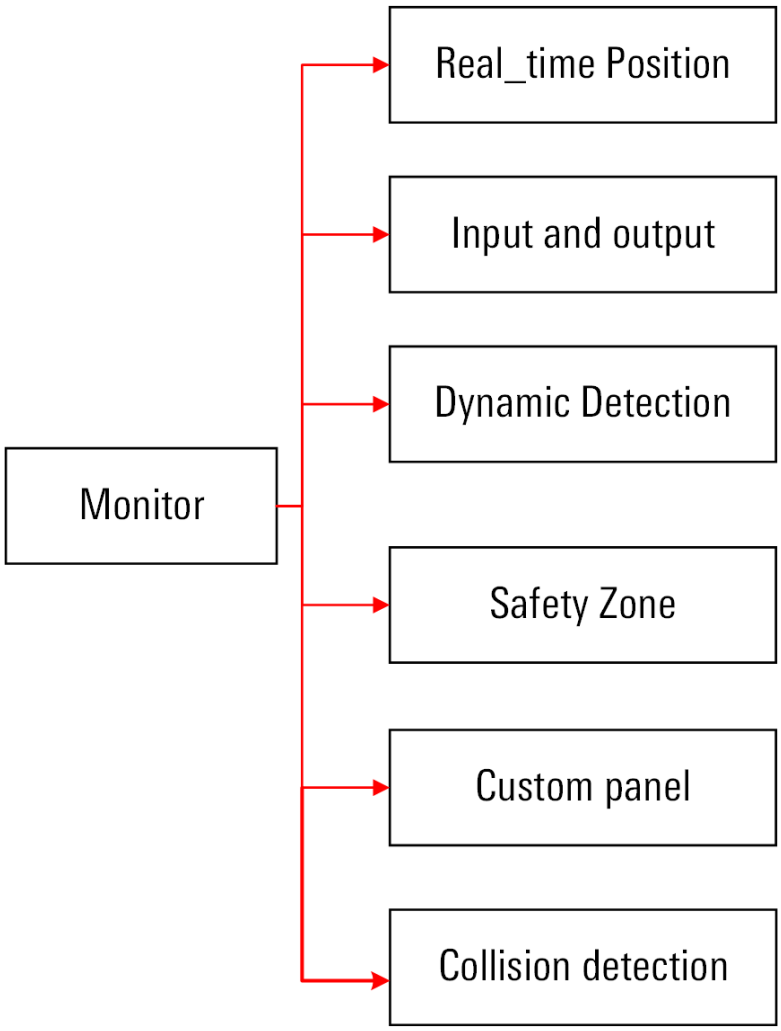


Figure 6-1 Expanded view of "Monitoring Menu"

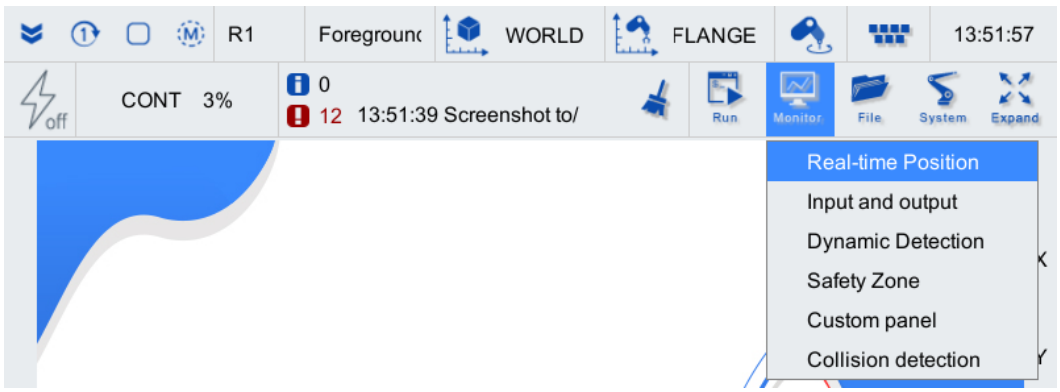


Figure 6-2"Monitoring Menu" page

6.1 Real-time position

On the main interface of the teach pendant, click "Monitor > Real-time Position" option to enter the "Real-time Position" interface shown in Figure 6-3. Please refer to Table 6-1 for each description.

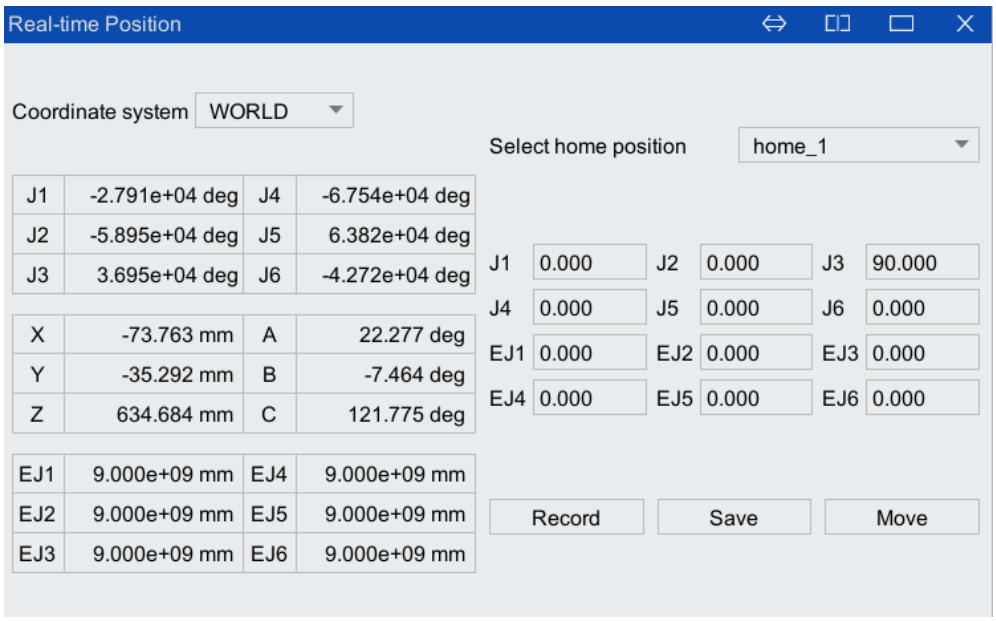
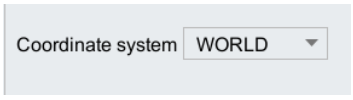
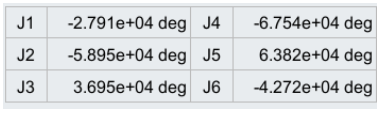
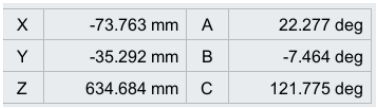
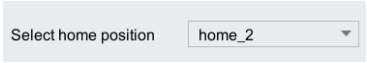
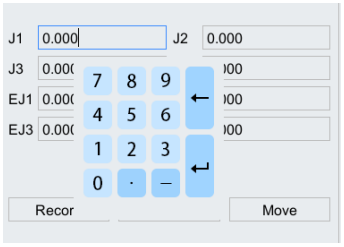


Figure 6-3 "Axis Real-time Position" interface

Table 6-1 Explanation of each part of the "Real-time location" interface

No.	Interface	Description	
1		The user can choose the Cartesian position coordinate system, which can refer to the world coordinate system, the basic coordinate system or the user-defined user coordinate system	
2		"J1~J6" is the current actual position of each axis of the manipulator, the unit is degree	
3		"X, Y, Z, A, B, C" indicates the current Cartesian position of the manipulator	"X, Y, Z" represents TCP point coordinates, the unit is mm "A, B, C" represents TCP attitude, the unit is degree
4		The user can select the home point from the drop-down list behind "Select home point", there are 5 home points to choose from	
5		Click on the text box behind "J1-J6" and "EJ1-EJ6", you can use the pop-up numeric keypad to input numbers that do not exceed the single-axis motion limit Prompt When the entered number exceeds the limit of the robot's single-axis motion, the background color of the number box turns red and cannot be saved. When saving, a prompt "there is an axis beyond the motion range and the home point cannot be saved" pops up. When clicking to move, a prompt "there is an axis beyond the motion range, and the one-key home point operation cannot be performed" pops up. When	

No.	Interface	Description
		the external axis is not configured, when the position of the external axis is 9e+09, it can be saved and moved normally
6	Record	Record the current pose of the robot and fill it in the axis position information of the home point
7	Save	Save the edited or recorded axis position data information of the home point
8	Move	Save and move the edited or recorded axis position data of the home point. If there is no enable signal, execute the save function separately; if there is a manual enable signal, execute the operation of saving and moving the robot to the home point

Prompt

One-key home operation is not allowed in automatic mode, please switch to manual mode to perform the operation.

6.2 IO

Prompt

External control input is only effective in automatic mode, and external automatic control output remains unchanged.

6.2.1 First generation cabinet IO (inCube1X)

On the main interface of the teach pendant, click "Monitor > Input/Output" option to enter the [Display IO] interface shown in Figure 6-4.

6.2.1.1 DI signal

The 1-31 DIs in the [User DI] tab in Figure 6-4 are all available DIs provided by the system. These 31 DIs are shared by the system DI, user DI and body DI. Refer to Table 6-2 for the allocation method.

Table 6-2 Logical address usage and distribution of the first-generation cabinet DI

Logical address of DI	Distribution
1-26	User DI
	System DI
27-31	Body manipulator

User DI

For user DI, 1-26 channels are available. If 1-26 channels are not enough, external expansion MF can be configured to increase the number of IOs.

[User DI] tab supports commenting on each signal. Refer to Table 6-3 for the description of annotation related buttons in [User DI] Interface.

Table 6-3 [User DI] interface annotation related button description

Name	Function
Save (edit) comments	Click on the text box of the user DI/DO annotation to edit and save the annotation content in the text box
Copy comment	Click the text box of the user DI/DO comment, and click the <Copy Comment> button to copy the comment content in the text box
Paste comment	Click the text box of the user DI/DO comment and click the <Paste Comment> button, the copied comment content will be pasted into the comment text box

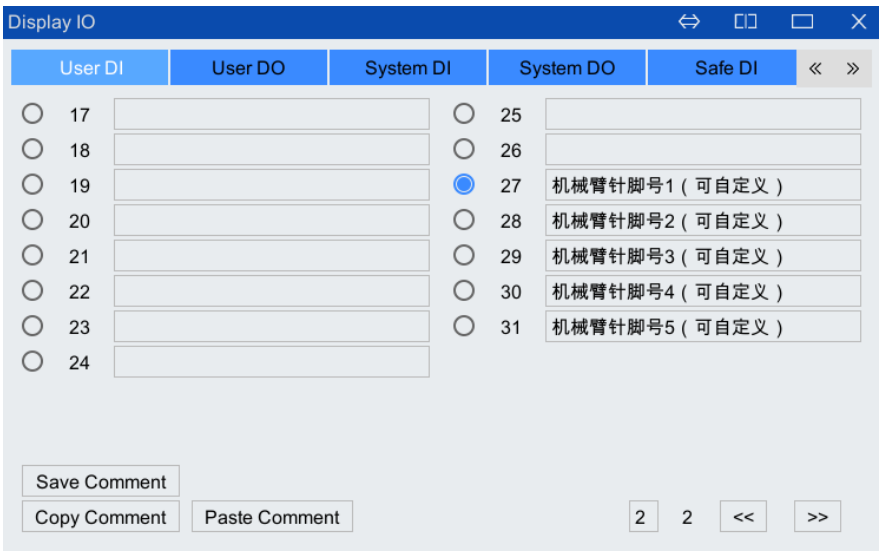
Operation steps:

Step1.Click the <Edit Comment> button in the lower left corner of the interface, and the content displayed by the button will immediately change to [Save Comment].

Step2.Enter the content to be added in the text box behind each signal, and click the <Save Comment> button.

Step3.The "Comment saved succeessfully!" prompt interface as shown in Figure 6-5 pops up. Click the <Yes> button to complete the comment on the signal.

(a) Route 1-16



(b) Route 17-31
Figure 6-4 [User DI] tab

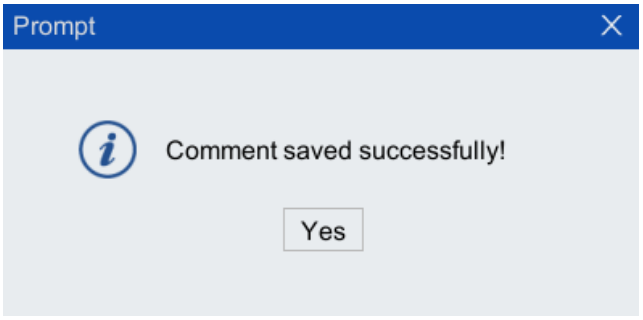


Figure 6-5 " Comment saved successfully! " prompt interface

System DI

[System DI] tab shows the status of each system DI function, as shown in Figure 6-6. If an external control function is triggered, the corresponding signal light is on. The robot control cabinet calculates the program number, that is, the PGNO value, according to the relevant system DI, and then executes the corresponding subroutine according to the program number.

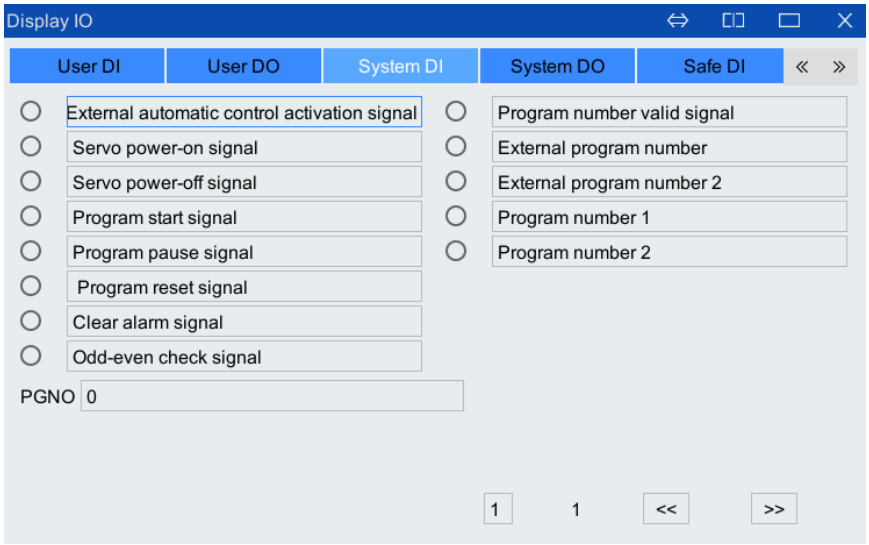


Figure 6-6 [System DI] tab

For system DI, when using it, the user needs to configure the corresponding DI logical address for each function in the [External Control] tab in "System > Parameter Configuration" before it can be used, as shown in Figure 6-7. For the description of parameter configuration, please refer to Chapter 8.1.

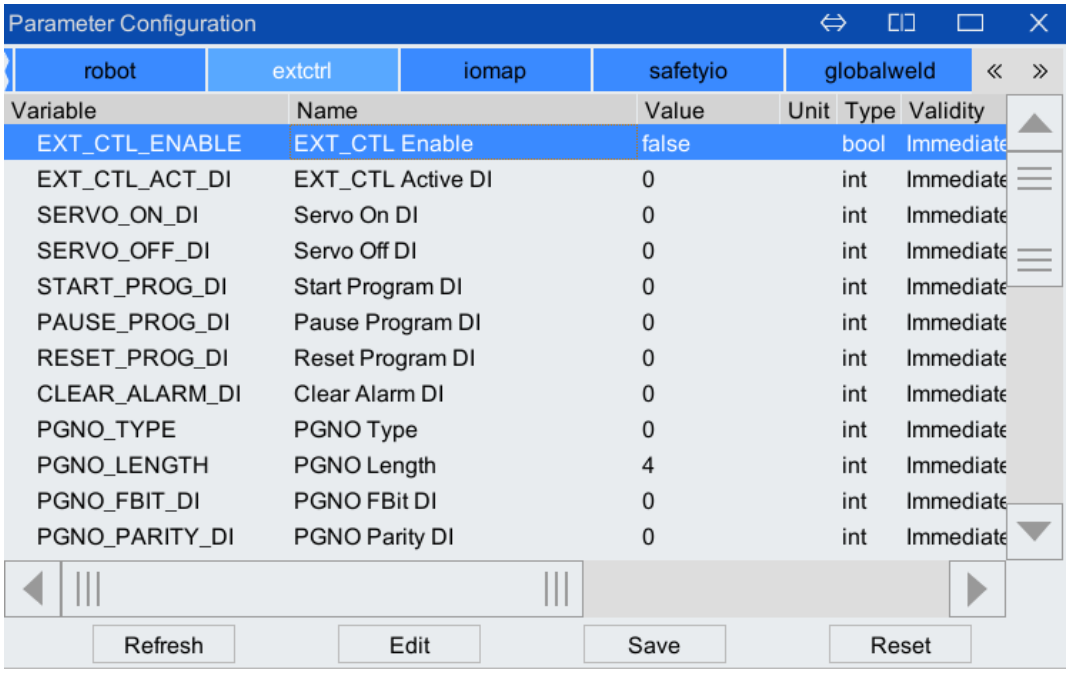


Figure 6-7 [External Control] tab in [Parameter Configuration]

Correspondence between logical address and pin number:

- If each function of the system DI is configured to the logical address of 1-16 DI, the system DI needs to be triggered on the pin of the X24 external device (the correspondence between the logical address of 1-16 DI and the pin number of X24. Please refer to Table 6-4);
- If each function of the system DI is configured to the logical address of DI 17-26, the system DI needs to be triggered on the pin of the X23 external device (the correspondence between the logical address of the 17-26 DI and the pin number of X23. Please refer to Table 6-5).

Table 6-4 Correspondence between the logical address of 1-16 DI and the pin number of X24

Logical address of 1-16 DI	X24 pin number
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11

Logical address of 1-16 DI	X24 pin number
12	12
13	13
14	14
15	15
16	16

Table 6-5 Correspondence between the logical address of DI 17-26 and the pin number of X23

17-26 logical address of DI	X23 pin number
17	39
18	40
19	41
20	42
21	4
22	8
23	9
24	45
25	44
26	2

6.2.1.2 DO signal

The 1-28 DOs in the [User DO] tab are all available DOs provided by the control system. These 28 DOs are shared by the system DO, user DO and body DO, as shown in Figure 6-8. See Table 6-6 for the allocation method.

Table 6-6 Distribution of logical address for the first-generation cabinet DO

DO logical address	Distribution
1-18	User DO
	System DO
19-24	Body solenoid valve, currently only 6A and 6L models contain solenoid valve (belonging to the user's optional accessory). Only when there is solenoid valve, DO signal can be set effectively
25-26	Body manipulator
27-28	User DO
	System DO

User DO

For user DO, if 1-18 and 27-29 DOs are not enough, external MF can be configured to increase the number of IOs. Refer to Table 6-7 for the description of the annotation-related buttons in the [User DO] interface.

Table 6-7 [User DO] interface annotation related button description

Name	Function
Save comments	Click on the text box of the user DI/DO annotation to save the annotation content in the text box
Enter edit	Click on the text box of the user DI/DO annotation to edit the annotation content in the text box
Copy comment	Click the text box of the user DI/DO comment, and click the <Copy Comment> button to copy the comment content in the text box
Paste comment	Click the text box of the user DI/DO comment and click the <Paste Comment> button, the copied comment content will be pasted into the comment text box

The method to set the user DO signal status is as follows:

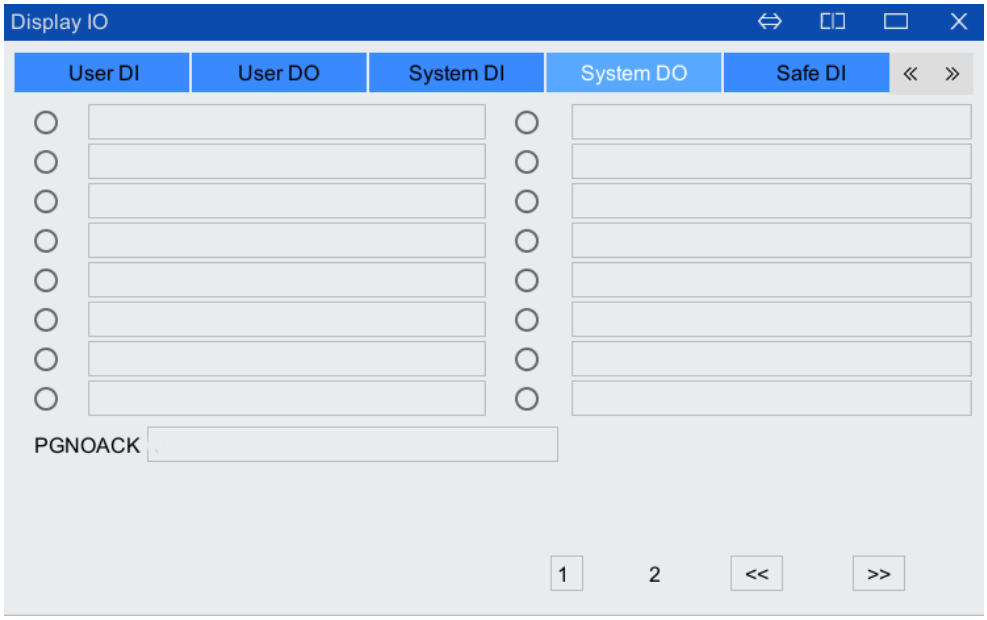
- Click the <Enter edit> button, After manually setting 1-29 DO signals, click the <Save comments> button to realize the change of the DO signal status.

(a) Route 1-16

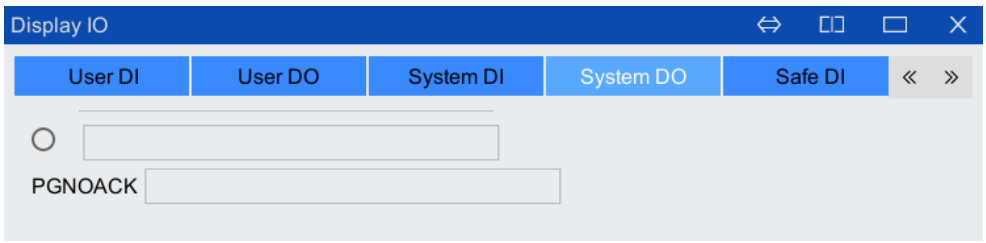
(b) Route 17-28
Figure 6-8 [User DO] tab

System DO

[System DO] tab shows the output status of each function of system DO, as shown in Figure 6-9. If the DO function of a certain system is output, the corresponding signal light is on. The robot control cabinet uses the received legal program number as the PGNOACK value, and outputs it to the external controller through the relevant system DO to confirm whether the program number is correct.



(a)



(b)
Figure 6-9 [System DO] tab

For system DO, when users use it, they need to configure the corresponding DO logic address for each function in the [External Control] tab in "System > Parameter Configuration" before using it, as shown in Figure 6-10. For configuration instructions, please refer to Chapter 8.1.

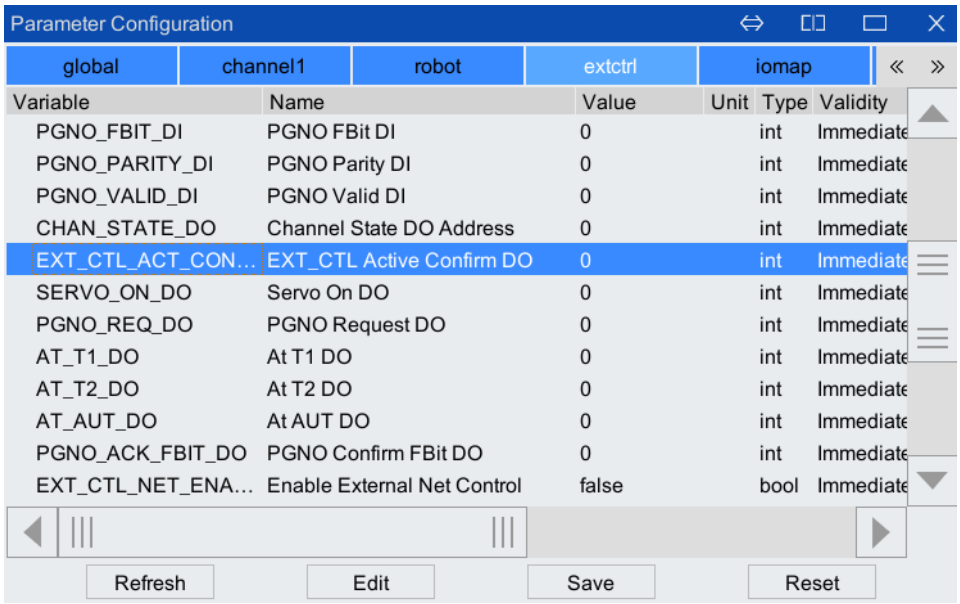


Figure 6-10 [External Control] tab in [Parameter Configuration]

Correspondence between logical address and pin number:

- If each function of the system DO is configured to the 1-16 DO logical address, the system DO needs to be triggered on the pin of the X24 external device (the correspondence between the 1-16 DO logical address and X24 pin number Refer to Table 6-8);
- If the functions of the system DO are configured to the 17-18 and 27-29 DO logical addresses, the system DO needs to be triggered on the pins of the X23 external device (Please refer to Table 6-9 for the corresponding relationship between the logical address of DO 17-18 and DO 27-29 and the pin number of X23).

Table 6-8 Correspondence between the logical address of 1-16 DO and the pin number of X24

1-16 DO logical address	X24 pin number
1	33
2	34
3	35
4	36
5	37
6	38

1-16 DO logical address	X24 pin number
7	39
8	40
9	41
10	42
11	43
12	44
13	45
14	46
15	47
16	48

Table 6-9 Correspondence between the logical address of DO 17-18 and DO 27-29 and the pin number of X23

Logical address of DO 17-18 and DO 27-29	X23 pin number
17	18
18	20
27	22
28	23

6.2.2 Second-generation cabinet IO (inCube2X P1.0)

On the main interface of the teach pendant, click "Monitor > Input/Output" option to enter the [Display IO] interface.

6.2.2.1 DI signal

The 1-21 DIs in the "[User DI] tab" are all available DIs provided on the second-generation cabinet. These 21 DIs are shared by the system DI, user DI and body DI. Refer to Figure 6-11. See Table 6-10 for the allocation method.

Table 6-10 Logical address usage and distribution of the second-generation cabinet DI

Logical address of DI	Distribution
1-16	User DI
	System DI
17-21	Manipulator

User DI

For user DI, 1-16 channels are available. If 1-16 channels are not enough, external expansion MF can be configured to increase the number of IOs.

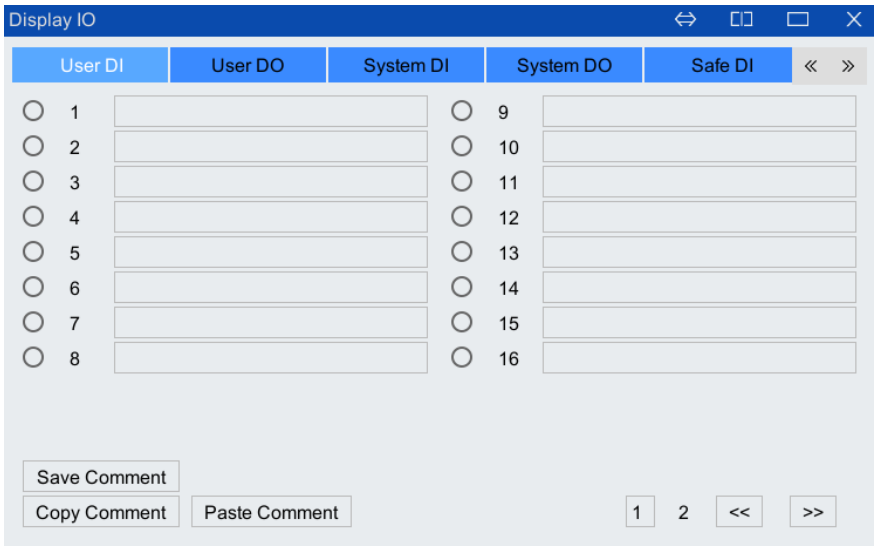
[User DI] tab supports commenting on each signal. Refer to Table 6-3 for the description of the annotation-related buttons in the [User DI] Interface.

Operation steps:

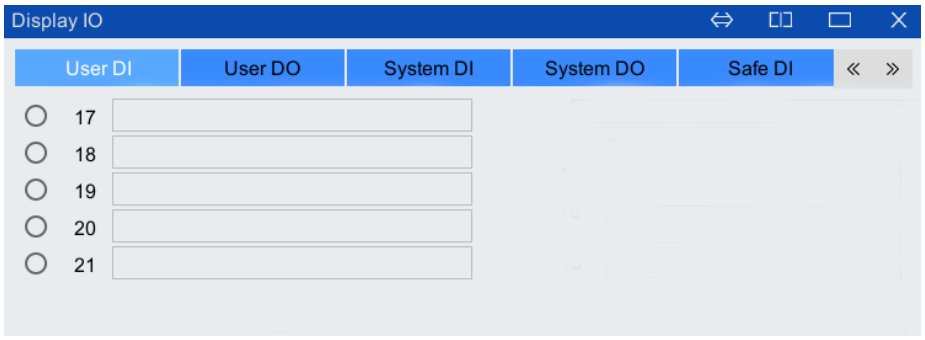
Step1.Click the <Edit Comment> button in the lower left corner of the interface, and the content displayed by the button will immediately change to [Save Comment].

Step2.Enter the content to be added in the text box behind each signal, and click the <Save Comment> button.

Step3.The "Comments Saved successfully!" prompt interface as shown in Figure 6-5 pops up. Click the <Yes> button to complete the comment on the signal.



(a) Route 1-16



(b) Route 17-21
Figure 6-11 [User DI] tab

System DI

[System DI] tab shows the status of the system DI functions, as shown in Figure 6-12. If an external control function is triggered, the corresponding signal light is on. The robot control cabinet calculates the program number, that is, the PGNO value, according to the relevant system DI, and then executes the corresponding subroutine according to the program number.

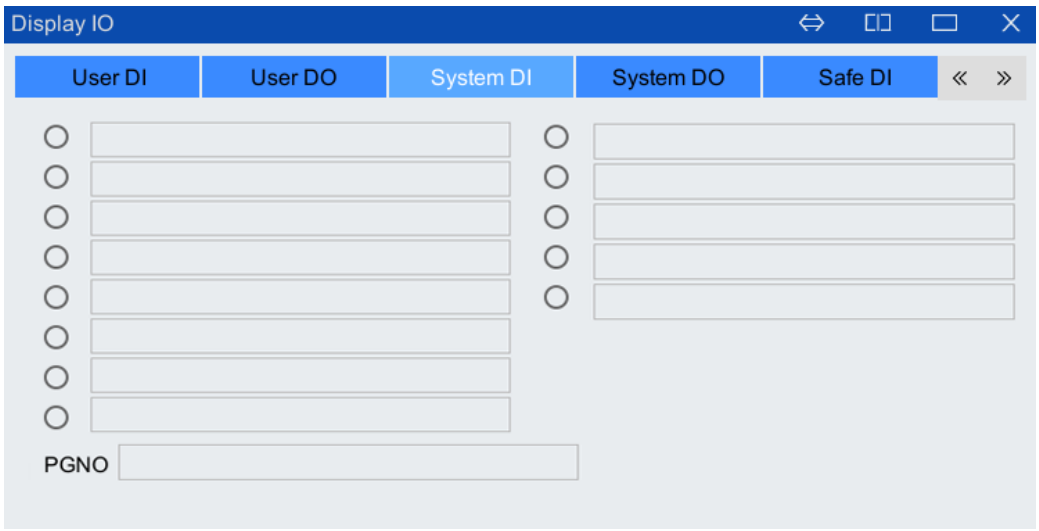


Figure 6-12 [System DI] tab

For system DI, when users use it, they need to configure the corresponding DI logic address for each function in the [External Control] tab in "System > Parameter Configuration" before they can be used, as shown in Figure 6-13. For configuration instructions, please refer to Chapter 8.1.

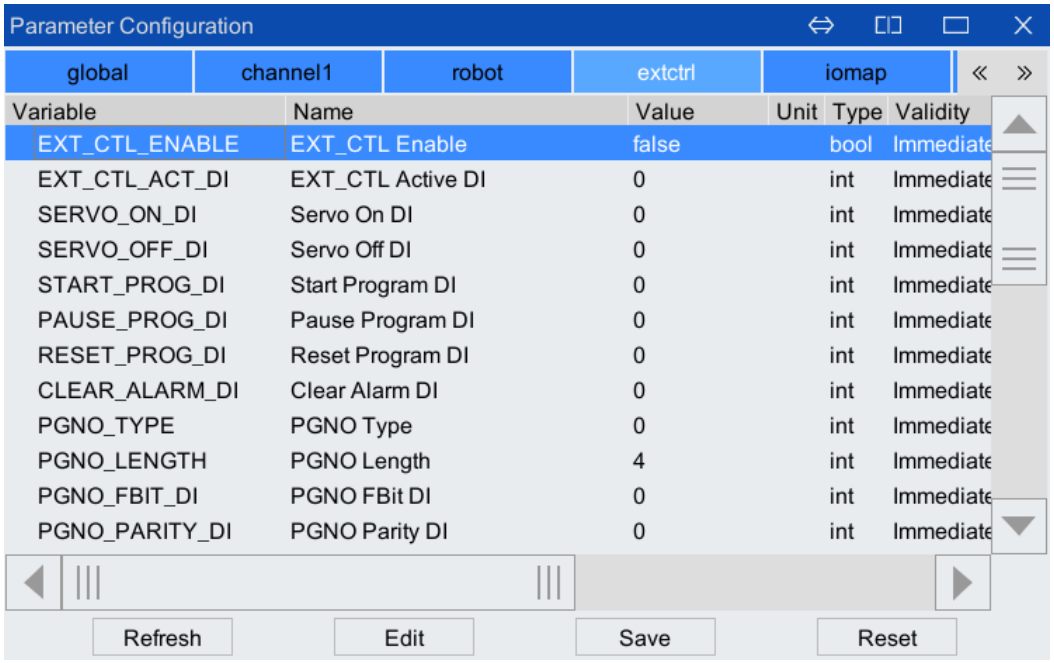


Figure 6-13 [External Control] tab in [Parameter Configuration]

Correspondence between logical address and pin number:

If each function of the system DI is configured to 1-16 DIs, the corresponding system DI needs to be triggered on the pins of the X7 external device. For the correspondence between the pin numbers on the external terminals of X7 and the logical addresses corresponding to 1-16 DIs, please refer to Table 6-11.

Table 6-11 Correspondence between the logical address of 1-16 DI and the pin number of X7

Logical address of 1-16 DI	X7 pin number
1	1

Logical address of 1-16 DI	X7 pin number
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	21
10	22
11	23
12	24
13	27
14	28
15	29
16	30

6.2.2.2 DO signal

[User DO] tab in the 1-24 DOs are all available DO provided on the second-generation cabinet, these 24 DOs are shared by the system DO, user DO and body DO. Refer to Table 6-12 for the allocation method.

Table 6-12 The logical address usage and distribution of the second-generation cabinet DO

DO logical address	Distribution
1-16	User DO
	System DO
17-22	Body solenoid valve, currently only 6A and 6L models contain solenoid valve (belonging to the user's optional accessory). Only when there is solenoid valve, DO signal can be set effectively
23-24	Body manipulator

User DO

For user DO, 1-16 channels of DO are available, if not enough, you can configure external expansion MF to increase the number of IOs. Refer to Table 6-7 for the description of the annotation-related buttons in the [User DO] interface.

There are 2 ways to set user DO signal status:

- Click the <Edit Status> button, manually set 1-16 DO signals, and click the <Save Status> button to change the state of the DO signal.

- After clicking the <Edit Status> button, press and hold the "2nd" key to directly set the DO signal state manually, and the DO signal state will take effect directly without clicking the <Save Coment> button.

Figure 6-14 1-16 [User DO] tab

- Click the <Edit Status> button, manually set the 17-~24 channels of DO signals, and then click the <Save Status> button to change the DO signal status. The 17-~24-channel DO signal settings vary depending on the connected body model. Table 6-13 shows the status description of DO signals of channels 17-~24 when connected to the AIR8-710A.

Figure 6-15 [User DO] tab

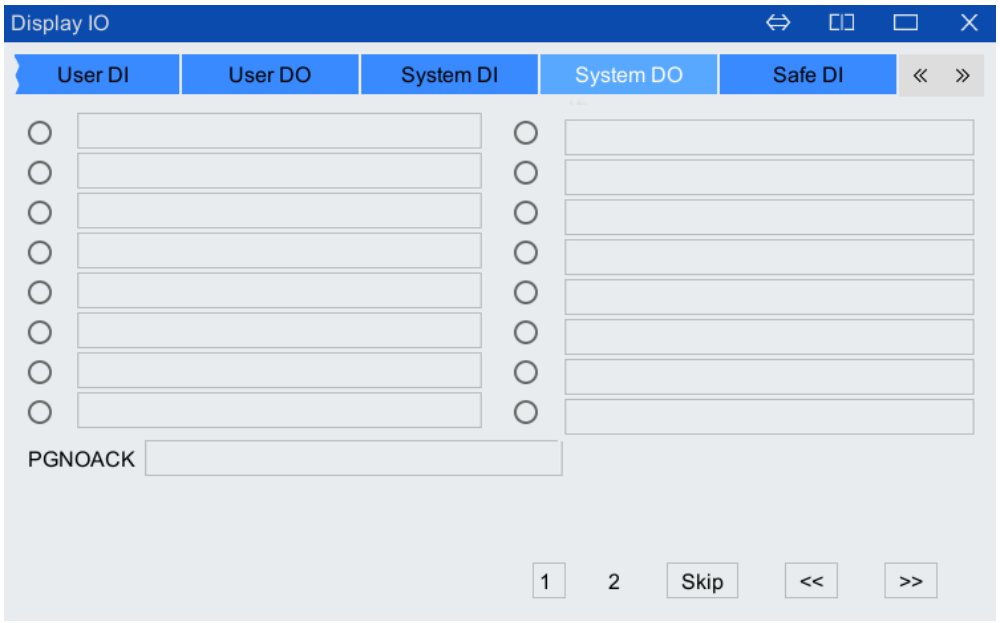
Table 6-13 Description of 17-24 channel DO signals when connecting AIR8-710A

DO number	Illustrate
17	Solenoid valve number 1-3B
18	Solenoid valve number 2-3A
19	Solenoid valve number 3-1B

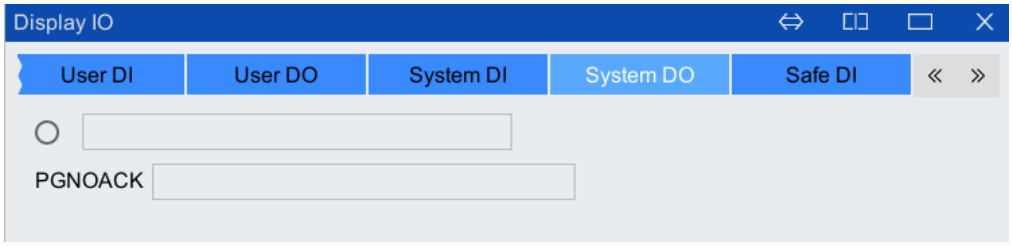
DO number	Illustrate
20	Solenoid valve number 4-1A
21	Solenoid valve number 5-2B
22	Solenoid valve number 6-2A
23	Manipulator DO1
24	Manipulator DO2

System DO

[System DO] tab shows the output status of each function of system DO, as shown in Figure 6-16. If the DO function of a certain system is output, the corresponding signal light is on. The robot control cabinet uses the received legal program number as the PGNOACK value, and outputs it to the external controller through the relevant system DO to confirm whether the program number is correct.



(a)



(b)
Figure 6-16 [System DO] tab

For system DO, when users use it, they need to configure the corresponding DO logic address for each function in the [External Control] tab in "System > Parameter Configuration" before it can be used, as shown in Figure 6-17. For configuration instructions, please refer to Chapter 8.1.

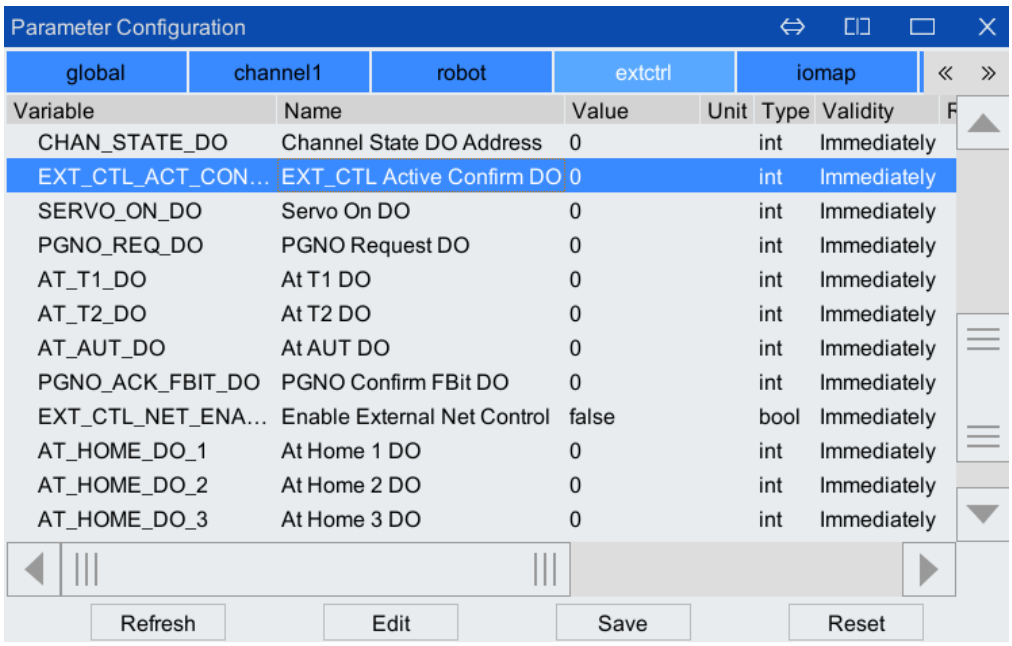


Figure 6-17 [External Control] tab in [Parameter Configuration]

Correspondence between logical address and pin number:

Therefore, if each function of the system DO is configured to 1-16 DO, the corresponding DO signal is output to the port signal corresponding to the pin of the X7 external device. Please refer to Table 6-14 for the correspondence between the pin numbers on the external terminals of X7 and the logical addresses corresponding to 1-16 DO.

Table 6-14 Correspondence between the logic address of 1-16 DO and the pin number of X7

1-16 DO logical address	X7 pin number
1	11
2	12
3	13
4	14
5	15
6	16
7	19
8	20
9	21
10	22
11	35
12	36
13	37
14	38
15	39

1-16 DO logical address	X7 pin number
16	40

6.2.3 Second-generation cabinet IO (inCube2X P2.0)

On the main interface of the teach pendant, click the “Monitor >Input/Output” option to enter the [Display IO] interface.

6.2.3.1 DI signal

The 1~21 DIs in the [User DI] tab are all available DIs provided on the second-generation cabinet. These 21 DIs are shared by the system DI, user DI and body DI. See Figure 6-18. See Table 6-15 for its distribution method.

Table 6-15 Logical address usage and distribution of the second-generation cabinet DI

Logical address of DI	Distribution
1-16	User DI
	System DI
17-21	Manipulator

User DI

For user DI, channels 1 to 16 are available. If channels 1 to 16 are not enough, external expansion MF can be configured to increase the number of IOs.

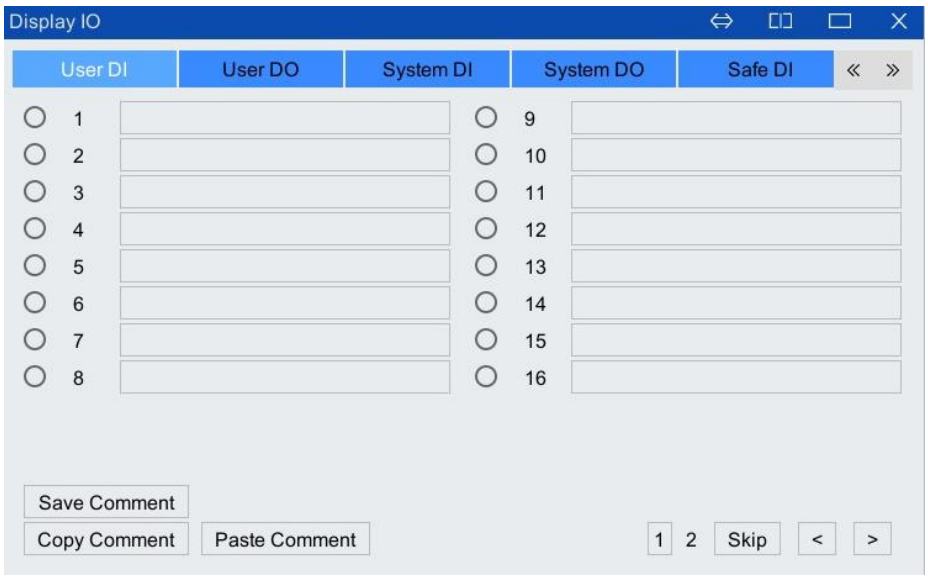
The [User DI] tab supports comments on various signals. The description of the comment-related buttons in the [User DI] interface is detailed in Table 6-3.

Operation steps:

Step1.Click the <Edit Comment> button at the bottom left corner of the interface, and the content displayed on the button will immediately change to <Save Status>.

Step2.Enter the content to be added in the text box behind each signal, and click the <Save Status> button.

Step3.The "Save the annotation successfully!" [Prompt] interface pops up, click the <Yes> button to complete the annotation of the signal.



(a) 1~16 channels

(b) 17~21 channels
Figure 6-18 [User DI] Tab

System DI

The tab displays the status of various functions of the system DI, as shown in Figure 6-19. If a certain external control function is triggered, the corresponding signal light will be on. The robot control cabinet calculates the program number, i.e. PGNO value, based on the relevant system DI, and then executes the corresponding subroutine according to the program number.

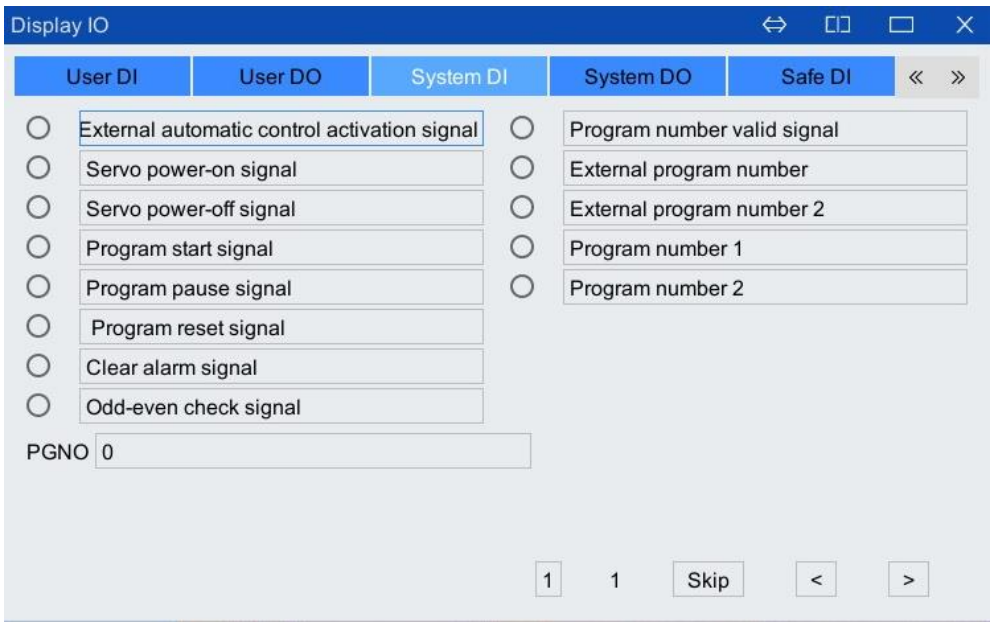


Figure 6-19 [System DI] Tab

For system DI, when users use it, they need to configure the corresponding DI logical address for each function in the 'System/Parameter Configuration' option tab, as shown in Figure 6-20. Please refer to Chapter 8.1 for the relevant instructions of parameter configuration.

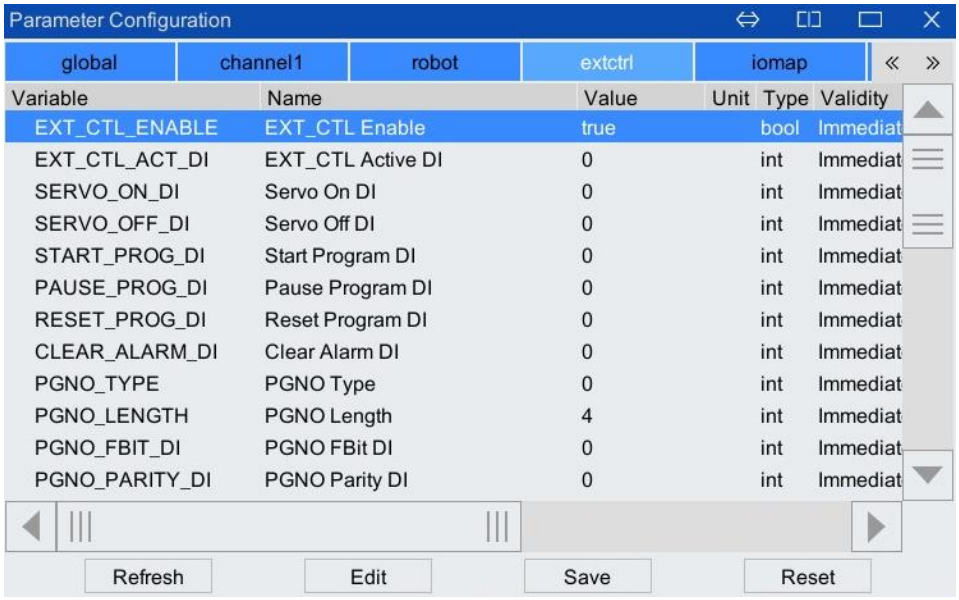


Figure 6-20 The 'External Control' tab in the 'Parameter Configuration'

The correspondence between logical address and pin number:

If you want to configure the functions of system DI to DI 1~16, you need to trigger the corresponding system DI on the pins of the external device connected to X7. Please refer to Table 6-16 for the correspondence between the pin numbers on X7's external terminal and the logical addresses corresponding to DI 1~16.

Table 6-16 The correspondence between the logical address of 1~16-channel DI and the pin number of X7.

Logic addresses of 1~16 channels of DI	Pin number of X7
1	1

Logic addresses of 1~16 channels of DI	Pin number of X7
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	21
10	22
11	23
12	24
13	27
14	28
15	29
16	30

6.2.3.2 Do signal

The 1-24 DOs in the [User DO] tab are all available DOs provided on the second-generation cabinet, and these 24 DOs are shared by the system DO, user DO, and manipulator DO. The allocation method is shown in Table 6-17.

Table 6-17 Allocation of logical address usage for second-generation cabinet DO

The logical address of DO	Allocation
1~16	User DO
	System DO
17~22	The manipulator solenoid valve, currently only the 6A and 6L models of the manipulator contain solenoid valves (which are optional accessories for users). Only when there is a solenoid valve, the DO signal can be effectively set.
23~24	Manipulator

User DO

For user DO, 1~16 channels of DO are available. If it is not enough, you can configure an external expansion MF to increase the number of IOs. For detailed instructions on the annotation-related buttons in the [User DO] interface, please refer to Table 6-7.

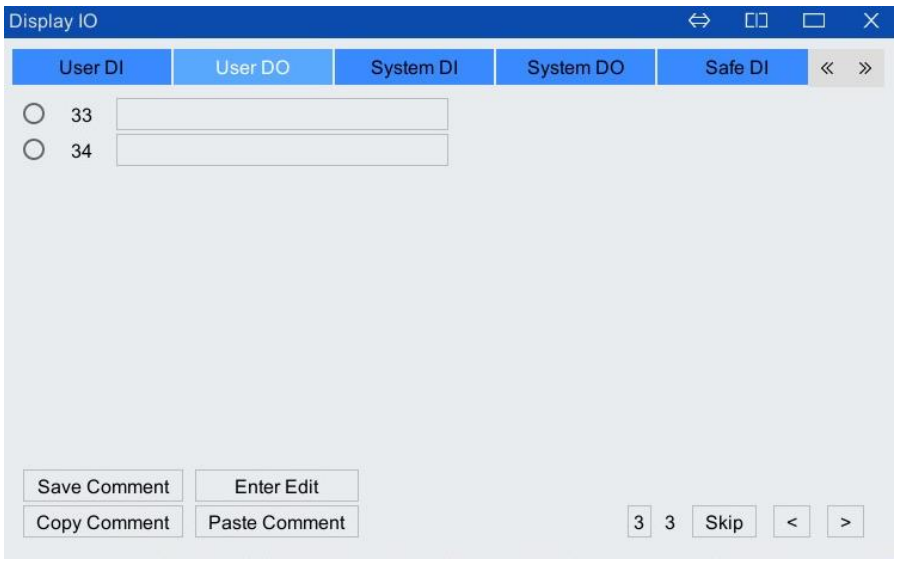
Method of setting user DO signal status:

Click the <Enter Edit> button, manually set the 1~16-channel DO signals, and then click the < Exit Edit > button to change the status of the DO signals.

Figure 6-21 1-16 channels [User DO] Tab

Click the < Enter Edit > button, manually set the 17~34 channel DO signals, and then click the < Exit Edit > button to change the status of the DO signals. The setting of the 17~34 channel DO signals varies depending on the connected manipulator model.

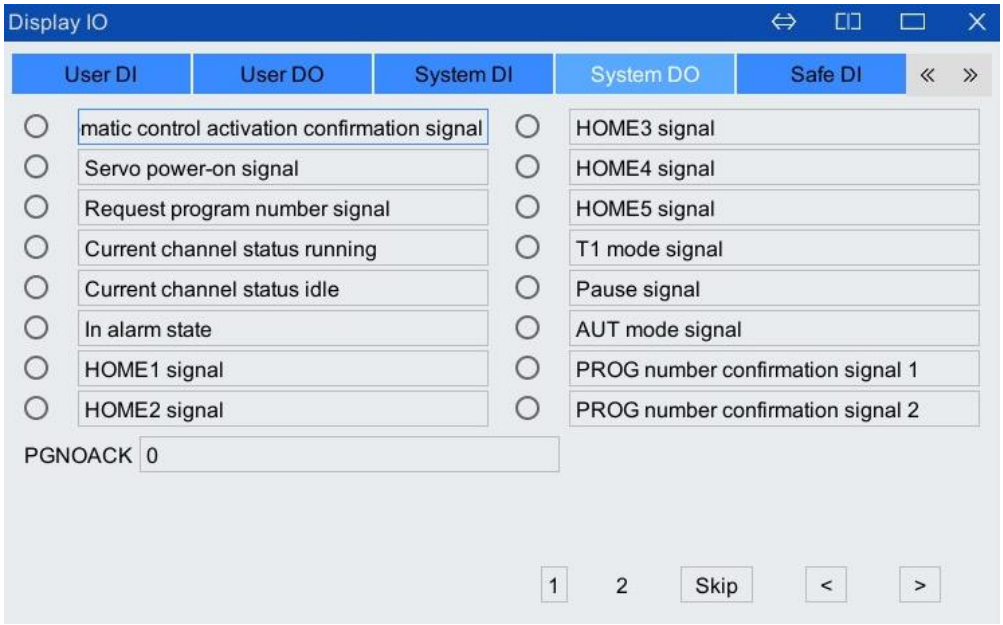
(a)



(b)
Figure 6-22 17-34 route [User DO] tab

System DO

The output status of various functions of the system DO is displayed in the [system DO] tab, as shown in Figure 6-23. If a certain system DO function is output, the corresponding signal light will be on. The robot control cabinet will receive the valid program number as the PGNOACK value, and output it to the external controller through the relevant system DO to confirm whether the program number is correct.



(a)

(b)
Figure 6-23 [System DO] tab

For system DO, when users use it, they need to configure the corresponding DO logical address for each function in the 'System/Parameter Configuration' option tab, as shown in Figure 6-24. Please refer to Chapter 8.1 for the relevant instructions of parameter configuration.

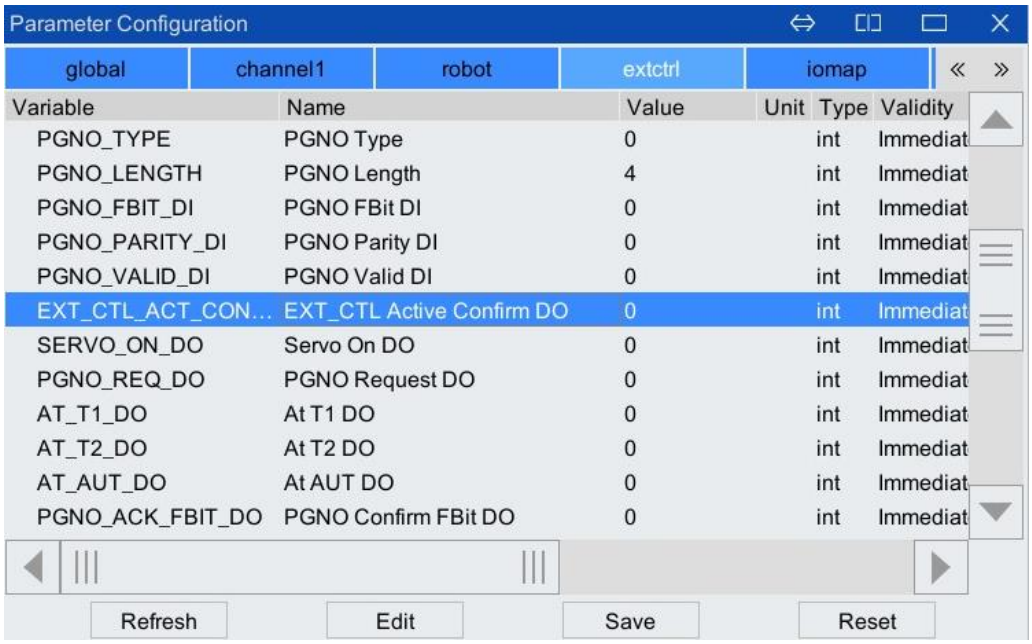


Figure 6-24 The 'External Control' tab in the 'Parameter Configuration'

The correspondence between logical address and pin number:

Therefore, if the functions of system DO are configured on DO channels 1 to 16, the corresponding DO signals will be output to the port signals on the pins of the external device connected to X7. Please refer to Table 6-18 for the correspondence between the pin numbers on the external terminals of X7 and the logical addresses corresponding to DO channels 1 to 16.

Table 6-18 The correspondence between the logical address of 1~16-channel DO and the pin number of X7.

Logic addresses of 1~16 channels of DO	Pin number of X7
1	11
2	12
3	13
4	14
5	15
6	16
7	19
8	20
9	21
10	22
11	35
12	36
13	37
14	38
15	39
16	40

6.2.4 Standard cabinet IO (ARC4-50\165)

On the main interface of the teach pendant, click "Monitor > Input/Output" option to enter the [Display IO] interface.

6.2.4.1 DI signal

The 1-40 DIs in the [User DI] tab in Figure 6-25 are all available DIs provided by the control system. These 40 DIs are shared by the system DI and the user DI. The user can arbitrarily assign these 40 DIs to used by user DI and system DI.

User DI

For user DI, 1-40 channels are available. If 1-40 channels are not enough, external MF can be configured to increase the number of IOs.

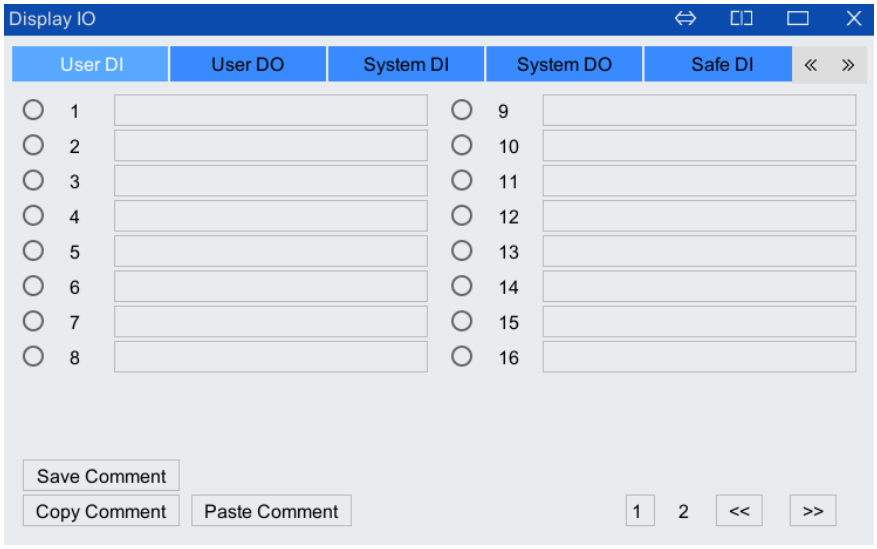
[User DI] tab supports commenting on various signals. Refer to Table 6-3 for the description of the annotation-related buttons in the [User DI] Interface.

Operation steps:

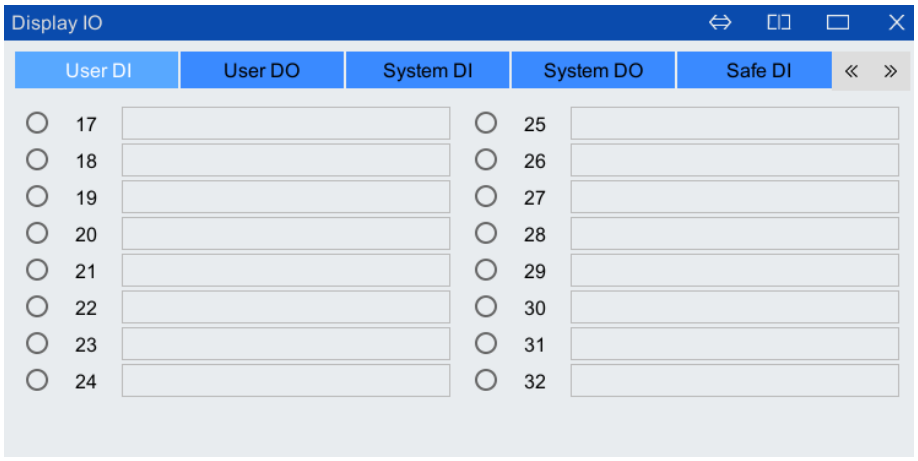
Step1.Click the <Edit Comment> button in the lower left corner of the interface, and the content displayed by the button will immediately change to <Save Comment>.

Step2.Enter the content to be added in the text box behind each signal, and click the <Save Comment> button.

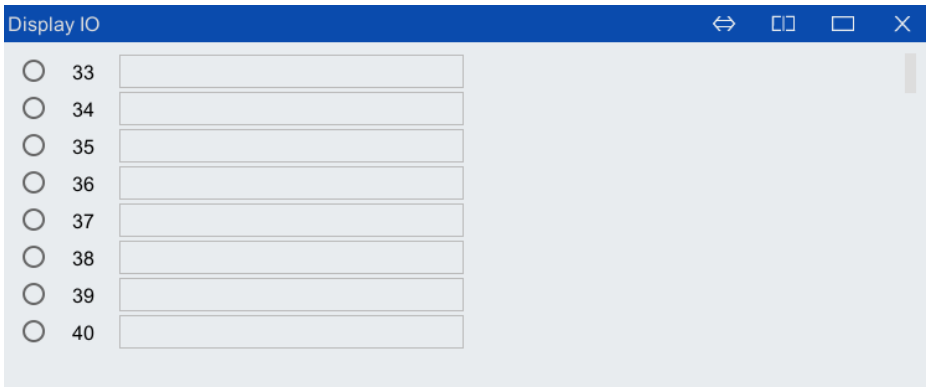
Step3.The "Comments saved successfully!" prompt interface. Click the <Yes> button to complete the comment on the signal.



(a) Route 1-16



(b) Route 17-31



(c) Route 33-40
Figure 6-25 [User DI] tab

System DI

[System DI] Tab shows the status of each function of the system DI, as shown in Figure 6-26. If an external control function is triggered, the corresponding signal light is on. The robot control cabinet calculates the program number, that

is, the PGNO value, according to the relevant system DI, and then executes the corresponding subroutine according to the program number.

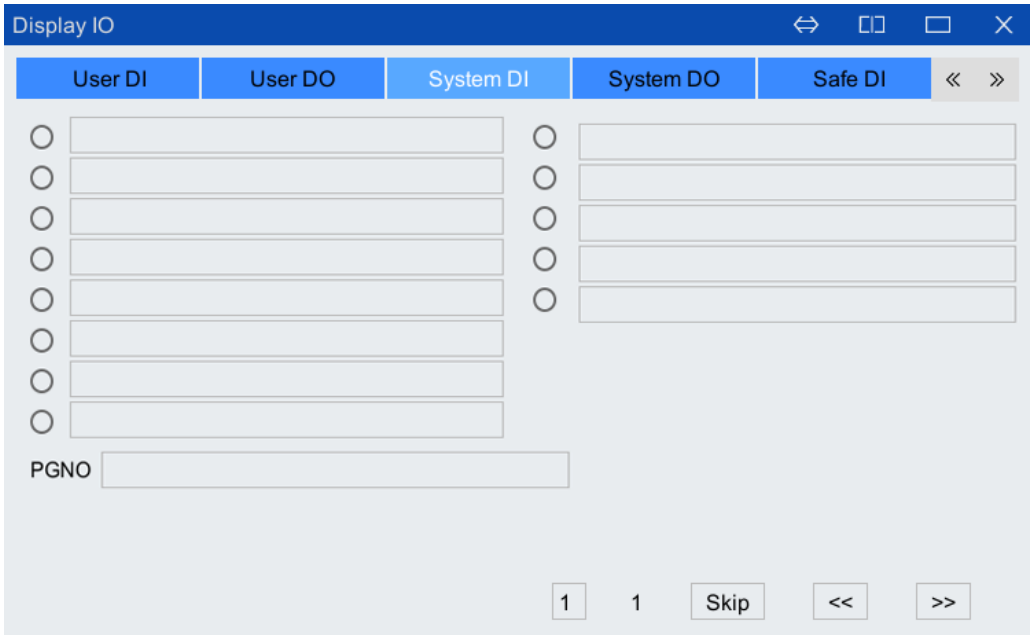


Figure 6-26 System DI tab

For system DI, when users use it, they need to configure the corresponding DI logic address for each function in the [External Control] tab in "System > Parameter Configuration", before using it, as shown in Figure 6-27.

Correspondence between logical address and pin number (the logical address of 1-40 DI corresponds to the pin number on MF):

- Configure DI logic address 1 for enabling DI function on the servo, then use pin number 1 on MF to trigger;
- Configure DI logic address 2 for the DI function of servo-off, then use pin number 2 on MF to trigger;
- Configure logic address 3 for the DI function of the startup program, then use pin number 3 on MF to trigger;
- Configure logic address 4 for the DI function of the pause program, then use pin 4 on MF to trigger;
- …

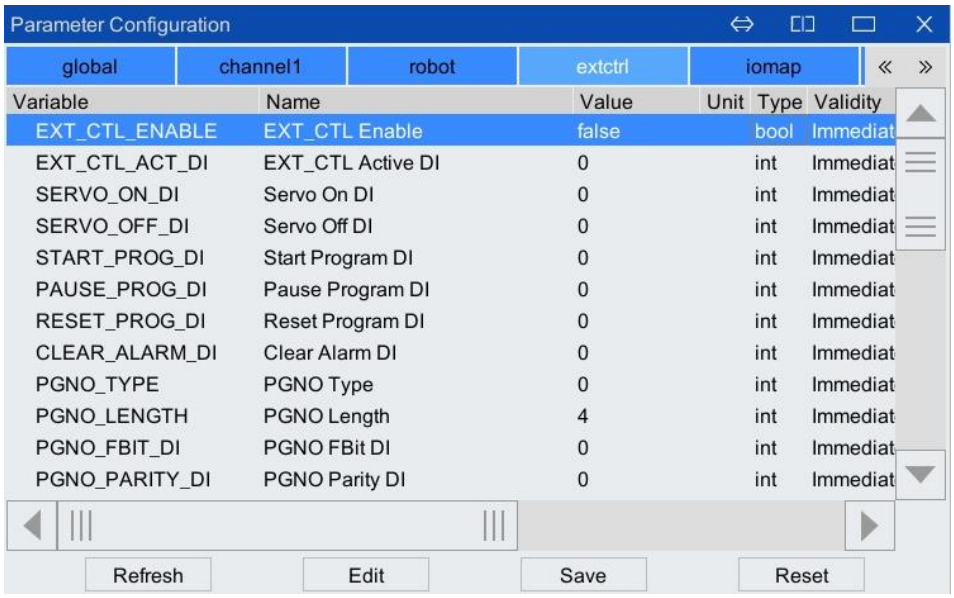


Figure 6-27 [External Control] tab in [Parameter Configuration]

6.2.4.2 DO signal

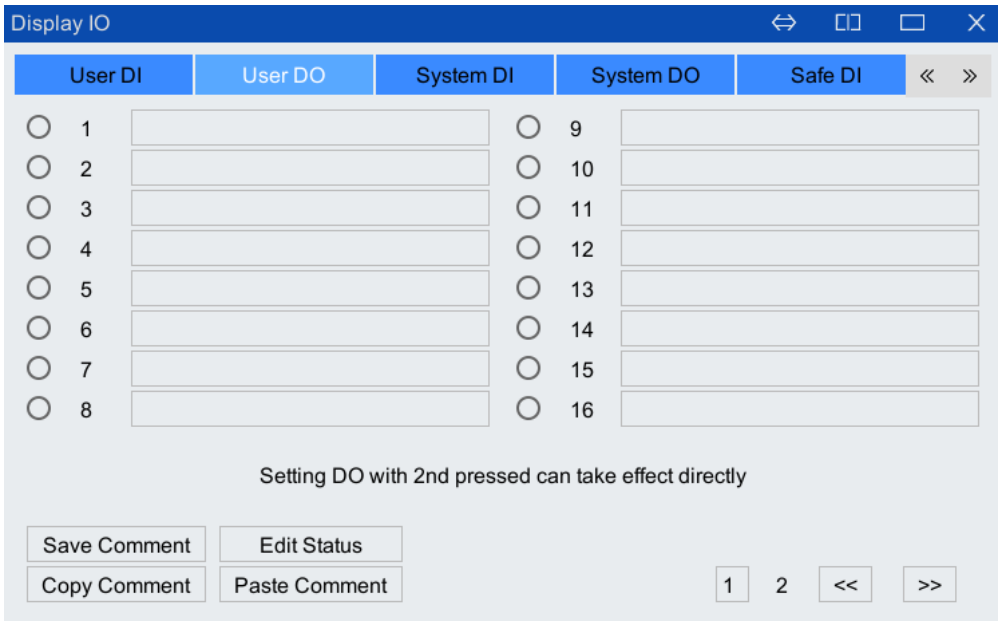
The 1-40 DOs in the [User DO] tab are all available DOs provided by the control system, as shown in Figure 6-28. These 40 DOs are shared by the system DO and the user DO, and the user can arbitrarily set 40 channels of DO are allocated to user DO and system DO.

User DO

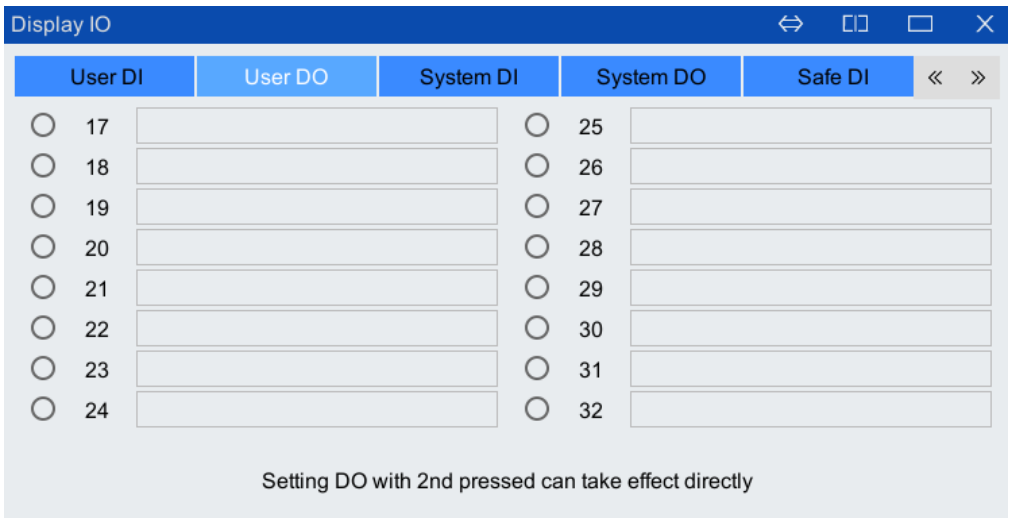
For user DO, if 1-40 DO is not enough, external MF can be configured to increase the number of IOs. Refer to Table 6-7 for the description of annotation related buttons in [User DO] Interface.

There are 2 ways to set user DO signal status:

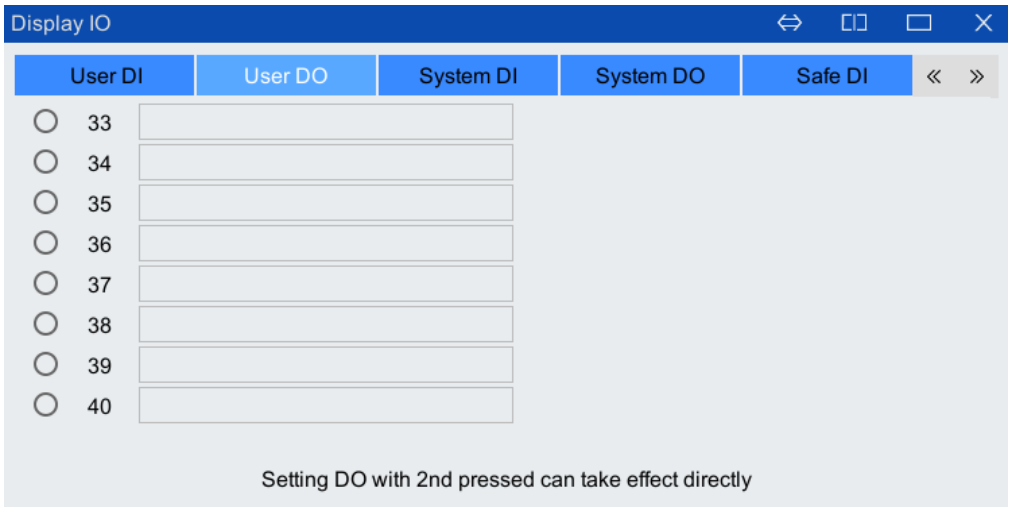
- Click the <Edit Status> button, and the content displayed by the button will immediately change to [Save Status]. After manually setting 1-40 DO signals, click the <Save Status> button to realize the change of the DO signal status.
- After clicking the <Edit Status> button, press and hold the 2nd key to directly set the DO signal status manually, and the DO signal status will take effect directly without clicking the <Save Status> button.



(a) Route 1-16



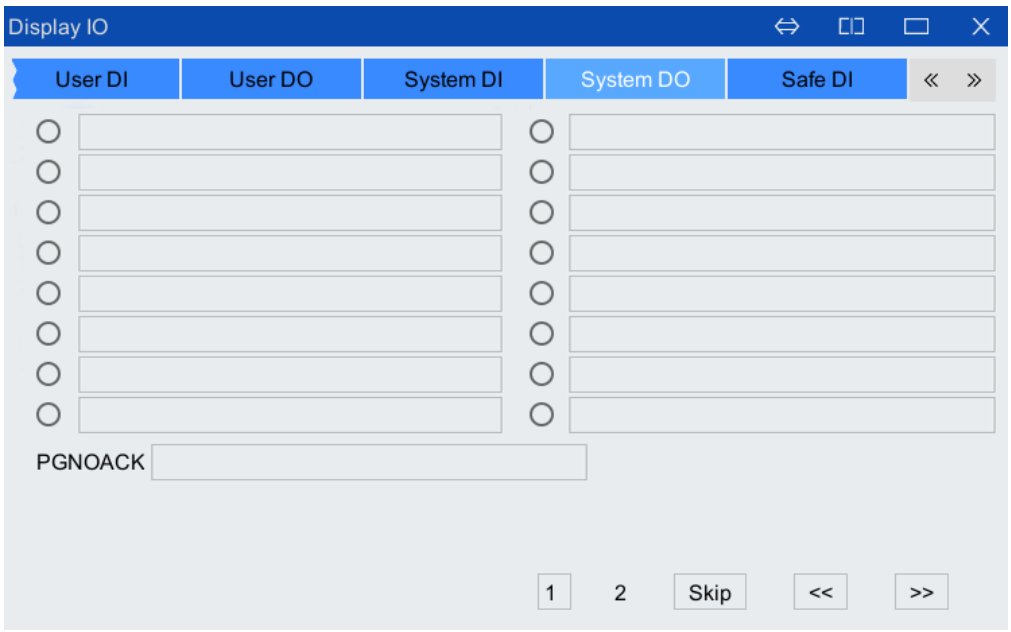
(b) Route 17-32



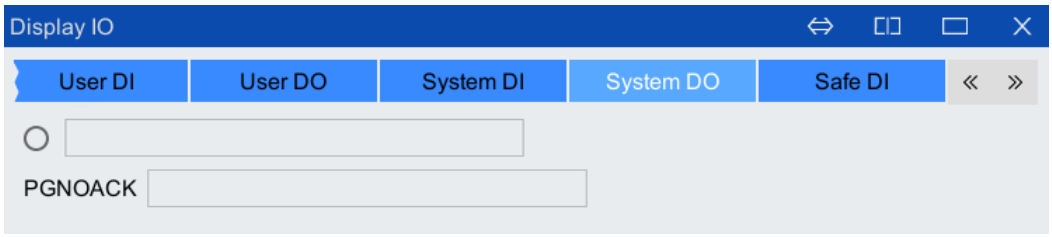
(c) Route 33-40
Figure 6-28 [User DO] tab

System DO

[System DO] tab shows the output status of each function of the system DO, as shown in Figure 6-29. If the DO function of a certain system is output, the corresponding signal light is on. The robot control cabinet uses the received legal program number as the PGNOACK value, and outputs it to the external controller through the relevant system DO to confirm whether the program number is correct.



(a)



(b)
Figure 6-29 [System DO] tab

For system DO, users need to configure the corresponding DO logic address for each function in the [External Control] tab in "System > Parameter Configuration" before using it, as shown in Figure 6-30.

Correspondence between logical address and pin number (1-40 DO logical address corresponds to the pin number on MF one to one):

- Configure DO logic address 11 for the DO function of the servo disabled state, then use the DO pin number 11 on the MF to trigger;
- Configure DO logic address 13 for DO function in T1 mode, then use DO pin number 13 on MF to trigger;
- ...

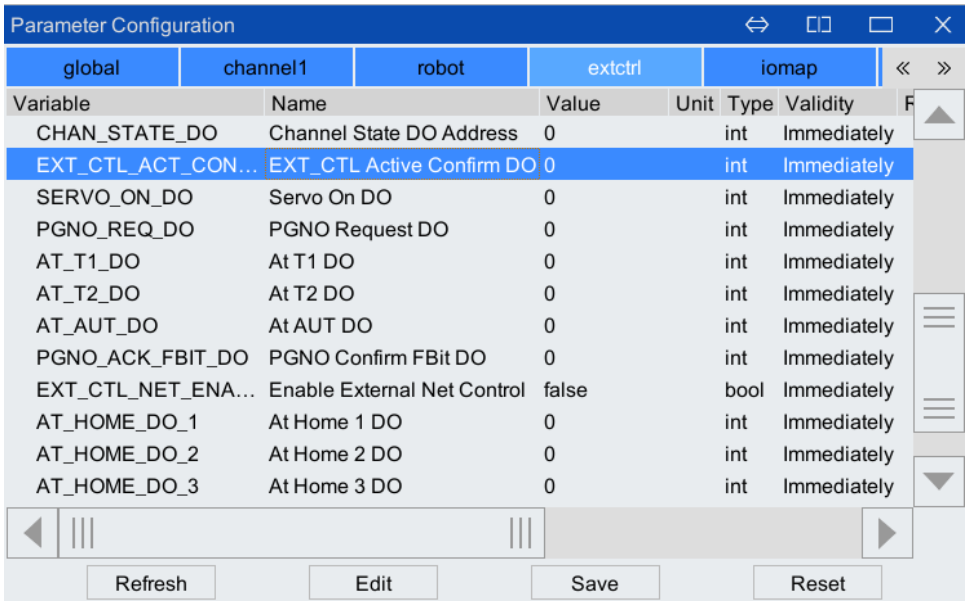


Figure 6-30 [External Control] tab in [Parameter Configuration]

6.2.5 Network control input and output

Use the user's network port with a background program to realize the function of automatic external control of the bus. Based on the socket (socket type, used to communicate with external devices through the network port), the network frame can be sent to the control cabinet through the upper computer (PC side), the background program parses the network frame information and then realizes related functions by changing system variables.

Prompt

The external network control input only takes effect in automatic mode, while the external network automatic control output remains unchanged.

6.2.5.1 Network control input

On the main interface of the teach pendant, click the "Monitor > Input and Output" option to enter the "Display IO" interface, and click the "Network Control Input" tab to switch to the "Network Control Input" display interface, as shown in Figure 6-31.

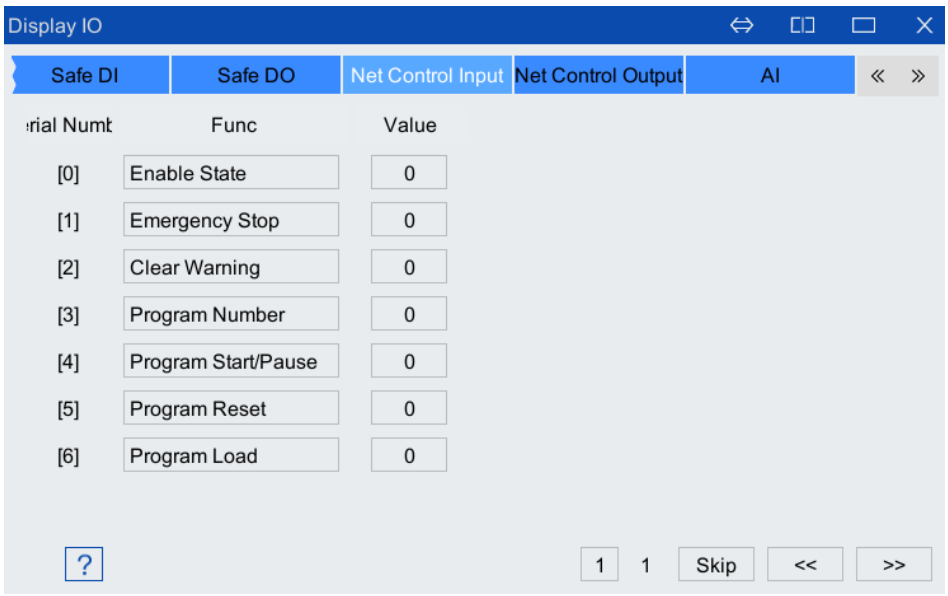


Figure 6-31 "Network control input" Display interface

"Network control input" Please refer to Table 6-19 for the setting description in the display interface.

Table 6-19 "Network control input" Setting instructions in the interface

Name	Description
Num	The serial number corresponds to the value in the system variable EXT_CTRL_IN "serial number", and the system variable EXT_CTRL_IN records the external control input value. For example, EXT_CTRL_IN"1" corresponds to serial number 1, and the function is "emergency stop"
Function	The corresponding function when the system variable EXT_CTRL_IN takes different values
Value	For the meaning of the value of the system variable EXT_CTRL_IN, please refer to "Appendix D Bus External Automatic Control Interface Data Sheet", or click the "?"at the bottom left of the interface to find it in the "Help" interface shown in Figure 6-14.

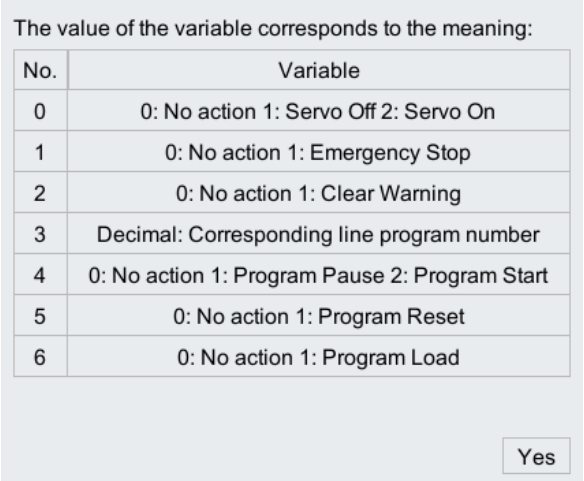
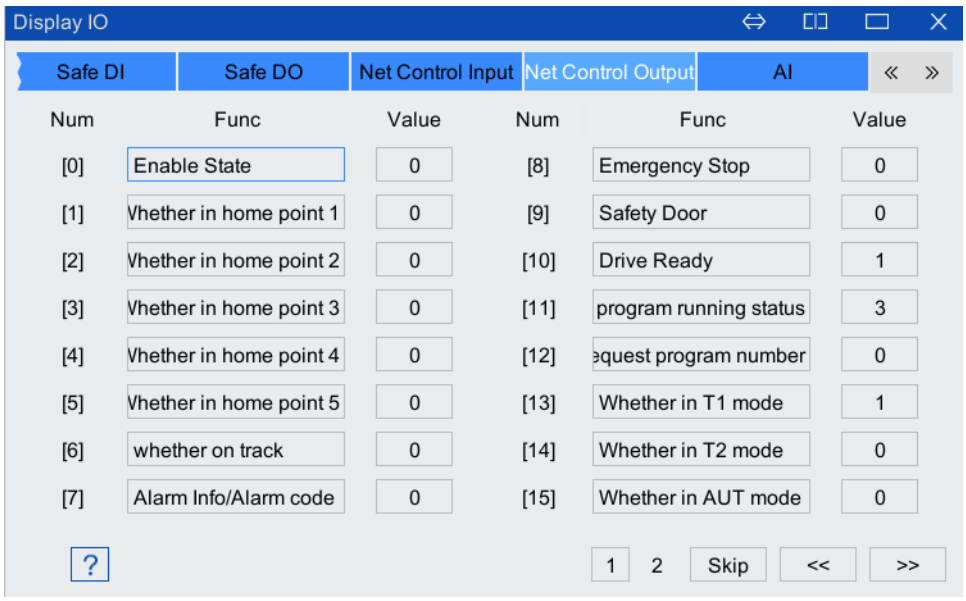


Figure 6-32 "Help" interface

6.2.5.2 Network control output

On the main interface of the teach pendant, click "Monitor > Input/Output" option, enter the "Display IO" interface, click the "Network Control Output" tab, switch to the "Network Control Output" display interface, as shown in Figure 6-33.

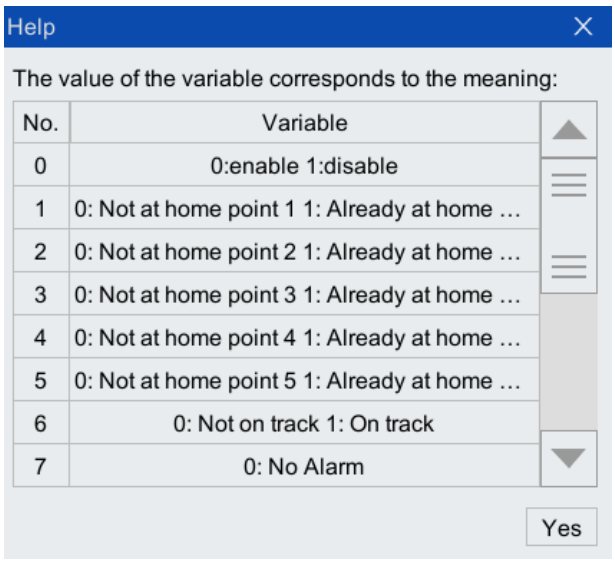


(a) Serial number "1"-"15"

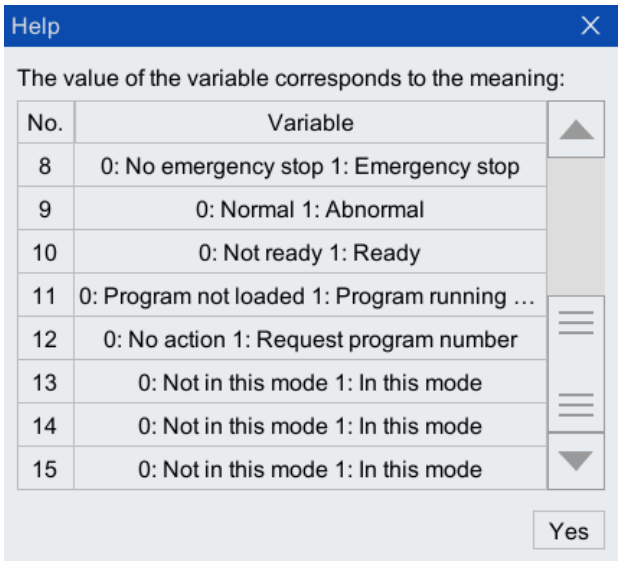
(b) Serial number "20"-"39"
Figure 6-33 "Network control output" display interface

Table 6-20 "Network control output" Setting instructions in the interface

Name	Description
Num	The serial number corresponds to the value in the system variable EXT_CTRL_OUT "serial number", and the system variable EXT_CTRL_OUT records the external control output value. For example, EXT_CTRL_OUT"1" corresponds to serial number 1, and the function is "Whether it is at home point"
function	The corresponding function when the system variable EXT_CTRL_OUT takes different values
Value	For the meaning of the value of the system variable EXT_CTRL_OUT, please refer to "Appendix D Bus External Automatic Control Interface Data Sheet", or click the "?" icon at the bottom left of the interface to find it in the "Help" interface that pops up as shown in Table 6-34



(a) Serial number "1"-"7"



(b) Serial number "8"-"15"
Figure 6-34 "Help" interface

6.2.6 Analogue real-time display

After the user configures the analog interface, the value of the analog can be displayed or modified in the "AI/AO" interface.

Take the IEB_BASE slave station as an example to introduce how to use the "AI/AO" interface.

Configuration steps:

Step1.Connect IEB and IEB_BASE for inCube20/21 control cabinet expansion analog interface, encoder interface, magnetic scale interface or PWM output interface. For the specific connection method, please refer to our company's "Multifunctional Interface Expansion System User Manual".

Step2.Configure IEB_BASE slave station. Please refer to Chapter 8.3.4 for the configuration method. Please refer to Figure 6-35 for the completed configuration interface.

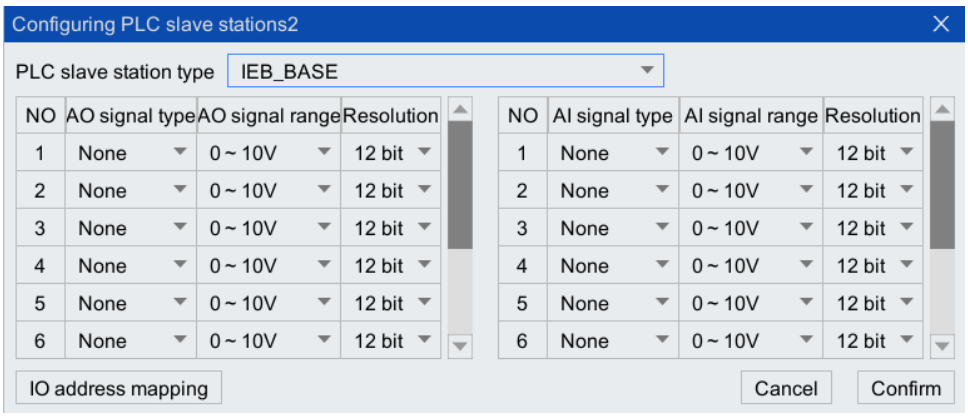


Figure 6-35 IEB_BASE slave configuration

Step3.On the main interface of the teach pendant, click "Monitor > Input/Output" option to enter the "Display IO" interface, and click the "AI/AO" tab to switch to the "AI/AO" display interface.

Step4.The "Port Number" 1-6 shown in Figure 6-36 corresponds to the "AI signal type" 1-6 in Figure 6-15; the "Port Number" 1-3 shown in Figure 6-37 corresponds to Figure 6-35. The "AO signal type" in 1-3 corresponds to 1-3. Please refer to Table 6-21 for the setting description in the "AI/AO" interface.

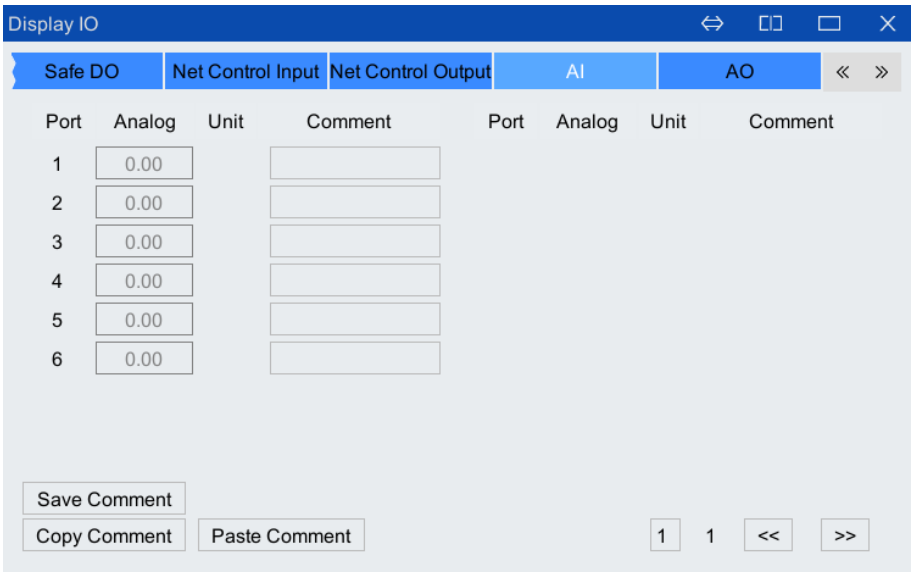


Figure 6-36 "AI" Real-time display of analog in the interface

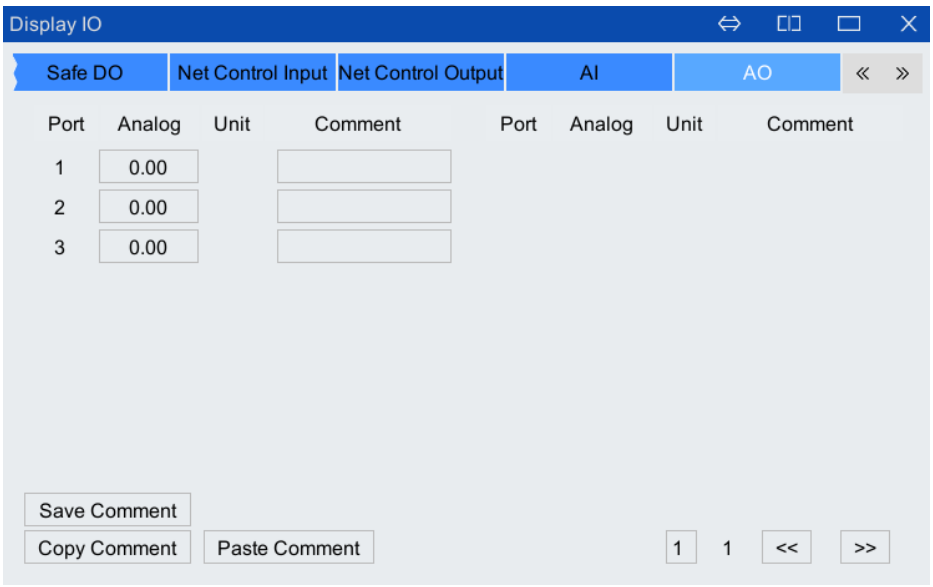


Figure 6-37 Real-time display of analog quantity in "AO" interface

Table 6-21 Setting instructions in "AI/AO" interface

Name	Description	Remarks
Port number	The number of AI/AO port numbers varies with the number of analog ports actually connected to the control cabinet	The number of ports varies with the actual configuration of the PLC
Analog	Display analog value	In the "AO" interface, click the "Analog" text box and a pop-up window will pop up. You can modify the value in the new window, and use the <Confirm/Cancel> button to determine whether the modification is effective or not.
		In the "AI" interface, the value displayed after "Analog" cannot be modified
Unit	mA or V	The specific unit is determined by the PLC configuration type (current type displays mA, voltage type displays V)
Comment	The default is empty, the user can modify	Same as user DI/DO, please refer to Chapter6.2.1-Chapter6.2.3

6.2.7 User safety DI

Configuration method

On the main interface of the teach pendant, click [System/Parameter Configuration/safety IO], and in the pop-up [Parameter Configuration] interface, click to select the [User safety DI] parameter to configure the value of the variable. The variable description is shown in Table 6-22.

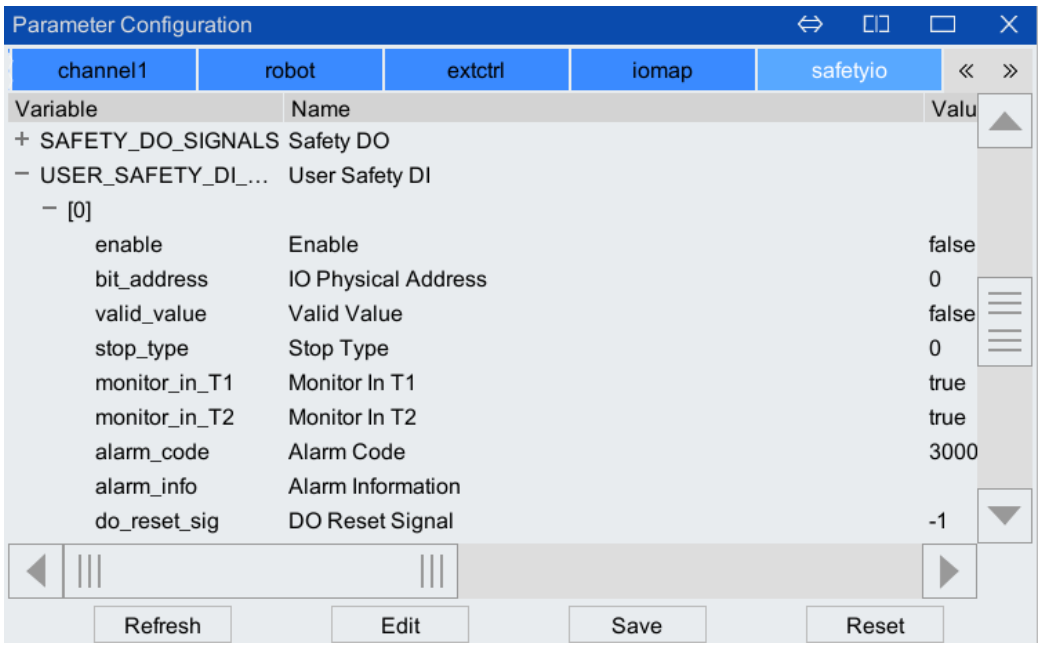


Figure 6-38 Safety IO parameter configuration interface

Table 6-22 Variable description

Variable	Description
enable	Set to true to enable user safety DI function
bit_address	Physical address used to set user safety DI
valid_value	If the DI status of this channel does not meet the valid value, it will alarm
stop_type	Types of stop robots include 0, 1, 2
monitor_in_T1	Whether to monitor in manual low speed mode
monitor_in_T2	Whether to monitor in manual high-speed mode
alarm_code	When an alarm is generated, the displayed alarm code is not recommended to be modified.
alarm_info	Alarm information displayed when an alarm is generated
do_reset_sig	When the alarm is cleared, the physical address of the output DO signal

Check configuration

On the main interface of the teach pendant, click the [Monitor/Input and Output] option to enter the [Display IO] interface, click the "User Safety DI" tab, and switch to the [User Safety DI] display interface, as shown in Figure 6-39.

The user can view and annotate the safety DI as needed in this interface. For the setting method, please refer to the relevant chapter of "User DI".

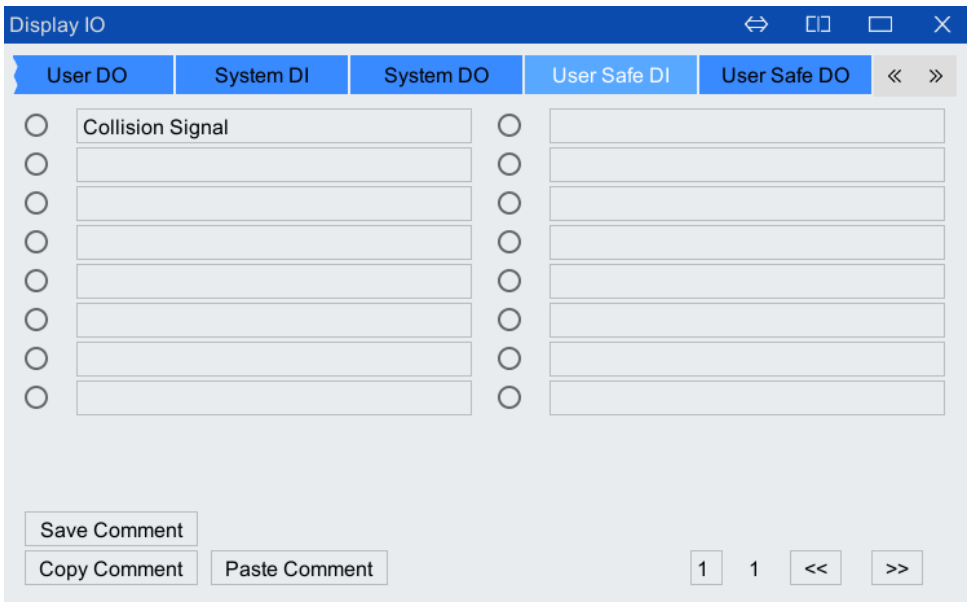


Figure 6-39 [User Safeity DI] display interface

Prompt

User safety DI function can configure user DI as safety class DI, its function is similar to safety DI, the difference is:

- Safety DI is a fixed configuration and cannot be changed
- Safety DI is more real-time and more secure

6.2.8 User safety DO

Application scenarios

The user safety DO function is used to output the alarm status of the safety DI. By setting the safety DI physical address list bound to the user safety DO, when an alarm occurs in the DI in the safety DI physical address list, the user safety DO signal will be output. If the safety DI physical address list bound to the user safety DO is not set, all alarms will trigger the output of the user safety DO by default.

Configuration method

On the main interface of the teach pendant, click "System>Parameter Configuration>Safety IO", and in the pop-up [Parameter Configuration] interface, click to select the [User Safety DO] parameter to configure the value of the variable. The variable description is shown in Table 6-23.

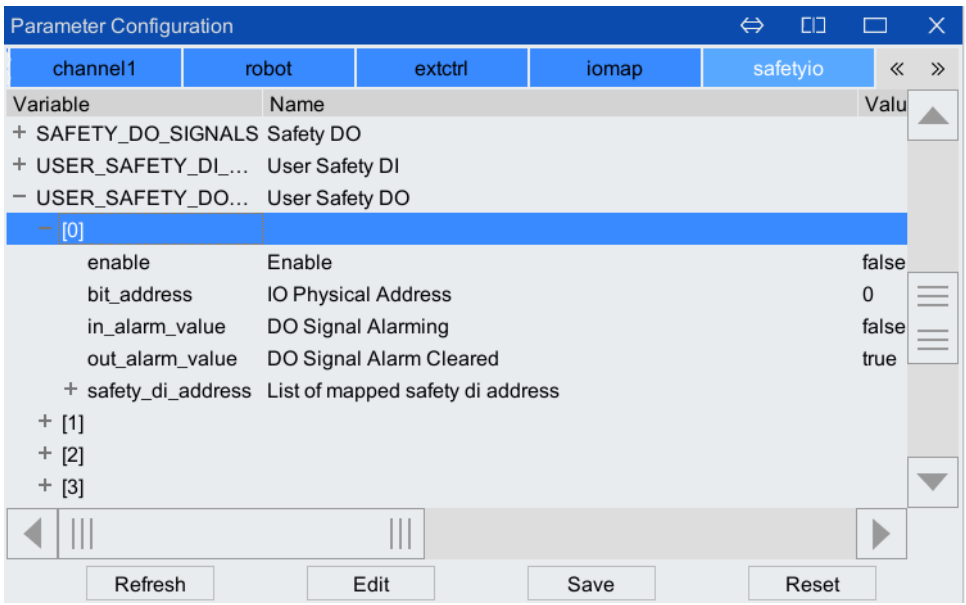


Figure 6-40 Safety IO parameter configuration interface

Table 6-23 Variable description

Variable	Description
enable	Set to true to enable user safety DO function
bit_address	Physical address used to set user safety DO
in_alarm_value	Set the output DO signal when an alarm is generated
out_alarm_value	Set the output DO signal when the alarm is cleared
safety_di_address	Sets a list of safety DI physical addresses bound to this user's safety DO. If default, all safety DI alarms will trigger user safety DO output by default

View configuration

On the main interface of the teach pendant, click the [Monitor/Input and Output] option to enter the [Display IO] interface, click the "User Safet DO" tab, and switch to the [User Safet DO] display interface, as shown in Figure 6-41.

Users can set the safety DO in this interface according to their needs. For the setting method, please refer to the relevant chapters of "User DO".

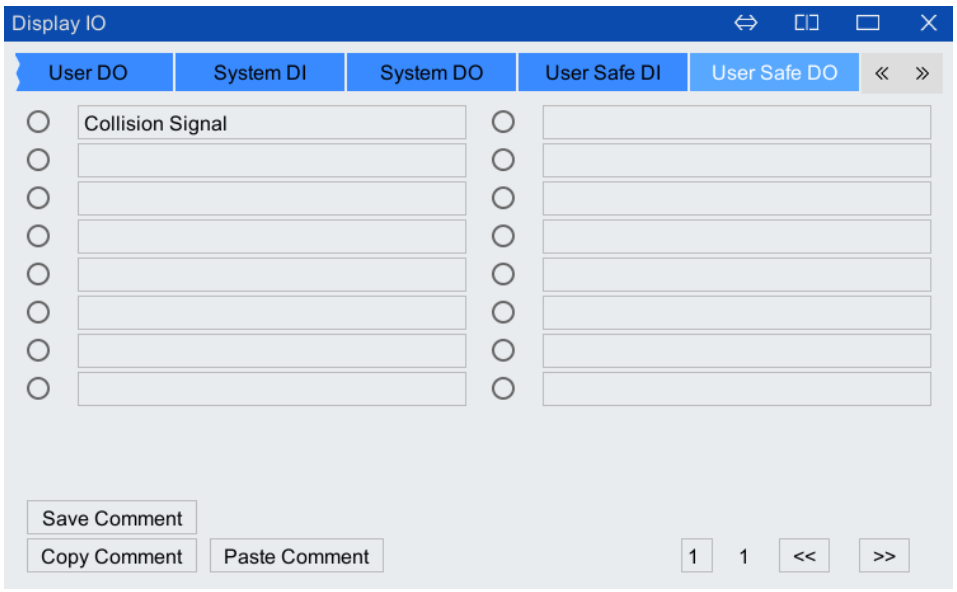


Figure 6-41 [User Safety DO] Display interface

Prompt

The user safety DO function can configure the user DO as a safety DO. Its function is similar to the safety DO, with the following differences:

- Safety DO is a fixed configuration and does not support changes
- Safety DO is more real-time and safer

6.3 Dynamic monitoring

On the main interface of the teach pendant, click "Monitor > Dynamic Detection" to enter the "Dynamic Monitoring" interface shown in Figure 6-42. The dynamic monitoring function can dynamically monitor the instruction position, feedback position, and Data such as rotation speed, torque and current. Refer to Table 6-24 for the description of each item in the interface.

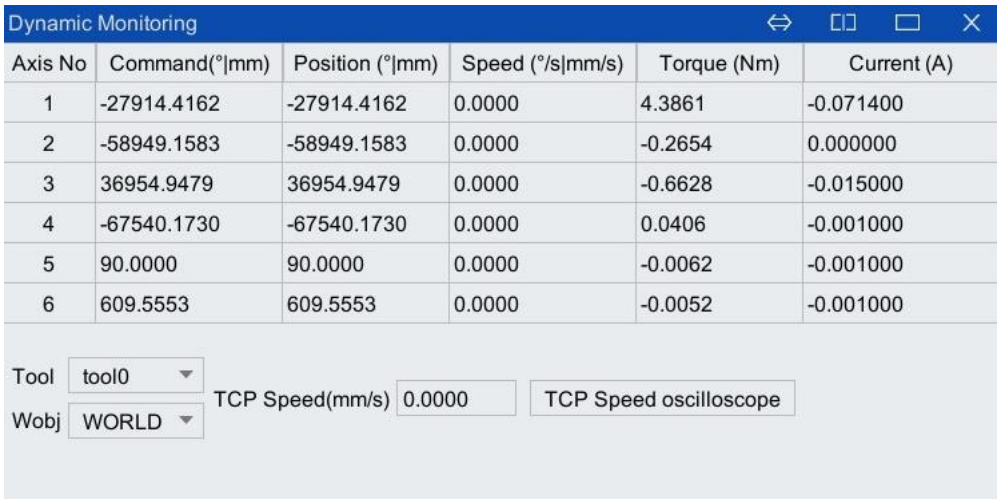
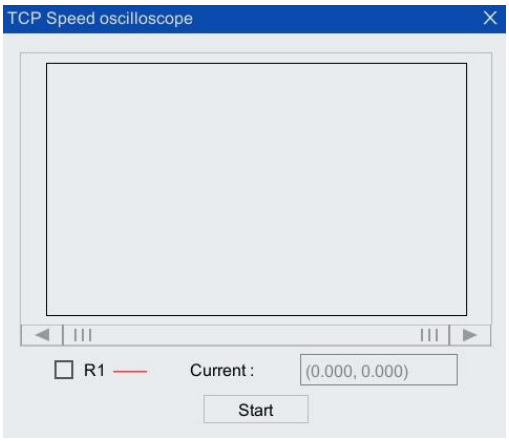


Figure 6-42 "Dynamic Monitoring" interface

Table 6-24 "Dynamic Monitoring" Setting instructions in the interface

Name	Description
Shaft number	1-6 axes of the robot
Instruction position (° or mm)	Instruction position of each axis of the robot

Name	Description
Position (° or mm)	Feedback position of each axis of the robot
Speed (°/s or mm/s)	The rotation speed of each axis motor of the robot
Torque (Nm)	The torque of each axis motor of the robot
Current (A)	The current of each axis motor of the robot
Tool coordinate system	Specify the tool coordinate system used for the linear velocity of the robot TCP point
Workobject coordinate system	Specify the workobject coordinate system used by the robot TCP point linear velocity
TCP speed (mm/s)	Real-time display of the line speed of the robot TCP point
TCP Speed Oscilloscope	Clicking this button will bring up the interface as shown in Figure 644. ■ You can select to display the speed of a specific channel's mechanical unit, and the speeds of different channels are differentiated by color. ■ Click <Start/Stop> to determine the time range for recording speed. The vertical axis (TCP speed) can adapt according to the maximum speed, while the horizontal axis remains fixed and can be scrolled using a progress bar.  Figure 6-43 [TCP Speed Oscilloscope] interface

6.4 Safety zone

In many production processes, a workstation requires two (see Figure 6-44) or even multiple robots to work together, such as transportation of large objects, welding of workobjects, etc.

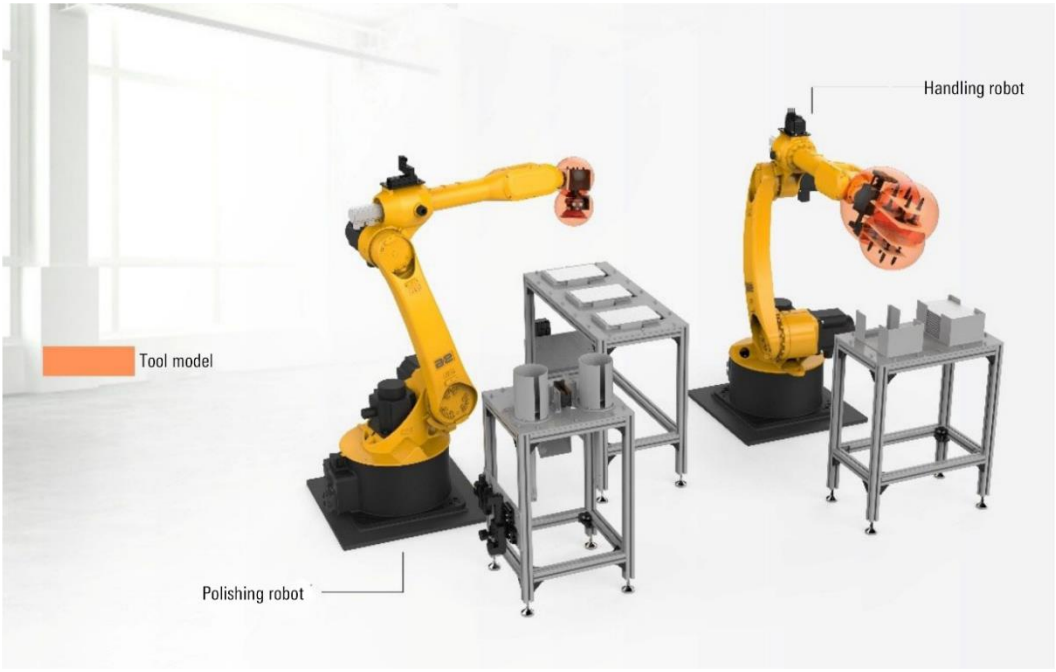


Figure 6-44 Contents of two robots working together

Therefore, in the production process, in order to avoid interference and collision when multiple robots work together or the robot cooperates with other devices, the user can limit the TCP's movement zone through the Safety Zone function.

The Safety Zone function can define 40 different monitoring zones, and control the movement and stopping of the robot by monitoring the position relationship between the envelope boundary and the monitoring zone in real time.

At the same time, the Safety Zone function can configure the related parameters such as the shape, type, size and position of the monitoring zone. Under the permission of Teacher or higher permission, select "Main Interface> Monitor> Safety Zone" option to enter "Safety Zone" setting interface, as shown in Figure 6-45.

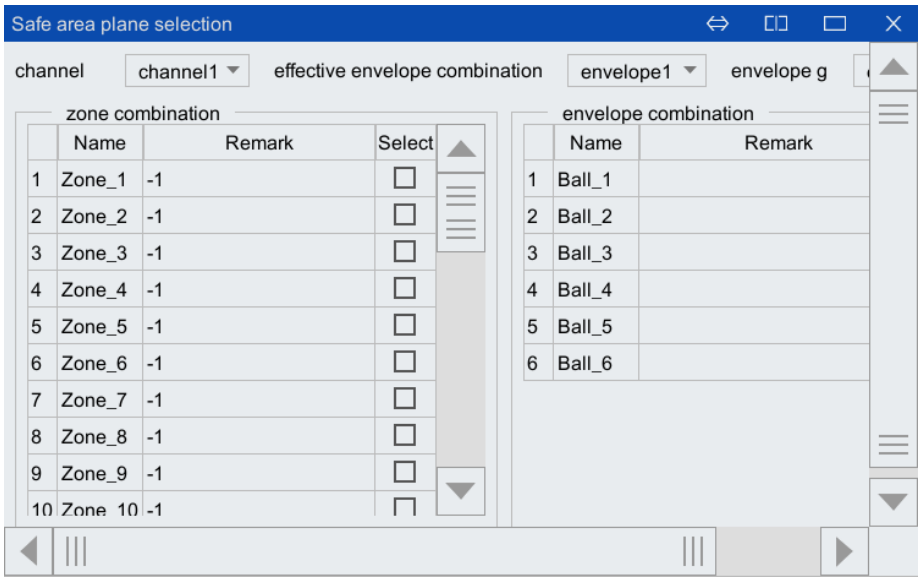


Figure 6-45 "Security zone" setting interface

6.4.1 Set tool envelope

Prompt

The number of envelope balls is selected according to the size of the tool. In theory, the tool can be wrapped with envelope balls.

Setting steps:

Step1.Click the [Envelope g] drop-down list in Figure 6-46. There are 6 sets of envelopes to choose from. Each set of envelopes can set up to 6 envelope balls (Ball), that is, one tool can have up to 6 envelopes. Enveloping the ball, the specific use of several enveloping balls can be customized by the user.

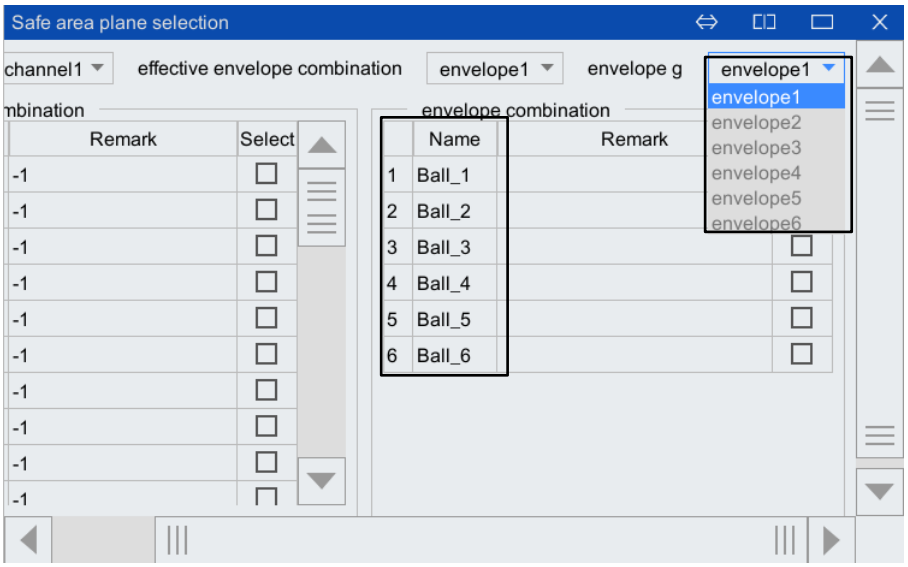


Figure 6-46 [Envelope] drop-down list

Step2.Click the row of any tool ball (Ball) in the [effective envelope combination] box in Figure 6-46 to set the envelope ball in the pop-up [Envelope combination] interface, as shown in Figure 6-47 As shown, the content description in the [Envelope combination] interface refers to Table 6-25.

Step3.After the setting is completed, click the <Yes> button to save the set value; click the <Cancel> button to abandon this setting without saving the set value.

Step4.Follow the above method to complete the settings of other envelope spheres.

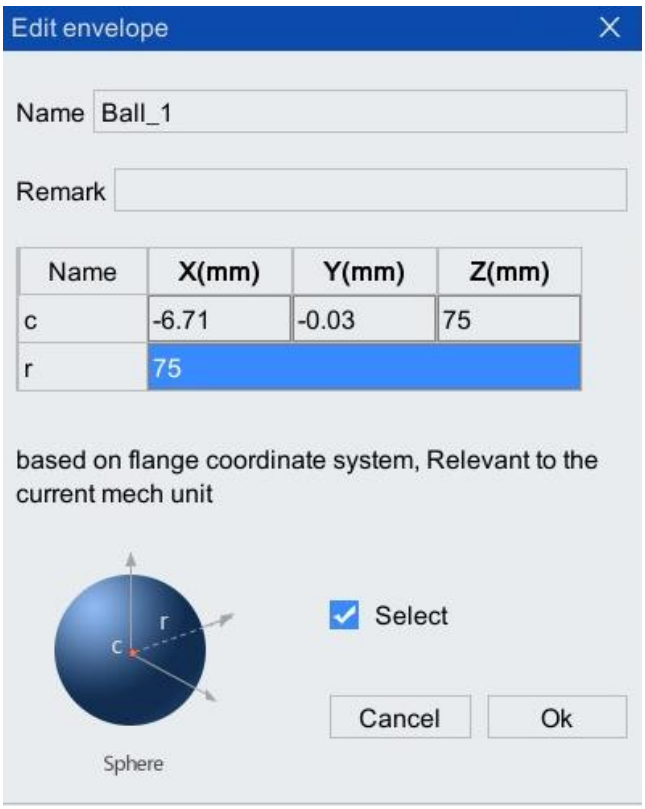


Figure 6-47 "Edit envelope" interface

Table 6-25 "Envelope Edit" interface content description

Content	Meaning
Name	Envelope name. The default names of the 6 envelope balls are Ball_1, Ball_2, Ball_3, Ball_4, Ball_5, Ball_6, which can also be customized by users
Remarks	Envelope notes. Users can make notes for each tool envelope according to their needs, supporting Chinese and English notes
c	Envelope the center of the ball. The reference coordinate system of the envelope sphere c is the flange coordinate system (refer to Figure 6-48). The user can manually input the X, Y, Z values corresponding to the envelope sphere center with reference to the flange coordinate system, in mm
r	The radius of the envelope sphere. The user can set the radius of the envelope ball according to the size and position of the tool, in mm
Enable	Envelope is enabled. When checked in front of the [Enable] box, it means that the envelope is enabled; if it is not checked, it means that the envelope is not enabled. Envelope can be checked by checking it, refer to Figure 6-49

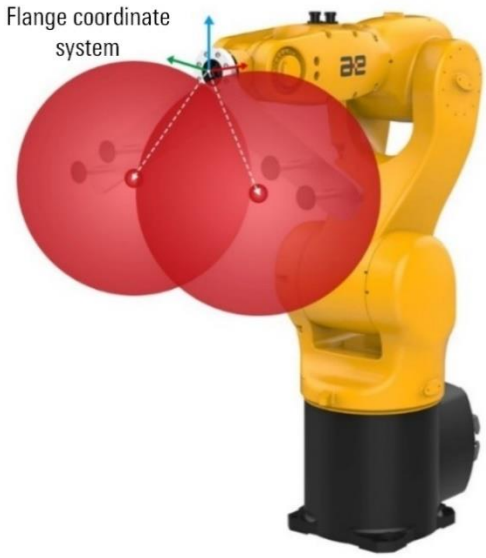


Figure 6-48 The location of the center of the envelope when the flange coordinate system is the reference coordinate system

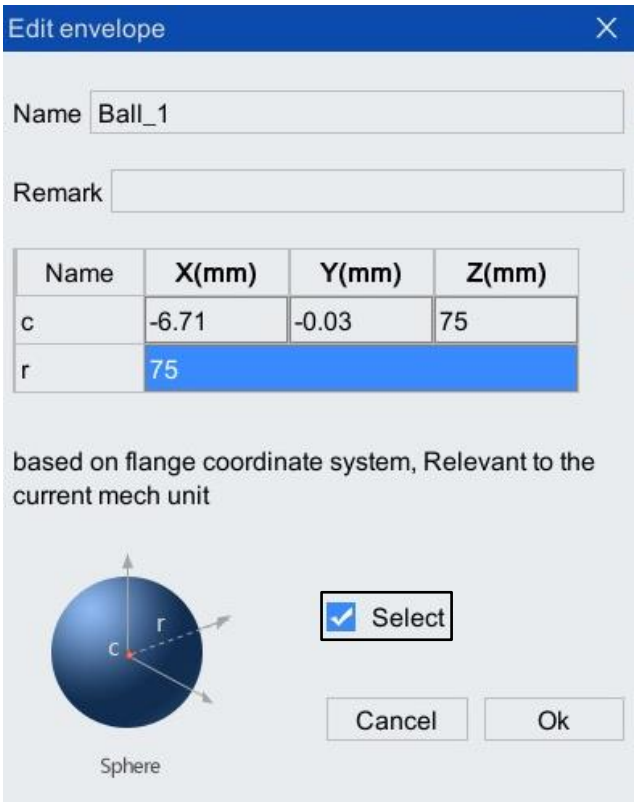


Figure 6-49 Envelope [Enable] is checked

Step5.After the [Envelope g] is set, you can switch [effective envelope combination] to determine which group of envelopes to use (refer to Figure 6-50).

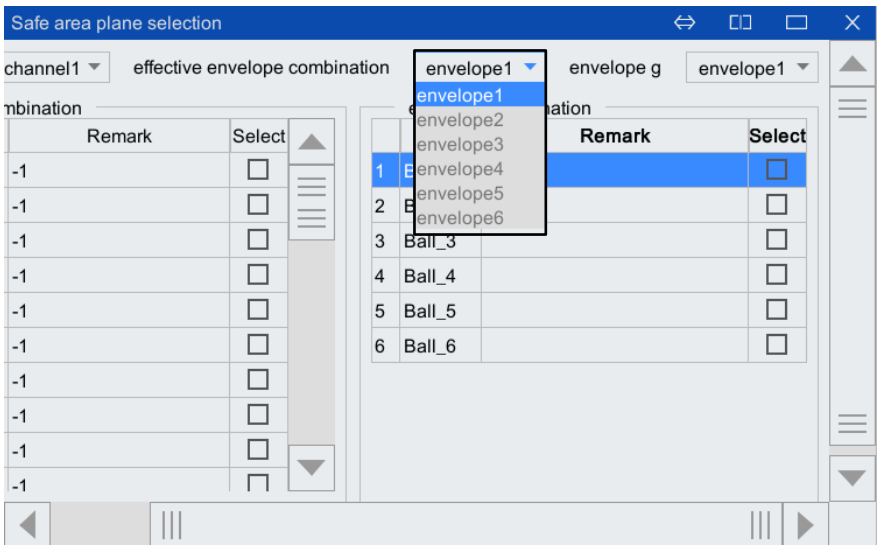


Figure 6-50 Toggle [effective envelope combination]

6.4.2 Set axis envelope

Description:

In order to monitor whether the robot axis joints touch the zone, J3 and J5 joint envelope balls are set, as shown in Figure 6-51.

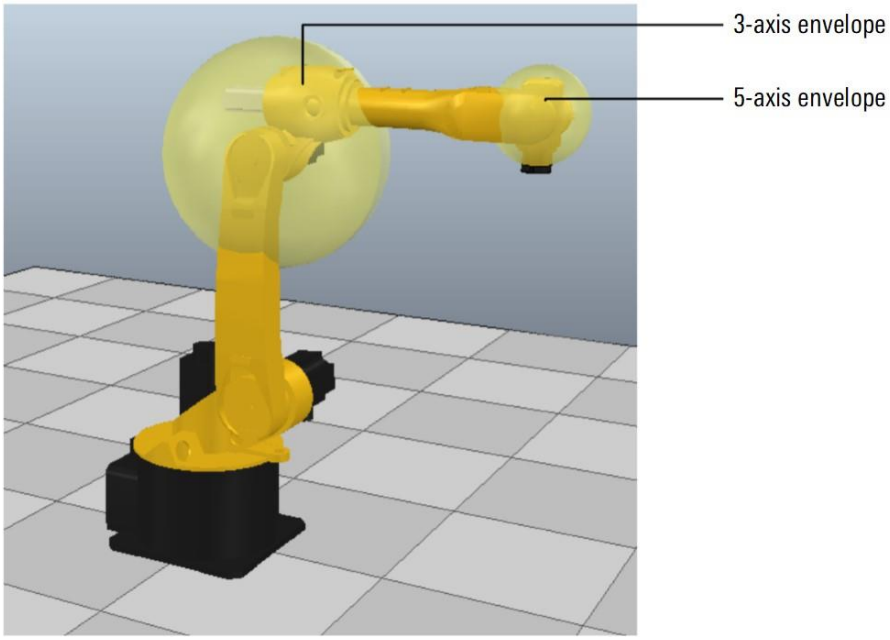


Figure 6-51 Envelope diagram of robot J3 and J5

For the radius of the J3 and J5 joint envelope balls in the model parameters of mechanical unit, please refer to Table 6-26.

Table 6-26 Information about J3 and J5 envelope balls for different body models

Body model	Radius of J3 envelope ball	Radius of J5 envelope ball
AIR4-560A	110mm	75mm
AIR8-710A	144mm	81mm

Body model	Radius of J3 envelope ball	Radius of J5 envelope ball
AIR6L-A	202mm	81mm
AIR7-920B	202mm	81mm
AIR10-1420A	268mm	105mm
AIR20-1700A	312mm	114mm
AIR50-2230A	335 mm	175 mm
AIR165-2750A	550 mm	248 mm
AIR6-1450A	144mm	81mm

Setting steps:

Step1.Click the row of any zone (Zone) in the [Zone Combination] box in Figure 6-46, and the [Zone Edit] interface shown in Figure 6-52 will pop up.

Step2.When checked before [Monitor Joint], it means that axis envelope is enabled; if it is not checked, it means that axis envelope is not disabled.

Prompt

The envelope radius of the 3 axis and 5 axis of different robot models are different. In the axis envelope, the information of the 3 and 5 axis of each model is set by default and does not need to be changed. The values in Table 6-26 are used without external equipment.

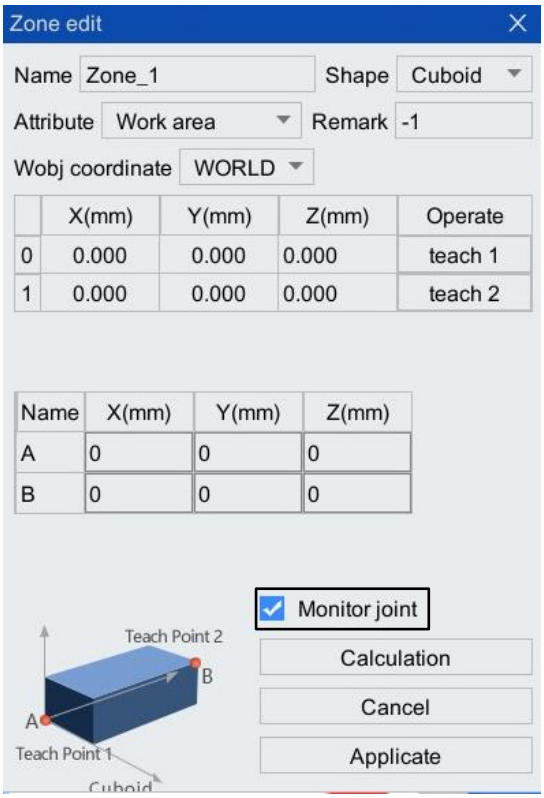


Figure 6-52[Monitor Joint] is checked

6.4.3 Set the safety zone

Click the line where any zone in "Zone Combination" is located to pop up "Zone Edit" interface shown in Figure 6-52, and you can configure the related parameters such as the name, shape, attribute, type, size and position of the Safety Zone.

6.4.3.1 Cuboid zone

The creation of the cuboid working zone is taken as an example to describe the setting method of "cuboid zone". In "zone editing" interface shown in Figure 6-53, select "Cuboid" as the shape, and select "Work area" as the attribute.

> Prompt
>
> The setting method of the cuboid "prohibited area" is the same as that of the cuboid "work area", and will not be described again.

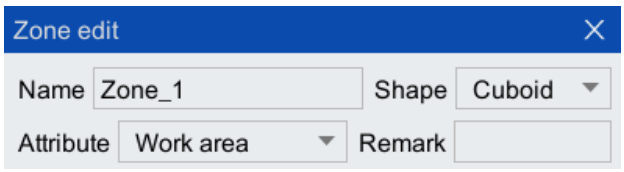


Figure 6-53 Setting interface of cuboid working zone

If you want to uniquely determine the working zone of the cuboid, you need to calculate the two points A and B on the diagonal of the cuboid, as shown in Figure 6-54. The A and B points can be determined through teaching method or manual input method.

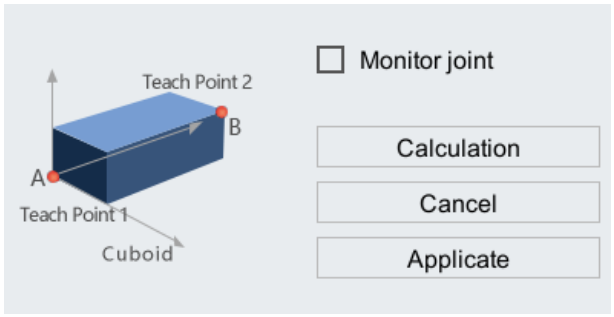


Figure 6-54 Contents of model of cuboid working zone

Teaching method

Operation steps:

Step1.Manually control the robot to move to the position point (X1, Y1, Z1), click "Teach 1" button shown in Figure 6-55, and record the (X1, Y1, Z1) points.

Step2.Manually control the robot to move to the position point (X2, Y2, Z2), click "Teach 2" button shown in Figure 6-55, and record the (X2, Y2, Z2) points.

	X(mm)	Y(mm)	Z(mm)	Operate
0	0.000	0.000	0.000	teach 1
1	0.000	0.000	0.000	teach 2

Figure 6-55 Teach the two points of diagonal A and B in the rectangular working area

Step3.After teaching "Point 1" and "Point 2", click <Calculate> button shown in Figure 6-54 to automatically calculate the coordinates of the points A and B on the diagonal of the cuboid, and click <Applicate> button to complete the zone setting.

Caution

- X, Y, Z are relative to the world coordinate system.
- When "*" symbol appears in the top right corner of the 0 and 1 numbers in the table, it indicates that the teaching of the point is completed. If you want to teach again or click the teaching again accidentally, a dialog box will pop up to ask if you want to teach again, and click <Yes> to get the current position again.
- The values of |X2-X1|, |Y2-Y1|, |Z2-Z1| respectively represent the length, width and height of the cuboid, which must be greater than 0, otherwise the calculated shape will not be a cuboid.

Manual input

Operation steps:

Step1.On the precondition of knowing the specific positions of the points A and B on the diagonal of the cuboid, the user can manually enter the coordinates of points A and B directly into the table in Figure 5-56.

Name	X(mm)	Y(mm)	Z(mm)
A	0	0	0
B	0	0	0

Figure 6-56 Manual input of points A and B on the diagonal of the cuboid working zone

Step2.Then click <Applicate> button shown in Figure 6-54 to write the calculated cuboid working zone into the database, and then the setting of the cuboid working zone will be completed. For the contents of the working conditions after setting, please refer to Figure 6-57.

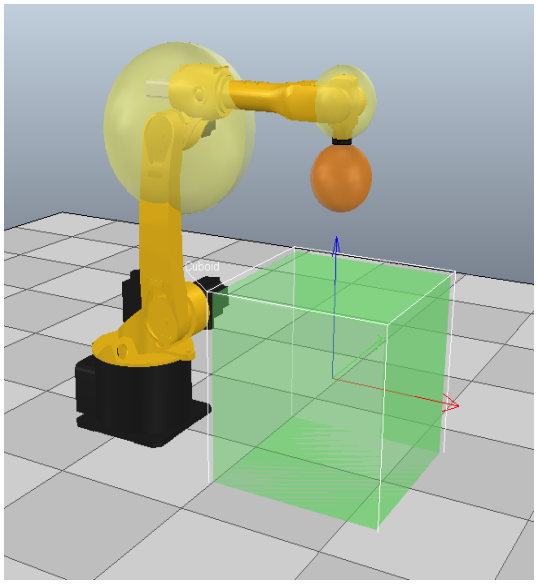


Figure 6-57 Contents of working condition of cuboid working zone

6.4.3.2 Cylinder zone

In the [Zone edit] interface as shown in Figure 6-58, select [Cylinder] for shape and [Work area] for attribute.

> Prompt
>
> The setting method of the cylinder "prohibited area" is the same as that of the cylinder "work area", so it will not be described again.

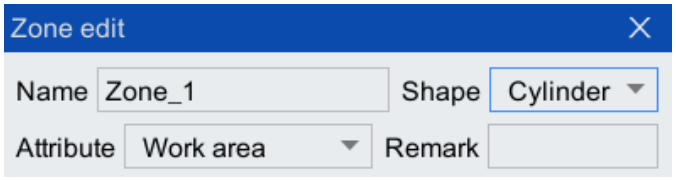


Figure 6-58 Cylinder working area setting interface

If you want to uniquely determine the working zone of the cylinder, you need to calculate the teach points 1, 2 on the bottom circle of the cylinder and the height (h) of the cylinder. As shown in Figure 6-59, the distance between the teach points 1, 2 is the diameter of the bottom circle (2r), and the center point of the teach points 1, 2 is the center of the bottom circle (c). The working zone of the cylinder can be determined through teaching method and manual input method.

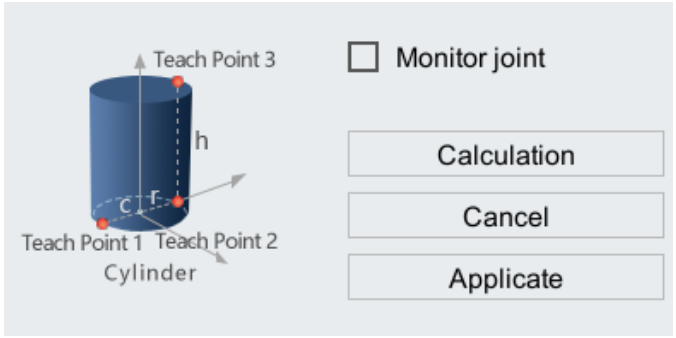


Figure 6-59 Contents of model of cylinder working zone

Teaching method

Operation steps:

Step1.Manually control the robot to move to the position point (X1, Y1, Z1), click "Teach 1" button shown in Figure 6-60, and record (X1, Y1, Z1) point as the teach point 1 on the bottom circle of the cylinder.

Step2.Manually control the robot to move to the position point (X2, Y2, Z2), click "Teach 2" button shown in Figure 6-60, and record (X2, Y2, Z2) point as the teach point 2 on the bottom circle of the cylinder.

Step3.Manually control the robot to move to the position point (X3, Y3, Z3), click "Teach 3" button shown in Figure 6-60, and record (X3, Y3, Z3) point as the teach point 3.

	X(mm)	Y(mm)	Z(mm)	Operate
0	0.00	0.00	0.00	teach 1
1	0.00	0.00	0.00	teach 2
2	0.00	0.00	0.00	teach 3

Figure 6-60 Teaching of three points in cylinder working zone

Step4.After the teaching of three points is completed, click <Calculate> button shown in Figure 6-59 to automatically calculate the coordinates of the bottom circle center (c), the radius of the bottom circle (r), and the height of the cylinder (h). Click <Applicate> button to complete the zone setting.

Caution

- X, Y, Z are relative to the world coordinate system.
- The deviation of Z component between point 1 and point 2 may not exceed 0.1, and the point 1 and point 2 are two points on any plane that parallels to the xoy plane.
- When "*" symbol appears in the top right corner of the numbers 0 and 1, 2 in the table, it indicates that the teaching of the point is completed, as shown in Figure 6-60.
- The |Z3-Z1|, |Z3-Z2| values must be greater than 0.

Manual input

Operation steps:

Step1.On the precondition of knowing the specific position of the center of bottom circle (c) of the cylinder, the radius of the bottom circle (r) and the height (h) of the cylinder, the user can manually enter the known data directly into the table in Figure 6-61.

Name	X(mm)	Y(mm)	Z(mm)
c	0	0	0
r	0		
h	0		

Figure 6-61 Setting of cylinder working zone through manual input method

Step2.After obtaining the center of bottom circle, the radius of bottom circle and the height of the cylinder, you need to click <Applicate> button to write the calculated Safety Zone of the cylinder into the database, and then the setting of the Safety Zone of the cylinder will be completed. The contents of working condition after setting is shown in Figure 6-62.

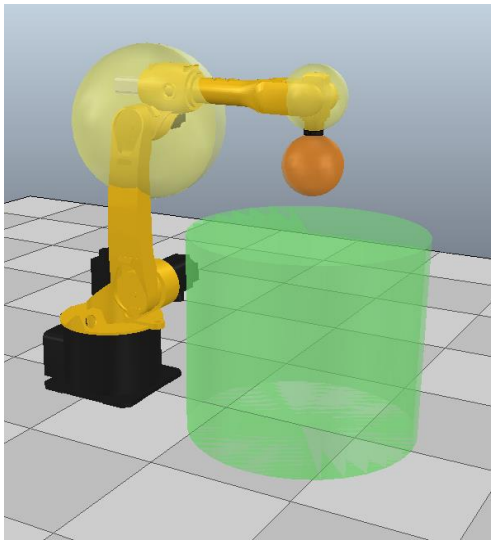


Figure 6-62 Contents of working condition in cylinder working zone

6.4.3.3 Ball zone

In the [Zone Edit] interface as shown in Figure 6-63, select [Sphere] for shape and [Work Area] for properties.

> Prompt
>
> The setting method of the "prohibited area" of the sphere is the same as the "work area" of the sphere, and will not be described again.

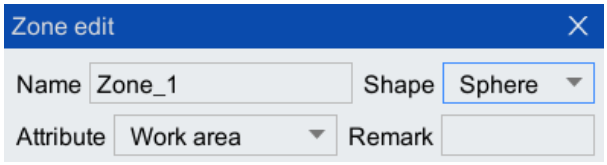


Figure 6-63 Setting interface of ball working zone

If you want to uniquely determine the working zone of the ball, you need to calculate the teach points 1, 2 on the ball. As shown in Figure 6-64, the distance between the two points is the diameter of ball (2r), and the center point between the two points is the center of ball (c). The working zone of the ball can be also determined through teaching method and manual input method.

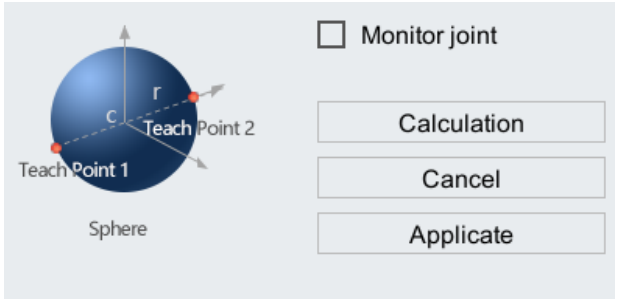


Figure 6-64 Contents of model of ball working zone

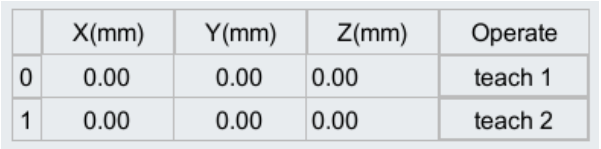
Teaching method

Specific process:

Step1.Manually control the robot to move to the position point (X1, Y1, Z1), click "Teach 1" button shown in Figure6-65, and record (X1, Y1, Z1) point as the teach point 1 on the ball.

Step2.Manually control the robot to move to the position point (X2, Y2, Z2), click "Teach 2" button shown inFigure6-65, and record (X2, Y2, Z2) point as the teach point 2 on the ball.

Step3.After the teaching of "Point 1" and "Point 2", click <Calculate> button shown in Figure 6-64 to automatically calculate the center of ball and the radius of ball. Click <Applicate> button to complete the zone setting.



	X(mm)	Y(mm)	Z(mm)	Operate
0	0.00	0.00	0.00	teach 1
1	0.00	0.00	0.00	teach 2

Figure6-65 Teaching of two point in ball working zone

Manual input method

Specific process:

Step1.On the precondition of knowing the specific position of the center of the ball and the radius of ball, the user can manually enter the known data directly into the table in Figure 6-66.

Name	X(mm)	Y(mm)	Z(mm)
c	0	0	0
r	0		

Figure 6-66 Setting of ball Safety Zone through manual input method

Step2.After obtaining the center of ball and the radius of ball, you need to click <Applicate> button to write the calculated ball Safety Zone into the database, and then the setting of the ball Safety Zone will be completed. The contents of working condition after setting are shown in Figure 6-67.

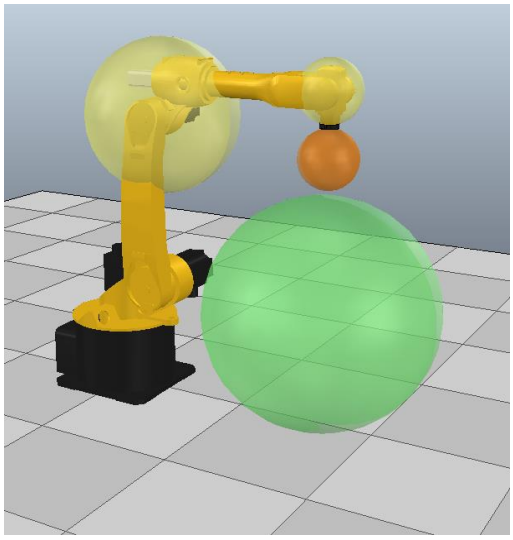


Figure 6-67 Contents of working condition in cylinder Safety Zone

6.4.4 Use of Safety Zone

As shown in Figure 6-68, the Safety Zone function can define 40 different monitoring zones, and control the movement and stopping of the robot by monitoring the position relationship between the envelope boundary and the monitoring zone in real time.

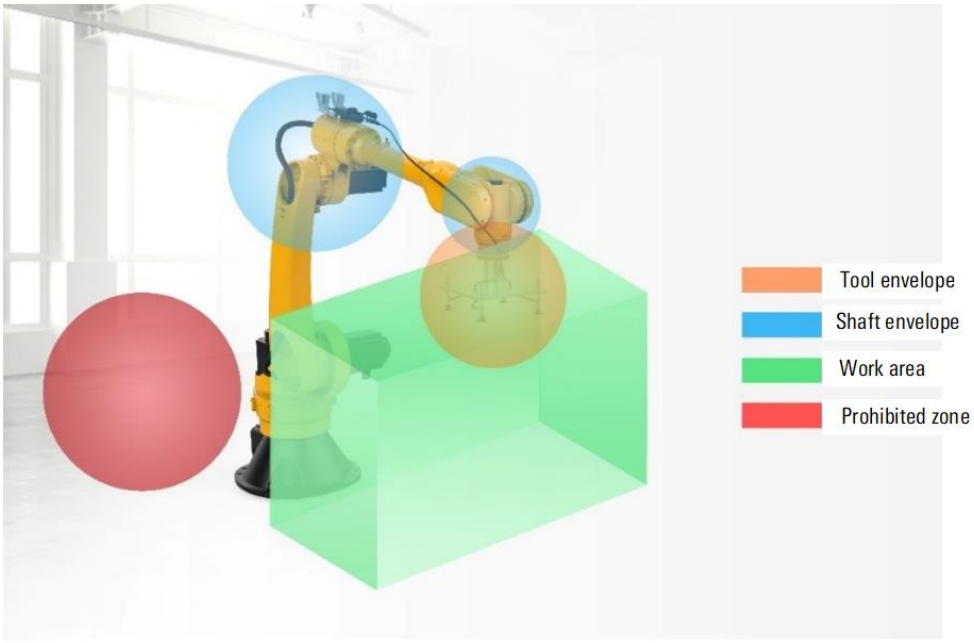


Figure 6-68 Contents of relationship between different zones when the robot is working

Click any line in "Safety Zone> Zone Combination" to pop up "Zone Edit" interface shown in Figure 6-69, and you can set the Safety Zone. For description about settings, please refer to Table 6-27. After setting, you can enable the Safety Zone by checking the corresponding box.

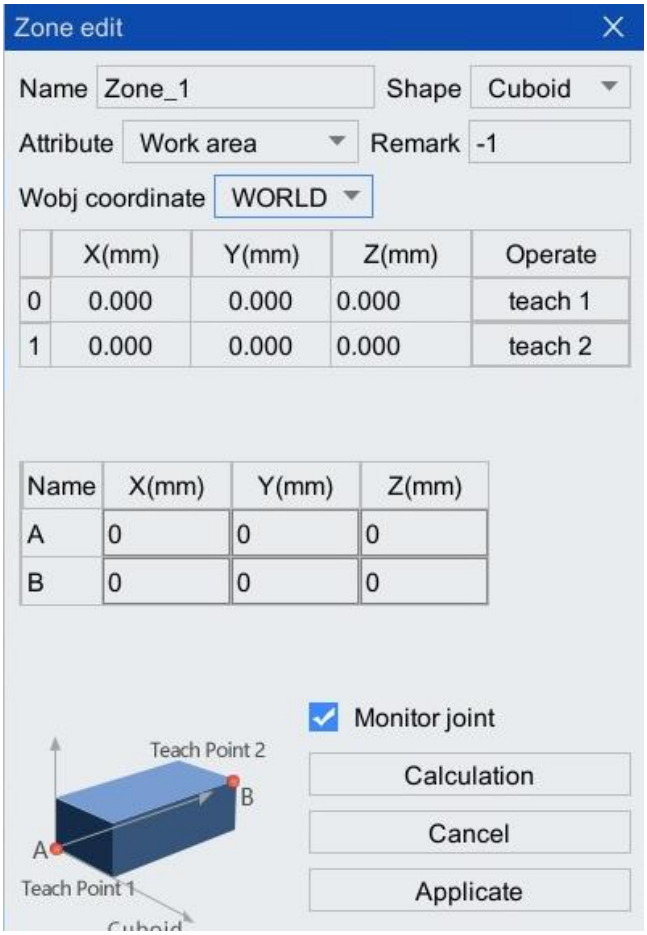


Figure 6-69 diting interface of Safety Zone

Table 6-27 Description about contents in Safety Zone

Contents	Meaning
Name	The default names are Zone_1, Zone_2, Zone_3 ..., and the user can also customize them.
Shape	The shapes are divided into three types: cuboid, cylinder and ball. The user can select it according to the needs.
Attribute	The attributes are divided into two types: working zone and prohibited zone. The user can select it according to the needs.
Remark	The user can add remarks for each Safety Zone according to the needs, supporting the remarks in Chinese and English.

6.4.4.1 Use of working zone

After "Work area" is enabled, the system will immediately monitor whether the envelope boundary of the robot is out of the working zone:

- If the manual JOG or running program controls the envelope boundary of the robot to be out of the working zone, the system will immediately send a warning, prompting that the corresponding envelope boundary is out of the working zone.
- If the manual JOG or running program controls the envelope of the robot to enter the working zone, the system will not send a warning.

If neither the tool envelope nor the axis envelope is enabled, the robot will not send a warning when it is out of the working zone.

6.4.4.2 Example of use of working zone

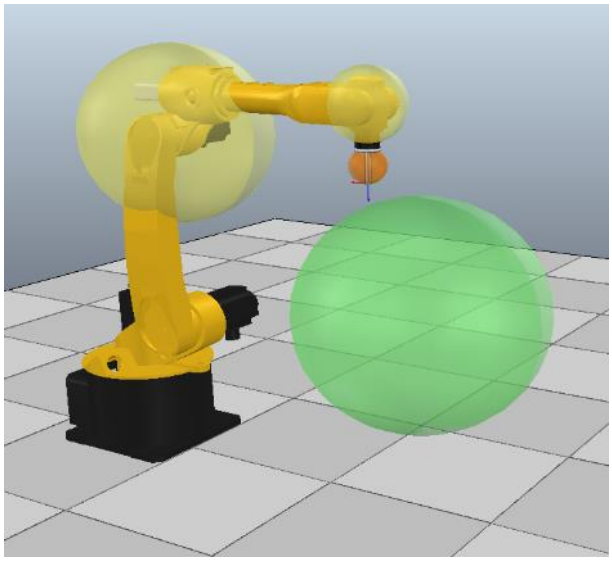


Figure 6-70 Contents of model used in example of use of working zone

Before the situation shown in Figure 6-70 is used for demonstration of use in the working zone (ball), you must complete "Tool Envelope" and "Safety Zone" settings.

Specific process:

Step1.Setting of tool envelope. Set a tool envelope ball named "sphere0" to the tool. The radius of the tool envelope ball is 50mm. For details about center of envelope ball, please refer to Figure 6-71.

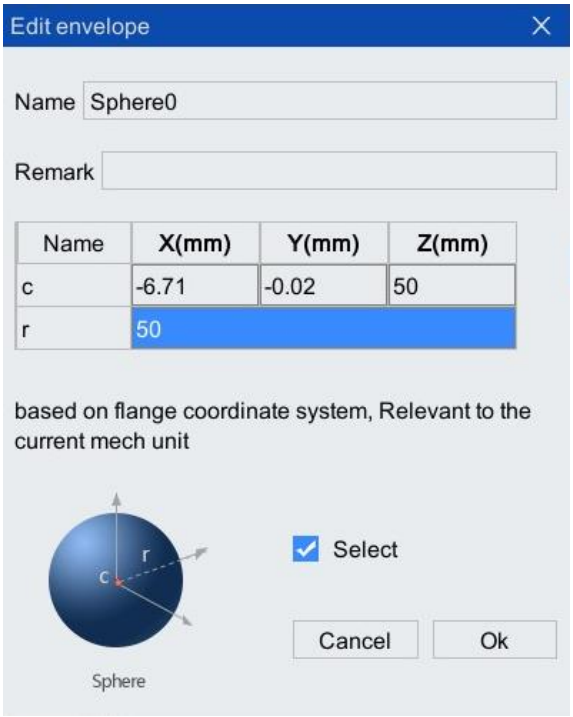


Figure 6-71 Editing interface of tool envelope ball "sphere0"

Step2.Setting of work zone. Set a shape named "Sphere" as the working zone of the ball, the coordinate value of the ball center is (700,450,400), and the radius of the ball is 400mm, as shown in Figure 6-72.

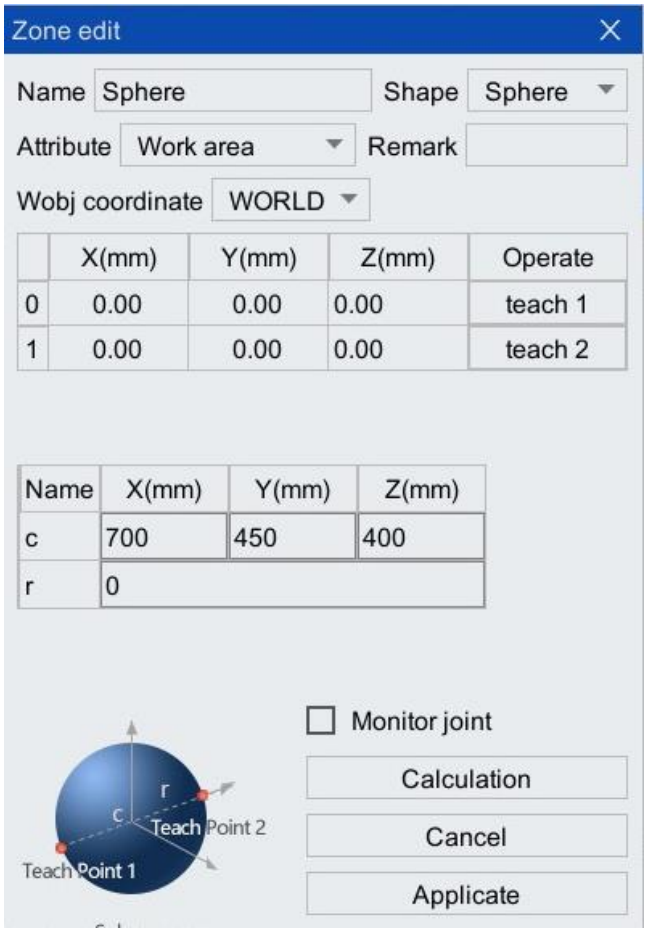


Figure 6-72 Editing interface of working zone "Sphere"

Step3.When both "Tool Envelope" and "Axis Envelope" are enabled, it can be seen from Figure 6-73 that the robot's J5 "Axis Envelope" and "Tool Envelope" are all in the working zone "Sphere" status.

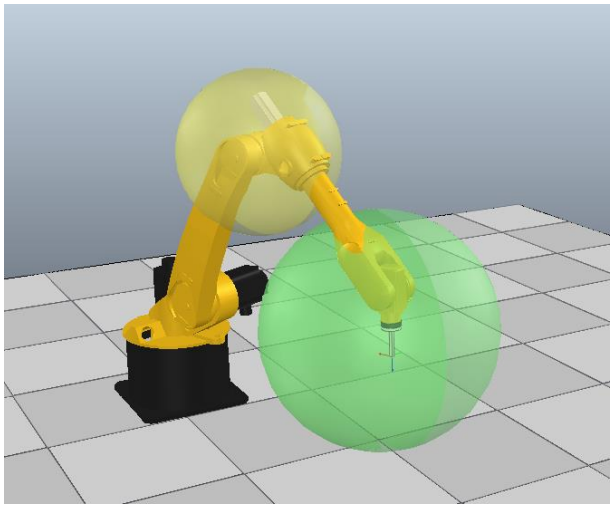


Figure 6-73 Robot' s J5 "Axis Envelope" and "Tool Envelope" inside working zone

Step4.The robot is controlled to move outside the working zone (see Figure 6-74). When the J5 "Axis Envelope" boundary is detected to be out of the working zone, the warning message shown in Figure 6-76 will appear.

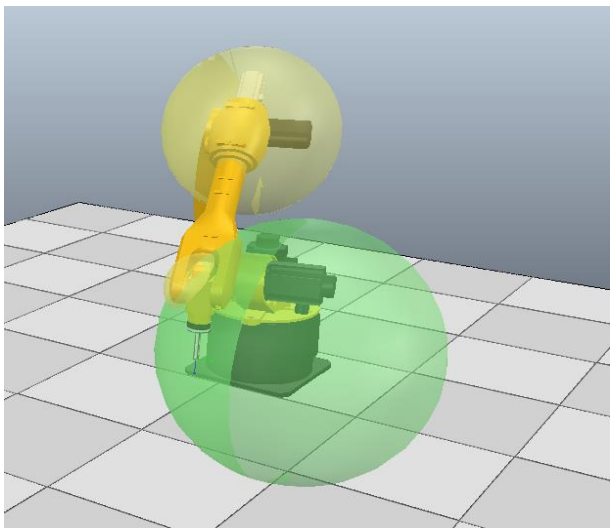


Figure 6-74 Robot’s J5 "Axis Envelope" outside working zone

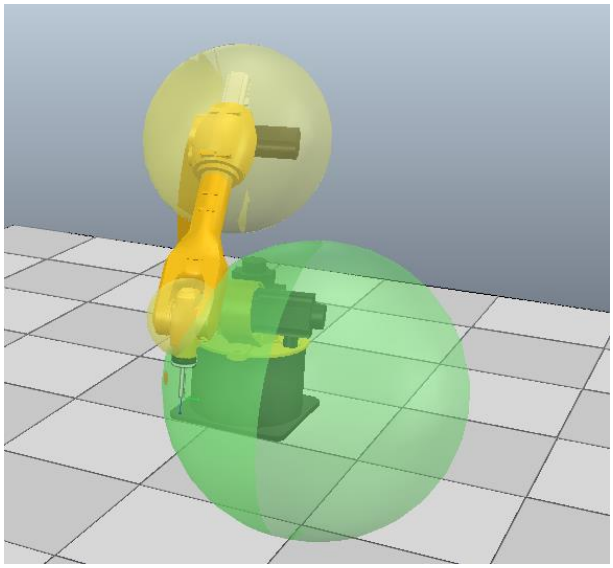


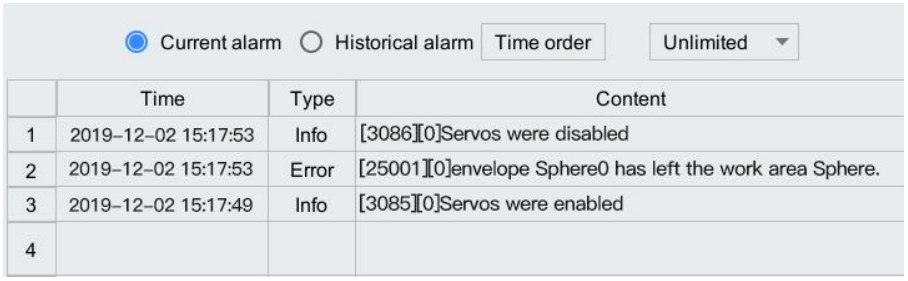
Figure 6-75 Robot’s "Tool Envelope" outside working zone

Current alarm Historical alarm Time order Unlimited

	Time	Type	Content
1	2019-12-02 15:17:42	Info	[3086][0]Servos were disabled
2	2019-12-02 15:17:42	Error	[25001][0]envelope JONT_ENVELOP5 has left the work area Sphere.
3	2019-12-02 15:17:40	Info	[3085][0]Servos were enabled
4			
5			
6			

Figure 6-76 Warning message of "Axis Envelope" outside working zone

Step5.After clearing the warning message, power on and continue to control the robot to move outside the working zone (see Figure 6-75). When "Tool Envelope" boundary is detected to start out of the working zone, the warning message shown in Figure 6-77 will appear.



	Time	Type	Content
1	2019-12-02 15:17:53	Info	[3086][0]Servos were disabled
2	2019-12-02 15:17:53	Error	[25001][0]envelope Sphere0 has left the work area Sphere.
3	2019-12-02 15:17:49	Info	[3085][0]Servos were enabled
4			

Figure 6-77 Warning message of "Tool Envelope" outside working zone

After the alarm occurs, clear the error message, continue to JOG the robot to leave the safe area, the robot can move normally and leave the safe area.

6.4.4.3 Use of prohibited zone

After enabling "Forbidden Area":

- The system immediately monitors whether the robot envelope boundary attempts to enter the prohibited area.
- Around the forbidden area, the system automatically calculates a maximum stop zone that extends outside the forbidden area according to the current robot running speed, that is, the stop buffer. The stop buffer does not need to be set by the user.
- If the robot tries to enter the prohibited area by manual JOG or running program, the system will intercept the "tool envelope" and "axis envelope" in the stop buffer area, that is, when the system detects that the robot envelope enters the stop buffer area. Will give an alert immediately, it prompts that an envelope enters the stop buffer, and executes STOP0 (refer to Table 6-28) to stop. The alarm can be cleared.

Table 6-28 Stop method and description

Type	Description	
STOP0	Case1	When the CCB sends a warning "stop0 indicate", the DCB will stop immediately and will not maintain the trajectory. Then the CCB delay control enables the power to be cut off through the thyristor, which is an uncontrollable stop.
	Case2	The DCB has an uncontrollable fault and a free stop or brake stop is triggered, which is an uncontrollable stop.
	Case3	In case of sudden external power failure, the DCB fails to implement immediate stop, and the brake stop is triggered, which is an uncontrollable stop.
STOP1	Stop the robot quickly and maintain the current planned path. When the robot stops, control the drive servo_off and cut off the power supply, which is a controlled stop.	
STOP2	Stop the robot quickly and maintain the current planned path. When the robot stops, do not serve_off and do not cut off the power supply, which is a controlled stop.	

When the envelope of the robot is in the stop buffer or forbidden area, if you want to move the robot out of the stop buffer or forbidden area:

- The alarm can be cleared, and the manual low-speed JOG mobile robot leaves the stop buffer or prohibited area. When leaving the prohibited area, the message bar will prompt the envelope to leave the prohibited area;
- You can also cancel the forbidden area, and then manually JOG control the robot to leave the stop buffer or the forbidden area.

Caution

- When the prohibited zone is enabled and the robot is in the stop buffer or prohibited zone, it is not allowed to move the robot in T2 or AUT mode through manual JOG or running the program; in T1 mode, it is not allowed to move the robot through running the program, and it is only allowed to move the robot through manual JOG.
- If neither "Tool Envelope" nor "Axis Envelope" is enabled, the robot will enter the stop buffer and the prohibited zone without warning.

6.4.4.4 Example of use of prohibited zone

Before the situation shown in Figure 6-78 is used for demonstration of use in the prohibited zone, you must complete "Tool Envelope" and "Safety Zone" settings.

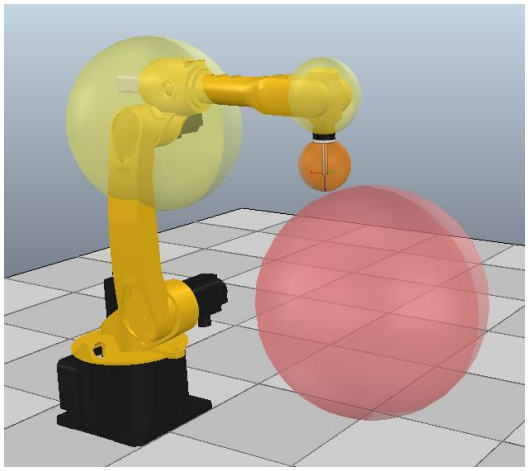


Figure 6-78 Contents of model used in example of use of prohibited zone

Setting process:

Step1.Setting of tool envelope. First, set a tool envelope ball named "sphere0" to the tool. The radius of the tool envelope ball is 75mm. For details about center of envelope ball, please refer to Figure 6-79.

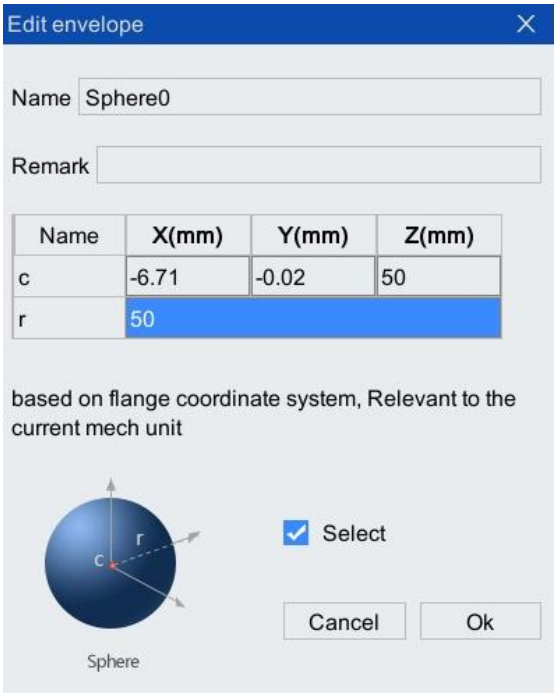


Figure 6-79 Editing interface of tool envelope ball "sphere0"

Step2.After setting of the prohibited zone, set a shape named "Sphere" as the prohibited zone of the ball, the coordinate value of the ball center is (700,450,400), and the radius of the ball is 400mm, as shown in Figure 6-80.

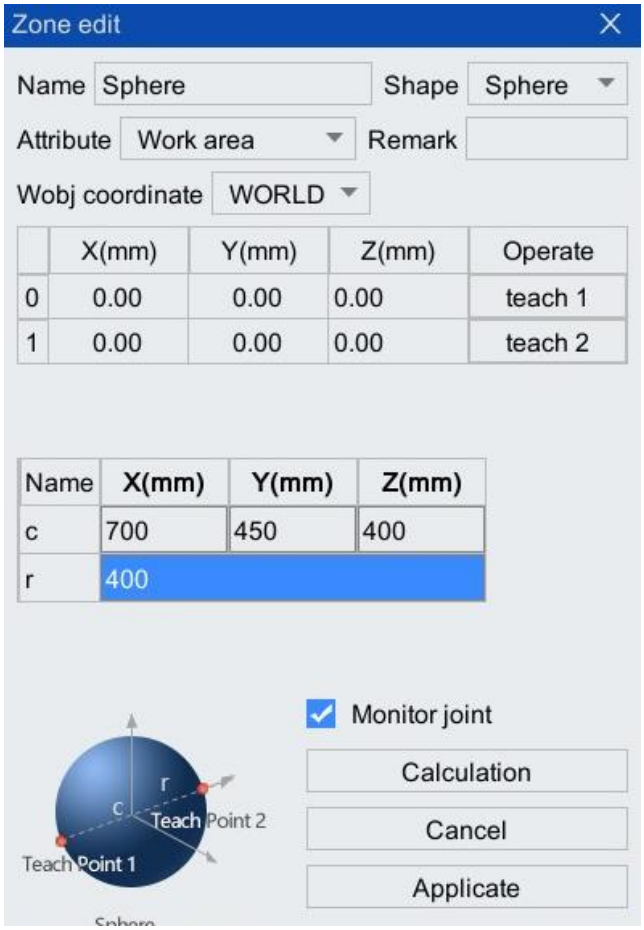


Figure 6-80 Editing interface of prohibited zone "Sphere"

Step3.When both "Tool Envelope" and "Axis Envelope" are enabled, it can be seen from Figure 6-81 that the robot's "Axis Envelope" and "Tool Envelope" boundaries are within an interval without warning outside the prohibited zone "Sphere".

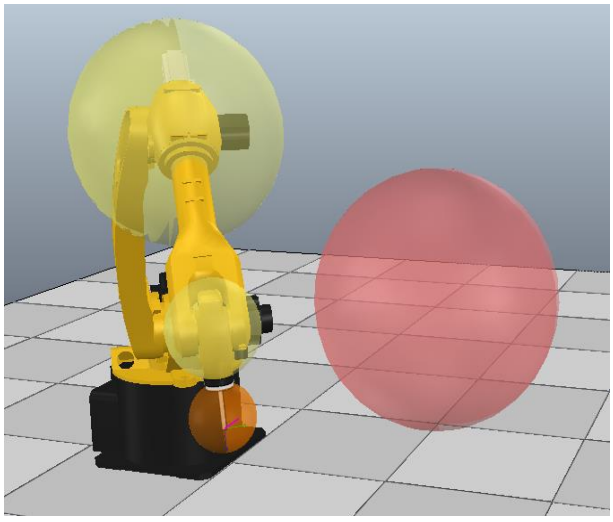


Figure 6-81 Robot's "Axis Envelope" and "Tool Envelope" boundaries are outside the prohibited zone

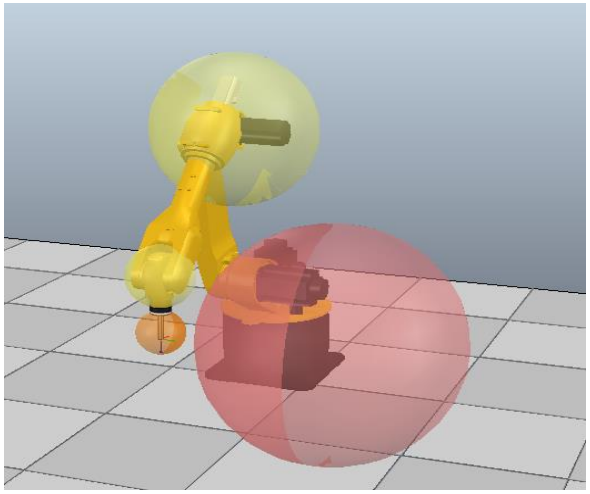


Figure 6-82 Robot's J5 "Axis Envelope" enters the stop buffer

Step4.When the robot is controlled to approach the prohibited zone "Sphere", the system will detect that the robot's J5 "Axis Envelope" boundary starts to enter the stop buffer and send a warning. For details about the warning message, please refer to Figure 6-84.

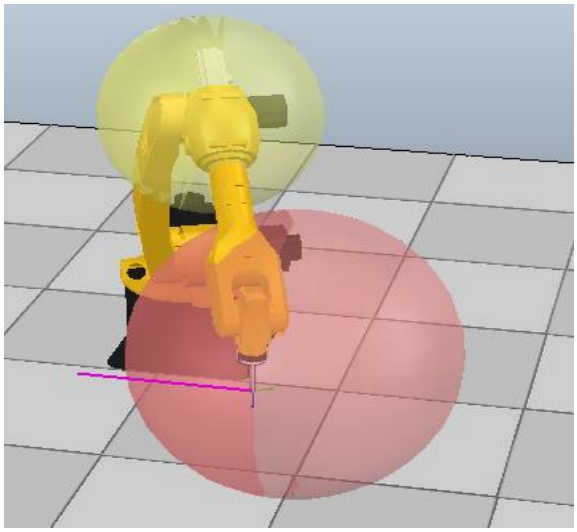


Figure 6-83 When the robot is in the stop buffer or prohibited zone

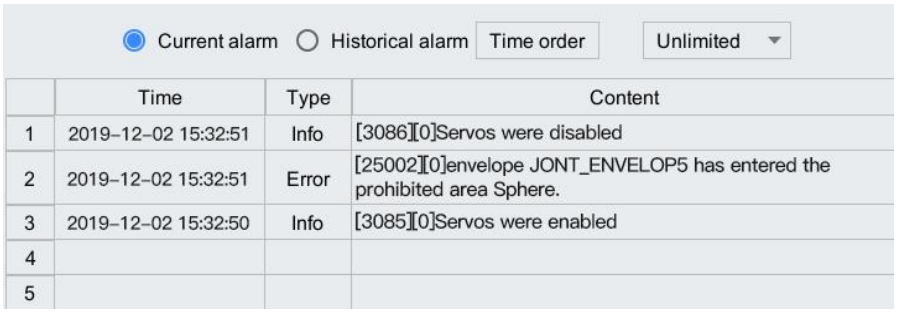
Current alarm Historical alarm Time order Unlimited

	Time	Type	Content
1	2019-12-02 15:29:06	Info	[3086][0]Servos were disabled
2	2019-12-02 15:29:06	Error	[25004][0]envelope JONT_ENVELOP5 has entered the stop area of prohibited area Sphere.
3	2019-12-02 15:29:03	Info	[3085][0]Servos were enabled
4	2019-12-02 15:28:57	Info	[3086][0]Servos were disabled
5	2019-12-02 15:28:57	Info	[3085][0]Servos were enabled
6			

Figure 6-84 Warning message of "Axis Envelope" entering the stop buffer

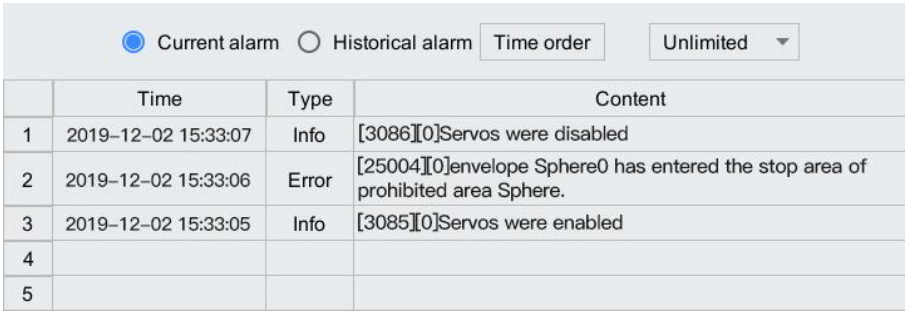
Step5.After clearing the warning message in Figure 6-84, power on and continue to control the robot to move outside the prohibited zone (see Figure 6-83). When the J5 "Axis Envelope" boundary is detected to already enter the prohibited zone, the warning message shown in Figure 6-85 will appear. After clearing the warning message,

power on and continue to move the robot, and "Tool Envelope" boundary will be detected to start to enter the stop buffer. Then a warning will be sent, as shown in Figure 6-86.



	Time	Type	Content
1	2019-12-02 15:32:51	Info	[3086][0]Servos were disabled
2	2019-12-02 15:32:51	Error	[25002][0]envelope JONT_ENVELOP5 has entered the prohibited area Sphere.
3	2019-12-02 15:32:50	Info	[3085][0]Servos were enabled
4			
5			

Figure 6-85 Warning message of "Axis Envelope" entering the prohibited zone



	Time	Type	Content
1	2019-12-02 15:33:07	Info	[3086][0]Servos were disabled
2	2019-12-02 15:33:06	Error	[25004][0]envelope Sphere0 has entered the stop area of prohibited area Sphere.
3	2019-12-02 15:33:05	Info	[3085][0]Servos were enabled
4			
5			

Figure 6-86 Warning message of "Tool Envelope" entering the stop buffer of the prohibited zone Sphere

Step6.When the robot is already in the stop buffer or prohibited zone (see Figure 6-83), if you want to move the robot out of the zone, you should keep in mind: when the enable of the prohibited zone is not canceled, it is not allowed to move the robot through running the program in T1 mode, otherwise the system will send a warning; it is only allowed to move the robot through manual JOG. In T2 and AUT modes, it is not allowed to move the robot in any way, otherwise the system will send a warning; when the enable of the prohibited zone is canceled, it is allowed to move the robot out of the zone through manual JOG and running the program.

6.4.4.5 Use of signal sharing areas

Support setting signal sharing area, this area is the common working area of two or more robots, this area can only be occupied by one robot at the same time. When this area is occupied by a robot, the shared area is equivalent to a working area for the robot; for other robots, it is equivalent to a forbidden area to trigger STOP2 shutdown, and no alarm will be triggered. When the robot in the shared area leaves, it can continue to run. Whether to run automatically is determined by parameters or programs. Robots entering or leaving the shared area will not be alerted.

DI status:

Low level:

- When approaching the signal sharing area: the robot decelerates and stops to the area boundary, and enters the stop hold state.
- When in the signal sharing area: decelerate to stop and enter the stop hold state.

High level:

- The stop hold state is released and the robot continues to move.

DO status:

- When the robot is in the signal sharing area, it outputs a low level.
- When the robot is outside the signal sharing area, it outputs a high level.

6.4.4.6 Signal sharing area usage example

The following takes two robots as an example to describe the configuration.

The configuration steps are as follows:

Step1.Set the tool envelope on the teach pendant of robot 1. First, set a tool envelope sphere named "Sphere0" for the tool, the radius of the tool envelope sphere is 75mm, and the center information of the envelope sphere is shown in Figure 6-87.

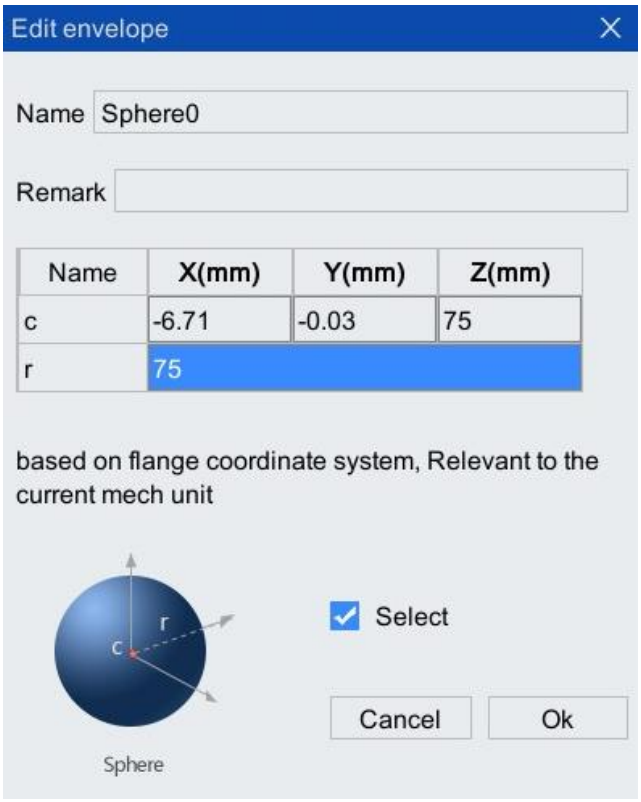


Figure 6-87 The editing interface of the tool envelope sphere "sphere0"

Step2.Signal sharing area setting. Set a signal sharing area named "Sphere" with the shape of a sphere, the coordinates of the center of the sphere are (700, 450, 400), the radius of the sphere is 400, the DI number is 1, and the DO number is 2. Please refer to Figure 6-88.

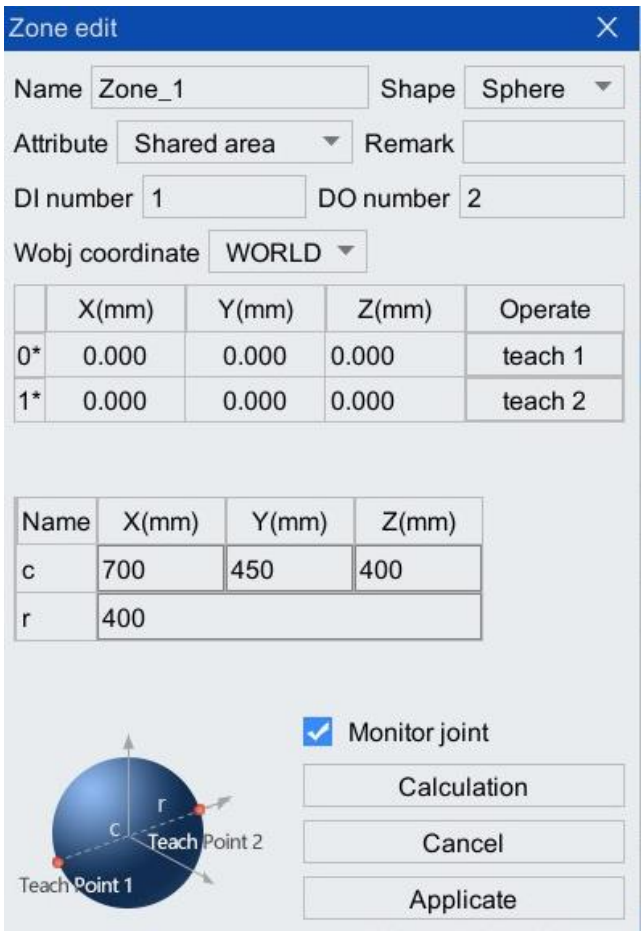


Figure 6-88 Signal sharing area editing interface

Step3.Click <Apply> after the configuration is complete.

Step4.Connect the DI1 of the robot 1 to the DO1 of the robot 2, and connect the DO2 of the robot 1 to the DI2 of the robot 2.

6.5 Custom Panel

6.5.1 Custom panel setting screen

On the main interface of the teach pendant, click "Monitor > Custom Panel" option to enter the "Custom Panel" interface shown in Figure 6-89. The user-defined panel is an operation panel that can be configured with indicator lights to display signal status, ON/OFF buttons to execute signals, etc. For the types of buttons that make up the screen, please refer to Figure 6-90.

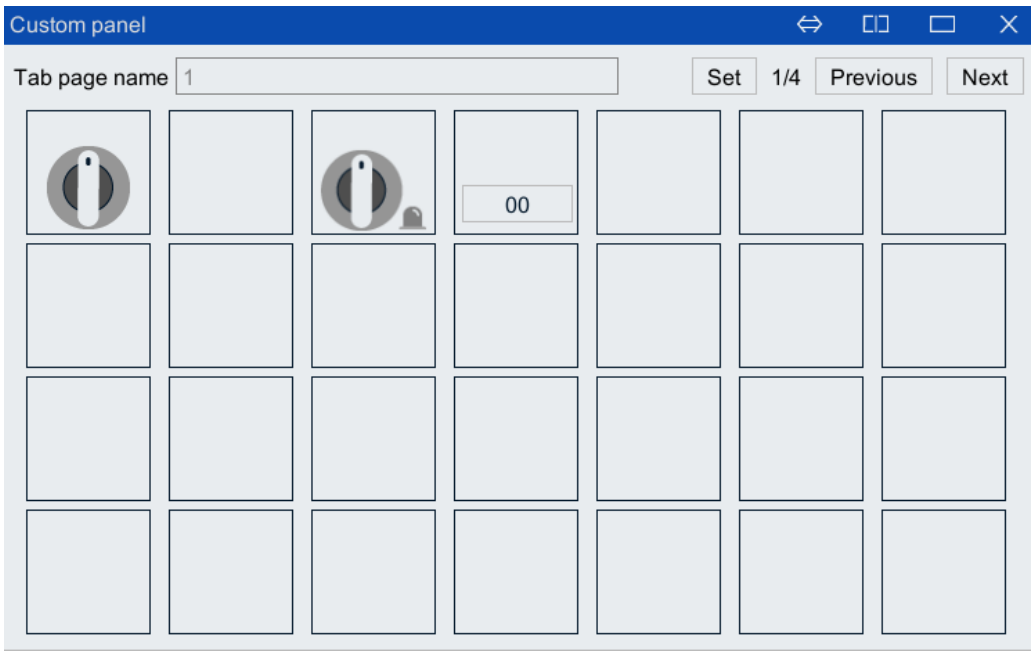


Figure 6-89 Custom panel setting screen

6.5.2 Switch/lamp type setting screen

Figure 6-90 is the screen for determining the switch/lamp type. Displayed when the <Settings> button is pressed on the custom panel screen.

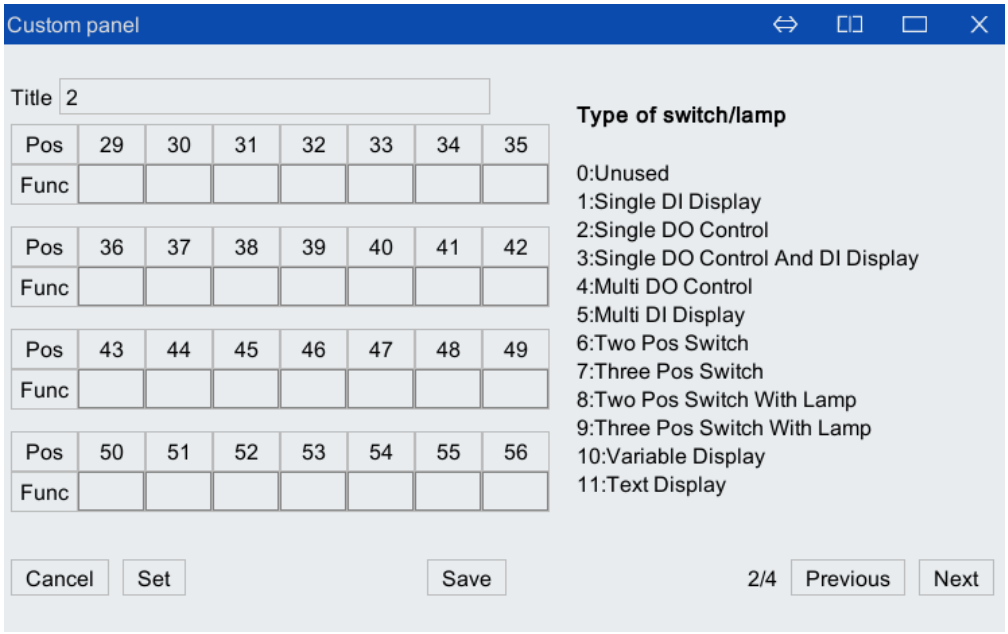
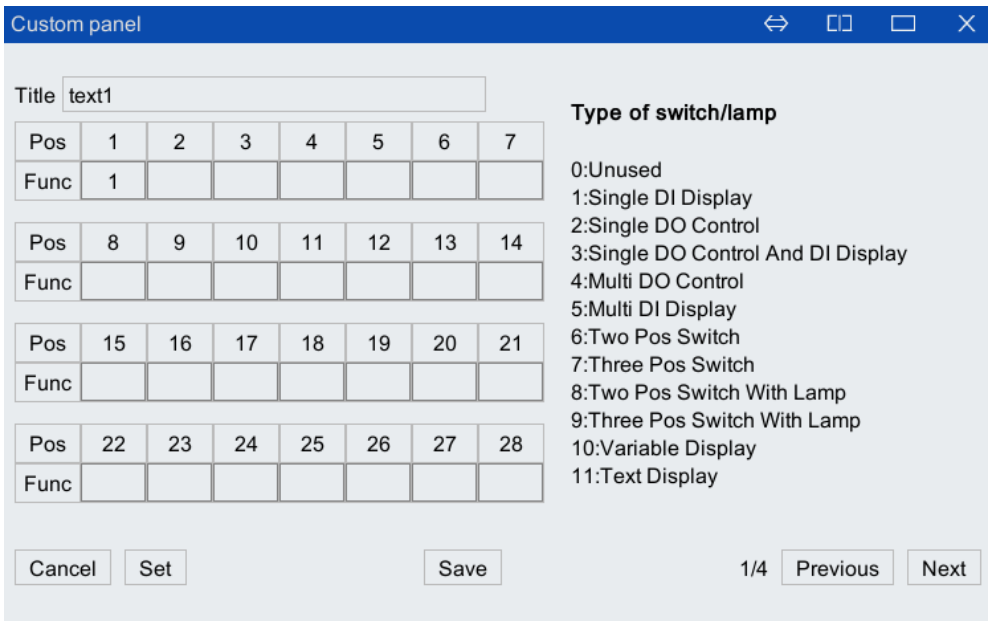


Figure 6-90 Switch/lamp type setting screen

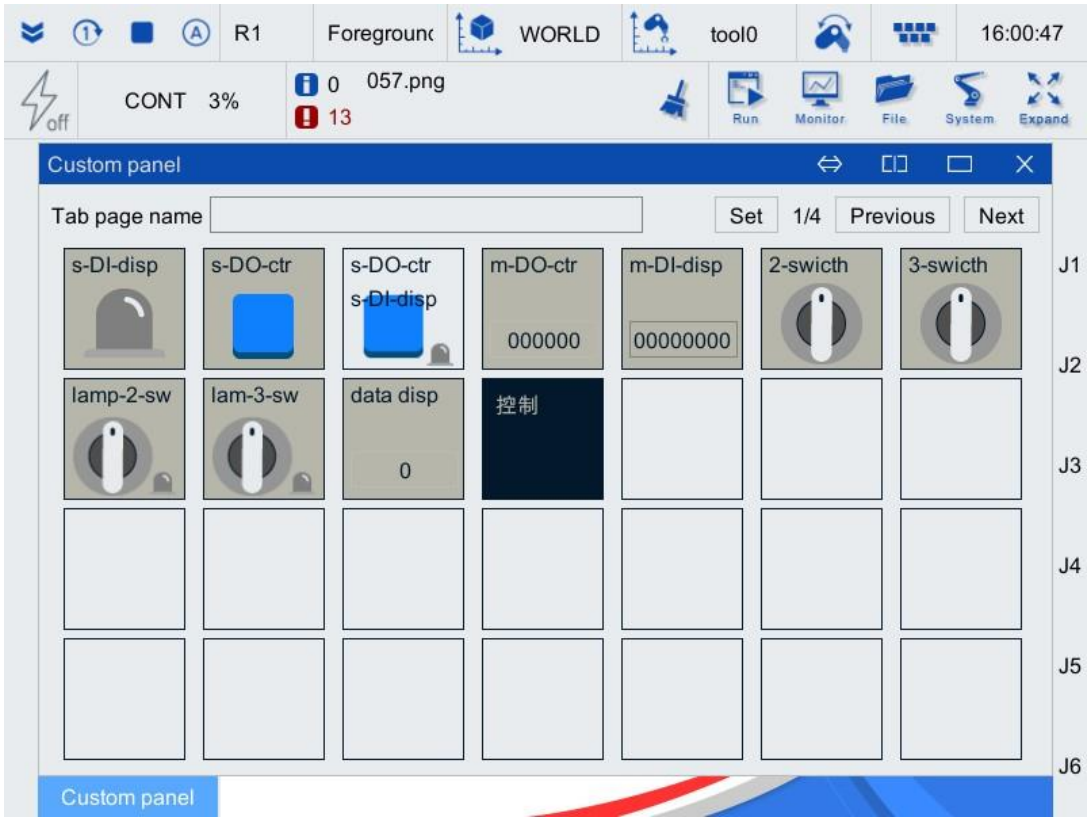
Screen title

In the "Screen Title" in Figure 6-90, you can set the "Label Page Name" that defines each panel screen.

For example, enter "text1" in the input box behind "Screen Title" and click the <Save> button at the bottom of the interface to jump to its corresponding custom setting screen. "Label Page Name" is displayed as "text1", refer to Figure 6-91.



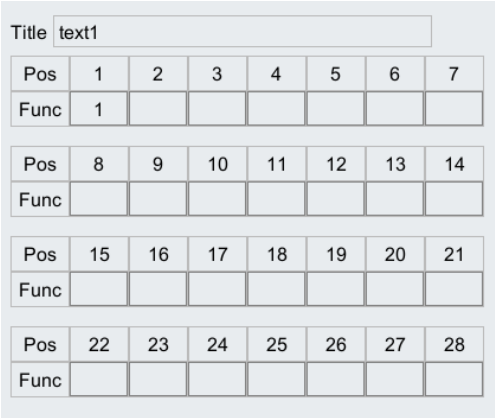
(a) Screen title



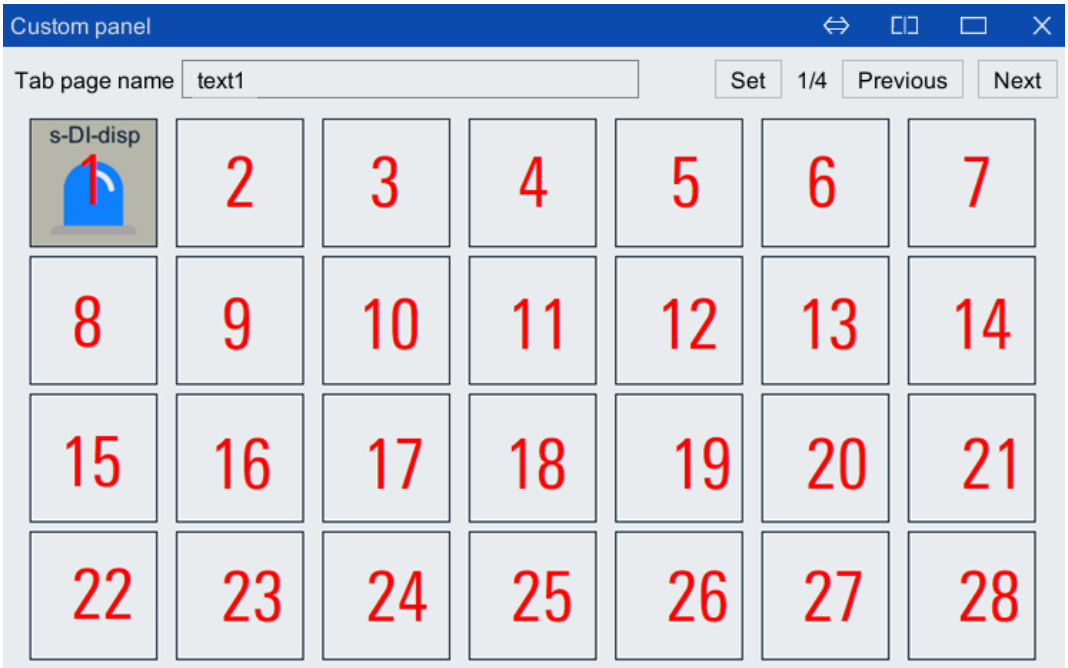
(b) Tab name
Figure 6-91 Setting and display of screen title

Position number

The "position number" in the switch/indicator type setting screen corresponds to the monitoring position in the custom panel. Please refer to Figure 6-92. Each page has 28 numbers, totaling 112.



(a) "Position number" in the switch/lamp type setting screen



(b) Custom panel monitoring position number
Figure 6-92 Position number correspondence

Function display bar

Below the position number is used to fill in the serial number of the selected switch/indicator, please refer to Figure 6-93.

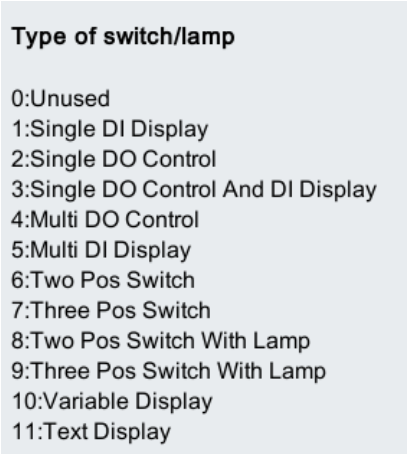


Figure 6-93 Position number correspondence

6.5.3 Switch setting method

This section explains the switch functions and setting methods provided by the controller.

6.5.3.1 Single DI display

After inputting "25" in the desired switch position, click the <Set> button to enter the "Single DI Display" interface as shown in Figure 6-94. For the setting instructions in the interface, see Table 6-29.

Figure 6-94 "Single DI display" Setting interface

Table 6-29 Setting instructions in "Single DI display" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the label name is set to s-DI-disp
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set

Name	Description
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of "Single DI Display" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
Corresponding DI port number	In this example, the corresponding DI port number is set to 1
Style "ON"	After the previous settings are completed, in the custom panel, when DI port number 1 turns ON, the indicator light turns green, as shown in Figure 6-95 Figure 6-95 Customized panel display when DI port number 1 turns ON
Style "OFF"	After the previous settings are completed, in the custom panel, when DI port number 1 turns OFF, the indicator light turns grey, as shown in Figure 6-96 Figure 6-96 Customized panel display when DI port number 1 turns OFF
Exclamation point (!)	Check this option under the style "On/Off", the indicator will display an exclamation mark when DI port number 1 turns ON/OFF. Take DI port number 1 as an example, as shown in Figure 6-97 Figure 6-97 When DI port number 1 turns OFF (check the exclamation mark) custom panel is displayed

6.5.3.2 Single DO control

After inputting "25" in the desired switch position, click the <Set> button to enter the "Single DO control" interface as shown in Figure 6-98. For the setting instructions in the interface, see Table 6-30.

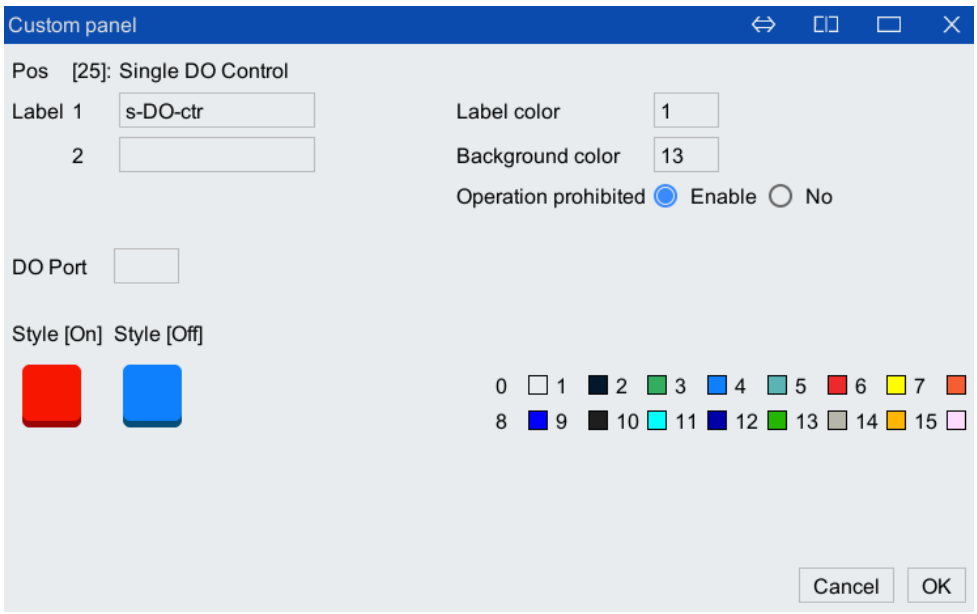


Figure 6-98 "Single DO control"setting interface

Table 6-30 Setting instructions in "Single DO control" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the tag name is set to s-DO-ctr
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of "Single DO control" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
Corresponding DO port number	In this example, the corresponding DO port number is set to 2
Style "ON"	After the previous settings are completed, in the custom panel, the switch turns red and the DO port number 2 turns ON, as shown in Figure 6-99 Figure 6-99 Customized panel display when DO port number 2 turns ON
Style "OFF"	After the previous settings are completed, in the custom panel, the switch turns blue and the DO port number 2 turns OFF, as shown in Figure 6-100 Figure 6-100 Customized panel display when DO port number 2 turns OFF
Allow operation	Set "Allow Operation" to "No", no operation, only the current status of DO is displayed

6.5.3.3 Single DO control and DI display

After inputting "25" in the required switch position, click the <Set> button to enter the "Single DO control and DI display" interface as shown in Figure 6-101. For the setting instructions in the interface, see Table 6-31.

Figure 6-101 "Single DO control and DI display" Setting interface

Table 6-31 Setting instructions in "Single DO control and DI display" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the tag name is set to s-DO-ctr
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, the label name is set to s-DI-disp
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Corresponding DO port number	In this example, the corresponding DO port number is set to 3
Corresponding DI port number	In this example, the corresponding DI port number is set to 4
Style "on"	After the previous settings are completed, in the custom panel, when the DO port number 4 turns ON, the switch turns red, as shown in Figure 6-102 Figure 6-102 Customized panel display when DO port number 2 turns ON
Style "OFF"	After the previous settings are completed, in the custom panel, when the DO port number 4 turns OFF, the switch turns blue, as shown in Figure 6-103

Name	Description
	 Figure 6-103 Customized panel display when DO port number 2 turns OFF
Allow operation	Setting "Allow Operation" to "No" will make the switch on the custom panel inoperable

6.5.3.4 Multi DO control

After inputting "1" in the desired switch position, click the <Set> button to enter the "Multi DO control" interface as shown in Figure 6-104. For the setting instructions in the interface, see Table 6-32.

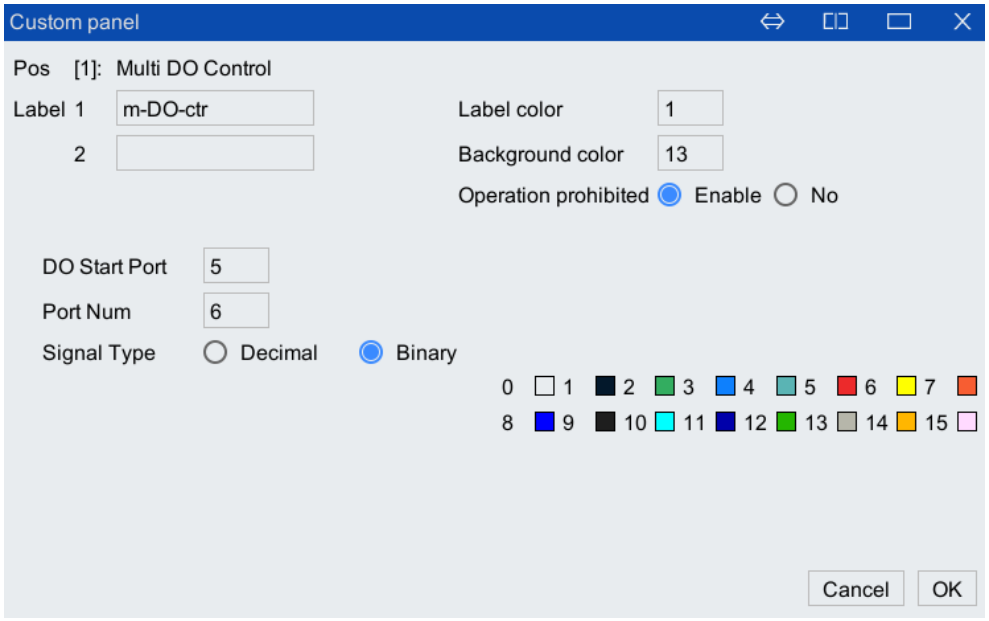


Figure 6-104 "Multi DO control"setting interface

Table 6-32 Setting instructions in "Multi-channel DO control" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name. The label name after setting will be displayed at the top of the switch. In this example, the tag name is set to m-DO-ctr
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of "Multi-channel DO control" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
Corresponding to the starting DO port number	In this example, the corresponding start DO port number is set to 5
Number of corresponding ports	In this example, the number of corresponding ports is set to 6

Name	Description
Signal display type	In this example, the signal display type is selected as "Binary"
	After the previous settings are completed, they will be displayed in the custom panel, as shown in Figure 6-105 below Figure 6-105 Custom panel display
Allow operation	Setting "Allow Operation" to "No" will make the switch on the custom panel inoperable; Set "Allow Operation" to "Yes", if it is set to 000001, then the corresponding output DO5 is high

6.5.3.5 Multi DI display

After inputting "1" in the desired switch position, click the <Set> button to enter the "Multi DI display" interface as shown in Figure 6-106. The setting instructions in the interface are shown in Table 6-33.

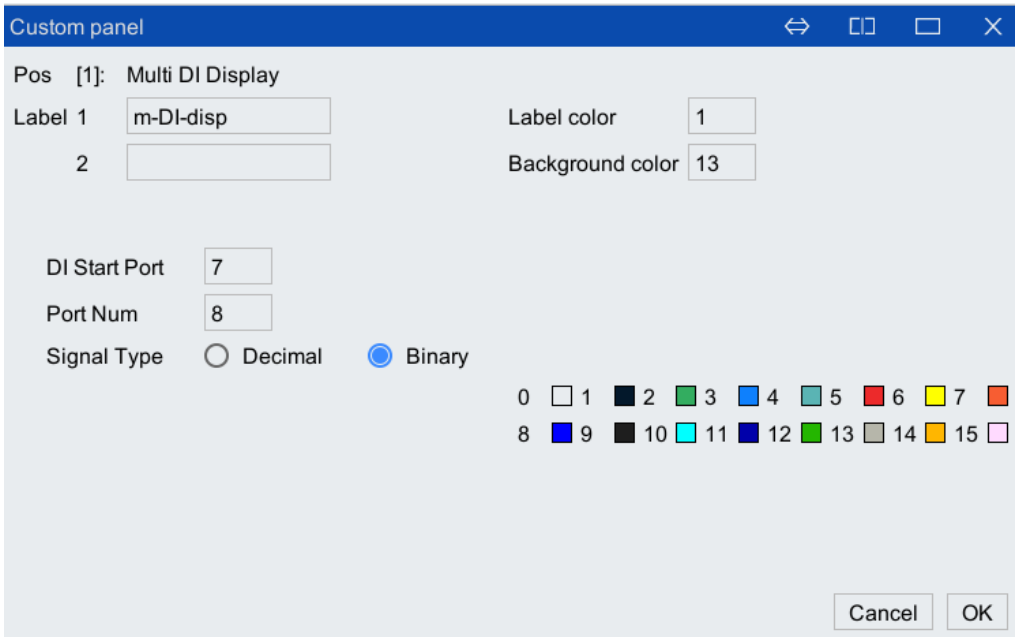


Figure 6-106 "Multi DI display"setting interface

Table 6-33 Setting instructions in "Multi-channel DI display" interface

Name	Description
Label 1	You can enter up to 10 characters in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name. The label name after setting will be displayed at the top of the switch. In this example, the label name is set to m-DI-disp
Label 2	You can enter up to 10 characters in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of "Multiple DI Display" in "Background Color". For details, please refer to

Name	Description
	Chapter 6.5.3.11. In this example, the background color is set to gray
Corresponding to the starting DI port number	In this example, the corresponding start DI port number is set to 7
Number of corresponding ports	In this example, the number of corresponding ports is set to 8
Signal display type	In this example, the signal display type is "Hexadecimal"
	After the previous settings are completed, they will be displayed in the custom panel, as shown in Figure 6-107 below Figure 6-107 Custom panel display

6.5.3.6 Two pos switch

After inputting "1" at the desired switch position, click the <Set> button to enter the "Two pos switch" setting interface as shown in Figure 6-108. For the setting instructions in the interface, see Table 6-34.

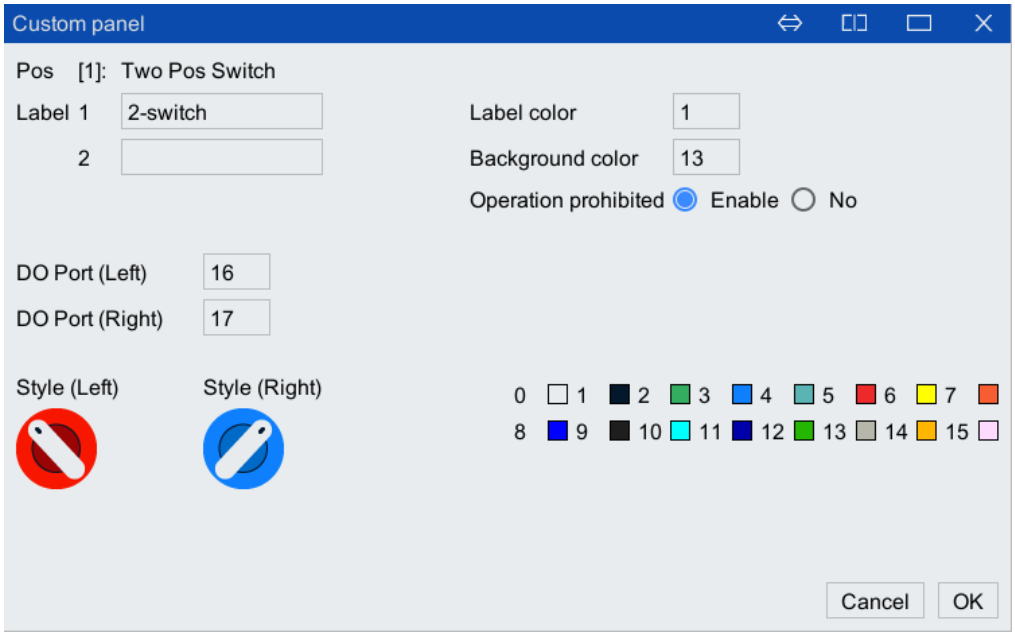


Figure 6-108 "Two pos switch" setting interface

Table 6-34 Setting instructions in "Two pos switch" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the label name is set to "2-switch"
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set

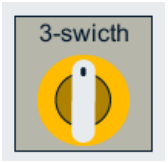
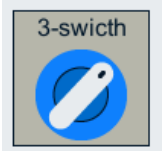
Name	Description
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of the "Two pos switch" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
DO port (Left)	In this example, the corresponding DO port number is set to 16
DO port (Right)	In this example, the corresponding DO port number is set to 17
Style (Left)	After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left), as shown in Figure 6 42 and the DO port number 16 turns ON, and at the same time, DO17 is low. Figure 6 The custom panel display when the switch is turned to (left)
Style (Right)	After the previous settings are completed, in the custom panel, the switch turns blue when it is turned (right) as shown in Figure 6 43 and the DO port number 17 becomes ON, and at the same time, DO16 will become low. Figure 6 The custom panel display when the switch is turned to (right)
Operation prohibited	Setting "Operation prohibited" to "No" will make the switch on the custom panel inoperable.

6.5.3.7 Three pos switch

After inputting "1" at the desired switch position, click the <Set> button to enter the "Three pos switch" setting interface as shown in Figure 6-109. For the setting instructions in the interface, see Table 6-35.

Figure 6-109 "Three pos switch" setting interface

Table 6-35 Setting instructions in "Three pos switch" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the label name is set to "3-switch"
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of the " Three pos switch" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
DO port (Left)	In this example, the corresponding DO port number is set to 20
DO port (Mid)	In this example, the corresponding DO port number is set to 21
DO port (Right)	In this example, the corresponding DO port number is set to 22
Style (Left)	After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left), as shown in Figure 6-110 and the DO port number 20 turns ON at the same time, DO21 and DO22 will turn low Figure 6-110 Customize the panel display when the switch is turned to (left)
Style (Mid)	After the previous settings are completed, in the custom panel, the switch turns blue when it is turned to (Mid), as shown in Figure 6-111 and the DO port number 21 turns ON, DO20 and DO22 will turn low  Figure 6-111 Customize the panel display when the switch is turned to (Mid)
Style (Right)	After the previous settings are completed, in the custom panel, the switch turns blue when it is turned (right) as shown in Figure 6-112 and the DO port number 22 turns ON  Figure 6-112 Customize the panel display when the switch is turned (right)
Operation prohibited	Setting "Operation prohibited" to "No" will make the switch on the custom panel inoperable

6.5.3.8 Two pos switch with lamp

After inputting "1" at the desired switch position, click the <Set> button to enter the "Two pos switch with lamp" setting interface as shown in Figure 6-113. The setting description in the interface is shown in Table 6-36.

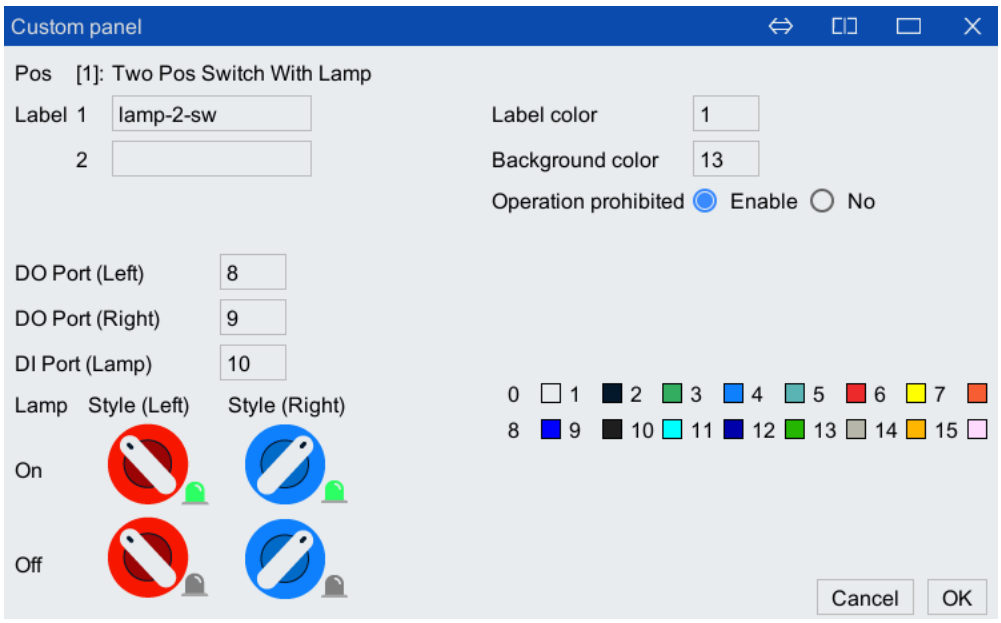


Figure 6-113 "Two pos switch with lamp" Setting interface

Table 6-36 Setting instructions in "Two pos switch with lamp" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the label name is set to "lam-2-sw"
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of the "Two pos switch with lamp " in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
DO port (Left)	In this example, the corresponding DO port number is set to 8
DO port (Right)	In this example, the corresponding DO port number is set to 9
DI port (Lamp)	In this example, the corresponding DI port number is set to 10, when the port number is ON/OFF, it corresponds to the on/off of the switch indicator.

Name	Description
Style (Left)	After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left) and the DO port number 8 becomes ON; if the DI port number 10 is ON, the indicator color changes to green (bright), As shown in Figure 6-114 below Figure 6-114 When the switch is turned to (left) and DI port number 10 is ON, the custom panel display After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left) and the DO port number 8 turns ON; if the DI port number 10 is OFF, the indicator color changes to grey (off), as shown in Figure 6-115 Figure 6-115 When the switch is turned (left) and the DI port number 10 is OFF, the custom panel display
Style (Right)	After the previous settings are completed, in the custom panel, the switch turns blue when it is turned (right) and the DO port number 9 becomes ON; if the DI port number 10 is ON, the indicator color changes to green (bright), as shown in Figure 6-116 below Figure 6-116 When the switch is turned to (right) and DI port number 10 is ON, the custom panel display After the previous settings are completed, in the custom panel, the switch turns blue when it is turned (right) and the DO port number 9 becomes ON; if the DI port number 10 is OFF, the indicator color changes to grey (Off), as shown in Figure 6-117 below Figure 6-117 When the switch is turned to (right) and DI port number 10 is OFF, the custom panel display
Operation prohibited	Setting "Operation prohibited" to "No" will make the switch on the custom panel inoperable

6.5.3.9 Three pos switch with lamp

After inputting "1" at the desired switch position, click the <Set> button to enter the "Three pos switch with lamp" setting interface as shown in Figure 6-118. For the setting instructions in the interface, see Table 6-37.

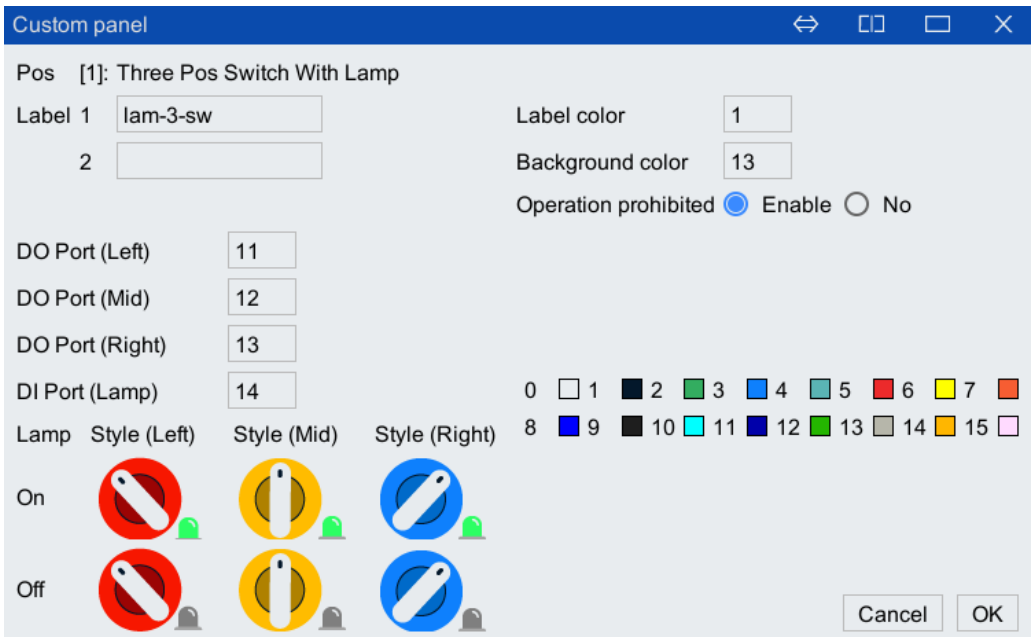
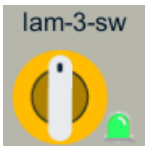
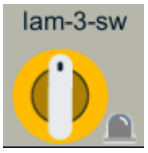


Figure 6-118 "Three pos switch with lamp" setting interface

Table 6-37 Setting instructions in "Three pos switch with lamp" interface

Name	Description
Label 1	Up to 10 characters can be displaied in the text box behind "Label 1". When editing, clicking the text box will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the label name is set to "lam-3-sw"
Label 2	Up to 10 characters can be displaied in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set
Label color	Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background color	Set the background color of the "Three pos switch with lamp" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray
DO port (Left)	In this example, the corresponding DO port number is set to 11
DO port (Mid)	In this example, the corresponding DO port number is set to 12
DO port (Right)	In this example, the corresponding DO port number is set to 13
DI port (Lamp)	In this example, the corresponding DI port number is set to 14, when the port number is ON/OFF, the corresponding switch indicator lights are on/off respectively

Name	Description
Style (Left)	After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left) and the DO port number 11 turns ON; if the DI port number 14 is ON, the indicator color turns grey(bright) , As shown in Figure 6-119 below Figure 6-119 When the switch is turned to (left) and the DI port number 14 is ON, the custom panel display After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left) and the DO port number 11 turns ON; if the DI port number 14 is OFF, the indicator color changes to grey (off), as shown in Figure 6-120 Figure 6-120 When the switch is turned (left) and the DI port number 14 is OFF, the custom panel display
Style (Mid)	After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left) and the DO port number 12 turns ON; if the DI port number 14 is ON, the indicator color turns green (bright), As shown in Figure 6-121 below  Figure 6-121 When the switch is turned to (mid) and the DI port number 14 is ON, the custom panel display After the previous settings are completed, in the custom panel, the switch turns red when it is turned (left) and the DO port number 12 turns ON; if the DI port number 14 is OFF, the indicator color changes to grey (off), as shown in Figure 6-122 below  Figure 6-122 When the switch is turned to (mid) and the DI port number 14 is OFF, the custom panel display

Name	Description
Style (Right)	After the previous settings are completed, in the custom panel, the switch turns blue when it is turned (right) and the DO port number 13 turns ON; if the DI port number 14 is ON, the indicator color changes to green (bright), as shown in Figure 6-123 below Figure 6-123 When the switch is turned to (right) and the DI port number 14 is ON, the custom panel display After the previous settings are completed, in the custom panel, the switch turns to (right) to blue and the DO port number 13 turns ON; if the DI port number 14 is OFF, the indicator color changes to grey (Off), as shown in Figure 6-124 below Figure 6-124 When the switch is turned to (right) and the DI port number 14 is OFF, the custom panel display
Operation prohibited	Setting "Operation prohibited" to "No" will make the switch on the custom panel inoperable

6.5.3.10 Variable display

After inputting "1" at the required switch position, click the <Set> button to enter the "Variable Display" setting interface as shown in Figure 6-125. For the setting description in the interface, see Table 6-38.

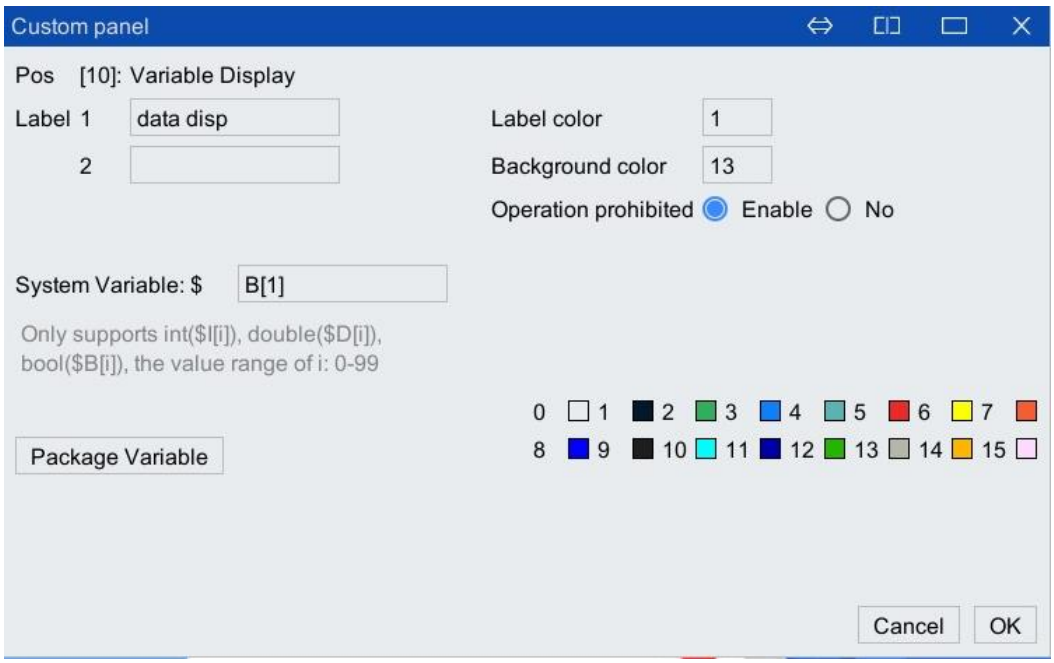


Figure 6-125 "Variable display" setting interface

Table 6-38 Setting instructions in "Variable Data Display" Interface

Name	Description
Label 1	You can enter up to 10 characters in the text box behind "Label 1". When editing, clicking the text box

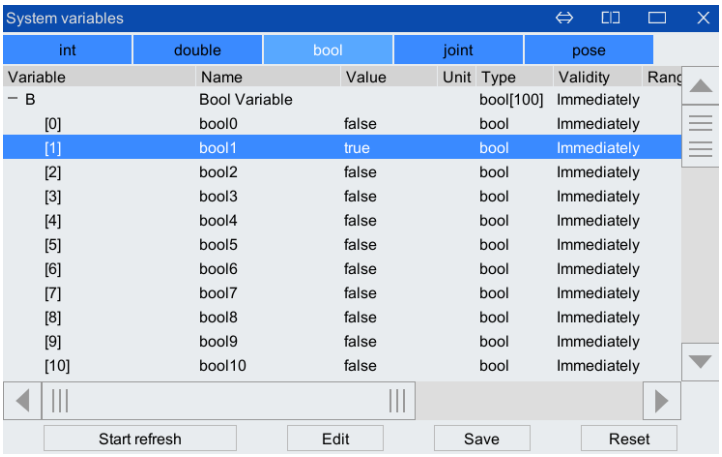
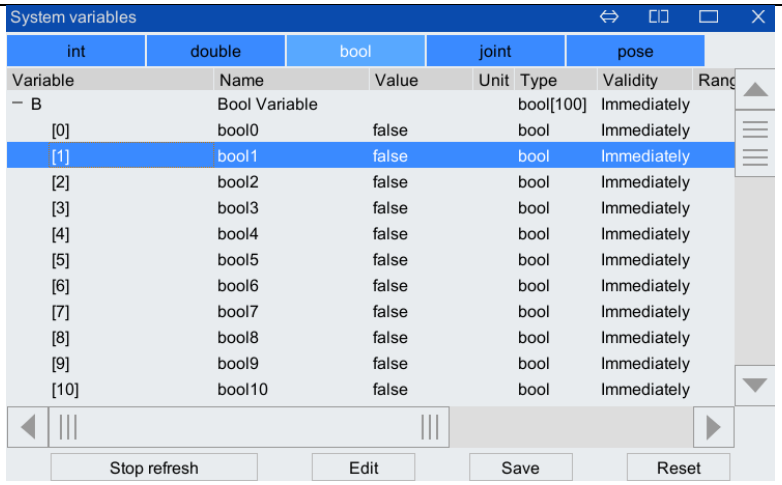
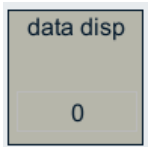
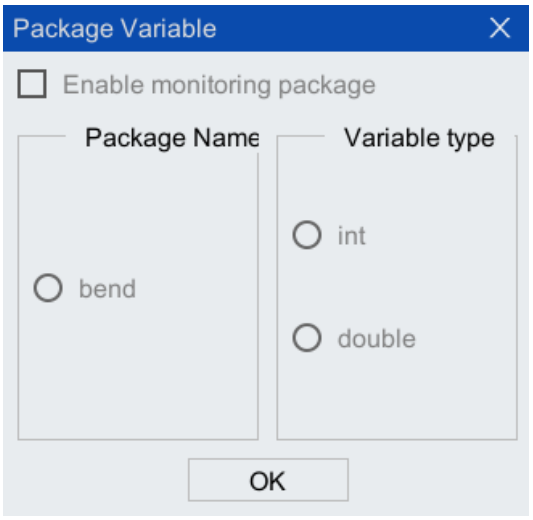
<table>
<tr><td>Name</td><td>Description</td></tr>
<tr><td></td><td>will display the soft keyboard for entering the label name, and the label name after setting will be displayed at the top of the switch. In this example, the tag name is set to s-DO-ctr</td></tr>
<tr><td>Label 2</td><td>Up to 10 characters can be entered in the text box behind "Label 2". When editing, clicking the text box will display the soft keyboard for entering the label name. In this example, do not set</td></tr>
<tr><td>Label color</td><td>Set the color of the label name in "Label Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue</td></tr>
<tr><td>Background color</td><td>Set the background color of "Single DO control" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray</td></tr>
<tr><td>Operation prohibited</td><td>Setting "Operation prohibited" to "No" will make the switch on the custom panel inoperable</td></tr>
<tr><td rowspan="3">System variable: $</td><td>In this example, select the variable $B"1"
Note: System variables only support integer variables, floating-point variables, and Boolean variables. Joint variables and pose variables are not supported.</td></tr>
<tr><td>On the main interface of the teach pendant, click the "System > System Variable" option, and set the value of variable B[1] to true in the "Boolean Variable" tab (refer to Figure 6-126). The definition panel is shown in Figure 6-127
 

Figure 6-126 Variable B[1] value setting interface

Figure 6-127 Custom panel display when the value of variable B[1] is set to true</td></tr>
<tr><td>On the main interface of the teach pendant, click the "System > System Variable" option, and set the value of variable B[1] to false in the "Boolean Variable" tab (refer to Figure 6-128). The definition panel is shown in Figure 6-129</td></tr>
</table>

Name	Description
	 Figure 6-128 Variable B[1] value setting interface  Figure 6-129 The custom panel is displayed when the value of variable B[1] is set to false
package variable	Click the <function package variable> button, and the interface shown in Figure 6-130 will pop up. The bending parameters can be modified. For the specific configuration method, please refer to the *Bending Function User Manual* .  Figure 6-130 Function package variable setting interface

6.5.3.11 Text display

After inputting "1" at the desired switch position, click the <Set> button to enter the "Text Display" setting interface as shown in Figure 6-131. The setting description in the interface is shown in Table 6-39.

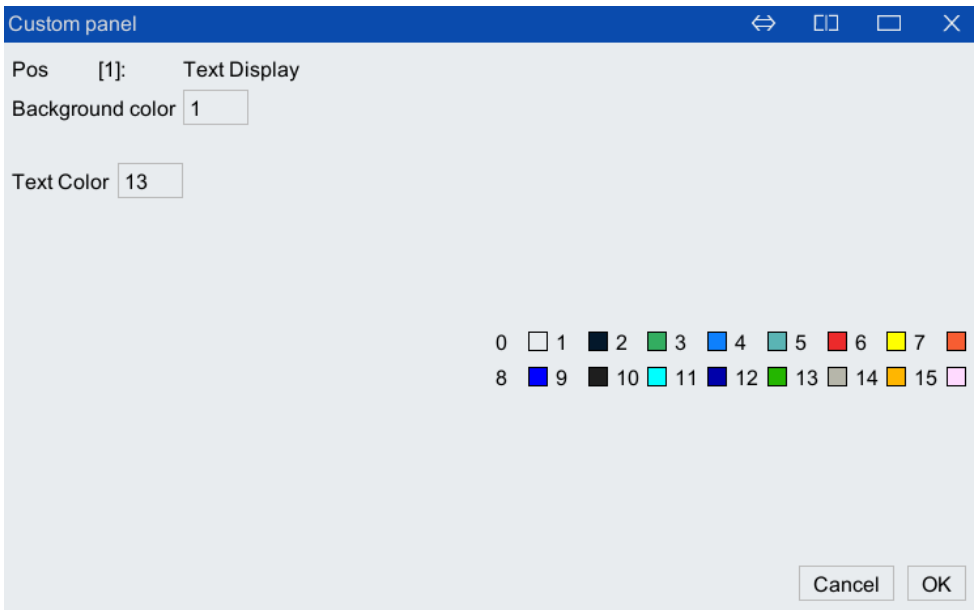


Figure 6-131 "Text display" setting interface

Table 6-39 Setting description in "Text Display Window" Interface

Name	Description
Text Color	Set the color of the label name in "Text Color". For details, please refer to Chapter 6.5.3.11. In this example, the label name is set to grayish blue
Background Color	Set the background color of "Single DI Display" in "Background Color". For details, please refer to Chapter 6.5.3.11. In this example, the background color is set to gray

After completing the settings in Table 6-39, enter "Control" through the keyboard in the corresponding position in the custom panel, and the display is shown in Figure 6-132.

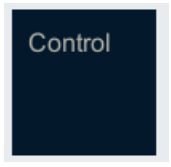


Figure 6-132 Customize panel display after keyboard input "control"

6.5.3.12 Label color

There are 15 colors to choose from in the "Custom Panel" Switch Setting Interface" (refer to Figure 6-133). Use the numbers 0 to 15 to select the desired color. The corresponding relationship between the label color and the number is shown in Table 6-40.

Figure 6-133 The label color display in the "Custom Panel" Switch Setting interface

Table 6-40 Correspondence between label color and number

Num	Colour	Num	Colour	Num	Colour	Num	Colour
0	White	4	Dry blue	8	Blue	12	Green
1	Gray blue	5	Red	9	Black	13	Gray
2	Light green	6	Yellow	10	Green orange	14	Dark yellow
3	Sky blue	7	Orange	11	Navy blue	15	Pink

7 File

The expanded view of "File Menu" is shown in Figure 7-1. The entry of "File Menu" is shown in Figure 7-2. The contents of parts of "File Menu" are described below.

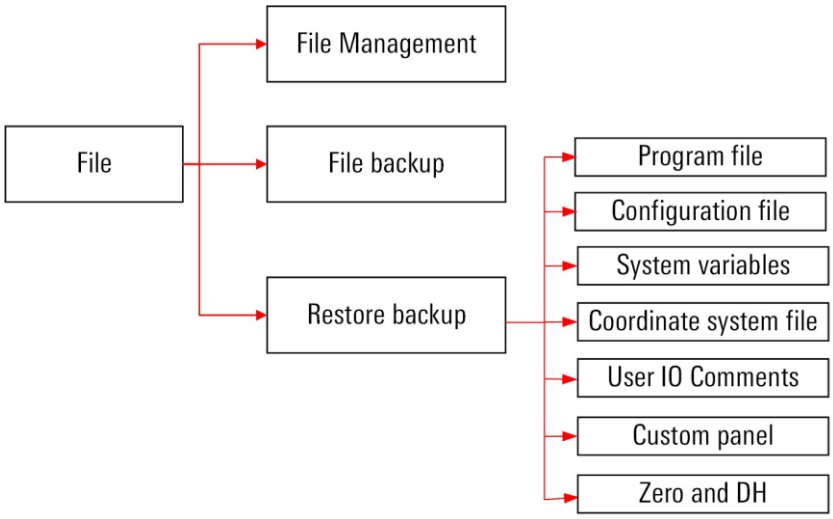


Figure 7-1 Expanded view of "File Menu"

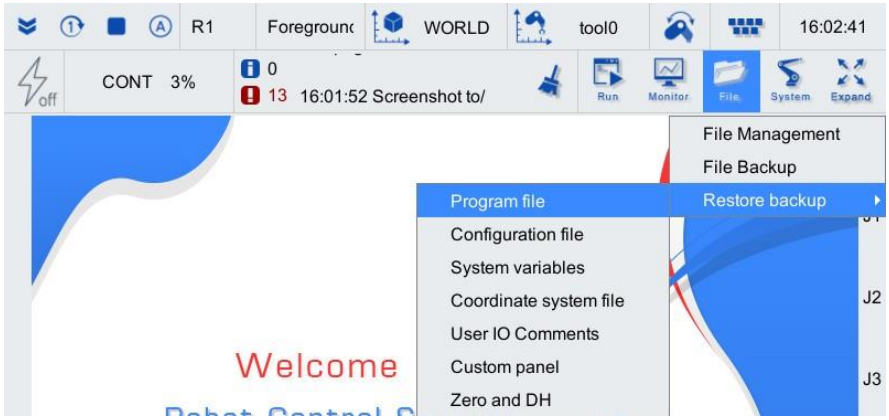


Figure 7-2 "File Menu" interface

7.1 File management

On the main interface of the teach pendant, click the "File > File Management" option to enter the "File Management" interface as shown in Figure 7-3. The file management mainly provides users with new, delete, copy and paste files (file Folder) and other file operation functions.

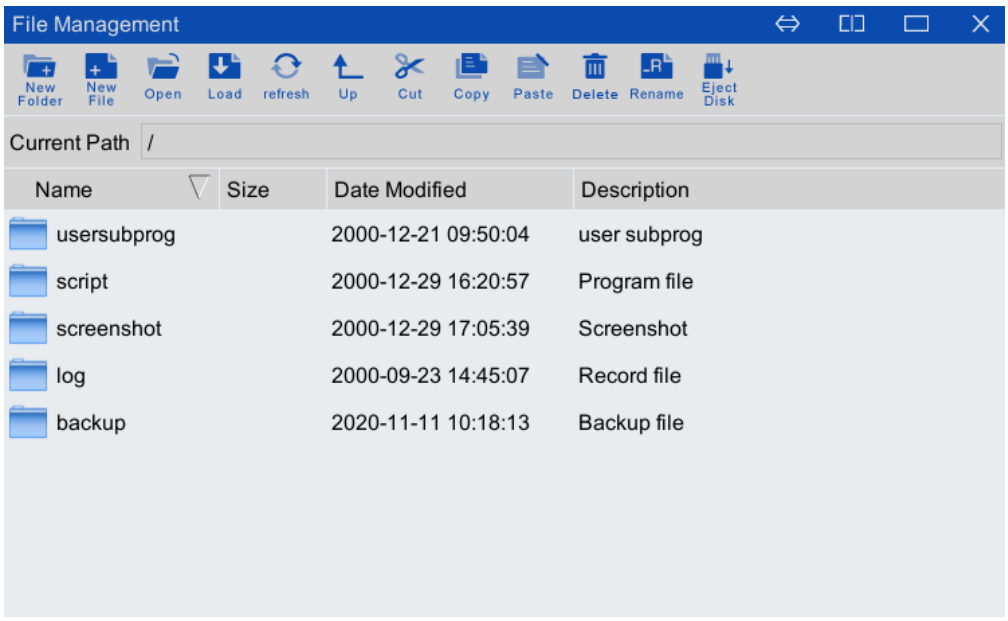


Figure 7-3 "File Management" interface

For details about functions on file management "Toolbar", please refer to Table 7-1.

Table 7-1 Description of functions of file management "Toolbar"

Icon	Name	Function
	New Folder	Create a folder in the current directory. At this time, the user can rename the created folder via the system soft keyboard.
	New File	Create a file in the current directory. At this time, the user can rename the created file via the system soft keyboard.
	Open	If a file is selected, the currently selected file will be opened in the editor. If a folder is selected, the folder will be opened in file management.
	Load	Load the currently selected program in the current channel and display it in the debugger.
	Refresh	The resource manager will automatically refresh the file tree. The user can also click "Refresh" to manually refresh the contents displayed on the resource manager.
	Up	Open the parent directory. At most home directory
	Cut	Highlight one or more file or folder and click "Cut" button. Move the file or folder to the clipboard
	Copy	Highlight one or more file or folder and click "Copy" button. Copy the file or folder to the clipboard
	Paste	Copy the file or folder in the clipboard to the current path. Copy the file and subfolder in the folder to the path
	Delete	Highlight one or more file or folder and click "Delete" button to delete the selected file or folder. Delete the file and subfolder in the folder. It should be noted that the deleted file or folder will not enter the recycle bin, and cannot be restored
	Rename	The user can rename the selected file via the system soft keyboard

Icon	Name	Function
	Eject Disk	Clicking the function button can eject the USB safely from the teach pendant
	Current Path	Display the current path

7.2 File backup

"File backup" mainly refers to the backup of programs, configurations, coordinate systems, log files and user IO comments.

Operation steps:

Step1.On the main interface of the teach pendant, click "File > File Backup" to enter the "File Backup" interface as shown in Figure 7-4, and select the desired backup in the "Backup Content" check box Options, here take <program> as examples.

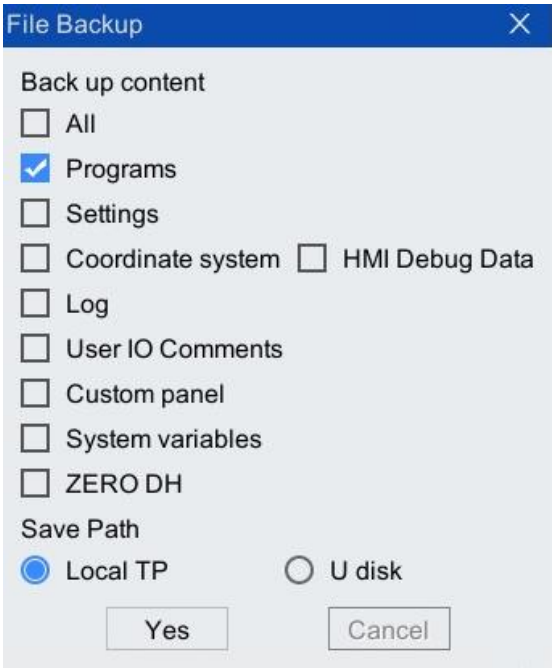


Figure 7-4 "File Backup" interface

Step2.Then select the position to save. By default, it is saved in "Local TP" (that is, saved to "Backup" folder of the teach pendant). The user can also save it to "USB" (the root directory of USB on the teach pendant), click <Yes> button, "Successful Backup" dialog box in Figure 7-5 will pop up, as shown in. Then click <Yes> button to complete the backup.

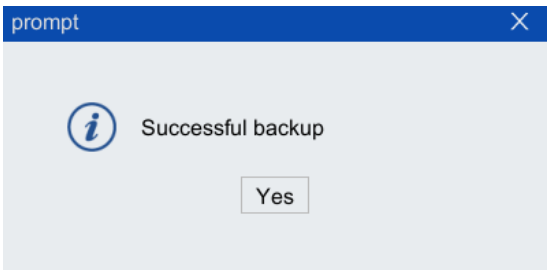


Figure 7-5 "Backup Succeeded" dialog box

Step3.After the backup is completed, you can click on the "File > File Management > backup" option on the main interface of the teach pendant to enter the interface as shown in Figure 7-6 to view the backup files.

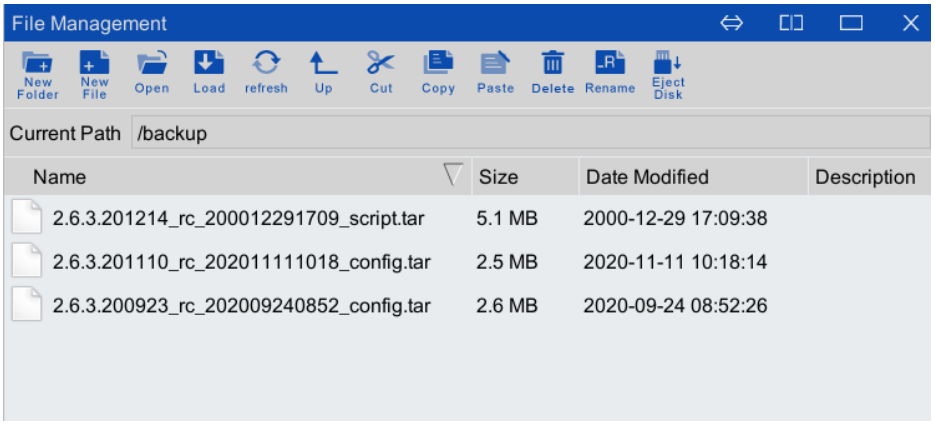


Figure 7-6 Path of file backed up

7.3 Restore backup

"Restore Backup" mainly refers to re-importing the required program, configuration and coordinate system files from the specified path.

7.3.1 Program file

Operation steps:

Step1.In the main interface of the teach pendant, click "File > Restore Backup > Program File" option, and the "Import Program" list box as shown in Figure 7-7 will pop up.

Step2.The user can find and highlight the program file to be imported in USB, and click <Select> button to import the program into the system.

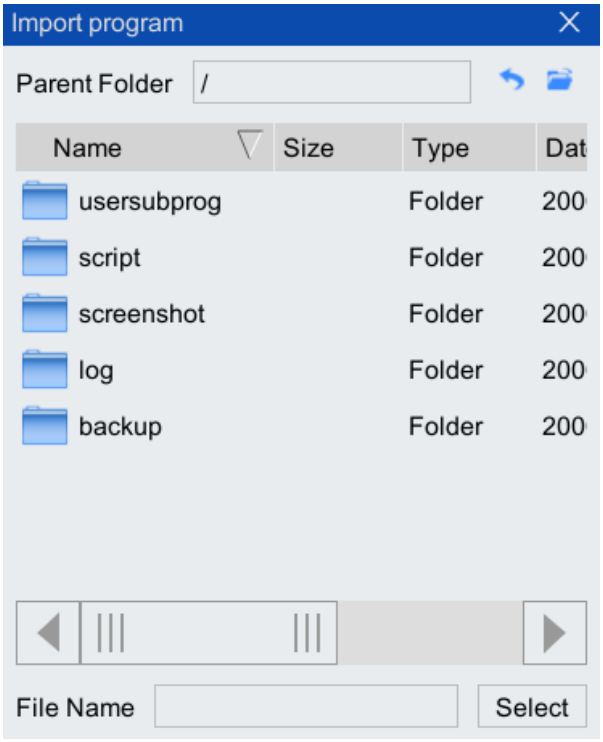


Figure 7-7"Import Program" interface

7.3.2 Configuration file

Prompt

The "import configuration" operation needs to be performed when the control system is powered off, select the compressed package of the configuration file, and after the prompt "Please restart the robot control system", power off the control system and power it on again. After the system is powered on, it will automatically import the configuration.

Operation steps:

Step1.On the main interface of the teach pendant, click "File > Restore Backup > Configuration File" option, and the "Import Configuration" list box as shown in Figure 7-8 will pop up.

Step2.Find and select the configuration file compression package (XXX.tar) you want to import in the U disk, and click the <Select> button to import it into the system.

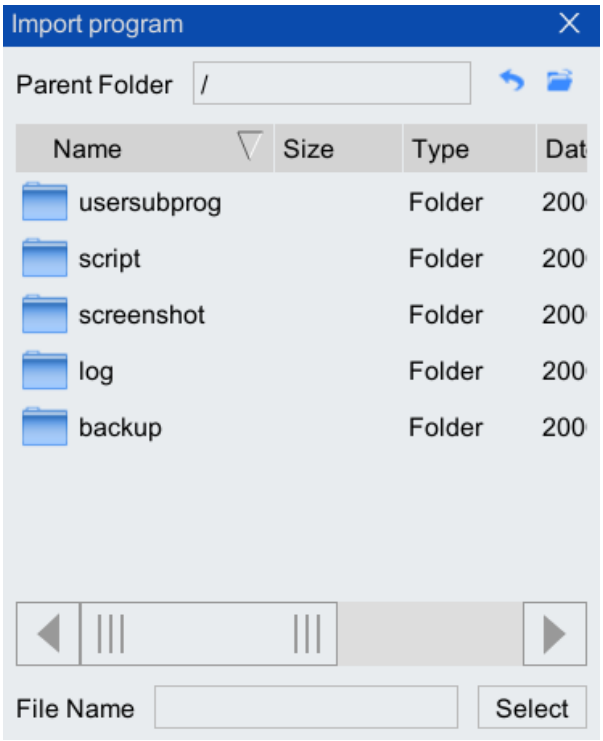


Figure 7-8 "Import configuration" list box

7.3.3 System variables

Operation steps:

Step1.In the main interface of the teach pendant, click the [File/Restore Backup/System Variables] option, and the [Import System Variables] list box as shown in Figure 7-9 will pop up.

Step2.Find and select the system variable file compressed package (XXX.tar) you want to import in the folder, and click the <Select> button to import it into the system.

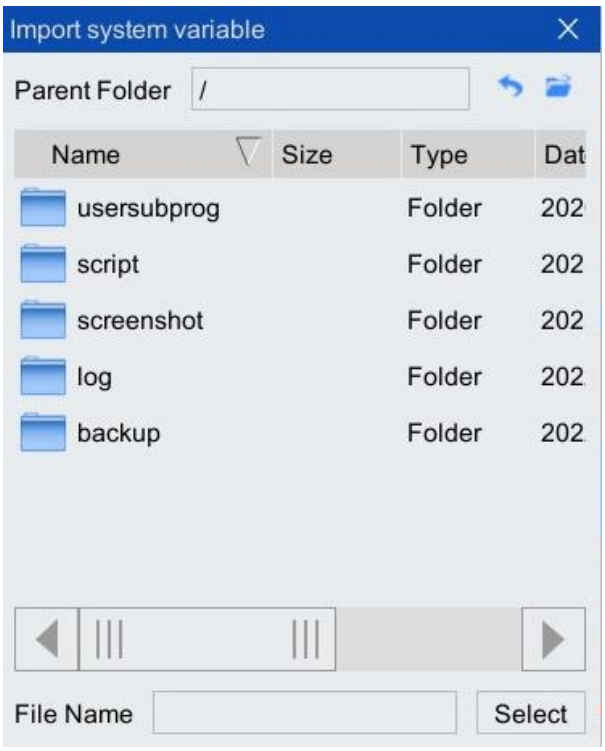


Figure 7-9 [Import system variables] list box

7.3.4 Coordinate system file

Prompt

The "import coordinate system" operation needs to be performed when the control system is powered off, select the compressed package of the coordinate system file, and after the prompt "Please restart the robot control system", power off the control system and power it on again. After the system is powered on, it will automatically import the coordinate system.

Operation steps:

Step1.In the main interface of the teach pendant, click "File > Restore Backup > Coordinate System File" option, and the "Import Coordinate" list box as shown in Figure 7-10 will pop up.

Step2.Find and select the coordinate system file compression package (XXX.tar) you want to import in the U disk, and click the <Select> button to import it into the system.

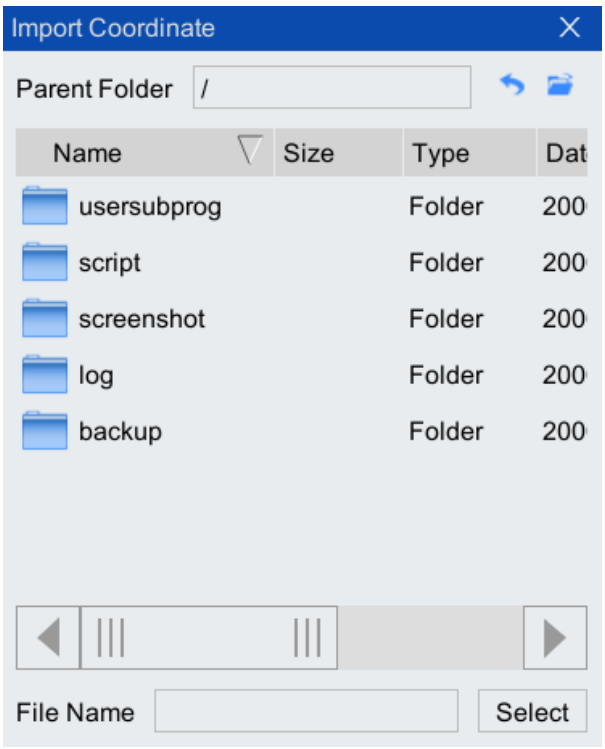


Figure 7-10 "Import coordinate system" list box

7.3.5 User IO comment

"User IO comment" is convenient for users to backup/restore user IO comment information.

Operation steps:

Step1.In the main interface of the teach pendant, click "File > Restore Backup > User IO Comment" option, and the "Import User IO Comment" list box as shown in Figure 7-11 will pop up.

Step2.Find and select the user IO comment file compression package (XXX.tar) you want to import in the U disk, and click the <Select> button to import it into the system.

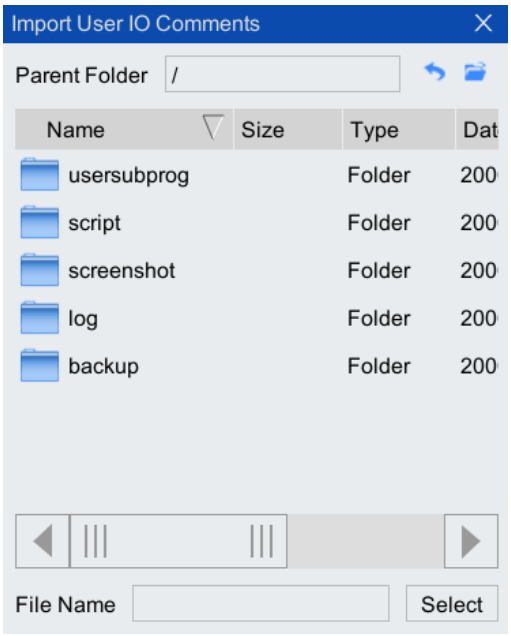


Figure 7-11 "Import user IO comments" list box

7.3.6 Custom panel

"Custom Panel" is convenient for users to restore the custom panel information.

The configuration steps are as follows:

Step1.On the main interface of the teach pendant, click "File> Restore Backup> Custom Panel" option, and the [Import Custom Panel] list box will pop up as shown in Figure 7-12.

Step2.Find and select the custom panel file (XXX.xml) you want to import in the U disk or local folder, and click the <Select> button to import it into the system.

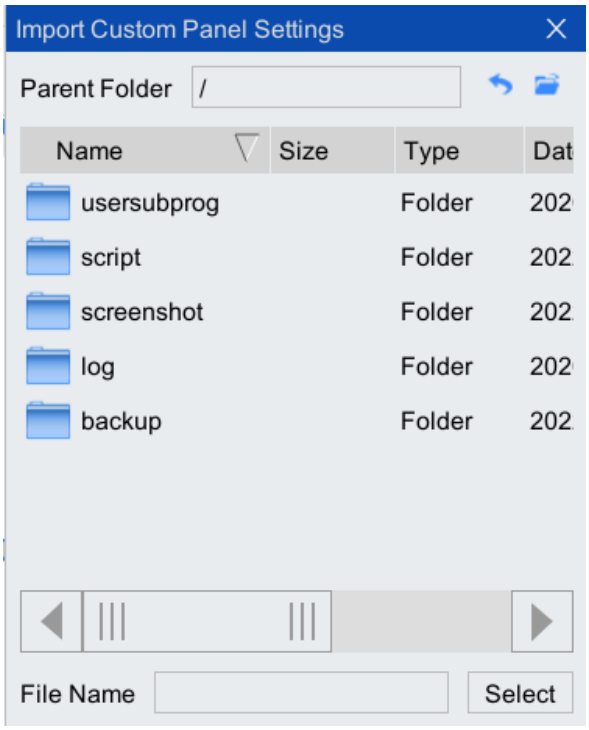


Figure 7-12 [Import custom panel] list box

7.3.7 Zero point DH parameters

The 'zero-point DH parameters' facilitate users to restore zero-point calibration information.

Operation steps:

Step1.On the main interface of the teach pendant, click on the option [File/Restore Backup/Zero and DH], and a dialog box named [Import Zero Point DH Parameters] will pop up as shown in Figure 7-13.

Step2.Find and select the zero-point DH parameter file you want to import in the USB flash drive or local folder, and click the <Select> button to import it into the system.

Figure 7-13 [Import Zero DH Parameters] list box

8 System

The expanded view of "System Menu" is shown in Figure 8-1. The entry of "System Menu" is shown in Figure 8-2. The contents of parts of "System Menu" are described below.

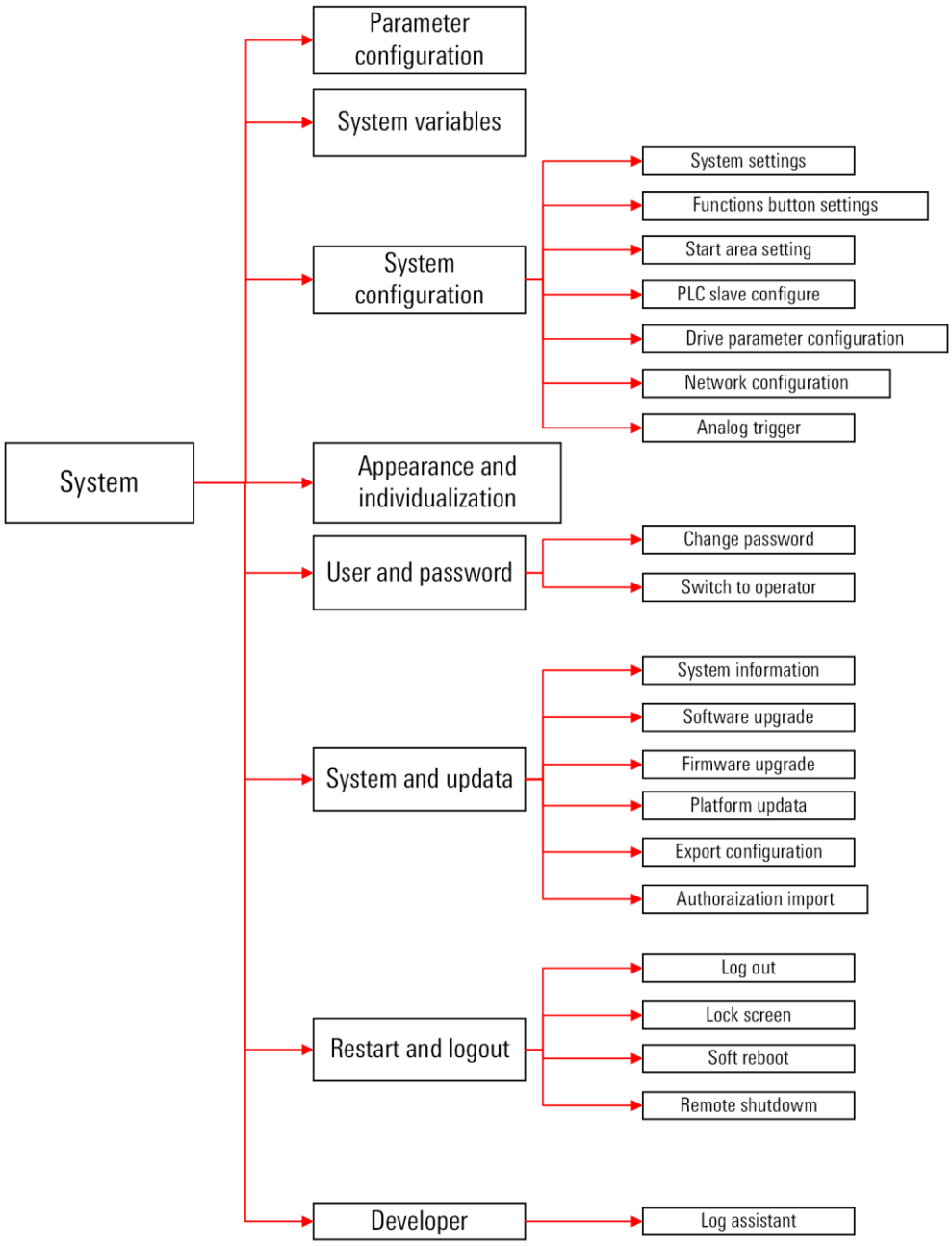


Figure 8-1 Expanded view of "File Menu"

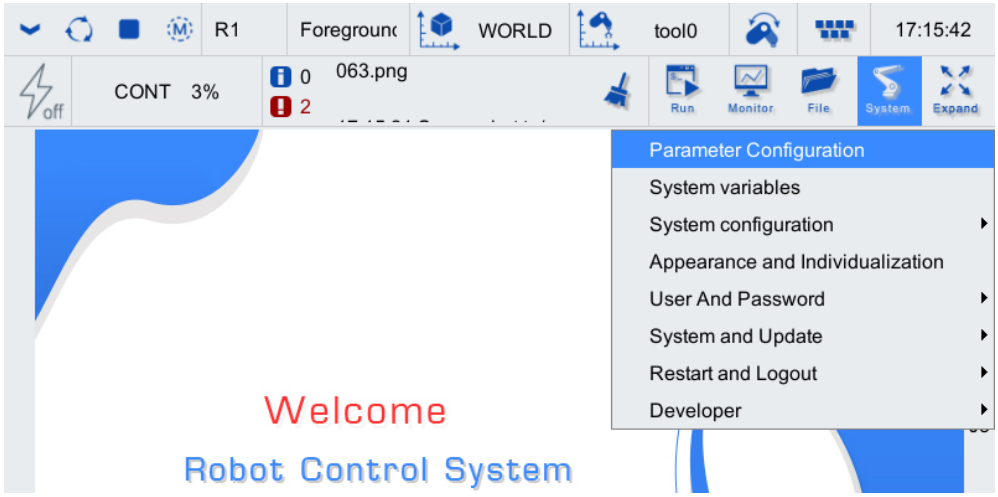


Figure 8-2 "Program Menu" interface

8.1 Parameter configuration

On the main interface of the teach pendant, click "System > Parameter Configuration" option to enter the "Parameter Configuration" interface as shown in Figure 8-3.

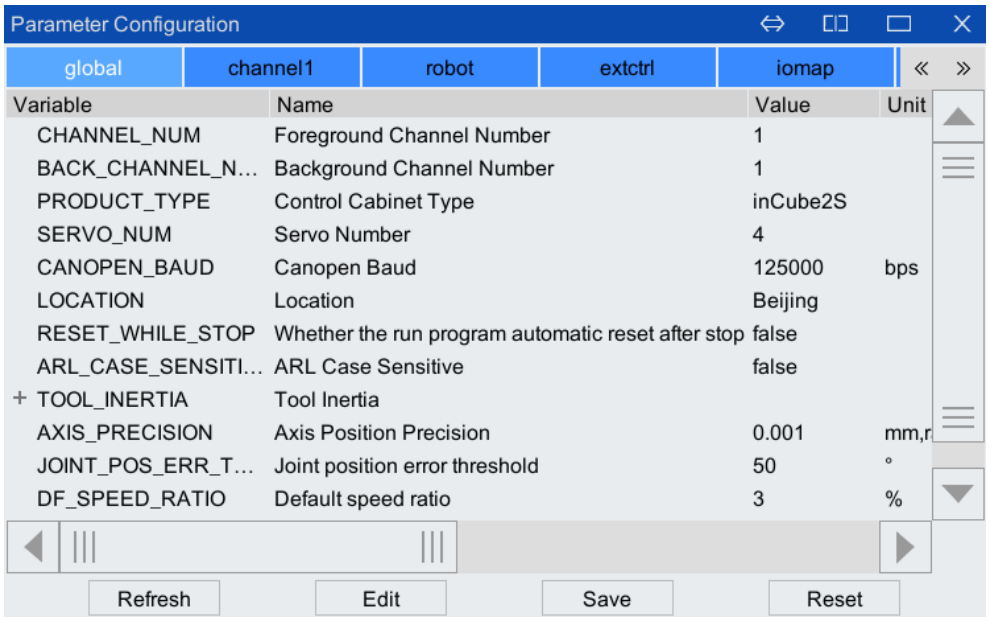


Figure 8-3 "Parameter Configuration" interface

8.1.1 Description of variables

From the configuration file tab, you can select the corresponding tab to configure the parameters. The tab mainly includes the following parts:

- Global: Global variables tab.
- Channel 1: Control channel configuration tab.
- Robot: Robot system parameter configuration tab.
- External: External control variables tab.
- IOma: Input/output configuration tab.
- Safety IO: The safety IO configuration tab. The default parameter configurations already exist, and do not need to be modified by the user.
- Conveyor: Conveyor related parameter configuration tab.

Prompt

- For all variable names and permissions contained in each tab, please refer to Appendix A "Summary of Parameter Configuration Permissions".
- External control input only takes effect in automatic mode, and the external automatic control output remains unchanged.

Each variable in the tab itself contains information such as variable, name, value, unit, type, etc. For details, please refer to Table 8-1.

Table 8-1 Description of information contained in variables

Name	Description
Variable	To display the list of variables under the current tab
Name	To display the list of names corresponding to variables under the current tab
Value	To display the value of variable corresponding to the current variable
Unit	To display the variable unit corresponding to the current variable
Type	To display the type of the current variable
Effective way	To remind the user of the effective method after changing the value of the current variable
Value range	To display the valid value range of the current variable
Authority	The authority level is divided into from low to high: operator, instructor, integrator, after-sales personnel and administrator.
Description	To describe the functional attributes corresponding to the variable

8.1.2 Setting of variables

The "SERVO_NUM (number of slaves)" in "Global" tab is taken as an example to describe the method of setting, modifying and saving the variables.

Operation steps:

Step1.In "global" tab, find and highlight the line where "SERVO_NUM (number of slaves)" is located (see Figure 8-4), click <Edit> button below to pop up the edit box, as shown in Figure 8-5.

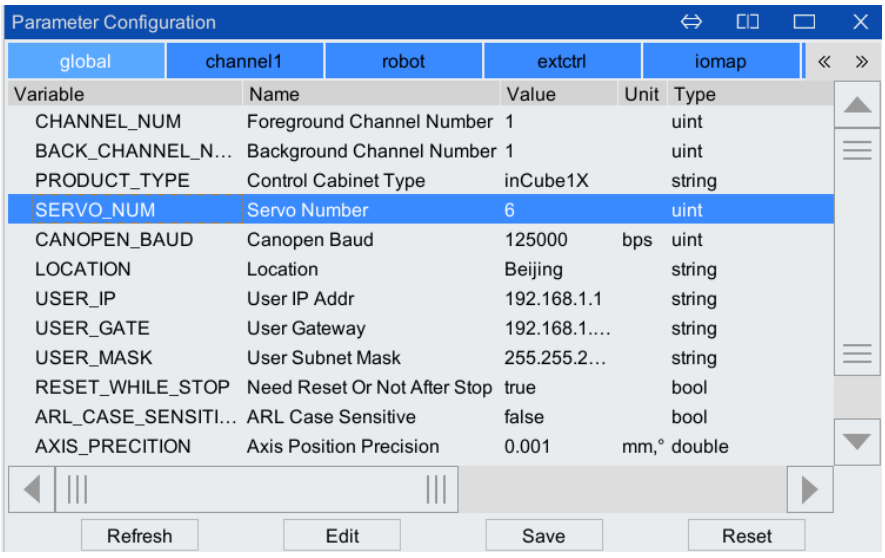


Figure 8-4 "Global" tab

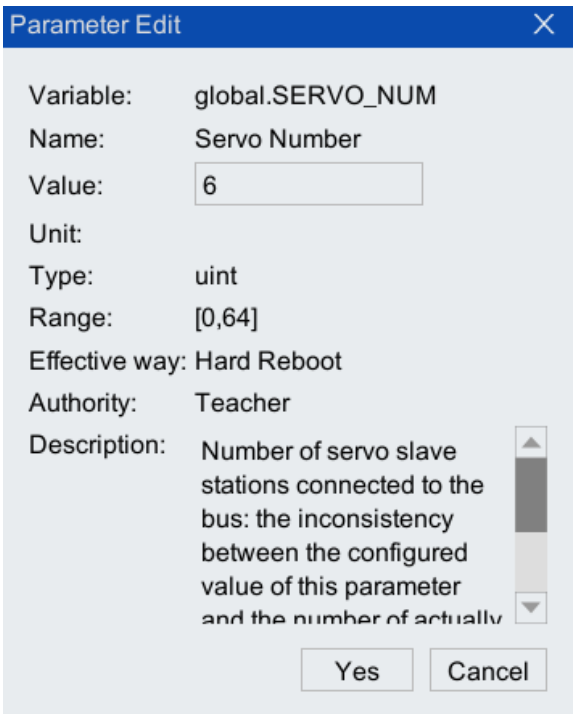
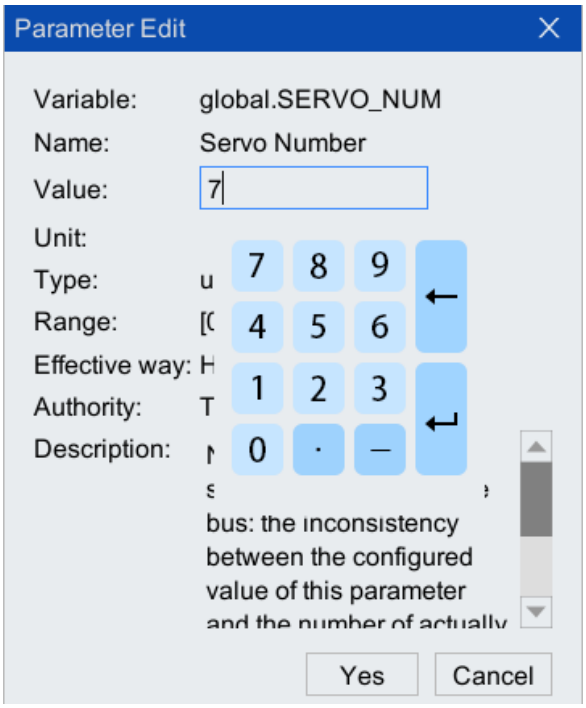
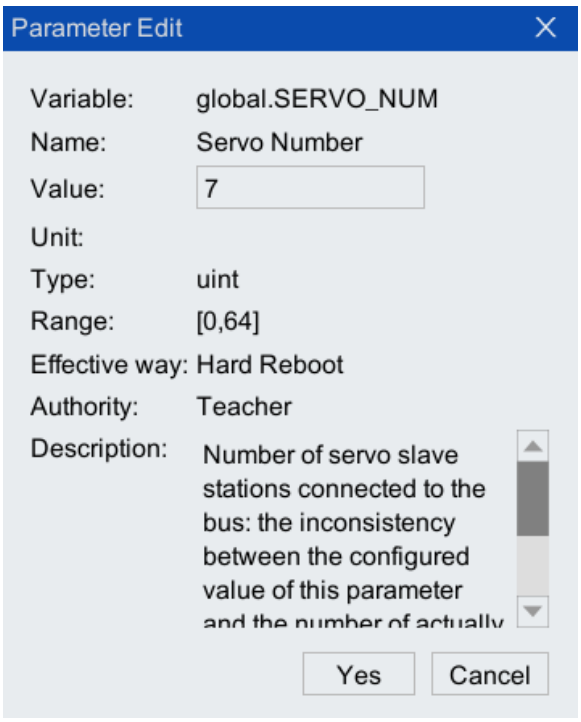


Figure 8-5 "Parameter Configuration" interface

Step2.Click the edit box behind the variable value shown in Figure 8-6, and modify the value you want to set via the small keyboard (please set according to the actual needs, 7 is taken as an example here). After the setting is completed, click <Yes> button to return to "Global" tab interface. You can see that the value of "SERVO_NUM (number of slaves)" has changed to 7 (see Figure 8-7).



(a)



(b)
Figure 8-6 Modification of variable value

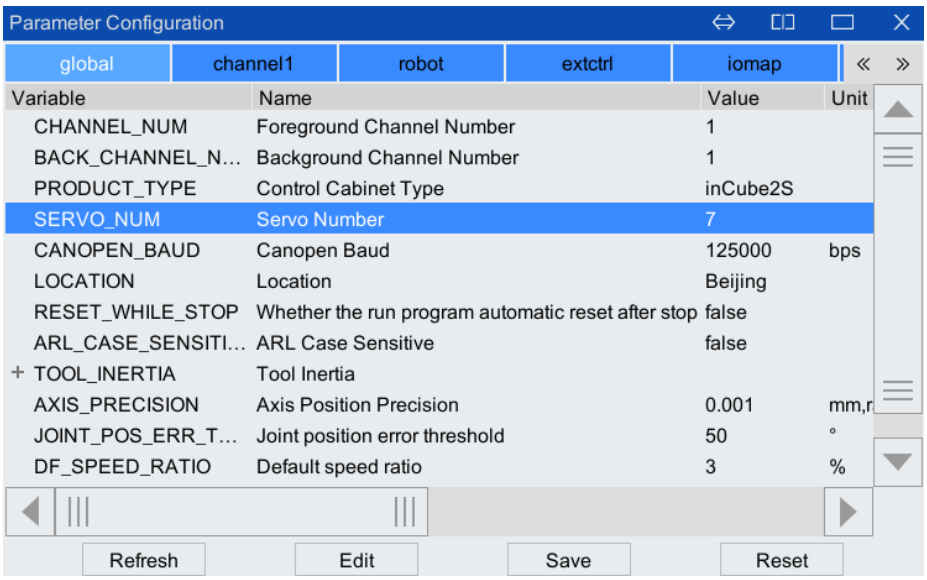
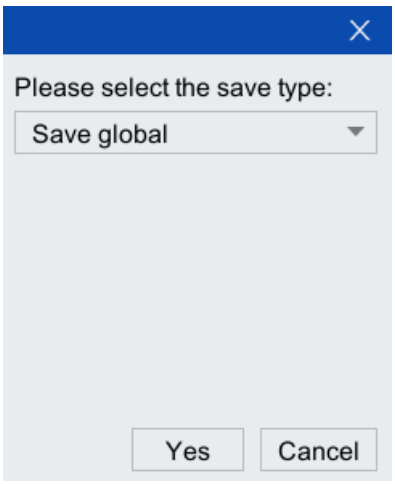
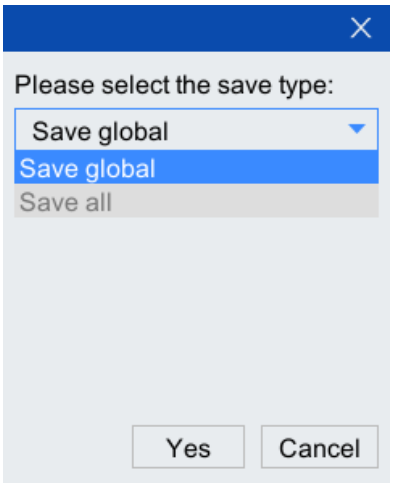


Figure 8-7"Modification of variable value completed" interface

Step3.Click <Save> button at the bottom of Figure 8-7, and the system will pop up "Save Selection" dialog box, as shown in Figure 8-8. The user can select "Save configuration data of the current tab" or "Save configuration data of all tabs". Only the variable values in "Global" tab are modified here. Then select "Save Global" and click "Yes" button to pop up "Comfirm save global?" dialog box, as shown in Figure 8-9. Click <Yes> button, and "Parameter saved successfully!" dialog box will pop up, as shown in Figure 8-10. That is, the parameters have been saved successfully.



(a)



(b)
Figure 8-8"Save Selection" dialog box

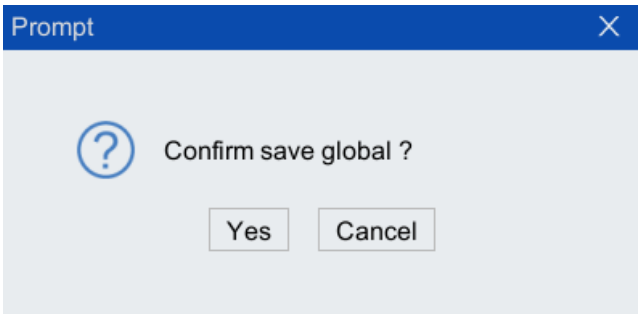


Figure 8-9 "Confirm save global" dialog box

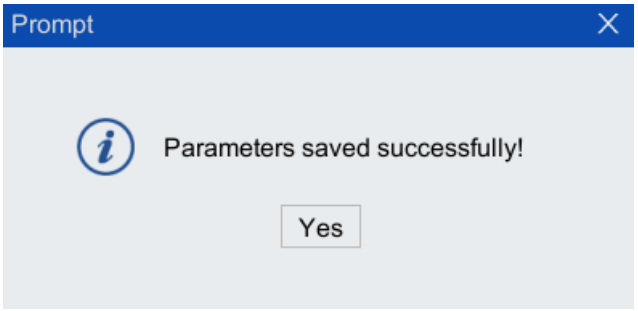


Figure 8-10 "Parameter Saved Successfully!" dialog box

Step4.If you want to return to the interface before setting the variable value, click <Refresh> button at the bottom of Figure 8-7, click <Refresh> button below to return to the interface shown in Figure 8-11.

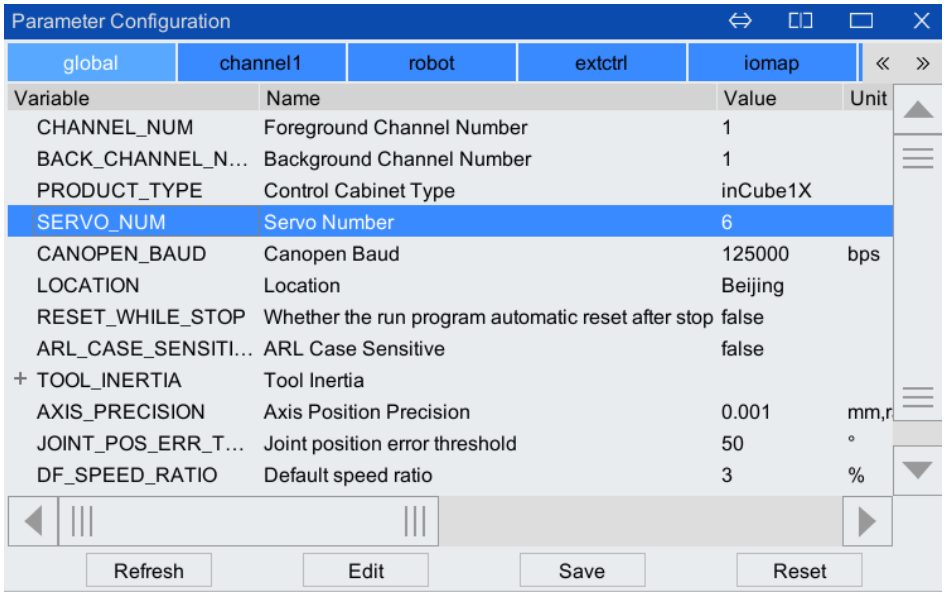
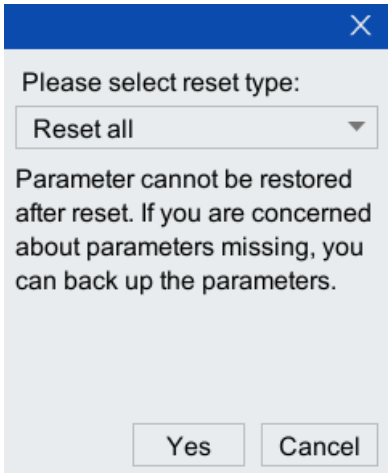
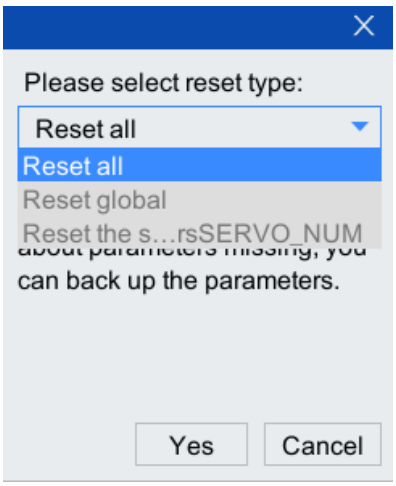


Figure 8-11 Refreshed interface

Step5.If you want to reset the parameter configuration of the current tab or all parameter configurations, click <Reset> button at the bottom of Figure 8-7, and the system will pop up "Restore Selection" dialog box (see Figure 8-12). The user can select "Reset the configuration data of the current tab" or " Reset the configuration data of all tabs". After selecting the save type, click the <Yes> button to pop up "Confirm all reset" dialog box in Figure 8-13. Click the <Yes> button, and "All Parameters are reset successfully! System is reboot after Power off." dialog box in Figure 8-14 will pop up. Then you can power off and restart it.



(a)



(b)
Figure 8-12"Restore Selection" dialog box

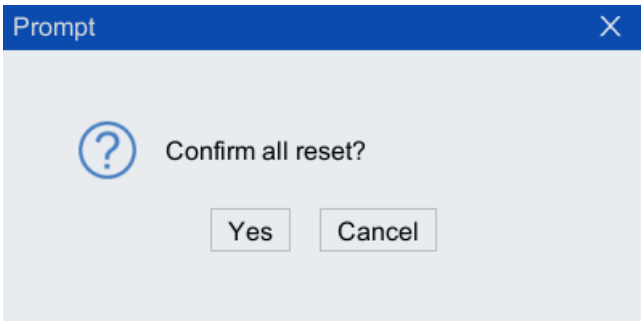


Figure 8-13 "Confirm all reset" dialog box

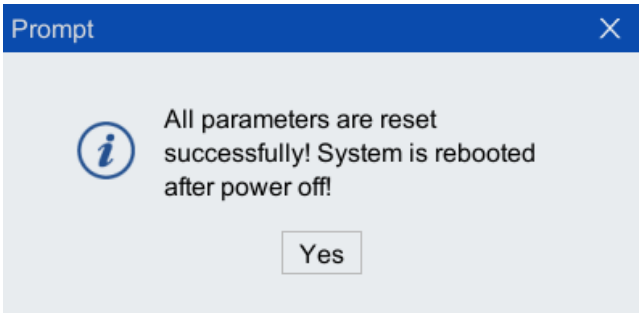


Figure 8-14 "Restore Selection" dialog box

8.2 System variables

On the main interface of the teach pendant, click the "System > System Variable" option to enter the "System Variable" interface as shown in Figure 8-15. For the setting, modification and saving methods of variables in each tab, please refer to "Variable Settings" in Chapter 8.1.2.

Prompt

- For all variable names and usage permissions contained in each tab, please refer to Appendix B for the list of system variable permissions.
- For the difference between "system variables" and "common variables", please refer to "ARL Programming Manual".

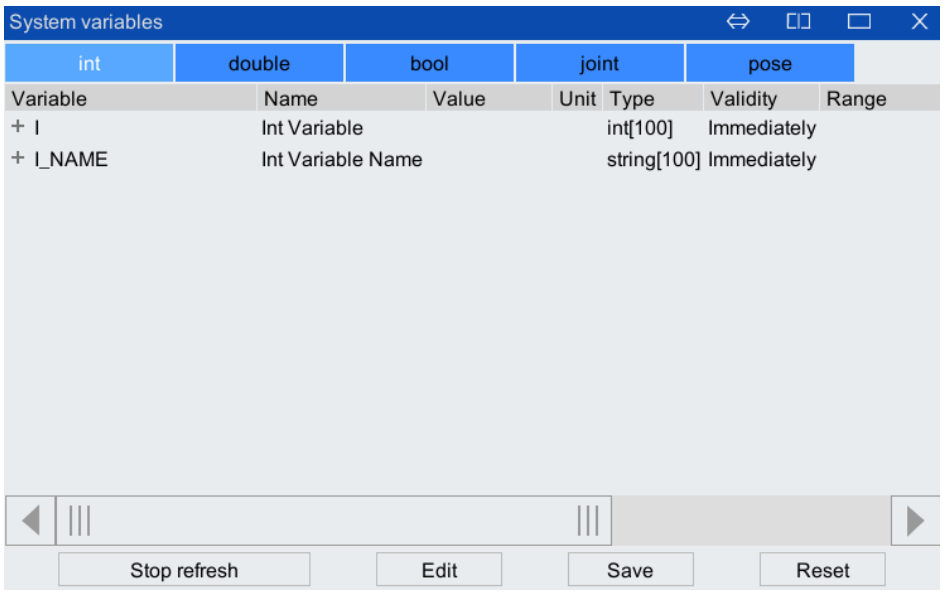


Figure 8-15 "Parameter Configuration" interface

8.3 System configuration

8.3.1 System settings

Operation steps:

Step1.On the main interface of the teach pendant, click "System > System Configuration > "System Settings" to enter the "System Settings" interface as shown in Figure 8-16. Please refer to the table for the description of each interface Table 8-2.

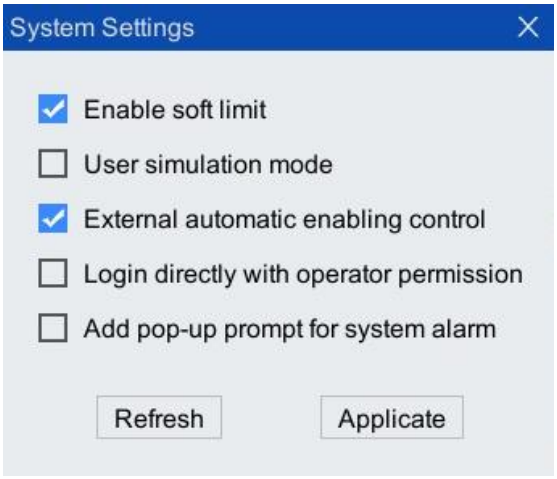


Figure 8-16 "System Settings" dialog box

Step2.After the setting is completed, click the <Applicate> button, and the "System settings have been changed" prompt box as shown in Figure 8-30 will pop up to complete the setting; if you click the <Refresh> button, it will return to the initial setting.

Table 8-2 Description of "System Settings" interface

Name	Function
Enable soft limit	The soft limit value of each axis is configured in the configuration file. When "Enable software limit" function is checked, if any axis is not within the software limit, no axis

Name	Function
	movement is allowed and a warning will be sent. When an axis reaches the limit point, the movement planning will be ended and a warning will be sent.
User simulation mode	After the user has written the program, he can run it in simulation mode to check the correctness of program syntax, logic and action, and then switch to running in actual mode.
External automatic enabling control	To set whether to enable external control. When not enabled, the robot can be only controlled by the teach pendant. After the external auto control is enabled, the user can control the robot's movement via external IO signals. If the value of the DI of the start program is set to 5, the instruction of the start program can be executed by changing the external IO signal of DI5.
Login directly with operator permission	To log into the teach pendant directly with operator permission after startup by default
ARL program Chinese display	Set whether to enable the display of ARL program in Chinese. After enabling, the program editor will display the motion instructions and their parameters in Chinese
Add pop-up prompt for system alarm	After the system generates an alarm, besides displaying the alarm message in the information bar, it will also prompt the alarm cause in the form of a pop-up window.

8.3.2 Function key settings

Operation steps:

Step1.On the main interface of the teach pendant, click "System > System Configuration > Function Button Settings" option to enter the "Function Buttons Settings" interface as shown in Figure 8-17. Refer to Table 8-3.

Step2.After the setting is completed, click the <Save> button to complete the setting.

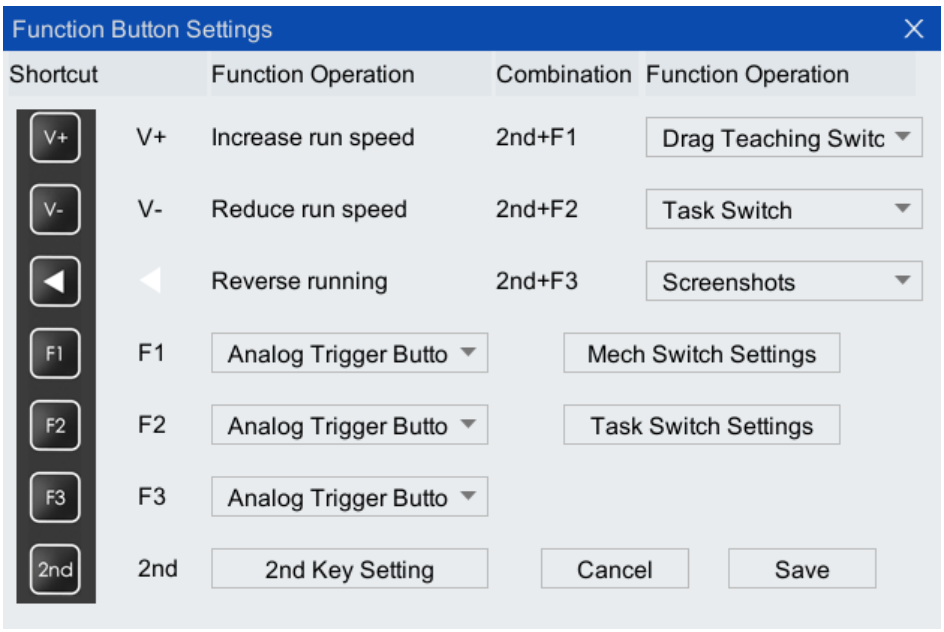


Figure 8-17"Function key setting"interface

Table 8-3 Setting instructions for teach pendant control function keys

Shortcut keys	Function operation
V+	Increase running speed

Shortcut keys	Function operation
V-	Slow down running speed
◀	Reverse operation of the program
F1 (Optional)	The default function is mechanical unit switching. The function of the F1 button can be configured through the drop-down option box. The supported functions include: ■ Analog trigger button 1 ■ Analog trigger button 2 ■ Analog trigger button 3 ■ Drag the teaching function switch ■ Screenshot ■ Mechanical unit switching ■ Spindle/external axis switch ■ Channel task switching ■ No welding
F2 (Optional)	The default function is spindle/external axis switching, the F2 button supports the same function as F1
F3 (Optional)	The default function is analog IO trigger, the function supported by F3 button is the same as F1
2nd (Optional)	Single-axis/Cartesian/tool mode switch, you can switch between single-axis mode, Cartesian mode (BASE, WORLD, WOBJ) and tool mode through configuration selection
2nd+F1(Optional)	The default function is to drag the teaching switch, the 2nd+F1 button supports the same function as F1
2nd+F2(Optional)	The default function is channel task switching. The 2nd+F2 button supports the same function as F1
2nd+F3(Optional)	The default function is a screenshot, and the 2nd+F3 button supports the same function as F1.
Mech Switch Settings	When the button is configured with the function of "mechanical unit switching", several mechanical units can be selected through configuration, and the mechanical unit can be cyclically switched by configuring the button
Task Switch Settings	When the button is configured with the function of "Channel Task Switching", several channel tasks can be selected through configuration, and the channel task can be switched cyclically through the configuration button

8.3.3 Setting of starting area

When the program starts, ARCS will check the initial position of each axis (or external axis) of the robot. The robot can be started normally only when the initial position of each axis (or external axis) of the robot is within the safe starting area.

Select "System> System Configuration> Start area setting " option to enter "Start area setting" interface shown in Figure 8-18. In this interface, the safe starting area of each axis (JI-J6) and external axis (EJI-EJ6) of the robot can be set.

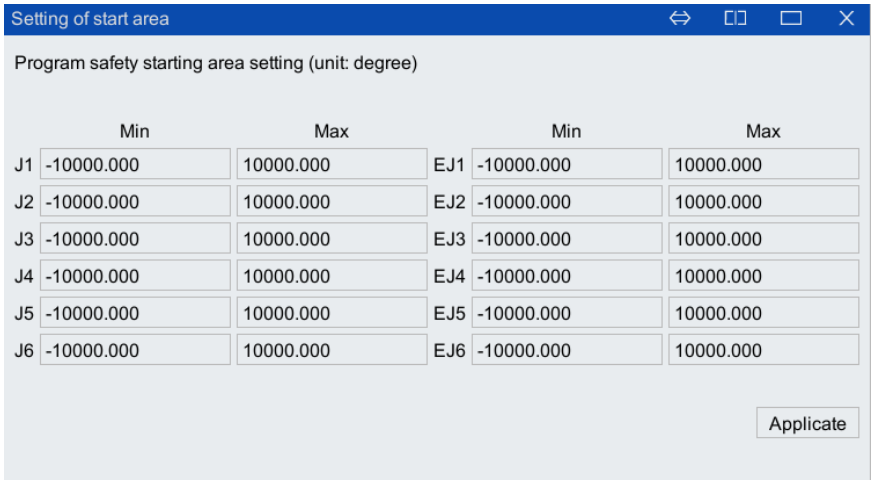


Figure 8-18 "Safety Zone Settings" interface

Operation steps:

Step1.Fill in or modify the max. and min. angles of the safe starting area of each axis (including the external axis).

Step2.Click <Applicate> button to complete saving.

8.3.4 Setting of PLC slaves

The PLC slave configuration function can help the user realize the configuration of some external expansion equipment. Here the configuration of PEB (Profinet External Board, namely the expansion board that supports Profinet protocol equipment) is taken as an example to describe the operation method.

Operation steps:

Step1.Under the access level of OEM or teacher, select "Main Interface> System> System Configuration> PLC Slave Configure" option to pop up "PLC Slave Configure" interface shown in Figure 8-19. Click <Configure> button behind the number 2 to enter "Configure PLC Slave station2" interface, as shown in Figure 8-20.

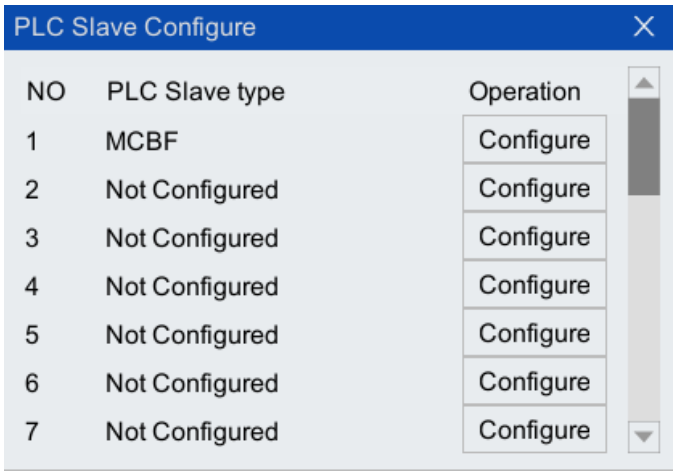


Figure 8-19 "PLC Slave Configuration" interface

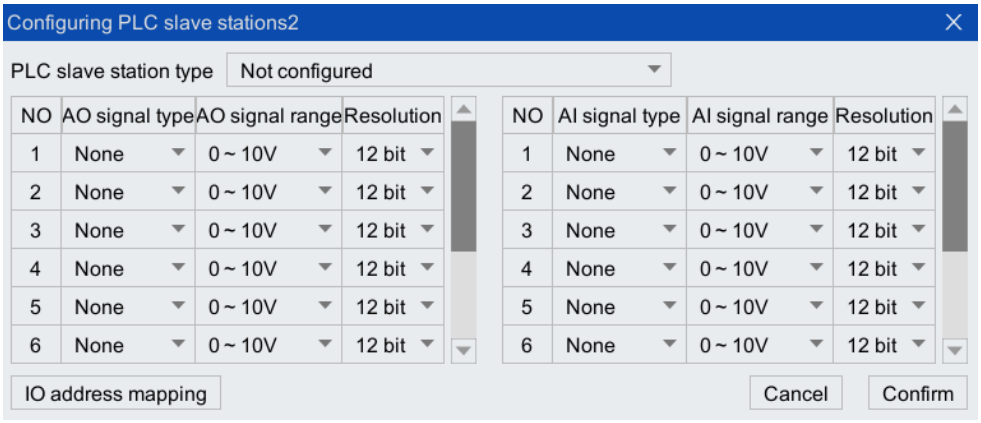


Figure 8-20 "Configure PLC Slave-2" interface

Step2.Select "PEB" from the drop-down list on the right of "PLC Slave station Type", as shown in Figure 8-21. Click <Confirm> button in the bottom right corner of the interface. After "Configuring PLC Slave station-2 successed, please reboot the system!" dialog box in Figure 8-22 pops up, click <Yes> button, power off and restart the control cabinet. Refer to Table 8-4 for the description of slave station types, and Table 8-5 for the description of PLC slave station configuration.

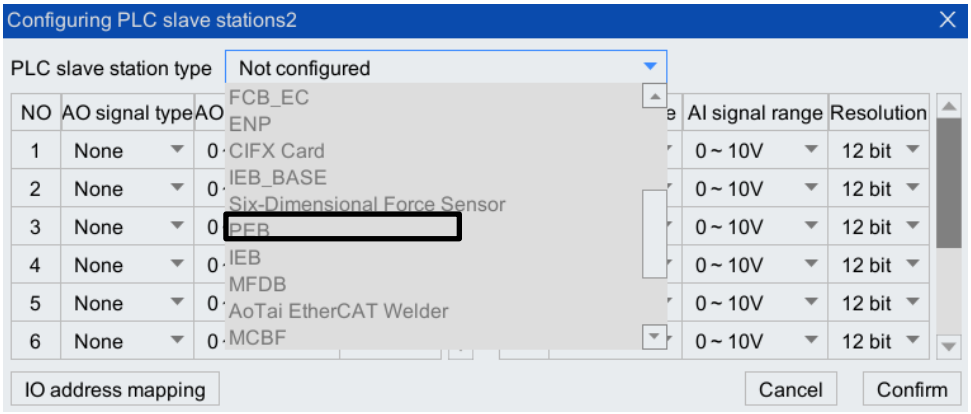


Figure 8-21 PLC slave-2 configured as PEB

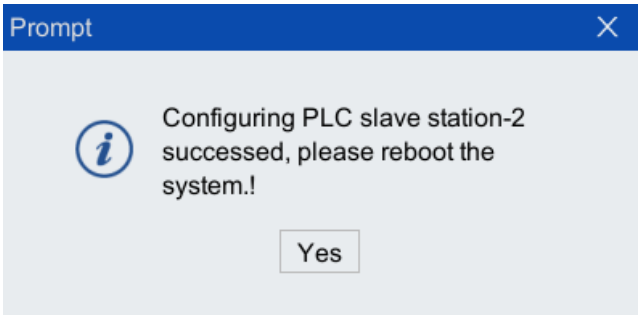


Figure 8-22 "PLC Slave-2 Configured Successfully" dialog box

Table 8-4 PLC slave type description

Slave type	Description
MF	Used to expand the number of user DI/DO, the slave station type needs to be configured after the PLC-MF module is connected to the control cabinet
INT	The internal function modules of ARCC/ARC4 control cabinet are automatically configured by software, without manual configuration by the user

Slave type	Description
CCB	InCube10/12 control cabinet internal functional modules, software automatic configuration, no manual configuration by the user
MCBS	InCube20/21/22 control cabinet internal functional modules, software automatic configuration, no manual configuration by the user
ACRC_MB	The internal function modules of the ACRC control cabinet are automatically configured by the software without manual configuration by the user
Hilscher DeviceNet Conversion Module	Used to convert EtherCAT interface to DeviceNet interface, the slave station type needs to be configured after the control cabinet is connected to the module
Beckhoff DeviceNet conversion module	Used to convert EtherCAT interface to DeviceNet interface, the slave station type needs to be configured after the control cabinet is connected to the module
MFDB_BASE	Used for inCube10/12 and ARC4 control cabinets to extend analog interface, encoder interface or magnetic scale interface. After the control cabinet expands these interfaces, the slave station type needs to be configured
FCB_EC	It is used for the sensor drag teaching function, and the slave station type needs to be configured after the module outside the Yuli six-dimensional force sensor
ENP	Adapt to the internal functional modules of inCube20, the software is automatically configured, no manual configuration by the user
CIFX card	The industrial computer used in the ARCC control cabinet expands the DeviceNet interface. After the industrial computer is installed with this board, the slave station type needs to be configured
IEB_BASE	Used for inCube20/21/22 control cabinet to extend the analog interface, encoder interface, magnetic scale interface or PWM output interface. After the control cabinet expands these interfaces, the slave station type needs to be configured
Yuli six-dimensional force sensor	Used for sensor drag and teaching function, the slave station type must be configured after the control cabinet is connected to the Yuli six-dimensional force sensor
PEB	It is used to convert EtherCAT interface to Profinet interface or analog interface. After the control cabinet is connected to the module, the slave station type needs to be configured. For details, please refer to "PEB Operation Manual"
IEB	Used for inCube20/21/22 control cabinet to expand CANopen interface, after the control cabinet expands this interface, the slave station type needs to be configured
MFDB	Used for inCube10/12 and ARC4 control cabinets to extend the CANopen interface. After the control cabinet expands this interface, the slave station type needs to be configured
Otai EtherCAT welding machine	Used to build a welding workstation, the slave station type needs to be configured after the control cabinet is connected to the Otai EtherCAT welder
MCBF	The internal function modules of inCube2S control cabinet are automatically configured by software, without manual configuration by users
HPS_FT	Used for sensor drag and teaching function, the slave station type needs to be configured after the control cabinet is connected to the HPS_FT six-dimensional force sensor
WRIST	Used for the sensor drag and teaching function, the slave station type needs to be configured after the control cabinet is connected to the WRIST six-dimensional force sensor

Slave type	Description
ACRC_MB_AO	ACRC_MB analog interface, expansion analog interface of collaborative robot main control board
ACR_EXT	ACR MB external axis interface, collaborative robot main control board expansion external axis interface
ENP_IO	Adapt the internal functional modules of inCube20, the difference from ENP is that this module only supports IO functions.
MCBS20	The internal functional modules of inCube2X control cabinet are automatically configured by the software without the need for manual configuration by the user.
BDI	Universal 16-channel digital input module, using Modbus communication interface.
BDO	Universal 8-channel digital output module, using Modbus communication interface.
Magmit Welding Machine	Magmit Welding Machine
IEB_DEC	inCube2X module only supports absolute value encoders
BDIO48	Universal 48-channel digital input and output module, using Modbus communication module, dedicated module inside the Siling control cabinet

Table 8-5 Description of PLC slave configuration

Name	Description
AO signal type	Voltage type
	Current type
AI signal type	Voltage type
	Current type
Signal range	0V -10V
	0V -5V
	-10V -10V
	4mA -20mA
	0mA -20mA
Resolution	12bit~20bit ,9 kinds
IO address mapping	Click the "IO Address Mapping" button in the lower left corner of the "Configure PLC Slave-2" interface, and the "PLC Slave-2 Address Mapping" interface will pop up. You can see DO (digital output) and DI (digital input) on this page.) Start logical address and end logical address, as shown inFigure 8-23 Figure 8-23 IO address mapping of PEB module

Step3.After restarting, in the main interface of the teach pendant, click "System > System Configuration > PLC Slave Configuration" option to enter the "PLC Slave Configuration" interface shown in Figure 8-24, the serial number is The PLC slave type of 2 has been successfully configured as "PEB".

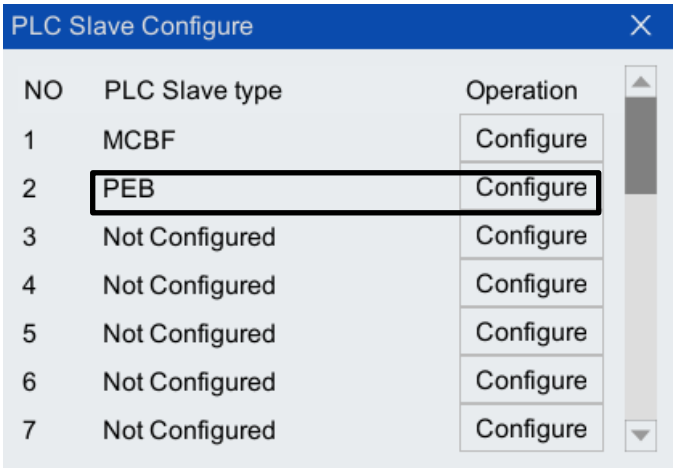


Figure 8-24 The type of PLC slave with serial number 2 is configured as "PEB"

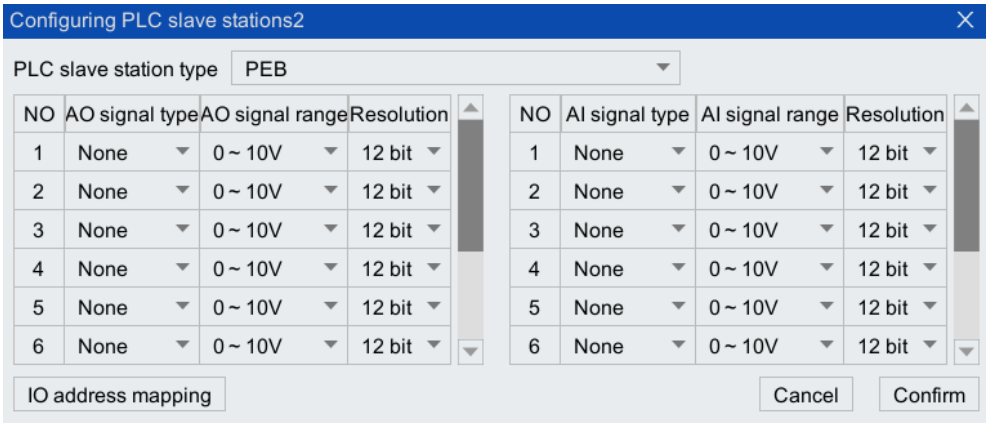


Figure 8-25 "Configure PLC Slave-2" interface

8.3.5 Drive parameter configuration

The user cannot change the drive parameters by himself. If you need to change it, you must contact the company's after-sales personnel to assist in the change.

8.3.6 Network configuration

On the main interface of the teach pendant, click the "System > System Configuration > Network Configuration" option, and the "Network Configuration" interface shown in Figure 8-26 will pop up, and each user's network port can be configured through this interface. Click the icon of any user network port, and the "User Network Port Settings" interface as shown in Figure 8-27 pops up, through which the IP address, subnet mask and gateway of the user's network port can be set.

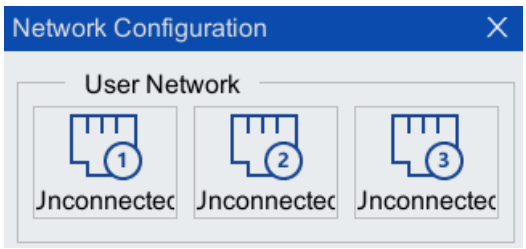


Figure 8-26 "Network Configuration" interface

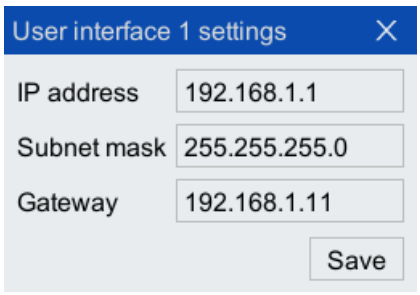


Figure 8-27 "User network port settings" interface

8.3.7 Analog trigger

On the main interface of the teach pendant, click "System > System Configuration > Analog Trigger" option, the "Analog Trigger" interface as shown in Figure 8-28 will pop up. For the setting description in the interface, please refer to Table 8-6.

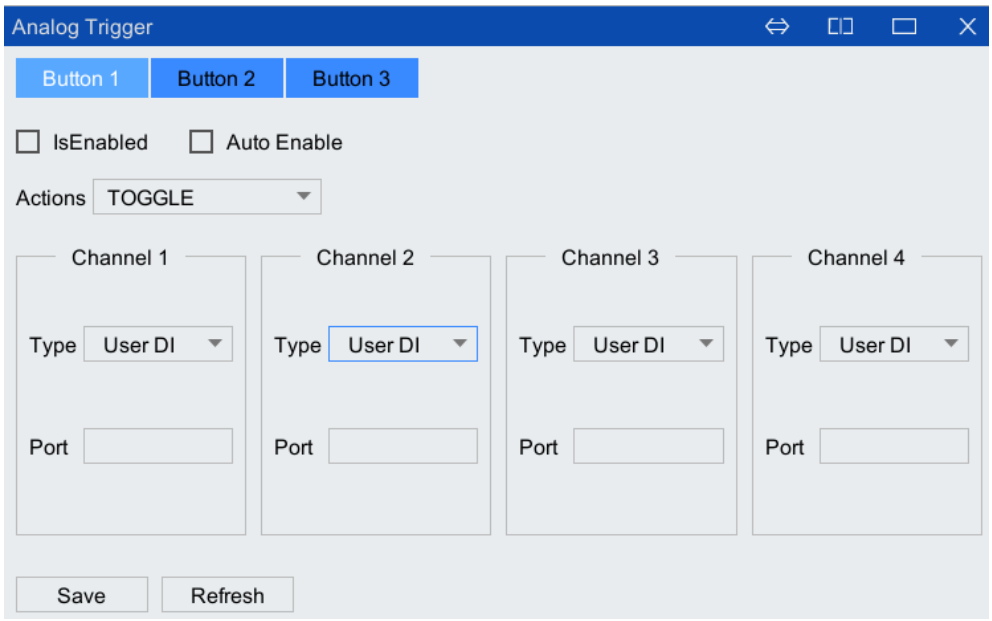


Figure 8-28 "Analog trigger" interface

Table 8-6 "Analog Trigger" interface setting instructions

Name	Description
"Button 1-3" tab	Corresponding to the "analog trigger button 1/2/3" that can be set in the function key "F1/F2/F3" in Figure 8-17 Note: A single analog trigger button allows control of multiple IOs (maximum number of channels: 4) Please refer to chapter 8.3.2 for the setting method of "analog trigger button 1/2/3"
"Enable" checkbox	If checked, it will respond to the key press; otherwise, it will not respond to the key press and give a prompt in the message bar
"Allow automatic mode" checkbox	In automatic mode, you need to turn on "Allow automatic mode" to respond to the analog IO button; otherwise, it will not respond to the button action and give a prompt in the message bar In the "other mode", the analog trigger function and the program are simultaneously effective for IO control When the analog trigger function is turned on and the program is running:

Name		Description
		■ Actual DO: respond to the program's control of DO (that is, in any case, the state of DO can be controlled by the program, such as: setdo) ■ Actual DI: Does not respond to these external signals. The state of analog DI shall prevail, and a "Prompt" window will pop up: "The DI port with logical address... has been configured for analog IO button triggering and cannot continue to respond to external signals. Continue to run?" (Note: ... represents all DI port numbers that are configured to take effect)
Perform actions		Switch: ■ It was high level state before, switch to low level state ■ It was in low level state before, switch to high level state
		Set to 1: Regardless of the previous level state, the state is set to true (high level state)
		Set to 0: Regardless of the previous level state, the state is set to false (low level state)
		Press/release: the specific performance depends on the IO state before triggering When the level state is high, it becomes low after pressing, and it returns to high when released When the original level state is low level, it will become high level after pressing, and it will return to low level after release.
		Pulse: The specific performance depends on the IO state before the trigger Each press changes the state and outputs a pulse. If it is originally high, it will output a low-level pulse for about 1s after pressing it once; if it is originally low, it will output a high-level pulse for about 1s after pressing it once
"4-way" IO area frame	type	Can trigger two types of signals, user DI and user DO
	port number	Set the port number corresponding to the selected user DI/DO
save		Save only the content in the current page
Refresh		Restore to the last saved state of the current page

8.4 Appearance and invididualization

Operation steps:

Step1.On the main interface of the teach pendant, click "System > Appearance and Personalization" option to enter the "Appearance and Personalization" setting interface as shown in Figure 8-29, screen saver time, lock screen time, language, The interface style and background picture can be set here (see Table 8-7 for each item description).

Step2.After the setting is completed, click the <Apply> button, and the "System settings have been changed" prompt box as shown in Figure 8-30 will pop up to complete the setting; if you click the <Refresh> button, it will return to the initial setting.

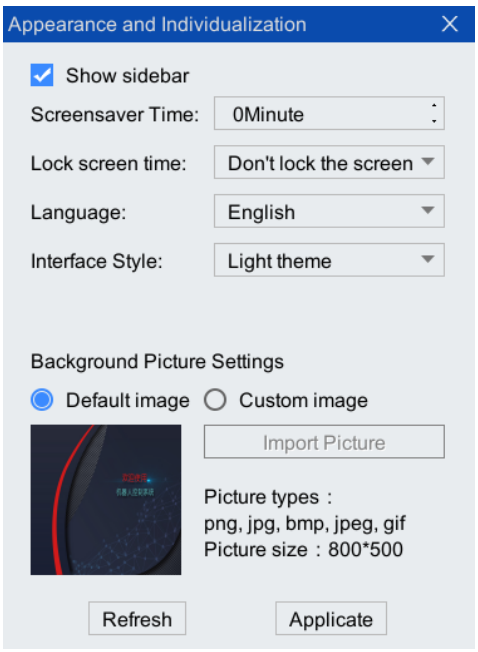


Figure 8-29 "Appearance and Invididualization" setting interface

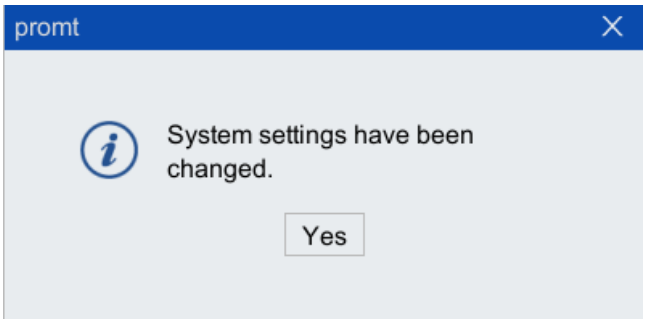


Figure 8-30 "System settings have been changed" dialog box

Table 8-7 Description of "Appearance and Invididualization" interface

Name	Description
Show sidebar	To display or hide the sidebar
Screensaver time	The screen saver trigger time can be changed via the system soft keyboard.
Lock screen time	The time required to trigger the lock screen function can be set.
Language	To display or modify the currently supported languages. Chinese by default
Interface style	To display or modify the currently supported theme styles. Dark theme by default
Background picture setting	The user can use the default background picture or customize the desired picture. The type and size requirements of the picture are shown below.

8.5 User and password

8.5.1 Password change

Operation steps:

Step1.On the main interface of the teach pendant, click "System > User and Password > Change Password" option, and the interface as shown in Figure 8-31 will pop up.

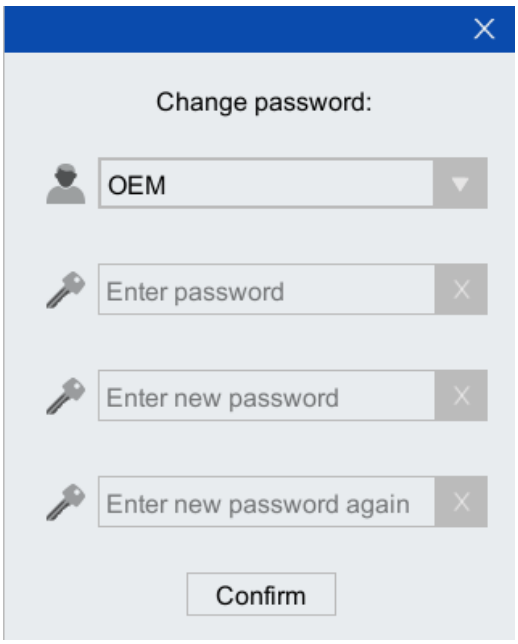


Figure 8-31 Modify password interface

Step2.The user can first enter the new password according to the prompt in the text box. After the input is completed (refer to Figure 8-32), click the <Confirm> button, and the "prompt" box of "Password updated Successfully!" as shown in Figure 8-33 will pop up , The password is changed successfully.

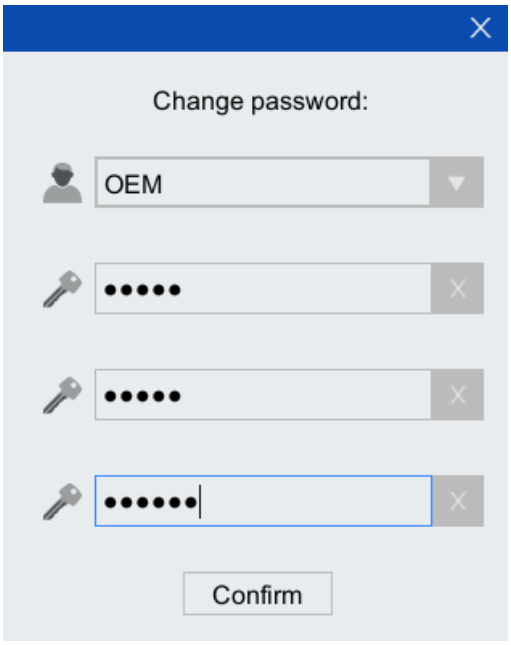


Figure 8-32 Password input complete interface

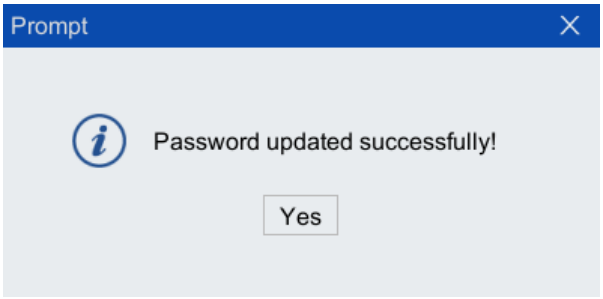


Figure 8-33 "Modify the password successfully!" "Prompt" box

8.5.2 Switch to operator

In the main interface of the teach pendant, click "System > User and Password > Switch to Operator" option, the user can quickly switch the current identity to the operator (Operator), without the need to "log out" and other operations, After the switch is successful, the "Message Bar" of the system displays "Switched to Operator", as shown in Figure 8-34.

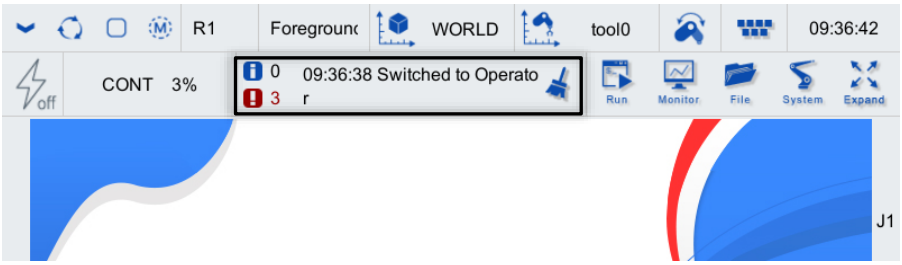


Figure 8-34 The message bar shows that it has been switched to operator authority

8.6 System and update

8.6.1 System message

On the main interface of the teach pendant, click "System > System and Update > System Information" option to enter the "System Information" interface shown in Figure 8-35. The interface contains detailed information such as version, time, authorization, storage, and IP. For instructions, please refer to Table 8-8.

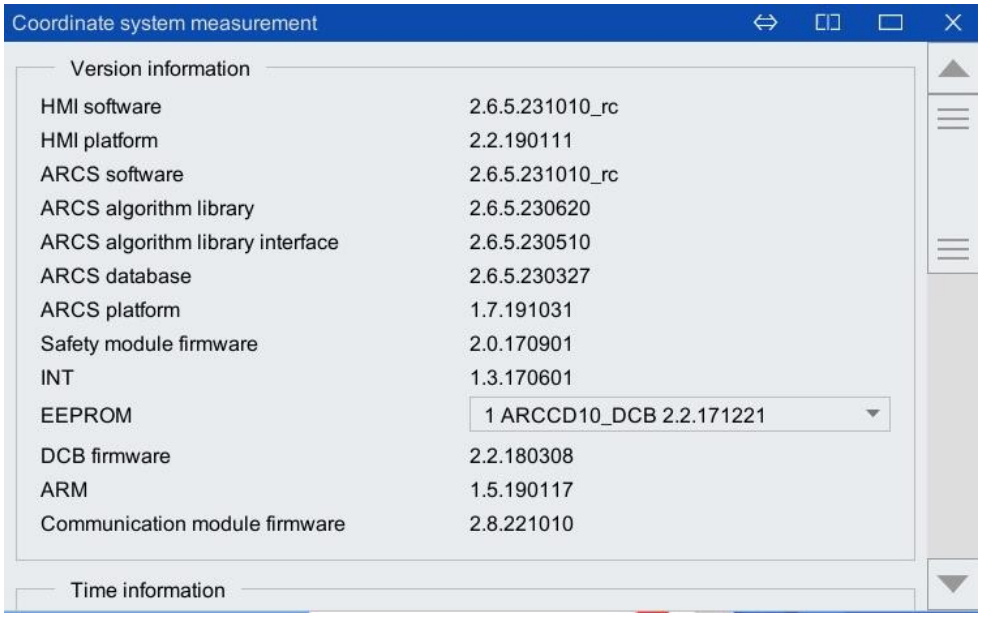


Figure 8-35 "System Information" interface

Table 8-8 Description of "system information"

Name	Description
Version information	It contains information such as the currently used HMI version number, controller RC version number, communication card firmware version number, etc.
Time information	It contains information such as cumulative enable, cumulative startup, cumulative action time, etc.
Authorization information	It contains information such as remaining usage times, accumulative time, and absolute time with authorized equipment ID, ARCS and HG.

Name	Description
Storage information	It contains information such as total system space, used system space, remaining system space, etc.
IP information	You can view HMI, ARCS and user IP information

8.6.2 Version update

8.6.2.1 HMI upgrade

Operation steps:

Step1.On the main interface of the teach pendant, click "System > System and Update > Software Update" option, the "Select Version" list box pops up, as shown in Figure 8-36.

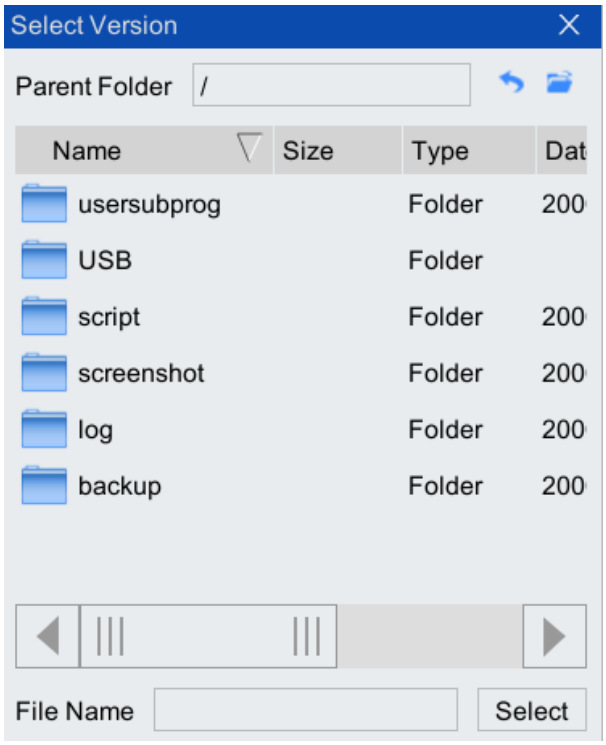


Figure 8-36 "Version Update" interface

Step2.As shown in Figure 8-37 switch the path to the path where the HMI upgrade file is located, select the HMI upgrade file, click <Select> button to pop up "Upgrade AIR-TP to ****?" dialog box in Figure 8-38, and click <Yes> button. When "Please power off and reboot to complete the HMI upgrade!" dialog box in Figure 8-39 pops up, click <Yes> button to restart the control cabinet to complete the HMI upgrade.

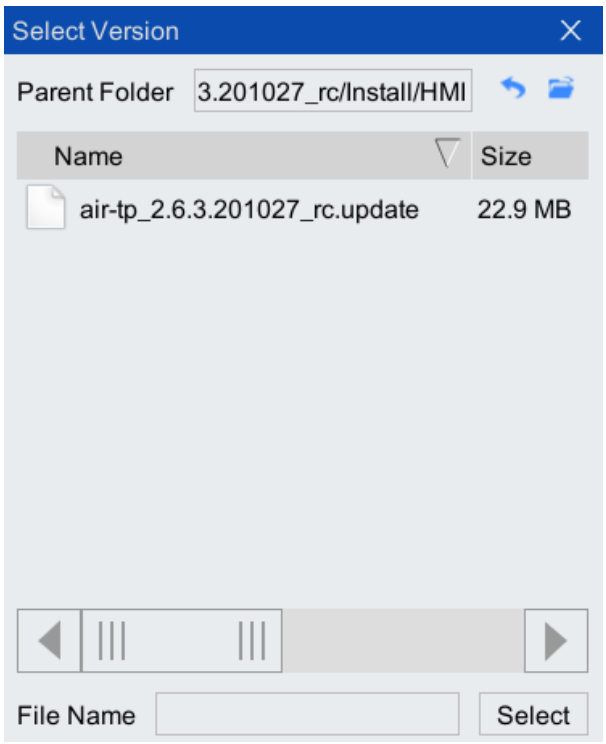


Figure 8-37 Path where HMI upgrade file is located

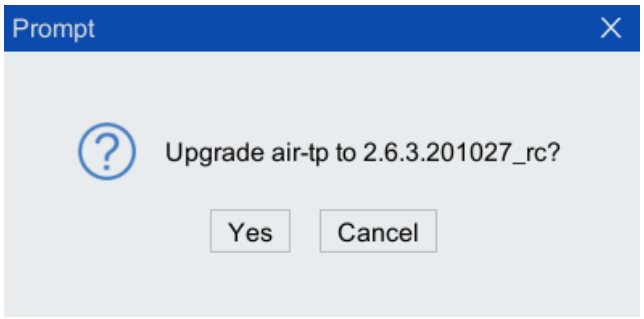


Figure 8-38 "Upgrade HMI to the corresponding version" dialog box

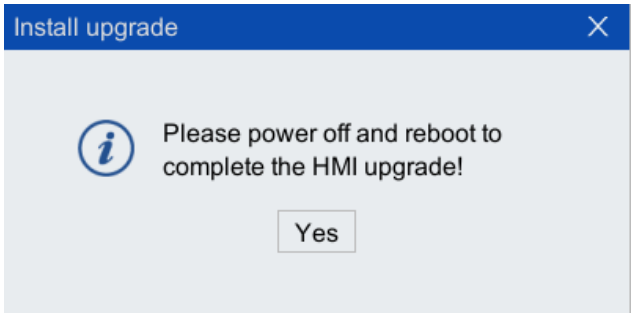


Figure 8-39 "Power off and restart to complete HMI upgrade" dialog box

8.6.2.2 ARCS upgrade

Operation steps:

Step1.On the main interface of the teach pendant, click "System > System and Update > Software Update" option, and the "Select Version" list box pops up, as shown in Figure 8-40.

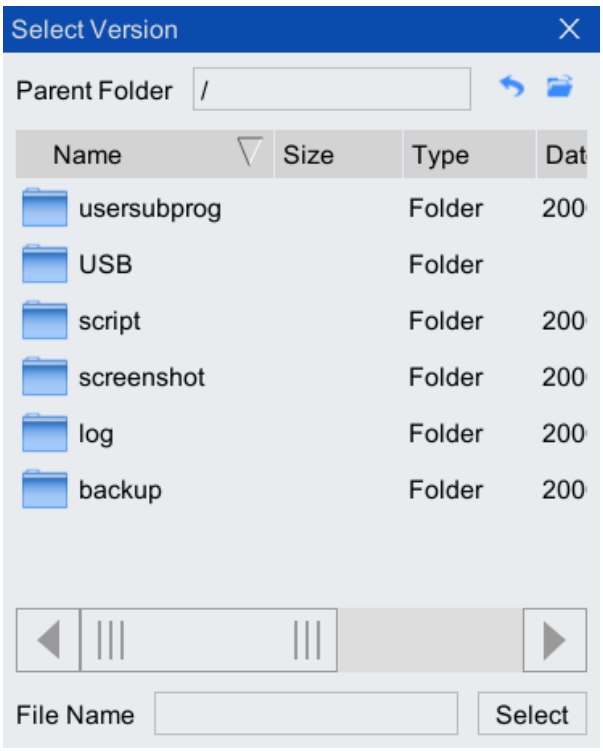


Figure 8-40 "Select Version" interface

Step2.As shown in Figure 8-41, switch the path to the path where the ARCS upgrade file is located, select the ARCS upgrade file, click <Select> button to pop up "Upgrade arcs to the corresponding version?" dialog box in Figure 8-42, and click <Yes> button.

Figure 8-41 Path where ARCS upgrade file is located

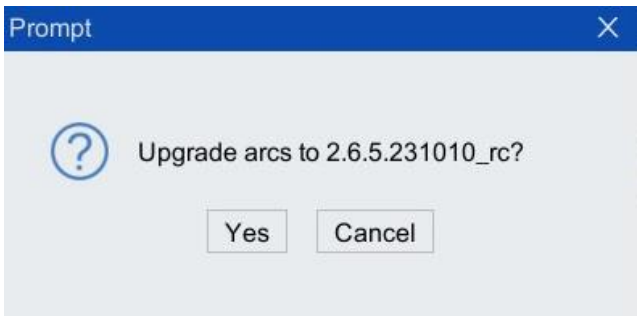


Figure 8-42 "Are you sure to upgrade ARCS to the corresponding version" dialog box

Step3.Pop up "Upgrade the Database Option" interface shown in Figure 8-43, configure the options according to the needs (for details, please refer to Table 8-9. You can only select one of the first 2 items in the table, and the last three items can be selected in multiples), and then click <Yes> button.

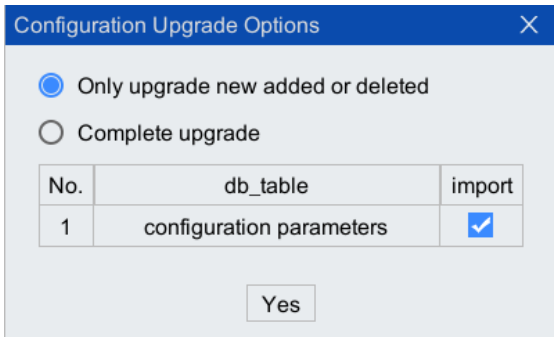


Figure 8-43 "Upgrade Database Option" interface

Table 8-9 Description of "Upgrade Database Option"

Num	Name	Description
1	Only update new or deleted	Compared with the database before the upgrade, the upgraded database only adds or deletes parameters, and does not change the parameter content (this option is generally checked by default)
2	Complete updated	After the upgrade, the database in the upgrade file completely replaces the original database. This option will cause the parameter values in the original database to be initialized. Use it with caution
3	Configuration parameters	It needs to be used in conjunction with the first and second options to upgrade the parameter configuration. "Configuration parameters" option is checked by default, if unchecked, no parameter configuration upgrade will be performed

Step4.When "Please power off and reboot to complete the ARCS upgrade!" dialog box in Figure 8-44 pops up, click <Yes> button to restart the control cabinet to complete the ARCS upgrade.

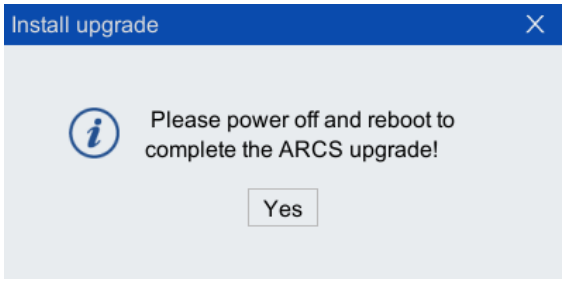


Figure 8-44 "Please power off and restart to complete the ARCS upgrade!" prompt box

8.6.3 Firmware upgrade

The firmware update function can complete the upgrade of DCB, CCB and MF firmware versions and the upgrade of corresponding configuration files.

8.6.3.1 Standard cabinet firmware update

When the control cabinet is a standard cabinet, the update of the MF firmware version is taken as an example to describe the update process.

Update process:

Step1.Before MF firmware upgrade, you need to configure the PLC slave. For the specific method of "PLC Slave Configuration", please refer to Section 8.3.1.

Step2.Select "System> System and Update> Firmware Upgrade" option to pop up "Select Firmware" dialog box in Figure 8-45, find the path where MF firmware upgrade file is located and highlight the upgrade file, and click <Select> button.

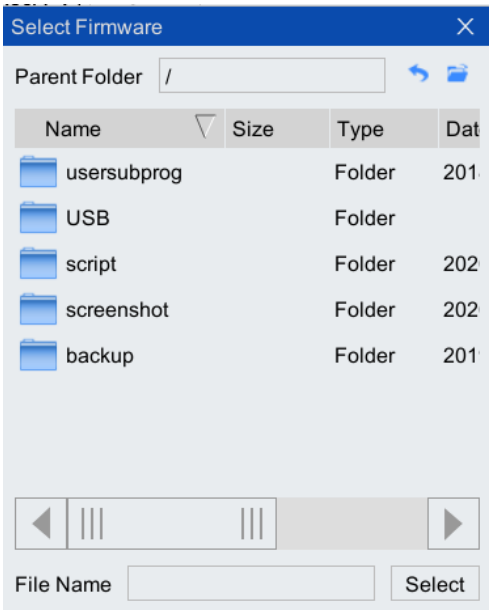


Figure 8-45 "Select firmware" interface

Step3.Pop up "Upgrade" window shown in Figure 8-46, find "PLC_MF" option in "Equipment Selection", and then click <Start Update> button. Pop up "Upgrade2---MF ***? " dialog box in Figure 8-47, and click <Yes> Button to pop up the upgrade progress bar. The MF file upgrade will take about 30s.

Figure 8-46 "Upgrade" window

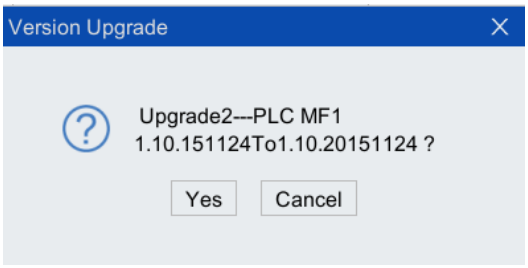


Figure 8-47 "Are you sure to upgrade MF to the corresponding version" dialog box

Step4.After upgrade, pop up "Please power off and reboot to complete the PLC upgrade!" dialog box in Figure 8-48, click <Yes> button, restart the control cabinet and MF to complete the MF firmware upgrade.

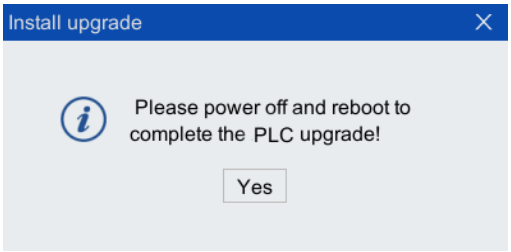


Figure 8-48 Prompt box

> Prompt
>
> The method of updating other firmware of the standard cabinet is the same as that of MF. No further description is given here. For the functions of DCB, CCB and MF firmware, please refer to "Manual of XX Control Cabinet".

8.6.3.2 Compact cabinet firmware update

When the control cabinet is a compact cabinet, the update of the DCB firmware version is taken as an example to describe the update process.

Update process:

Step1.Select "System> System and Update> Firmware Update" option to pop up "Firmware Update" interface shown in Figure 8-49.

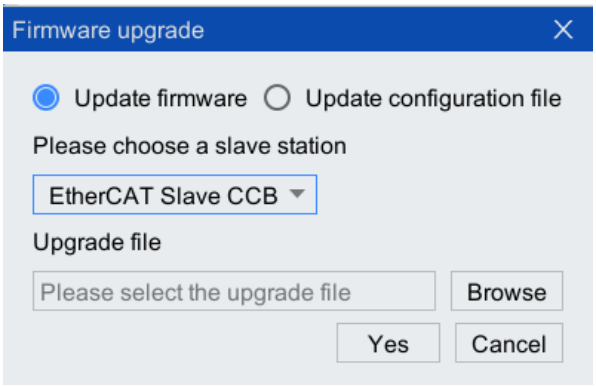


Figure 8-49 [Firmware Upgrade] interface

Step2.As shown in Figure 8-49, select "Upgrade File", select "DCB" as slave, and then click <Browse> button to pop up "Please select the upgrade file" dialog box, as shown in Figure 8-50. Find the path where the DCB firmware upgrade file is located, select the upgrade file, and click <Select> button.

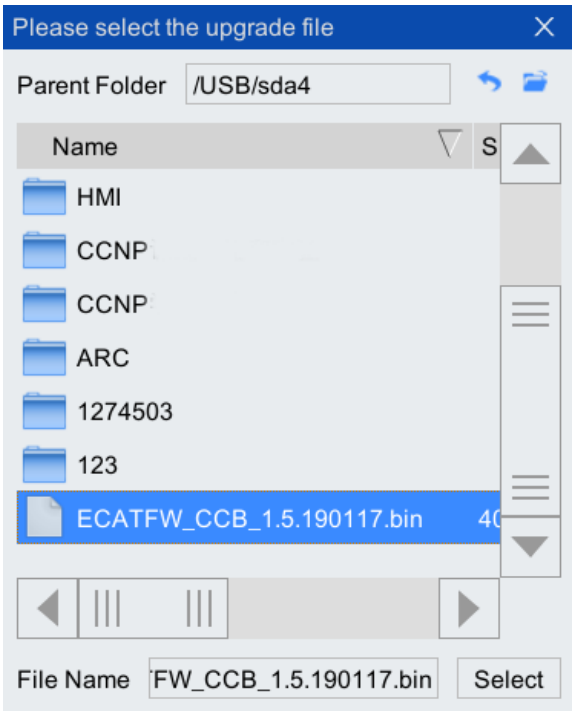


Figure 8-50 "Please select the upgrade file" dialog box

Step3.After "Are you sure to upgrade?" dialog box in Figure 8-51 pops up click <Yes> button to pop up the upgrade progress bar. The CCB file upgrade will take about 1 min.

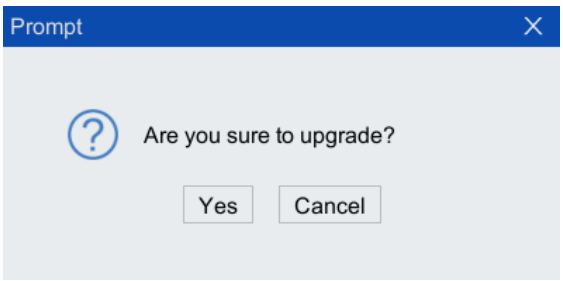


Figure 8-51 "Are you sure to upgrade?" dialog box

Step4.After upgrade, "Please power off and reboot to complete the upgrade!" dialog box in Figure 8-52 click <Yes> button, and power off and restart to complete the DCB firmware upgrade.

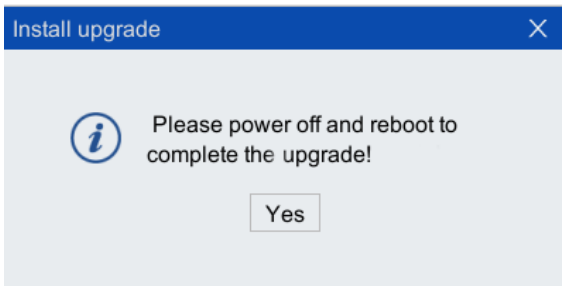


Figure 8-52 "Please power off and reboot to complete the upgrade!" dialog box

Prompt

The method of updating the CCB and "Configuration File" is the same as that of the DCB. No further description is given here.

8.6.4 Platform update

Update process:

Step1.On the main interface of the teach pendant, click "System > System and Update > Choose Platform Version" option, the "Choose Platform Version" list box pops up, as shown in Figure 8-53.

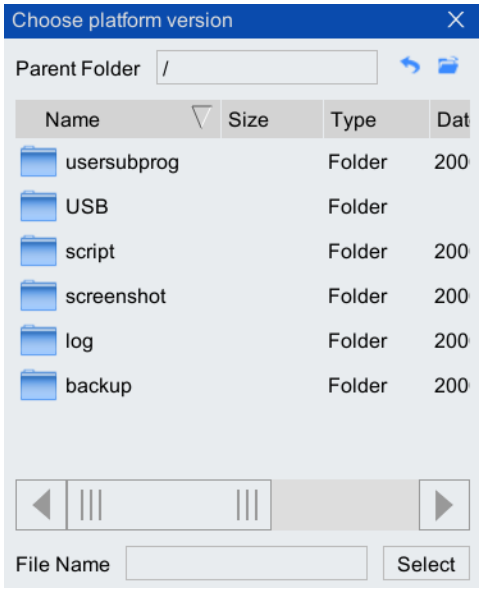


Figure 8-53 "Select platform version" list box

Step2.Switch the path from Figure 8-54 to the path where the platform upgrade file is located, select the platform upgrade file, click the <Select> button, and the "Upgrade os to **?" prompt dialog box shown in Figure 8-56 will pop up, Click the <Yes> button.

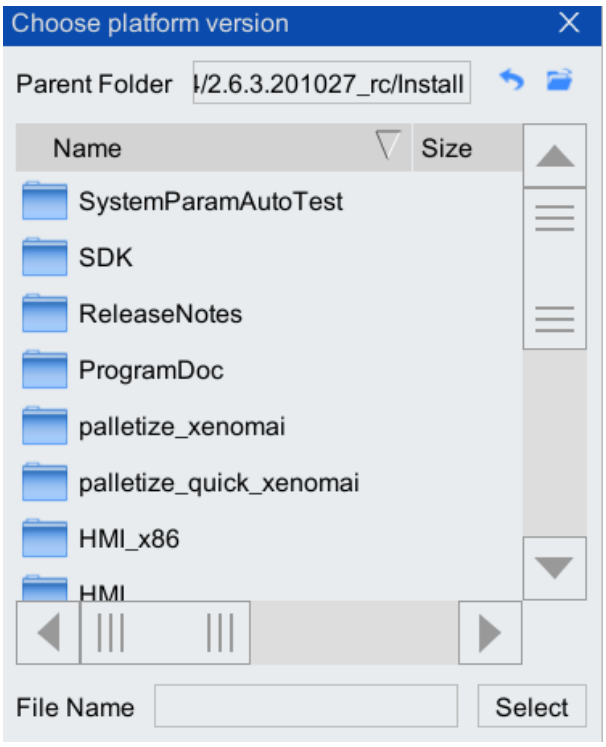


Figure 8-54 "Please select upgrade file"list box

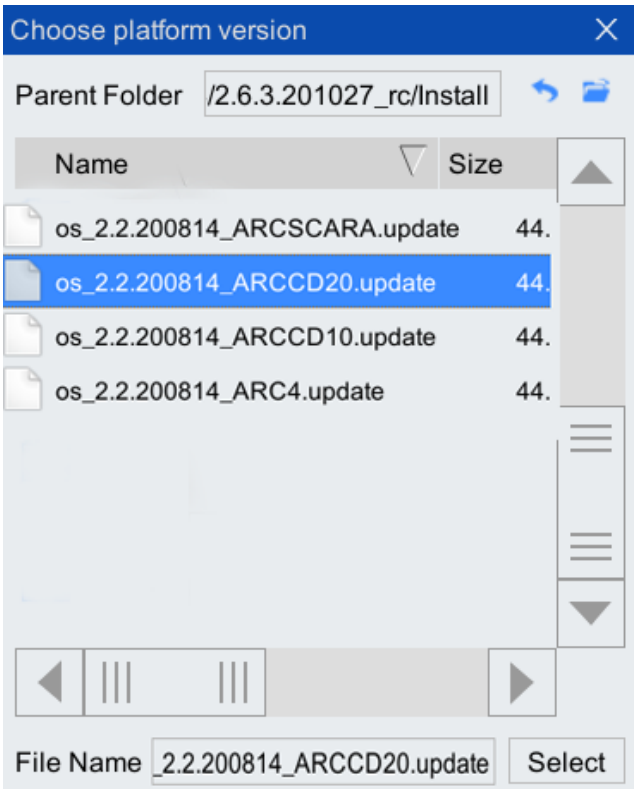


Figure 8-55 The path of the platform upgrade file

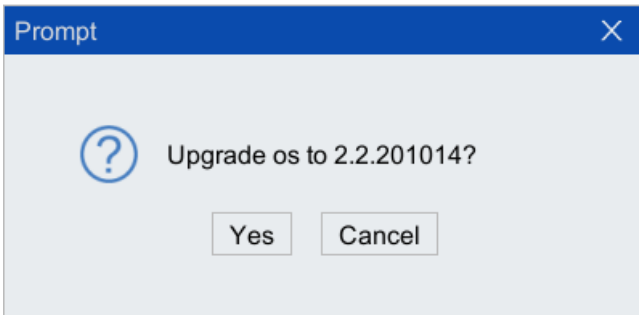


Figure 8-56 "Upgrade os to **?" prompt dialog box

Step3.After the upgrade is completed, the "Please power off and restart to complete the ARCS platform upgrade!" prompt box as shown in Figure 8-57 pops up. After clicking the <Yes> button, power off and restart to complete the platform update.

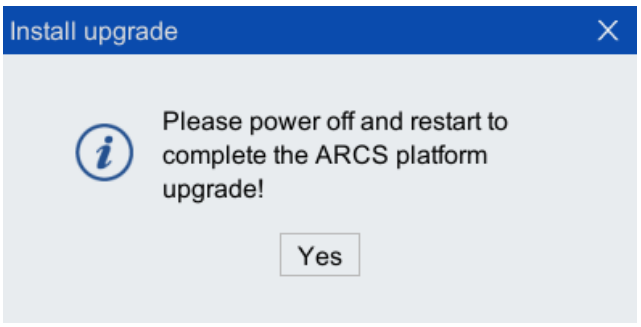


Figure 8-57 "Please power off and restart to complete the ARCS platform upgrade!" prompt box

8.6.5 Export configuration

The export configuration function can complete the export of DCB and CCB configuration files.

Specific process:

Step1.On the main interface of the teach pendant, click "System > System and Update > Export Configuration" option, and the "Save Configuration" interface as shown in Figure 8-58 pops up.

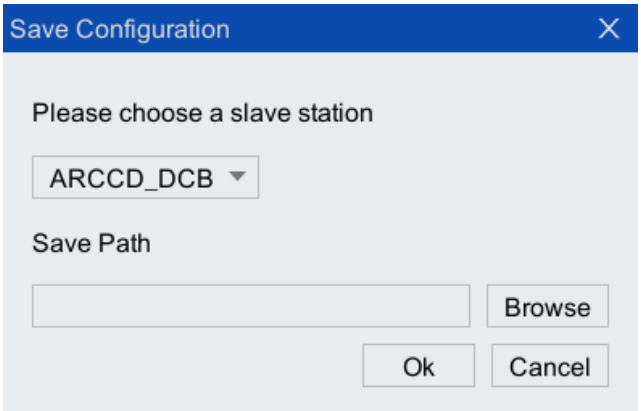


Figure 8-58 Export Configuration File

Step2.Select "D_DCB" or "EtherCAT Slave CCB" as slave, click <Browse> button, select the save path, then click <Yes> button to pop up "Save configuration or not?" dialog box in Figure 8-59 and click <Yes> button.

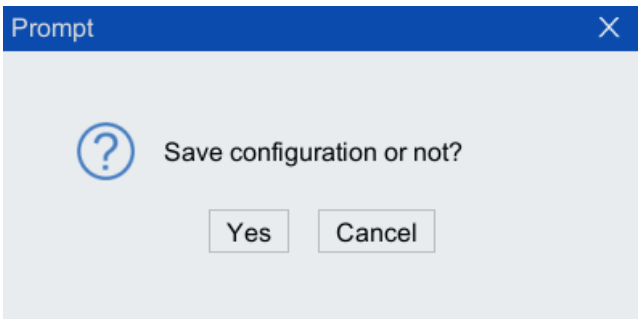


Figure 8-59 "Save Configuration" dialog box

Step3.The message bar prompts "EEPROM configuration file has been saved!", as shown in Figure 8-60. Then the configuration file is exported to the selected path.

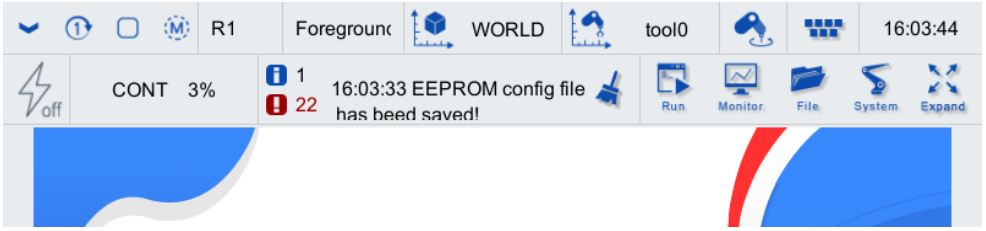


Figure 8-60 "Configuration file is exported successfully" prompt message

8.6.6 Authorized import

When the user is restricted by the trial period or needs to activate the extended feature pack, the authorized file (License) officially released by Peitian must be imported for activation. Related operations such as feature packs are not currently supported.

8.7 Restart and logout

8.7.1 Logout

On the main interface of the teach pendant, click "System > Restart and Logout > Logout" to log out the current user identity and return to the login interface. The user needs to log in to the teach pendant again.

Caution

After logout, the "Workobject Coordinate System" and "Tool Coordinate System" will not be affected.

8.7.2 Lock screen

On the main interface of the teach pendant, click "System > Restart and Logout > Lock Screen" option to quickly lock the current operation page and display the login interface to prevent misoperation. At the same time, the user can log in to the current identity again with a password, or switch to another identity to log in.

8.7.3 Remote shutdown

Prompt

In order to protect the device more safely, the "remote shutdown" option is set. Remote shutdown is soft shutdown, and the difference between directly turning off the power switch of the control cabinet is similar to the difference between turning off the computer by pressing the power and turning off in the start bar.

On the main interface of the teach pendant, click "System > Restart and Logout > Remote Shutdown" option to enter the "Remote Shutdown" interface as shown in Figure 8-61, click the <Yes> button to close the control system at the

same time, the teach pendant will also be closed; click the <Cancel> button to abandon the remote shutdown operation.

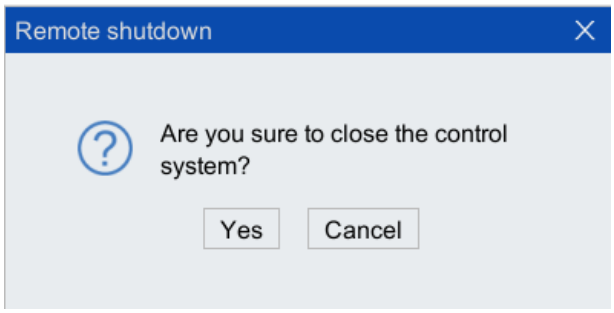


Figure 8-61 "Remote Shutdown" interface

8.7.4 Shielded teach pendant (ARC4 control cabinet)

When using the ARC4 control cabinet, on the main interface of the teach pendant, click on the option [System/Restart and Logout/ Lock screen] to enter the [Lock Screen] interface as shown in Figure 8-62. In the middle of the interface, it displays the prompt message 'The teach pendant has been locked, the emergency stop function of the teach pendant is invalid, please unplug the teach pendant in time'. At this time, clicking the <Unlock> button will not unlock it. You can switch to the interface shown in Figure 8-63 by clicking on the < Enable the teach pendant> in the upper left corner of the interface, and then click the < Unlock> button to re-enter the main interface of the teach pendant.

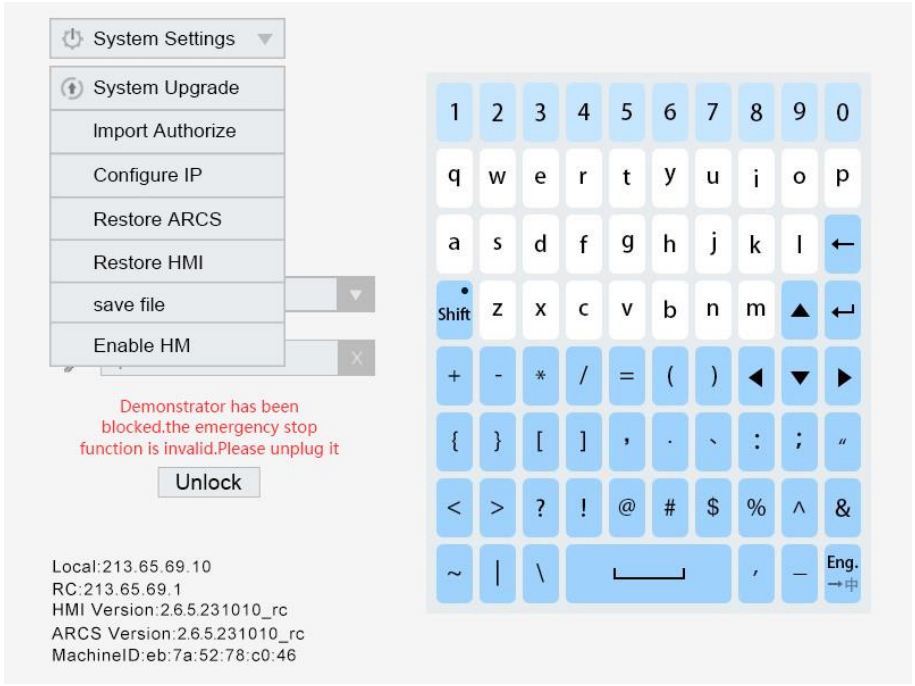


Figure 8-62 Teaching pendent [Lock Screen] Interface 1

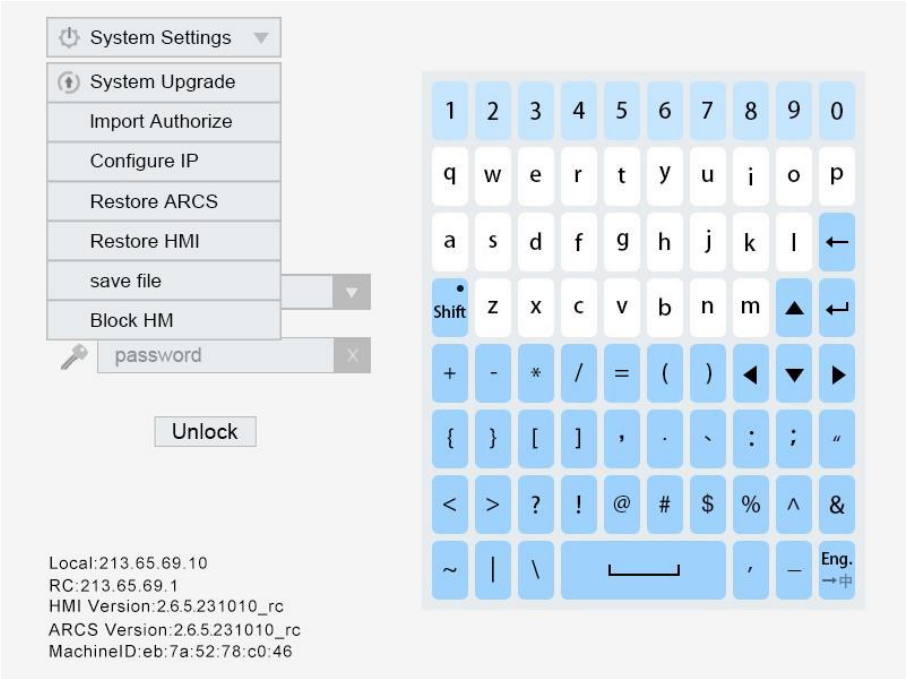


Figure 8-63 Teaching pendent [Lock Screen] Interface 2

8.8 Developer

8.8.1 Log assistant

On the main interface of the teach pendant, click "System > Developer > Log Assistant" to open the "Log Assistant" interface as shown in Figure 8-64.

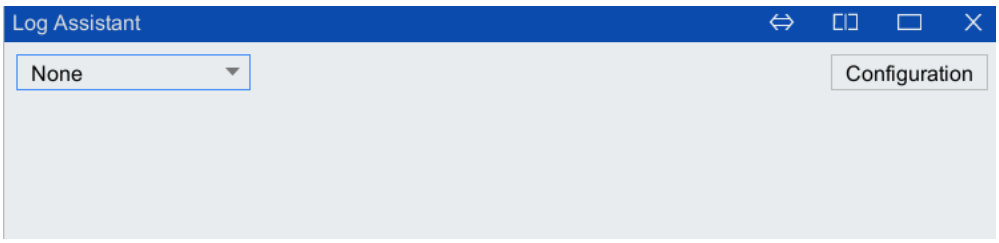


Figure 8-64"Log Assistant" interface

Click the drop-down list in the top left corner in Figure 8-64 to pop up the 4 display content types in Figure 8-65. For details, please refer to Table 8-10.

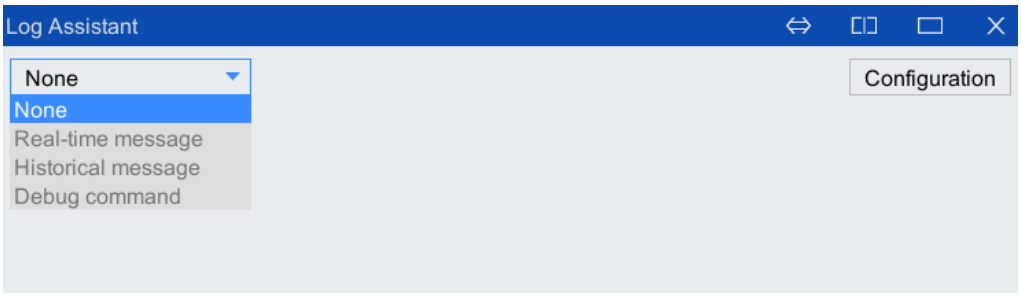


Figure 8-65 Display content list

Table 8-10 Description of "Display Content"

Name	Description
None	It represents that no information will be output in "Log Assistant" interface
Real-time message	It represents that real-time operation message will be output. For details, please refer to Section 8.8.1.1
Historical message	It represents that the historical messages recorded by the system will be output. For details, please refer to Section 8.8.1.2
Debug instruction	It represents that the system data information obtained through some debugging instructions will be output. For details, please refer to Section 8.8.1.3

Click <Configuration> button in the top right corner in Figure 8-64 to pop up the log assistant "Settings" interface shown in Figure 8-66. The interface can configure "Source", "Message Purpose" and "Tracking Level". For details, please refer to Table 8-11. After setting, click <Applicate> button and then click <Yes> button to complete the configuration.

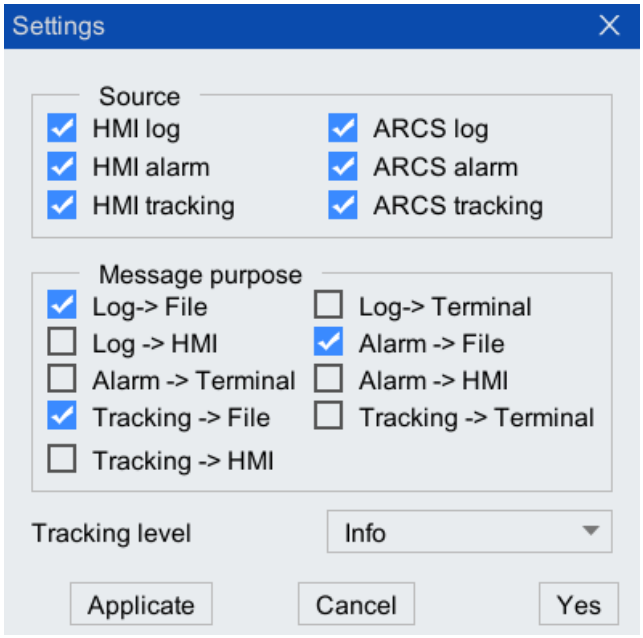
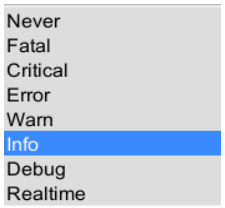


Figure 8-66 Log assistant "Configuration" interface

Table 8-11 Description of "Configuration" interface

Name	Description
Source	It mainly includes log information, warning message and tracking information from HMI; log information, warning message and tracking information from ARCS.
Message Purpose	The obtained message is output to the file (the log file in the/log/log directory)
	The obtained message is output to HMI (log assistant interface)
	The obtained message is output to the terminal (usually used by R&D personnel for debugging, and not used by the user)
Tracking level	It will be used together with "HMI Tracking" and "ARCS Tracking" options in the message source

Name	Description
	 Figure8-67"Tracking Level" interface If "HMI Tracking" or "ARCS Tracking" in "Message Source" is checked, you need to specify the tracking level. As shown in Figure8-67, the tracking level is increasing from Never to Realtime. If the specified tracking level is Critical, the output tracking information will include Critical and Fatal below Critical, and if the specified tracking level is Realtime, the output tracking information will include Realtime and all levels below Realtime.

8.8.1.1 Real-time message

In addition to the existing "Configuration" options, the "Real-Time Messaging" interface (see Figure 8-68) also includes the "Message Type", "Source" and "Empty" options. For details, please refer to Table 8-12. When selecting "Message Type" and "Source", you must ensure that the corresponding "Source" has been set in the configuration.

Prompt	If you want to print "real-time messages" to the log assistant interface, you also need to set the "message purpose" in the "configuration" interface to HMI, such as selecting "Log -> HMI", "Alarm -> HMI" or "Tracking- >HMI" to display the corresponding "real-time message" on the log assistant interface.

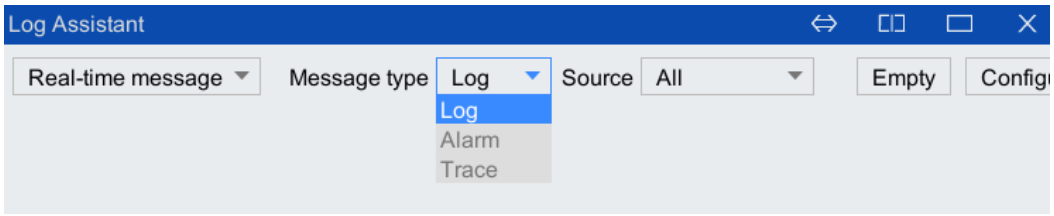


Figure 8-68"Real-Time Message" interface

Table 8-12 Description of "Real-Time Message" interface

Name	Description
Message type	"Log" represents the output of real-time operation information on the interface; "Warning" represents the output of warning message; "Tracking" is an option used by the developer for debugging, and mainly outputs the auxiliary debugging information added by the developer during operation.
Source	Include the options such as all, ARCS only and HMI only
Empty	To clear all messages output to the log assistant interface

8.8.1.2 Historical message

In addition to the existing "Configuration" option, the "Historical Message" interface (see Figure 8-69) also includes "Message Type", "Empty " and "Page Turn" options.

Different from "Real-Time Message", the display of "Historical Message" does not need to select the corresponding message source and message destination in "Configuration" interface. After selecting "Message Type" shown in Figure 8-69 and clicking <Page Turn Right> button, the corresponding type of "Historical Message" will be displayed. Clicking

<Empty> button will clear the content displayed in the log assistant interface. Click <Page Turn Right> button again to display "Historical Message" again.

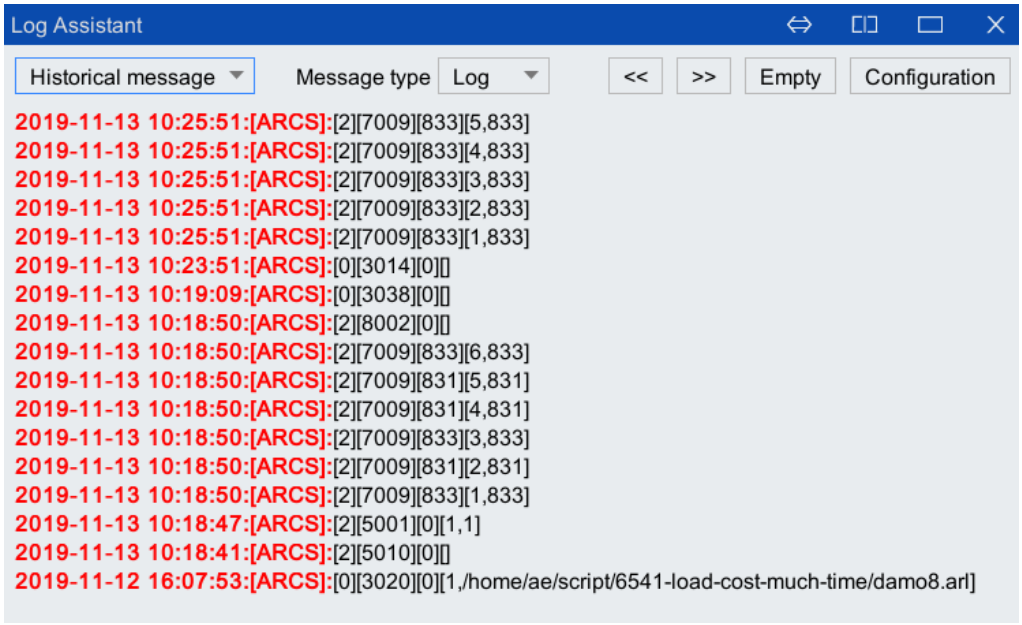


Figure 8-69 "Historical Message" interface

8.8.1.3 Debug instruction

In addition to the existing "Configuration" options, the "Debug instruction" interface (see Figure 8-70) also includes the "Instruction Input" and "Clear Historical commas" options.

Enter the instruction to be sent in "Instruction Input Box" and click <Send> button. The instruction will be displayed on the log assistant interface. The information obtained by some instructions will be displayed on the log assistant interface, and the information obtained by some instructions will be directly output to the txt file. Clicking <Clear historical instructions> button will clear all the contents displayed in the log assistant interface.

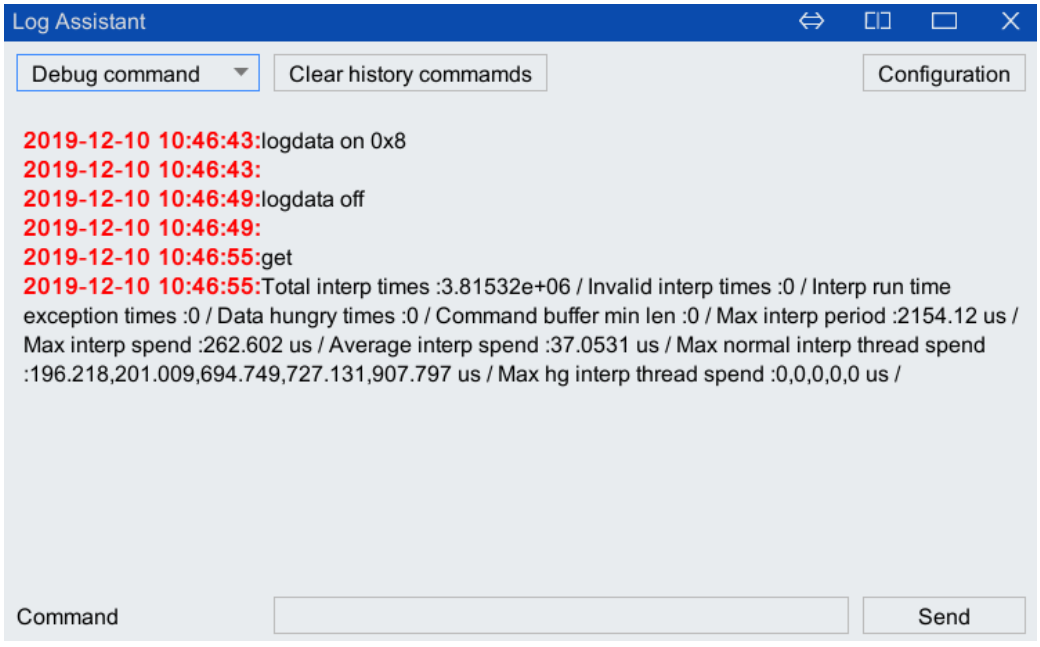


Figure 8-70"Debug Instruction" interface

"Debug instruction" is used by R&D personnel for debugging and is usually not open to the user.

9 Extension

9.1 Feature pack management

In the function package management, the installation, upgrade, uninstallation and authorization of function packages such as palletizing, bending and arc welding can be realized.

9.2 Vision

For details about vision system, please refer to the relevant manuals of the company:

- "Vision System Fast Import Manual"
- "Visual Application Scheme Design"
- "AEIV User Manual"

9.3 Classic palletizing

For the detailed usage of "Classic Palletizing Function", please refer to our "Classic Palletizing Function Package Manual".

9.4 Convenient edition palletizing

For the detailed usage of "Convenient Edition Palletizing Function", please refer to our company's "Convenient Edition Palletizing Function Package User Manual".

9.5 Bending

For details about "Bending Function", please refer to "Operation Instructions for Bending Feature Pack" of the company.

9.6 Arc welding

For details about "Arc Welding Function", please refer to "Operation Instructions for Arc Welding Feature Pack" of the company.

10 Advanced functions

10.1 Wrist singularity automatic avoidance function

10.1.1 Overview of Singularity

Singularity refers to some special poses of the robot. When the robot is in these poses, the speed of the end in a certain Cartesian direction will result in an infinite speed of a joint of the robot. Therefore, when the robot reaches a singular point, it will cause an axis overspeed warning.

There are three types of robot singularities:

Singularity of shoulder

The shoulder singularity occurs when the center of the robot wrist and the J1 axis joint are on the same line, as shown in Figure 10-1. In this case, the joint axis 1 and 4 will try to rotate 180 degrees immediately.

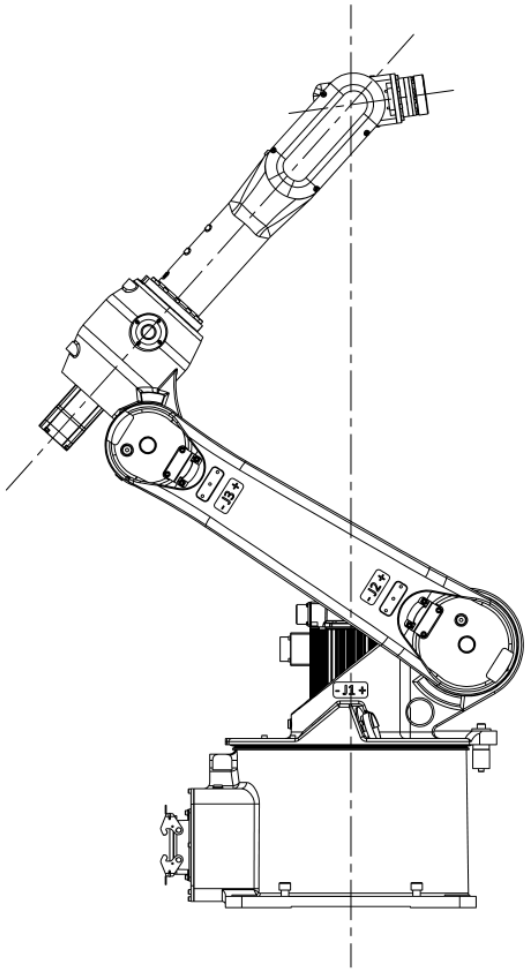


Figure 10-1 Contents of the singularity of the shoulder

Singularity of elbow

When the center of the robot wrist is on the same plane as the joint axes 2 and 3, a singularity of elbow will be generated, as shown in Figure 10-2. The singularity of the elbow looks like the robot "stretched too far", causing the elbow to lock in a certain spatial position.

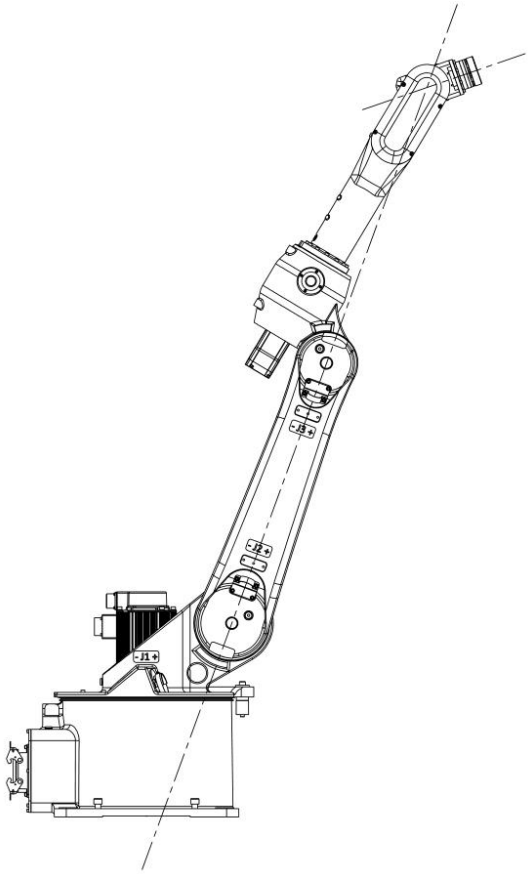


Figure 10-2 Contents of singularity at elbow

Singularity of wrist

When the two wrist axes (joint axes 4 and 6) of the robot are on the same straight line, a singular point of the wrist will be generated, as shown in Figure 10-3. This may cause these joints to try to rotate 180 degrees immediately.

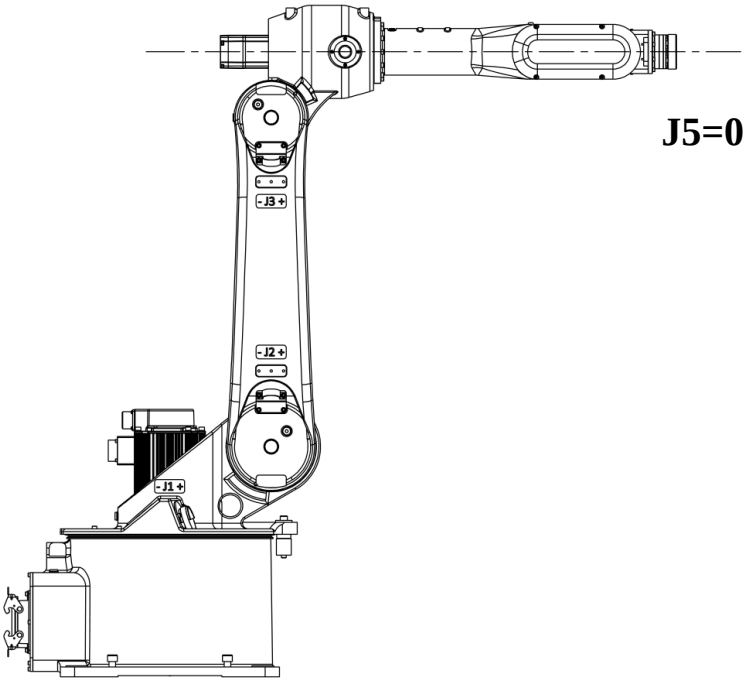


Figure 10-3 Contents of the singularity of the wrist

For shoulder singularity and elbow singularity, as long as the robot's working range is limited, it can be easily avoided. However, wrist singularity may occur in almost all positions of the robot's work area. When the robot passes the wrist singularity or near it, the J4 axis and J6 axis of the robot wrist axis will perform a large amount of rotation movement in a short time, making the robot produce an extremely strange movement posture; If you limit the running speed of the wrist axis at this time, it will cause the tool center point (TCP) to slow down, and the robot will also deviate from the trajectory shown in the teaching.

In response to the wrist singularity, we have developed an automatic singularity avoidance function that can dynamically avoid the singularity of the wrist in real-time.

By using the singularity automatic avoidance function, it is possible to avoid excessive rotation of the robot wrist joint axis and smoothly pass through the singularity point of the wrist, thus maintaining a constant speed of the robot tool center point (TCP).

10.1.2 Adapted models

The wrist's singularity automatic avoidance function is an advanced feature. For robot models that support this function, please refer to Table 10-1.

Table 10-1 Robot model that supports wrist singularity avoidance function

NO.	Robot model
1	AIR4-560A
2	AIR8-710A
3	AIR7-920B
4	AIR10-1420A
5	AIR20-1700A
6	AIR50-2230A
7	AIR165-2750A
8	AIR6-1450A

10.1.3 Avoidance method

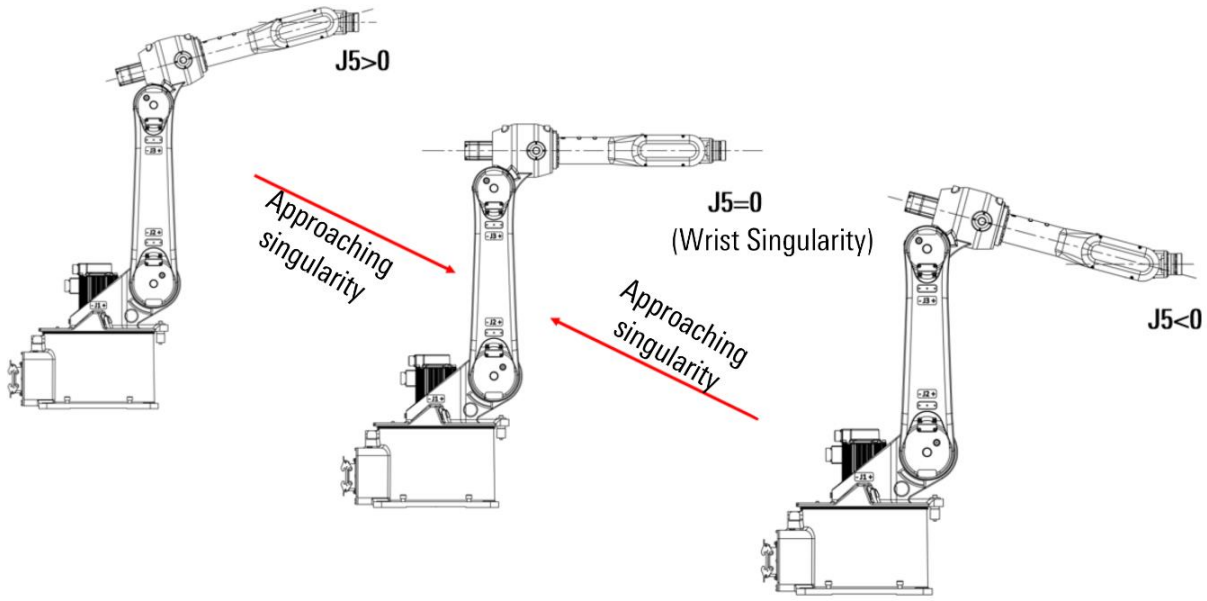


Figure 10-4 Contents of robot approaching singularity

In theory, robots cannot traverse singular points in their trajectory and will sound an alarm for overspeed when approaching a singular point. The wrist singular point refers to the position where the 5th axis of the robot is 0 (J5=0). Refer to Figure 10-4.

When it is necessary to traverse a position where the fifth axis is at 0 (J5=0) for lin, cir, and other Cartesian trajectory movements, the robot will sacrifice some posture accuracy to ensure TCP accuracy, thus passing through singular points.

10.1.4 Precautions

The wrist singularity avoidance function should pay attention to the following matters during use:

- The singularity automatic avoidance function is only limited to the handling tool application type (HandingPRO) robots, and cannot be used at the same time for robots with additional functions such as linkage and tracking.
- When using the singularity automatic avoidance function, the posture of the robot when it is moving is slightly different from the posture when the function is not turned on.

10.1.5 Parameter configuration

Configuration steps:

Step1.Log in to the teach pendant with Teacher or above permissions.

Step2.In the main interface of the teach pendant, click the [System/Parameter Configuration] option.

Step3.In the [Channel] tab, select [Whether to turn on the automatic singular point avoidance function (ENABLE_SINGULAR_AVOID)] and click the <Edit> button. As shown in Figure 10-5.

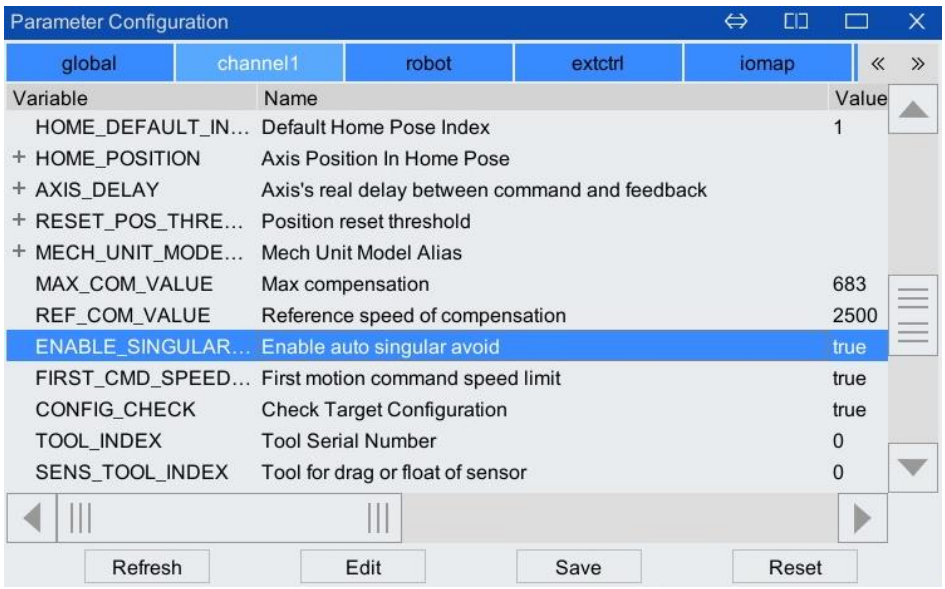


Figure 10-5 [Channel] tab

Step4.In the parameter configuration page that pops up, configure the value of [Value]. true means on, false means off, and the default value is false. As shown in Figure 10-6.

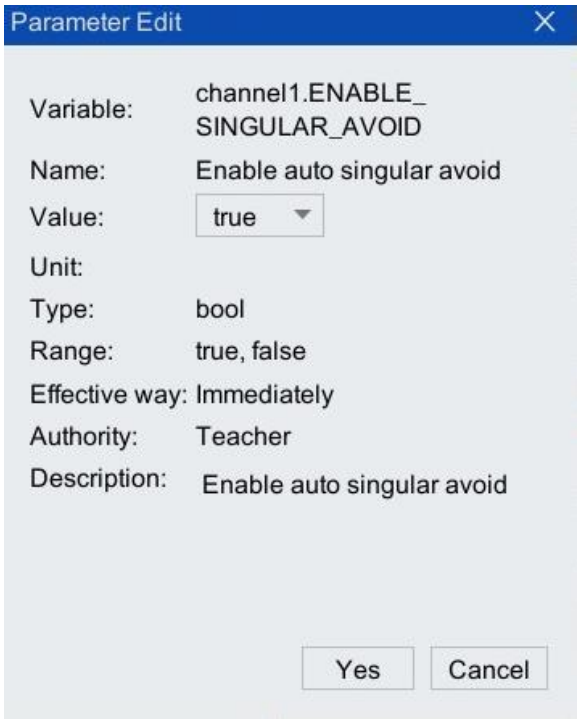


Figure 10-6 Parameter setting page

Step5.After the configuration is completed, click the <Save> button to save the configuration.

10.2 Collision detection function

Prompt

Collision detection requires friction identification before leaving the factory. Customers who need to use this function should contact the company before sending out the equipment.

10.2.1 Introduction to collision detection

Collision detection function, that is, when the robot collides with peripheral equipment during operation (refer to Figure 10-7), it can be detected in an instant without the use of additional force sensors, and safety responses such as shutdown can be made immediately. In order to minimize the damage to personnel and equipment caused by the collision.

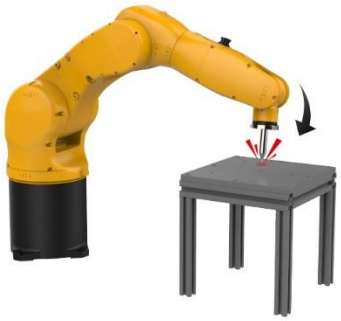


Figure 10-7 Contents of robot collision detection

The collision events that the collision detection needs to respond to include:

- The robot body collides.
- The tool installed at the end of the robot collides.

- The collision detection function cannot completely avoid equipment damage. For example, if the robot is running at full speed when a collision occurs, the damage is usually unavoidable.
- The collision detection function also cannot guarantee human safety. Therefore, be sure to take safety measures such as using safety bars.
- Contact with the robot arm may cause personal injury or equipment damage.
- At present, the collision detection function of our company's products is only valid for robot axes, not for external axes.
- If you want to guarantee the sensitivity, you need to notify our company before shipment.

10.2.2 Restrictions

The collision events that the collision detection function responds to include:

- Robot collides
- The tool installed at the end of the robot collides, etc.

When the following functions are turned on, the collision detection function is invalid (it is prone to false alarms and is not recommended):

- Soft move
- Independent axis (infinite rotation axis)

10.2.3 Collision detection under program operation

In the program running mode, the detailed process of the user using collision detection is as follows:

Step1.Write a motion program in the program editor, insert collision detection instructions before and after the block where collision detection needs to be performed, and specify the mechanical unit and collision detection conditions for collision detection. See section 10.2.5 for details.

Step2.Click "Monitoring>Collision Detection" on the main interface of the teach pendant to open the [Collision Detection Settings] interface, as shown in Figure 10-9;

Step3.Select [Condition No] as "Auto Mode", the serial number of the automatic mode should be the same as the cid parameter in the first step insert instruction. <Current state>change to the state of <Learn>;

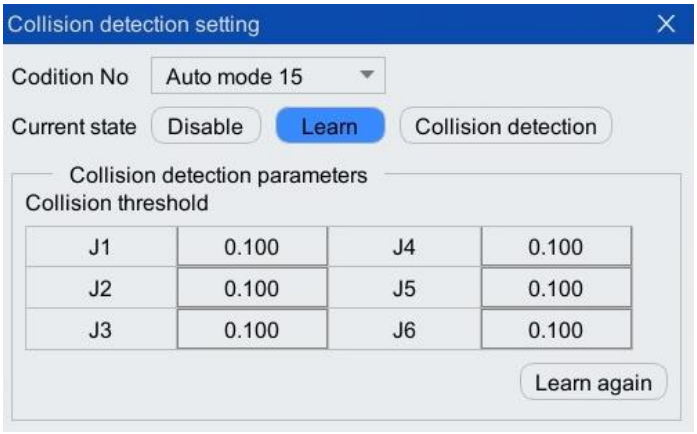


Figure 10-8 Collision detection learning setting interface

Step4.Repeatedly run the program according to the actual running rate to accumulate the data of the detected program, and the collision threshold will be automatically updated according to the accumulated data;

Step5.When the collision threshold is no longer updated, change the [Current State] to the "Collision Detection" status, and click <Save>;

Step6.Run the program and adjust the threshold multiple in Figure 10-9 according to the actual detection effect. If a false alarm occurs, increase the threshold multiple. After the configuration is complete, click <Save>.

Step7.Set the DO in the collision condition, the behavior after collision and other parameters (see Table 10-2 for the meaning of the parameters), and click <Save> after the configuration is complete.

Step8.Click <Save> and run the program.

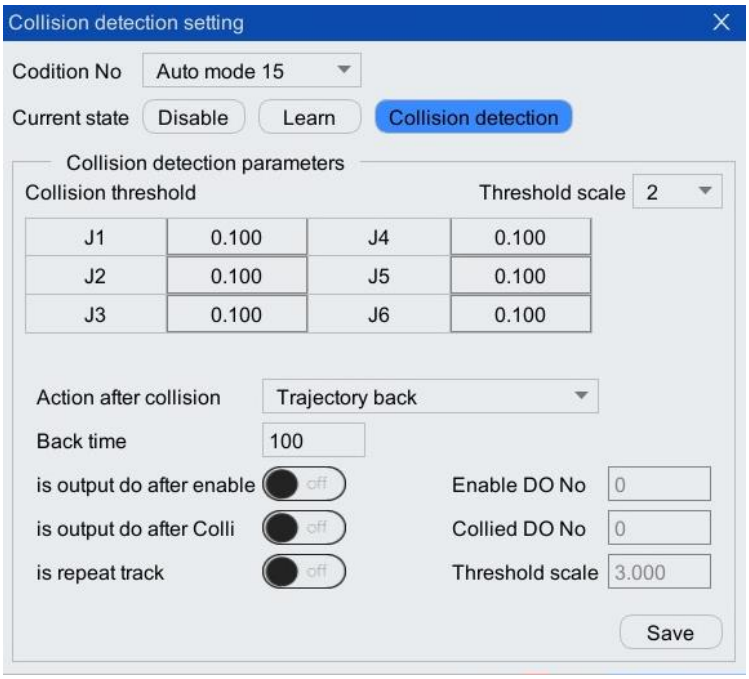


Figure 10-9 Collision detection setting interface

Table 10-2 arameter Description

Parameter	Description
Condition No	Collision Detection Mode: ■ [Manual mode] represents manual jog mode. ■ [Auto Mode 1~16] represents the program running mode and the corresponding condition number.
Current State	Collision detection conditions, the values are as follows: ■ Disable: The default state of collision detection function is invalid. ■ Learn: After changing to learning state, run the detected program for the system to obtain feedback data and learn. ■ Collision detection: After learning, change to collision detection state.
Collision threshold	Collision threshold of axes 1-6. When it is judged that the external force of a certain axis is greater than "collision threshold * threshold scale", it is judged that the axis is a collision. When in the learning state, the threshold is updated according to the difference between the dynamic model and the actual feedback current, so as to avoid false alarms caused by inaccurate dynamic models.
Threshold scale	The product of the single-axis collision threshold and the threshold scale is the actual threshold, which is used to facilitate the customer to manually adjust the collision sensitivity.
Action after collision	The behavior after collision, the values are as follows: ■ Trajectory back: After a collision, the robot will retreat a certain distance according to the original path. ■ Power-off and emergency stop: After a collision, the robot stops in an emergency, and the stop mode is stop1 (quick stop, the servo-controlled motor stops, and the brake is applied, refer to Table 6-26). ■ Pause program: After a collision, the program operation is paused. ■ Only hint: After a collision, only the prompt will be displayed in the "Message Bar".
Back time(ms)	This parameter is used to calculate the retreat distance. After collision, the robot will retreat to the position before the time according to the original trajectory.
Whether it is output DO after enabled	Whether it is output DO after enabled
Whether it is output DO after collision	Whether it is output DO after collision
Whether it is a repeat track	Whether the trajectory of each run is completely repeated (for conveyor belts and programs with logical judgment, the trajectory is not completely repeated, cannot be checked)
Enable DO No	Output DO number of DO after collision detection is enabled. DO output is level output.
Collied DO No	Whether to output DO after a collision is detected
Threshold scale	Threshold multiple for repeating trajectories

10.2.4 Collision detection settings in JOG mode

For manual mode collision detection conditions, users only need two states: "collision detection" and "invalid". The setting steps are as follows:

Step1.Click "Monitor>Collision Detection" on the main interface of the teach pendant to open the [Collision Detection Settings] interface.

Step2.Select [Condition No] as "jogmode", change [Current Status] to <Collision detection> status

Step3.Run the program and adjust the collision threshold based on the actual detection effect. If a false alarm occurs on a certain axis, increase the collision threshold for that axis and click <Save>. Refer to Figure 10-10.

Step4.Click <Save> to complete the configuration.

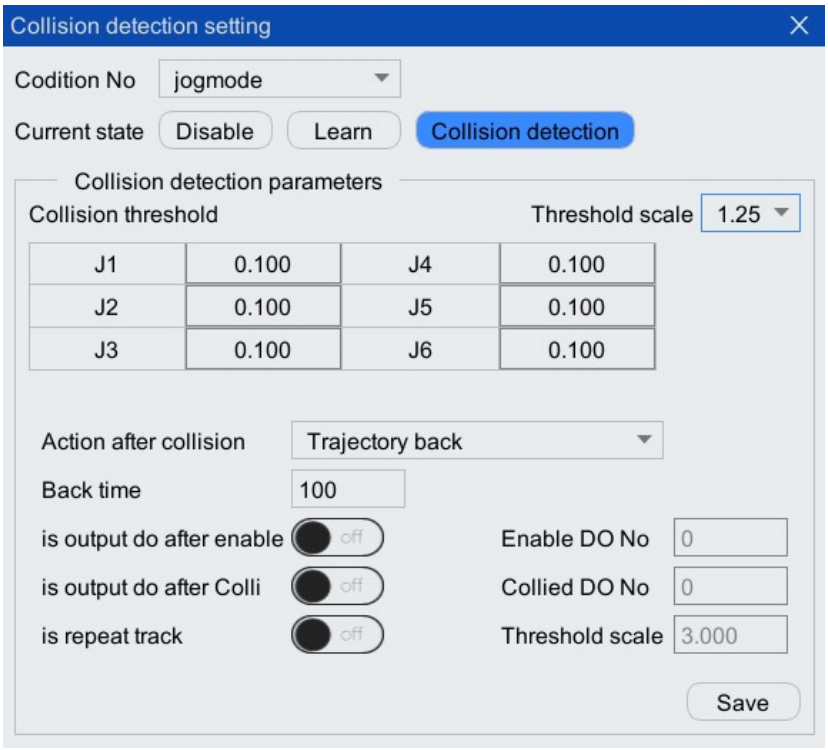


Figure 10-10 Collision detection settings interface

10.2.5 Instruction Description

ARL needs to provide the instruction to set the condition number of collision detection. Between the open and close instructions, specify the condition number used for the learning/detection of this section of the program.

10.2.5.1 Enable collision detection command (startdetect)

Description

Command to enable collision detection.

Format

startdetect cid: , mu:

Parameter

Parameter	Name	Meaning
cid	Collision detection condition number	The value range is 0~16, as follows: ■ 0: Represents the condition to enable manual jog mode in the program

Parameter	Name	Meaning
		■ 1-16: Indicates that the program operation mode corresponding to the condition number is enabled in the program
mu	Mechanical unit name	The name of the mechanical unit that starts the collision detection function.

Insert instruction

The steps to insert a command are as follows:

Step1.In the program editor, open the program to be run, and insert the cursor before the block where collision detection needs to be performed.

Step2.Click "Insert command>Auxiliary command>startdetect", and the [startdetect] setting interface will pop up. As shown in Figure 10-11.

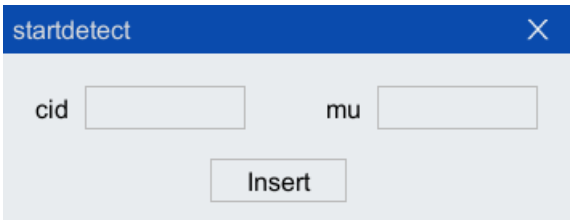


Figure 10-11 The startdetect command parameter configuration interface

Step3.Configure the values of [cid] and [mu]. Click <Insert > to complete the instruction insertion.

10.2.5.2 Disable collision detection command (enddetect)

Description

Command to disable collision detection.

Format

enddetect mu:

Parameter

Parameter	Name	Meaning
mu	Mechanical unit name	The name of the mechanical unit that starts the collision detection function.

Insert instruction

The steps to insert a command are as follows:

Step1.In the program editor, open the program to be run, and insert the cursor after the block where collision detection needs to be performed.

Step2.Click "Insert Command>Auxiliary Command>enddetect" to pop up the [enddetect] setting interface. As shown in Figure 10-12.

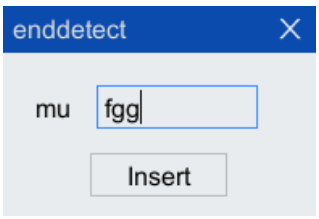


Figure 10-12 The enddetect command parameter configuration interface

Step3.Configure the value of [mu], and click <Insert > to complete the command insertion.

10.3 Jitter suppression function

10.3.1 Introduction to jitter suppression function

The jitter suppression function has a good suppression effect on the jitter generated by the robot during the start and stop (acceleration, deceleration) process, and can improve the motion performance of the robot during the start and stop (acceleration, deceleration) process.

10.3.2 Jitter suppression parameter configuration

Setting steps:

Step1.Use Teacher (teacher) and above authority to log in to the teach pendant.

Step2.On the main interface of the teach pendant, click "System > Parameter Configuration" option.

Step3.In the [Robot] tab, select "Enable vibrate suppression (VIBRATE_SUPPRESSION_ENABLE)", and click the <Edit> button. As shown in Figure 10-13.

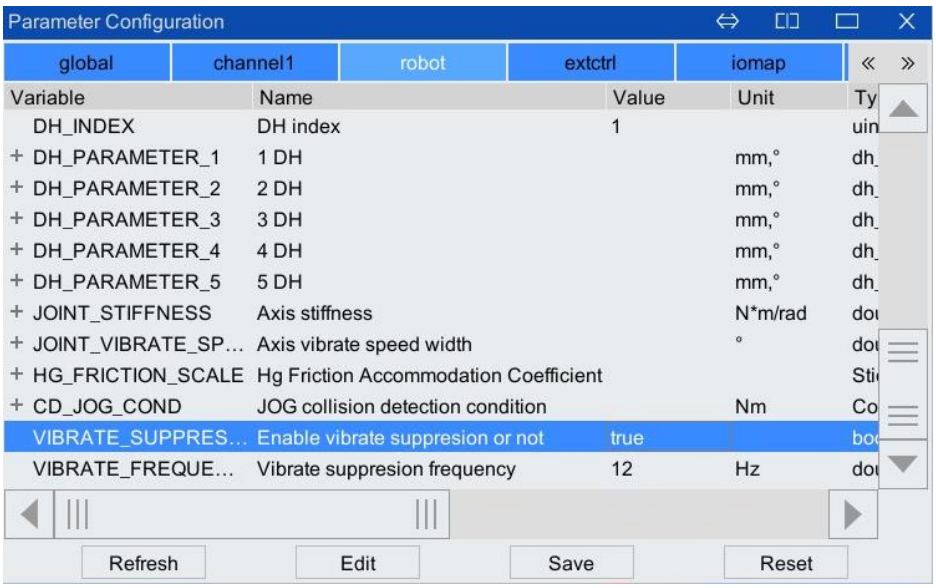


Figure 10-13 [Robot] tab

Step4.On the parameter configuration page that pops up, configure the value of "Value". True means open, false means closed, and the default value is false. As shown in Figure 10-14.

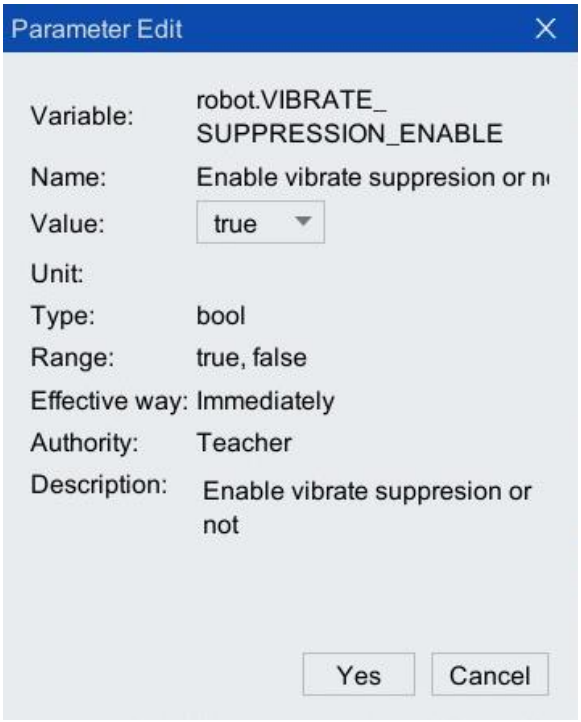


Figure 10-14 Parameter setting page

Step5.In the "Robot" configuration interface, select "Vibrate suppression frequency (VIBRATE_FREQUENCY)", and click the <Edit> button. As shown in Figure 10-15.

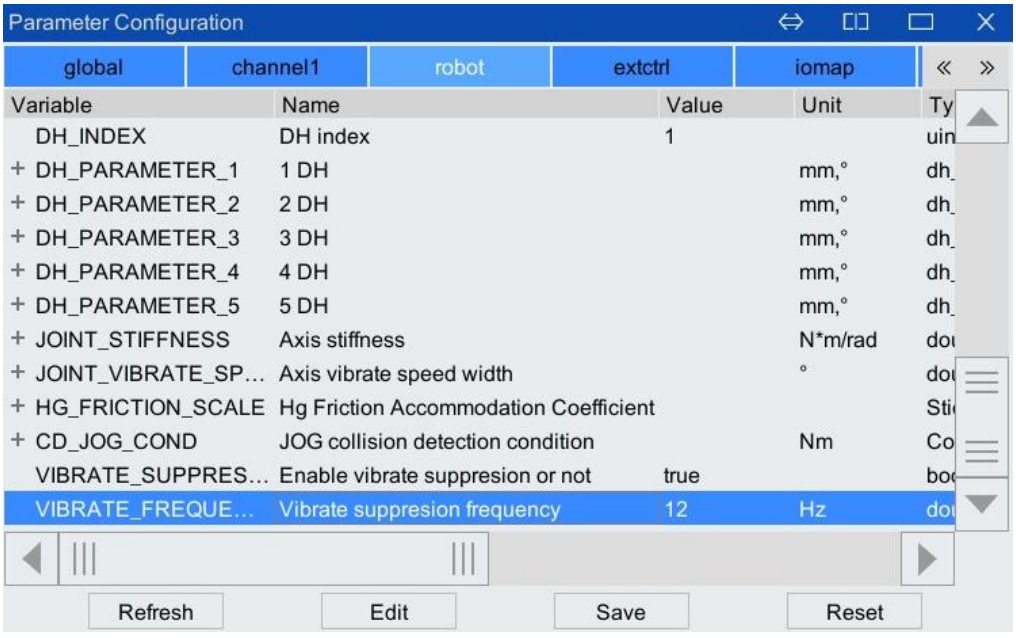


Figure 10-15 Parameter setting page

Step6.On the parameter configuration page that pops up, configure "Value". The value of the jitter suppression frequency needs to be set according to the actual jitter frequency of the tool installed at the end of the TCP flange. The default value is 0Hz. The user can set the jitter suppression frequency around the recommended frequency value corresponding to each model in Table 10-3.

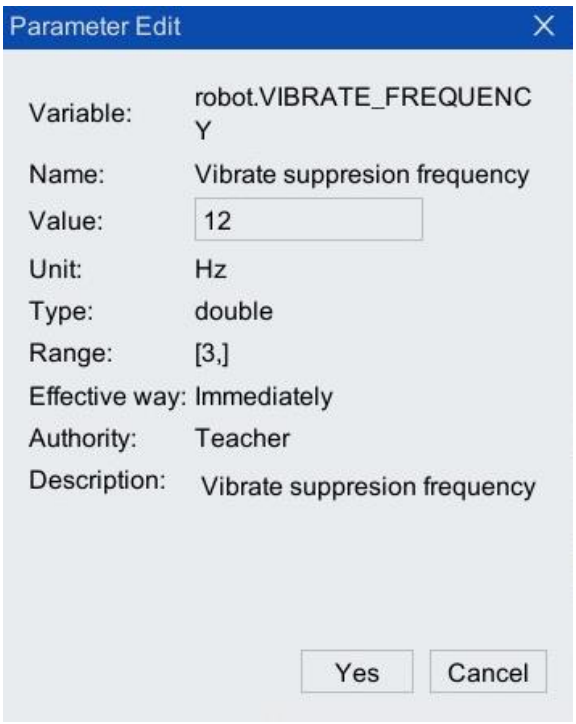


Figure 10-16 Parameter setting page

Table 10-3 Recommended value of jitter suppression frequency for each model

Robot model	Recommended frequency
AIR4-560A	15Hz
AIR8-710A	12Hz
AIR7-920B	10Hz
AIR10-1420A	8Hz
AIR20-1700A	8Hz
AIR50-2230A	6Hz
AIR165-2750A	6Hz
AIR6-1450A	8Hz
AIR20-2000A	8Hz
AIR20-2000B	8Hz
AIR12-2000B-HI	8Hz
AIR25-1700B	8Hz

Step7.After the configuration is completed, click the <Save> button to save the configuration.

10.4 Following axis function

10.4.1 Introduction to the following axis function

The following axis function is a function for synchronizing the actions of two motors to make one axis move. One of the two motors is the master motor (master axis) and the other is the follower motor (follower axis).

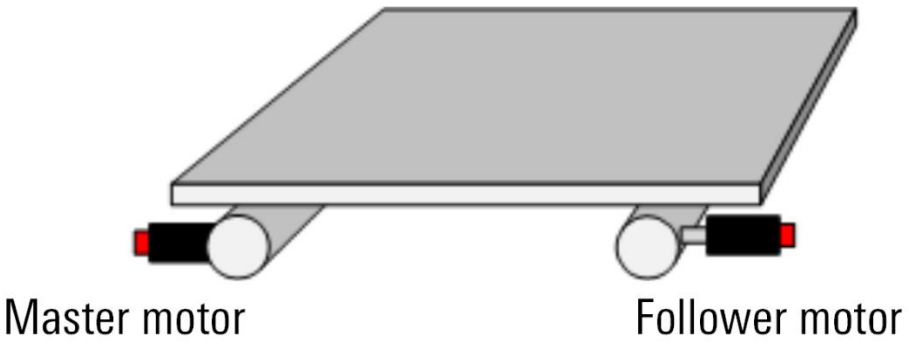


Figure 10-17 Master/follower Motor Schematic

- This function can correct the synchronization error caused by the delay of the servo command between the master and the follower, and realize high-precision dual drive control.
- By using this function, it is possible to assemble a system with a size and a high load that cannot be realized with a single motor.
- By setting this function, it is not necessary to set the following axis separately. By jogging and teaching the master axis, the two motors can be synchronized.

10.4.2 Parameter configuration of following axis

Parameter settings

The setting parameters are shown in Table 10-4.

Table 10-4 Following axis parameter description

Parameter	Description
SERVO_NUM (Number of servo slaves)	The actual total number of servo slaves for the robot and external axes.
EX_JOINT_NUM (Number of external axes)	The value of the number of servo slaves of the external axis minus the number of following axis pairs.
MECH_UNIT_NUM (Number of mechanical units)	The value of the number of robots plus the number of external axes.
HAS_FOLLOW_AXIS (Whether there is a following axis in the channel)	Set the selected channel as the main axis with the following values: ■ true: there is a follow axis in the channel ■ false: there is no following axis in the channel

The parameters of the follower servo need to be set separately, for example, the rotation direction of the follower motor needs to be set according to the actual application scenario.

Configuration example

Configure a 6-axis robot, an external axis and a follower axis, the total number of axes is 8, the number of external axes is 1, the follower axis is directly configured as the follower axis of the external axis, and is not displayed in the external axis.

The configuration steps are as follows:

Step1.Click "System>Parameter Configuration" on the main interface of the teach pendant, and the [Parameter Configuration] interface will pop up.

Step2.In the [Global] configuration interface, click to select [SERVO_NUM (number of servo slaves)], and configure the [Value] to be "8", as shown in Figure 10-18. Click <Yes> to complete the configuration.

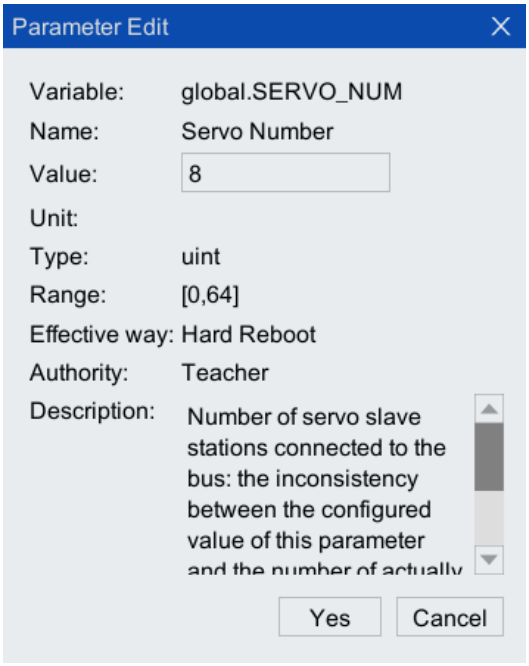


Figure 10-18 Servo slave configuration interface

Step3.In the [Channel] configuration interface, click to select the row of [EX_JOINT_NUM (number of external axes)], and configure [Value] to 1 (8 is is a follower axis of 7 axis), as shown in Figure 10-19. Click <Yes> to complete the configuration.

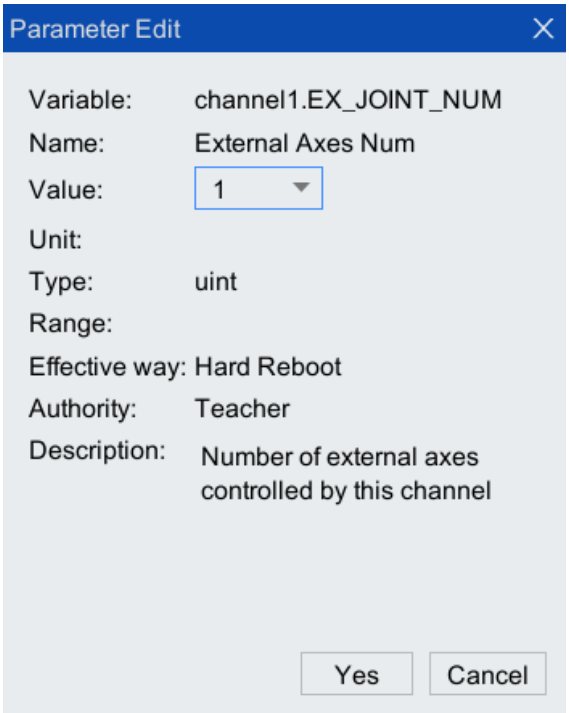


Figure 10-19 External axis configuration interface

Step4.In the [Channel] configuration interface, click to select the row where [MECH_UNIT_NUM (mechanical unit number)] is located, and set the [Value] to "1", as shown in Figure 10-20. Click <Yes> to complete the configuration.

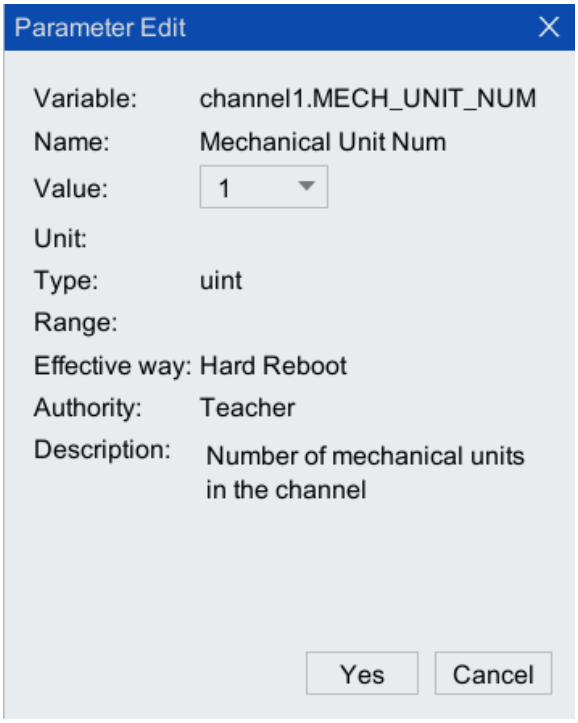


Figure 10-20 Mechanical unit quantity configuration interface

Step5.In the [Channel] configuration interface, click to select the [+] in front of [HAS_FOLLOW_AXIS (whether there is a follow axis)], and click to select the row of [6] (representing the 7th axis as the main axis) in the expanded sub-items. Configure [Value] to be "true", as shown in Figure 10-21. Click <Yes> to complete the configuration.

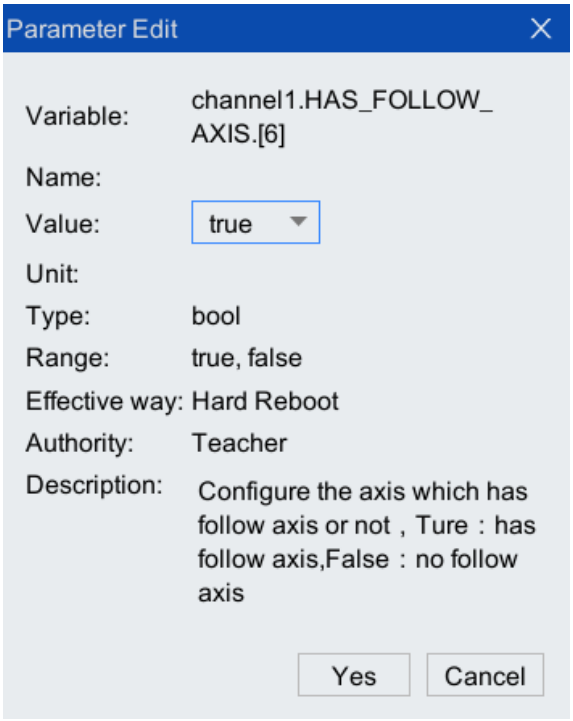


Figure 10-21 Following axis configuration interface

Step6.Click <Save> under the interface, the interface shown in Figure 10-22 will pop up, and select "Save All" in [Please select the type of saving]. Click <Yes>.

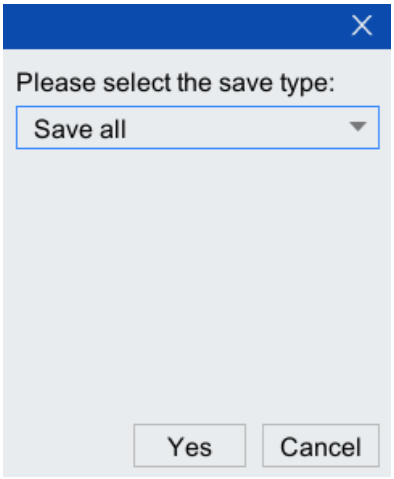


Figure 10-22 Save type prompt interface

Step7.In the pop-up [Prompt] interface, click <Yes>. As shown in Figure 10-23.

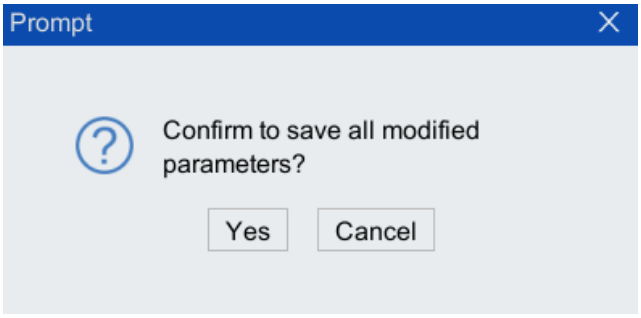


Figure 10-23 Save confirmation prompt interface

Step8.Click <Yes> in the pop-up [Prompt] interface, the parameters are saved successfully. As shown in Figure 10-24.

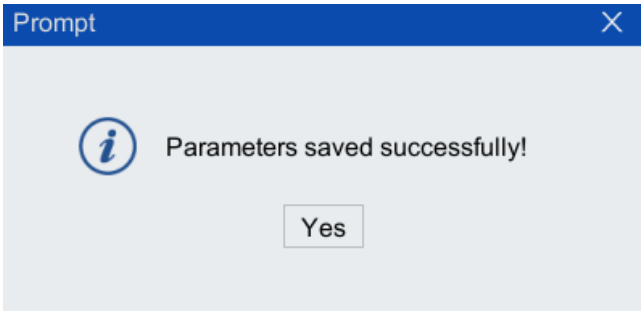


Figure 10-24 Save successful prompt interface

Appendix A Summary of Parameter Configuration Permissions

Permissions 1-5 correspond to the administrator, maintainer, OEM, teacher and operator respectively.

Schedule 1 Summary of "Global" Tab Variables

Name	Meaning	Read permission	Write permission
CHANNEL_NUM	Number of foreground channels	5	4
BACK_CHANNEL_NUM	Number of background channels	5	4
PRODUCT_TYPE	Product type	5	1
SERVO_NUM	The number of servo slaves connected on the bus. If the number of slaves configured by the parameter is different from the l number of slaves connected actually, the bus connection may fail during system startup.	5	4
CANOPEN_BAUD	Set the canopen bus transmission baud rate	4	4
LOCATION	The place where the equipment is located. The user can freely modify the parameter to indicate the place where the equipment is located.	5	4
RESET_WHILE_STOP	Whether to reset the program while stopping (including emergency stop)	4	4
ARL_CASE_SENSITIVE	Whether ARL program text is case sensitive	4	4
AXIS_PRECITION	Confirmation of axis position accuracy	5	4
TOOL_INERTIA	Inertial parameters of tool	5	4
DF_SPEED_RATIO	Default speed multiplier	4	4
AUT2MANU_SPEED	Default speed multiplier in manual mode	4	4
FUSE_DURATION	Interpolation for self-protection duration	5	4
TRAJ_PLANNER_CACHE_SIZE	Trajectory planning cache length	5	4
RESET_POS_TYPE	Position reset mode when powering on	5	4
START_CHANNEL_T1T2	Channel selection when starting the program in manual mode	5	4
JOG_MIN_STEP	JOG minimum step size	5	4
FILT_DI	Whether to enable DI filtering	4	4
ARCS_START_DELAY	ARCS start delay	4	4
JOINT_VAR_NUM	Number of joint system variables	5	4
POSE_VAR_NUM	The number of pose system variables, up to 10,000 can be configured, and the default pose variable is 1,000	5	4
LOOKAHEAD_TIME	Look-ahead time	5	4
WOBJ_NUM	The number of workpiece coordinate systems, up to 200 can be configured, the default workpiece coordinate system is 32	4	4
MODBUS_TCP_CONFIG	Modbus-TCP configuration	5	4
PROG_ID	Modbus-TCP control program name	5	4

Schedule 2 Summary of "Channel" Tab Variables

Name	Meaning	Read permission	Write permission
BASE	The basic coordinate system of the mechanical unit of the channel (defined relative to the world coordinate system)	5	4
EX_JOINT_NUM	Number of external axes controlled by this channel	5	4
MECH_UNIT_NUM	Number of mechanical units in the channel	5	4
MECH_UNIT_MODEL	Model of mechanical unit controlled by this channel	5	4
MECH_UNIT_NAME	The name of the mechanical unit controlled by this channel, the user can set this parameter to distinguish the mechanical unit of different channels	5	4
VIRTUAL_AXIS_MAP	Virtual axis configuration. This parameter can be used to set some axes of the mechanical unit body or some of the external axes as virtual axes. This parameter is only used for robot debugging	5	4
HAS_FOLLOW_AXIS	Configure whether each axis in the channel has a following axis	5	4
MAX_ALLOW_FOLLOW_ERROR	Configure the maximum allowable following error, the unit is the number of pulses. When the following error is greater than this value, the system will alarm	5	4
EXJOINT_TYPE	External axis type	5	4
EXJOINT_OFFSET	Zero offset of external axis	5	1
EXJOINT_ENCODER_RESO	Number of single-turn pulses of external axis encoder	5	4
EXJOINT_REDUCER_RATIO	Reduction ratio of external axis reducer	5	4
EXJOINT_MAX_STROKE	Positive limit of external axis	5	4
EXJOINT_MIN_STROKE	External axis negative limit	5	4
EXJOINT_MAX_SPEED	Maximum speed of external axis	5	4
EXJOINT_MAX_ACC	Maximum acceleration of external axis	5	4
EXJOINT_MAX_JERK	Maximum jerk of external axis	5	4
CALI_JOINT_POS	The position of each axis recorded during fast calibration	5	1
EXJOINT_ENCODER_TYPE	External axis encoder type	5	4
EXJOINT_EXT_CONTROL	Whether the external axis uses external control	5	4
MECH_UNIT_HG	Mechanical unit type that supports dragging and teaching	0	0
SUPPORT_HG	Whether to support drag teaching	4	4
HOME_DEFAULT_INDEX	Select the home point by default	4	4
HOME_POSITION	A set of HOME points for each channel	4	4
MECH_UNIT_MODEL_ALIAS	Mechanical unit model alias	5	4
TOOL_INDEX	Choose which process	5	4
JOG_COLLISION_DETECT	Whether JOG mode collision detection is enabled	4	4
JOG_COLLISION_SENSITIVITY	JOG mode collision detection sensitivity	4	4

Name	Meaning	Read permission	Write permission
MAX_COM_VALUE	Maximum settable compensation number of tool position compensation	5	4
REF_COM_VALUE	The maximum speed of tool position compensation can set the compensation value	5	4
SLOPE_INSTALL_ANGLE	The maximum speed of tool position compensation can be set compensation value	5	4
ENABLE_VIBRATE_SUPPRESSION	Whether to enable jitter suppression	4	4
VIBRATE_FREQUENCY	Jitter suppression frequency	4	4
AUTO_LOAD_PROGRAM_PATH	Start the autoloader path. When a program is successfully loaded, the system will automatically record the program path to the variable, and the program will be automatically loaded when it is started next time	5	1

Schedule 3 Summary of "Robot" Tab Variables

Name	Meaning	Read permission	Write permission
MECH_UNIT_MODEL_NO	Mechanical unit model	5	0
MECH_UNIT_TYPE	The type of mechanical unit controlled by this channel. cartesian is a Cartesian coordinate robot, palletizer is a palletizing robot, and the robot is a general 6-axis robot	5	0
JOINT_OFFSET	Zero offset of each axis of mechanical unit	5	1
JOINT_ENCODER_RESO	Number of single-turn pulses of each shaft encoder of mechanical unit	5	2
JOINT_REDUCER_RATIO	Reducer ratio of each axis of mechanical unit	5	2
JOINT_MAX_STROKE	Positive limit of each axis of mechanical unit	5	3
JOINT_MIN_STROKE	Negative limit of each axis of mechanical unit	5	3
JOINT_MAX_ACC	Maximum acceleration of each axis of mechanical unit	5	4
JOINT_MAX_JERK	Maximum jerk of each axis of mechanical unit	5	4
TCP_MAX_SPEED	TCP maximum moving speed of mechanical unit	5	4
TCP_MAX_ACC	Maximum moving acceleration of mechanical unit TCP	5	4
TCP_MAX_JERK	Mechanical unit TCP maximum movement jerk	5	4
TCP_MAX_ROTATE_SPEED	Mechanical unit TCP maximum movement jerk	5	4
TCP_MAX_ROTATE_ACC	Maximum rotational acceleration of mechanical unit TCP	5	4
TCP_MAX_ROTATE_JERK	Maximum rotational jerk of mechanical unit TCP	5	4
GEOMETRY	Geometric parameters of arm length of general 6-axis robot body	5	2
COUPLE45	Coupling coefficient between 4-axis and 5-axis of mechanical unit	5	1
COUPLE46	Coupling coefficient between 4-axis and 6-axis of mechanical unit	5	1
COUPLE56	Coupling coefficient between 5-axis and 6-axis of mechanical unit	5	1

Name	Meaning	Read permission	Write permission
ROBOT_STICTION	Static friction parameters of each axis of mechanical unit	5	4
AXIS_SPEED_BUFFER_WIDTH	Width of mechanical unit axis speed buffer	5	4
AXIS_POS_BUFFER_WIDTH	Buffer width of mechanical unit axis position	5	4
AXIS_MAX_RESISTANCE_TORQUE	Maximum additional resistance torque of mechanical unit axis	5	4
TCP_SPEED_BUFFER_WIDTH	TCP speed buffer width of mechanical unit	5	4
TCP_MAX_RESISTANCE_FORCE	Maximum additional resistance value limited by TCP motion state	5	4
JOINT_MAX_SPEED_HG	Maximum drag speed of each axis of mechanical unit	5	4
TCP_MAX_SPEED_HG	Drag and teach TCP maximum moving speed	5	4
USE_DH	Whether to use DH model parameters	5	4
DH_INDEX	Select which set of DH model parameters	5	4
DH_PARAMETER_1	DH model parameters 1	4	1
DH_PARAMETER_2	DH model parameters 2	4	1
DH_PARAMETER_3	DH model parameters 3	4	1
DH_PARAMETER_4	DH model parameters 4	4	1
DH_PARAMETER_5	DH model parameters 5	4	1
J3_ENVELOP_RADIUS	Three-axis joint envelope radius	5	4
J5_ENVELOP_RADIUS	Five-axis joint envelope radius	5	4
HG_JOINT_MAX_STROKE	Drag the positive limit of each axis of the mechanical unit in the teaching mode	5	4
HG_JOINT_MIN_STROKE	Drag the negative limit of each axis of the mechanical unit in the teaching mode	5	4
JOINT_MAX_SPEED_SF	Maximum speed of each axis of mechanical unit when soft floating	5	4
TCP_MAX_SPEED_SF	TCP maximum moving speed during soft float	5	4
IMPEDANCE_CTRL_CARTESIAN_INERTIA	Cartesian impedance control inertia parameters	5	2
IMPEDANCE_CTRL_CARTESIAN_DAMPING	Cartesian impedance control damping parameters	5	2
IMPEDANCE_CTRL_CARTESIAN_STIFFNESS	Cartesian impedance control stiffness parameter	5	2
IMPEDANCE_CTRL_JOINT_INERTIA	Axis impedance control inertia parameter	5	2
IMPEDANCE_CTRL_JOINT_DAMPING	Axis impedance control damping parameters	5	2
IMPEDANCE_CTRL_JOINT_STIFFNESS	Axis impedance control stiffness parameter	5	2

Name	Meaning	Read permission	Write permission
JOINT_STIFFNESS	Stiffness parameters of each axis of mechanical unit	5	2
JOINT_VIBRATE_SPEED_WIDTH	Shaking width of each axis of mechanical unit	5	2

Schedule 4 Summary of "External Control" Tab Variables

Name	Meaning	Read permission	Write permission
EXT_CTL_ENABLE	External automatic control enable	5	4
EXT_CTL_ACT_DI	DI logic address number of external automatic control activation	5	4
SERVO_ON_DI	DI logic address number of servo on	5	4
SERVO_OFF_DI	DI logic address number of servo off	5	4
START_PROG_DI	DI logic address number of program start	5	4
PAUSE_PROG_DI	DI logic address number of program pause	5	4
RESET_PROG_DI	DI logic address number of program reset	5	4
CLEAR_ALARM_DI	DI logic address number of clear warning	5	4
PGNO_TYPE	Program number type	5	4
PGNO_LENGTH	Program number digit	5	4
PGNO_FBIT_DI	DI logic address number of program number start digit	5	4
PGNO_PARITY_DI	DI logic address number of program number parity digit	5	4
PGNO_VALID_DI	DI logic address number of program number ready	5	4
CHAN_STATE_DO	Start logic address number of current channel status	5	4
EXT_CTL_ACT_CONF_DO	DI logic address number of external automatic control activation confirmation	5	4
SERVO_ON_DO	DI logic address number of servo on status	5	4
PGNO_REQ_DO	DI logic address number of request program number	5	4
AT_T1_DO	DO logic address number in T1 mode	5	4
AT_T2_DO	DO logic address number in T2 mode	5	4
AT_AUT_DO	DO logic address number in AUT mode	5	4
PGNO_ACK_FBIT_DO	DI logic address number of program number confirmation start digit	5	4
EXT_CTL_NET_ENABLE	External network bus automatic control enable	5	4
AT_HOME_DO_1	DO logic address number in HOME status	5	4
AT_HOME_DO_2	DO logic address number in HOME status	5	4
AT_HOME_DO_3	DO logic address number in HOME status	5	4
AT_HOME_DO_4	DO logic address number in HOME status	5	4
AT_HOME_DO_5	DO logic address number in HOME status	5	4

Schedule 5 Summary of "IO Mapping" Tab Variables

Name	Meaning	Read permission	Write permission
SIM_IO	-	5	4
F1	-	5	4
F2	-	5	4
F3	-	5	4

Schedule 6 Summary of "Safety IO" Tab Variables

Name	Meaning	Read permission	Write permission
SAFETY_DI_SIGNALS	Definition of safety DI signal	5	1
TP_ENABLE_INDEX	Teach pendant enable signal index number	5	1
TP_ESTOP_INDEX	Teach pendant emergency stop signal index number	5	1
SAFETY_MODULE_ACTION_INDEX	Safety module action signal index number	5	1
TP_ESTOP_DISABLE_BIT_ADDRESS	Teach pendant emergency stop mask signal bit address number	5	1
SAFETY_DO_SIGNALS	Definition of safety DO signal	5	1
CHAN_RUN_STATE_BIT_ADDRESS	Output current channel running status signal bit address number	5	1
STOP0_INDICATE_BIT_ADDRESS	STOP0_INDICATE signal bit address number	5	1
MAIN_POWER_SWITCH1_BIT_ADDRESS	Main circuit switch signal bit address number	5	1
MAIN_POWER_SWITCH2_BIT_ADDRESS	Bit address number of main circuit switch signal	5	1
ENABLE_SAFETY_MODULE1_BIT_ADDRESS	Bit address number of enable safety module signal 1	5	1
ENABLE_SAFETY_MODULE2_BIT_ADDRESS	Bit address number of enable safety module signal 2	5	1
RESET_SAFETY_MODULE1_BIT_ADDRESS	Bit address number of reset safety module signal 1	5	1
RESET_SAFETY_MODULE2_BIT_ADDRESS	Bit address number of reset safety module signal 2	5	1
USER_SAFETY_DI_SIGNALS	User-defined safety DI signal	5	4
EXTERNAL_ACTION_DO_INDEX	DO logic address of body programming external action	5	1
USER_SAFETY_DI_SIGNALS (User Safe DI)			
enable	enable	enable	enable
bit_address	bit_address	bit_address	bit_address
valid_value	valid_value	valid_value	valid_value

stop_type	stop_type	stop_type	stop_type
monitor_in_T1	monitor_in_T1	monitor_in_T1	monitor_in_T1
monitor_in_T2	monitor_in_T2	monitor_in_T2	monitor_in_T2
alarm_code	alarm_code	alarm_code	alarm_code
alarm_info	alarm_info	alarm_info	alarm_info
do_reset_sig	do_reset_sig	do_reset_sig	do_reset_sig
USER_SAFETY_DO_SIGNALS (User Safe DO)			
enable	enable	enable	enable
bit_address	bit_address	bit_address	bit_address
in_alarm_value	in_alarm_value	in_alarm_value	in_alarm_value
out_alarm_value	out_alarm_value	out_alarm_value	out_alarm_value
safety_di_address	safety_di_address	safety_di_address	safety_di_address

Schedule 7 Summary of "Conveyor C1" Tab Variables

Name	Meaning	Read permission	Write permission
MECH_UNIT_MODEL_NO	Mechanical unit model number	3	0
MECH_UNIT_TYPE	Sub-mechanical unit type. conveyor refers to the conveyor	3	0
CONV_TYPE	Sub-mechanical unit type. conveyor refers to the conveyor	3	3
CONV_USE_EXAXIS_NO	External axis number used by conveyor	3	3
MM_PER_PULSE	Conveyor distance per pulse	3	3
PULSE_NUM_PER_CIRCLE	Number of pulses per circles of encoder used by conveyor	3	3
WOBJCS_RELATED_MIN_DIS	Min distance associated with workobject coordinate system	3	3
WOBJCS_RELATED_MAX_DIS	Max distance associated with workobject coordinate system	3	3
PROCESS_START_AREA_DIS	Processing start zone	3	3
QUEUE_TRACK_DIS	Queue tracking distance	3	3
SYNC_TRIGGER_SIG_MIN_DIS	Min distance of synchronization trigger signal	3	3
GET_ON_OR_OFF_ACC	Get on/off jerk	3	3
ADJUST_SPEED	Adjustment speed	3	3
ENCODER_TYPE	Encoder type	3	3
CONV_SYNC_TRIGGER_DI	Conveyor triggers the switch DI	3	3
REMOVE_WOBJ_LIST_R0_DI	Conveyor removes the waiting-associated workobject DI	3	3
CLEAR_WOBJ_LIST_DI	Conveyor clears the current queue DI	3	3
DROP_WOBJ_LIST_RELATED_R0_DI	The conveyor releases the currently moving workobject coordinate system DI	3	3
CLEAR_WOBJ_LIST_NEVER_RECORD_DI	Clear the current workobject queue and no longer record DI	3	3

Name	Meaning	Read permission	Write permission
WORKOBJECT_MIN_DIS	Min distance between different workobjects	3	3
TRIGGER_TYPE	Workobject trigger type	3	3

Appendix B Summary of System Variable Permissions

Schedule 1 Schedule 8 Summary of "Integer Variables" Tab Variables

Name	Meaning	Read permission	Write permission
I	System predefined int array type system variables	5	4
I_NAME	$I array element variable name, you can set a significant name for each element of $I array, and then you can access the variable by this name in ARL.	5	4

Schedule 2 Summary of "Float Variables" Tab Variables

Name	Meaning	Read permission	Write permission
D	System-predefined bool array system variable	5	4
D_NAME	$D array element variable name, you can set a significant name for each element of $D array, and then you can access the variable by this name in ARL.	5	4

Schedule 3 Summary of "Boolean Variable" Tab Variables

Name	Meaning	Read permission	Write permission
B	System-predefined double array system variable	5	4
B_NAME	$B array element variable name, you can set a significant name for each element of $B array, and then you can access the variable by this name in ARL.	5	4

Schedule 4 Summary of "Joint Variable" Tab Variables

Name	Meaning	Read permission	Write permission
J	System-predefined joint array system variable	5	4
J_NAME	$J array element variable name, you can set a significant name for each element of $J array, and then you can access the variable by this name in ARL.	5	4

Schedule 5 Summary of "Pose Variable" Tab Variables

Name	Meaning	Read permission	Write permission
P	System-predefined array system variable	5	4
P_NAME	$P array element variable name, you can set a significant name for each element of $P array, and then you can access the variable by this name in ARL.	5	4

Appendix C List of Interface Functions

Schedule 1 List of interface functions

Num	Interface function	function
Robot management		
1	ConnectRobot	Initialize and connect the robot
2	DisconnectRobot	Disconnect the robot
3	EnableApiControl	Enable or disable external API control
4	SetControlMode	Set robot control mode
5	SwitchChannel	Switch channel
6	PowerOn	Power on the robot
7	PowerOff	Power off the robot
8	ClearAlarm	Clear robot alarm
Movement		
1	Move2Home	Robot return to zero
2	Move2Joint	The movej instruction controls the movement of each axis to a certain angle
3	Move2Pos (Single Position)	The ptp instruction controls the robot to move to a certain pose
4	Move2Pos (Multi Position)	The ptp instruction controls the robot to move to several poses in sequence
5	Line2Pos (Single Position)	The lin instruction controls the robot to move to a certain pose in a straight line
6	Line2Pos (Multi Position)	The lin instruction controls the robot to move to several positions in a straight line
7	Circle2Pos	The cir instruction controls the robot to move to a certain pose
8	StopMove	Control the robot to stop moving
IO		
1	GetDigitalIn	Get the digital input value of a certain way
2	GetDigitalOut	Get the digital output value of a certain way
3	SetDigitalOut	Set the digital output value of a channel
Configuration		
1	SetSpeedRatio	Set speed override
2	SetToolCoordinate	Set tool coordinate system value
3	SetWorkobjectCoordinate	Set workobject coordinate system value
4	SetIntVariable	Set integer variable value
5	SetDoubleVariable	Set floating-point variable value
6	SetBoolVariable	Set Boolean variable value
Query		
1	GetControlMode	Query the current robot control mode

Num	Interface function	function
2	GetProgramState	Query current robot running status
3	GetSpeedRatio	Query current speed override
4	IsPowerOn	Query whether it is currently powered on
5	GetPos24	Query the current robot pose
6	GetJoint	Query the current angle of each axis of the robot, unit: degree
7	GetAlarmState	Query current alarm status
8	GetAlarmList	Query the current alarm list
9	GetIntVariable	Query integer variable value
10	GetDoubleVariable	Query floating-point variable value
11	GetBoolVariable	Query Boolean variable value
The program runs		
1	SendProgram	Send ARL program
2	LoadProgram	Load ARL program
3	StartProgram	Start the ARL program
4	PauseProgram	Pause the program
5	ResetProgram	Reset procedure

Appendix D Data Sheet of Bus External Automatic Control Interface

Schedule 1 Correspondence between EXT_CTRL_IN and its function

Variable name	Function	Variable value		
EXT_CTRL_IN[0]	Enable state	0: No action	1: Servo off	2: Servo on
EXT_CTRL_IN [1]	Emergency stop	0: No action	1: Emergency stop	
EXT_CTRL_IN [2]	Clear alarm	0: No action	1: Clear alarm	
EXT_CTRL_IN [3]	Program number	Decimal: Corresponding program number		
EXT_CTRL_IN [4]	Program start/pause	0: No action	1: Program pause	2: Program start
EXT_CTRL_IN [5]	Program reset	0: No action	1: Program reset	
EXT_CTRL_IN [6]	Program loading	0: No action	1: Program loading	

Schedule 2 Correspondence between EXT_CTRL_OUT and its function

Variable name	Function	Variable value			
EXT_CTRL_OUT[0]]	Enable state	0: Servo off	1: Servo on		
EXT_CTRL_OUT[1]	Whether it is at home point 1	0: Not at home point 1	1: Already at home point 1		
EXT_CTRL_OUT[2]	Whether it is at home point 2	0: Not at home point 2	1: Already at home point 2		
EXT_CTRL_OUT[3]	Whether it is at home point 3	0: Not at home point 3	1: Already at home point 3		
EXT_CTRL_OUT[4]	Whether it is at home point 4	0: Not at home point 4	1: Already at home point 4		
EXT_CTRL_OUT[5]	Whether it is at home point 5	0: Not at home point 5	1: Already at home point 5		
EXT_CTRL_OUT[6]	Whether at the track	0: Not on track	1: On track		
EXT_CTRL_OUT[7]	Alarm information/alarm code	0: No alarm			
EXT_CTRL_OUT[8]	Emergency stop	0: No emergency stop	1: Emergency stop		
EXT_CTRL_OUT[9]	Safety door	0: Normal	1: Abnormal		
EXT_CTRL_OUT[10]	Drive ready	0: Not ready	1: Ready		
EXT_CTRL_OUT[11]	Current channel program running status	0: Program not loaded	1: The program is running	2: Program pause	3: Program stop
EXT_CTRL_OUT[12]	Request program number	0: No action	1: Request program number		
EXT_CTRL_OUT[13]	Whether in T1 mode	0: Not in this mode	1: In this mode		
EXT_CTRL_OUT[14]	Whether in T2 mode	0: Not in this mode	1: In this mode		
EXT_CTRL_OUT[15]	Whether it is in AUT mode	0: Not in this mode	1: In this mode		
EXT_CTRL_OUT[20~39]	Alarm code	Two as a group	The low bit is the alarm main code		The high bit is the alarm subcode

Appendix E Supported External Communication Protocols

Schedule 1 Supported external communication protocols and reference manuals

Communication protocol	Reference manual
DeviceNet	*Optional parts installation manual, ARL Programming Manual*
Socket	*ARL Programming Manual*
RS232	*Optional parts installation manual, ARL Programming Manual*
Melsec	*ARL Programming Manual*
Modbus-RTU	*ARL Programming Manual, Modbus function instruction manual*
Modbus-TCP	*Modbus function instruction manual*
PROFINET	*Optional parts installation manual,*
IO	*Optional parts installation manual,*

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