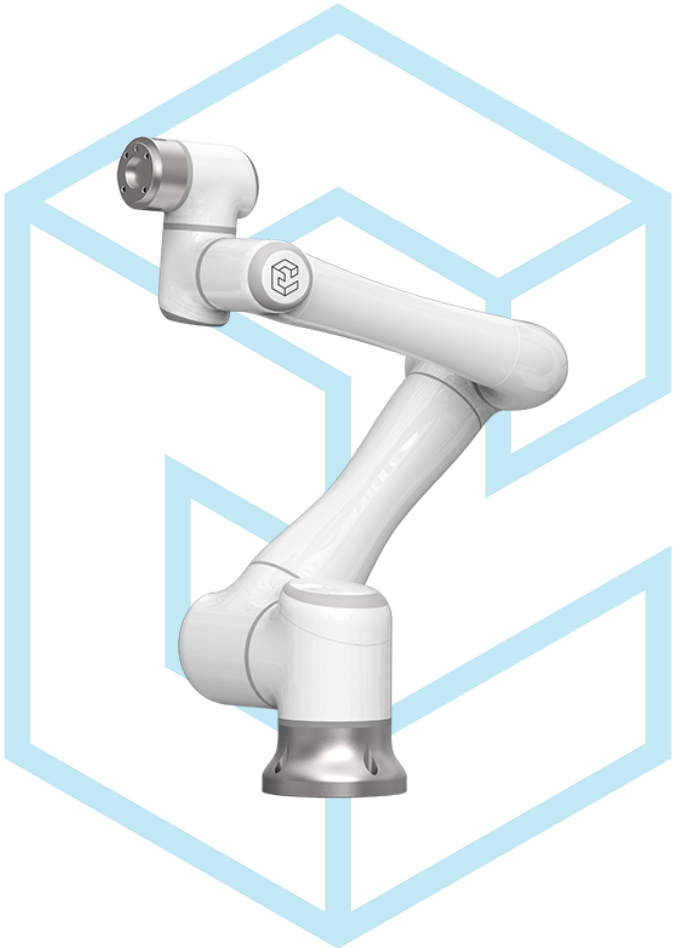
ELITE ROBOTS
艾利特机器人

ELITE ROBOTS EC Series User Guide



EC66 User Manual

Suzhou Elite Robot Co., Ltd

2023-01-13

Version: Ver3.8.2

Please read this manual carefully before use

Please carefully check the version informations in this manual matches the corresponding software version of the system, to ensure consistency.

This user manual shall be periodically checked and revised, and the renewed contents will appear in the new version. The contents or information herein is subject to change without prior notice.

ELITE ROBOT Co.,Ltd. shall assume no liability for any errors which will occur in the manual probably.

ELITE ROBOT Co.,Ltd. shall assume no liability for the accident or indirect injury as a result of using this manual and the product mentioned herein.

Please read this manual before installing and using the product.

Please keep this manual so that you can read and use it for reference at any time.

The pictures in the specification shall be used for reference only. The goods received shall prevail.

Table 1 . Version Information

Name	Version
Software version	V3.8.2
Servo version	V11.44.5
Mechanical version	V4.B2.1
Hardware version	V2.0
Web teach pendant version	3.8.2-0-g81ce123
Manual version	Ver3.8.2

Contents

Preface

Thank you for purchasing and using the lightweight 6-degree-of-freedom (DOF) collaborative robot EC66 developed by ELITE Robot Co., Ltd.

Figure 1 : EC66

The EC66 is one of the ELITE 6-DOF modular collaborative robot series with a payload of 6kg.

The ELITE collaborative robot series adopts a joint modular design and the uses a developer-oriented robot system. Users can develop a customize control system in accordance with an application program interface provided by a ELITE collaborative robot platform. In addition, the ELITE collaborative robot is equipped with a dedicated programmable interface, which allows the users to program, adjust multiple control settings, implement offline simulations, and observe the running state of the robot in real-time. Accordingly, the work efficiency of the practical application may be improved greatly.

Product Composition

The detailed outbound list of one set of complete EC66 robot is shown in the **Table** 2 .

Table 2 . outbound

Name	Quantity
Robot body	1
Controller including teach pendant	1
Power cord	1
Base (Optional)	1

More Information

For more Information please visit our website:www.elibot.cn

Chapter 1 Safety

1.1 Introduction

This chapter introduces the safety principles and specifications that should be followed when operating the robot. The integrator and the user must read this manual carefully and comply with all safety guidelines and warning labels. Users must fully understand the inherent risks of operating the robot arm, and strictly comply with the requirements listed in this manual. The user and the integrator must comply with ISO 10218 Industrial Robots - Safety Specification.

1.2 Liability

ELITE ROBOT Co.,Ltd. should provide the necessary spare parts to replace or repair relevant parts if the new equipment and its components are trapped in defects resulting from manufacturing and/or poor materials.

ELITE ROBOT Co.,Ltd. shall possess the ownership of the equipment or components replaced or returned to ELITE ROBOT Co.,Ltd.

If the product is no longer under warranty, ELITE ROBOT Co.,Ltd. shall reserve the right of charging the customer for replacement or repair. In case of defects of the equipment which is out of warranty, ELITE ROBOT Co.,Ltd. shall not be responsible for any damage or loss caused therefrom, such as loss of production or damage due to other production equipment.

If the equipment defect is caused by improper disposal or falling to comply with the relevant information stated in the user manual, the “Product Quality Assurance” will be invalid.

Failure caused by the following circumstances will not be covered by the warranty:

1. Installation, wiring and connection to other control equipment are not in line with the industrial standards or not implemented in accordance with the requirements of the user manual.
2. Outside the specification or standards shown in the user manual during use.
3. This product is applied to the non-designated purposes.
4. The storage mode and operating environment are beyond the specified scope (such as pollution, salt damage and dewing) of the user manual.
5. The product is damaged as a result of improper transportation.
6. Damage due to the accident or impact.
7. The non-original parts and accessories are installed.
8. Damage as a result of modification, debugging or repair of the original parts by the third party beyond ELITE ROBOT Co.,Ltd. or other integrators designated by ELITE ROBOT Co.,Ltd.

9. Natural disasters, such as fire, earthquake, tsunamis, lightning stroke, gale and flood.
10. Failure outside the abovementioned circumstances and not caused by ELITE ROBOT Co.,Ltd.

The following circumstances should not be covered by warranty:

1. The date of production or the start date of the warranty cannot be identified.
2. Alteration of the software or internal data.
3. The failure cannot be reproduced, or ELITE ROBOT Co.,Ltd. cannot identify the failure.
4. This product is used on the radioactive equipment, the biological test equipment or in the dangerous use judged by ELITE ROBOT Co.,Ltd.

In accordance with the product quality assurance agreement, ELITE ROBOT Co.,Ltd. shall be responsible for making the commitment of quality guarantee for the defects or deficiencies occurring in the products and the parts sold to the dealers.

As for any other explicit or implied warranties or liabilities including, but not limited to, any implied warranty for marketability or specific use, ELITE ROBOT Co.,Ltd. shall not bear the related liability to guarantee. In addition, ELITE ROBOT Co.,Ltd. shall not be responsible for the related liabilities in allusion to any form of indirect damage or consequence generated by the related product.

1.3 Warning Symbols

The safety-related contents of this manual are illustrated with the following warning symbols. The descriptions related to the warning symbols in this manual represent the important contents, please comply with these symbols.

DANGER

This indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

This indicates a hazardous situation which, if not avoided, may result in death or serious injury.

CAUTION

This indicates a hazardous situation, which, if not avoided, may result in minor or moderate injury.

WARNING

This indicates a potentially hazardous electrical situation which, if not avoided, could result in injury or major damage to the equipment.

WARNING

This indicates a potentially hazardous hot surface which, if not avoided, may result in burns.

1.4 Safety Precautions

When running the robot system, safety of the operating personnel must be ensured first. The general cautions are listed below. Please properly take corresponding measures of ensuring safety of the operating personnel.

CAUTION

1. Preliminary tests and inspections must be performed before using the robot for the first time or putting it into production.
2. All personnel operating the robot system should receive training from ELITE ROBOT Co.,Ltd. Users should fully understand the operational process and be qualified to operate the robot. For detailed training, please contact with the company by E-mail: tech@elibot.cn.
3. While operating the robot system loose clothing or jewellery should not be worn. Long hair must also be tied back for safety.
4. When the equipment is powered on, even if the robot is not moving, maintain caution as the robot may be waiting for a signal to continue motion.
5. Markings, guardrails, ropes, signage, or protective screens should be placed around the robot to clearly show the workspace of the robot.
6. Maintenance workers or operators should ensure that the robot is not plugged in or powered on while performing electrical maintenance.
7. Gloves should not be worn while operating the robot.
8. Electrical equipment must be installed in accordance with specifications in the manual.
9. Make sure that the robot arm and tools are properly and securely installed.
10. Make sure that the robot arm has ample space to operate freely.
11. Never use the robot if it is damaged.
12. Do not connect any safety equipment to normal I/O's. Use safety-related I/O's only.
13. Stand clear of the robot while using the teach pendant.
14. Never modify the robot. If the robot is changed or altered in any way, ELITE ROBOT Co.,Ltd. will not take any responsibility.
15. Before transporting the robot, the user needs to ensure that the robot is safely and properly packaged.
16. Comply with the transportation requirements when transporting the robot.
17. When the robot is combined, or works with the machines capable of damaging the robot, it is highly recommended to test all functions and the robot program separately.
18. Do not expose the robot to permanent magnetic fields for long periods of time. Strong magnetic fields may damage the robot.

WARNING

1. The robot and the controller may generate heat during running. When the robot is working or just stops working, please do not operate or touch the robot.
2. Provide ample time for the robot to cool down after pausing operations.
3. Do not place hands near or around the heating part of the controller.

1.5 Risk Assessment

A risk assessment is the most important task an integrator or operator must complete. The information in this manual does not cover how to design, install, or operate an integrated system, nor does it cover proper safety and handling of peripheral devices. The safety of the complete system depends on how the robot tooling and devices are installed and used. Integrators should comply with all laws, regulations, safety specifications, and standards of the country where the integrator is working while installing the robot system.

WARNING

A risk assessment must be performed before setting up and operating the EC66

The integrator may perform the risk assessment by using the following standards for reference:

1. ISO 12100:2010 Safety of machinery - General principles for design - Risk assessment and risk reduction
2. ISO 10218-2:2011 Robots and robotic devices - Safety requirements for industrial robots - Part 2: Industrial robot system and integration
3. RIA TR R15.306-2014 Technical report of industrial robots and robot systems - Safety require-ments and task-based risk assessment method
4. ANSI B11.0-2010 Safety of machinery – General requirements and risk assessment

The ELITE robot integrator should perform, but not limited to, the following responsibilities:

1. Make a comprehensive risk assessment for the complete robot system
2. Confirm that the whole system is designed and installed accurately
3. Provide users and staff with proper safety training
4. Create the operation specification of the complete system and clarify the instructions for using the robot
5. Establish appropriate safety measures
6. Remove potential hazards or minimize all hazards to acceptable levels with appropriate safety measures
7. Pass the remaining risks to the end-user
8. Mark the logo and contact information of the integrator on the robot
9. Store this manual and other related technical documents where they can be easily accessed for reference

Dangerous interactions between operating personnel and the robot during operation should be considered during the risk assessment. Situations where the robot or tooling could come into contact with the neck, face, or head must be avoided. Risk assessments must be performed before using the robot to avoid injury or death. Potential risks to safety may include, but are not limited to:

1. Potential injury resulting from using a sharp or pointed end effector tool
2. Handling of toxic or other harmful substances
3. Fingers or limbs getting pinned between the robot and a workpiece
4. Potential collisions with personnel or equipment
5. Tools or equipment coming loose during operation
6. Damage to the robot caused by hard impacts

Integrators must determine the level of risks through the risk assessment then implement safety measures to reduce the risk to acceptable levels.

For reference to applicable standards and legal guide, please visit the website: www.elibot.cn. All safety-related information contained in this manual shall not be regarded as the warranty of ELITE ROBOT Co.,Ltd. Even though all safety instructions are followed, the personnel injury or equipment damage caused by the operating personnel may occur.

ELITE ROBOT Co.,Ltd. is committed to continuously improving reliability and performance of the products, and accordingly reserves the right to upgrade the products without prior notice. ELITE ROBOT Co.,Ltd. strives to ensure accuracy and reliability of the contents in this manual, but takes no responsibility for any errors or missing information herein.

For more information refer to Chapter 14.

1.6 Intended Use

The EC66 is intended for use in lightweight manufacturing. Not all environments are suitable for operation of the EC66. The EC66 must not be used in the following scenarios:

1. Flammable, explosive, or other hazardous environments
2. Carrying or moving humans or animals
3. Used as a medical device of any type
4. High traffic areas without appropriate safety barriers
5. Environments subject to excessive vibration
6. Installed on a vehicle or ship
7. As a climbing tool

1.7 Emergency Situations

In the event of an emergency, the user may press the emergency stop button to cut power to the robot arm immediately.

Figure 1-1 : Emergency stop button

CAUTION

When the emergency stop button is pressed, the robot arm may slowly fall a short distance while the system brakes engage.

when the emergency stop button is pressed, it will be in the lock state. To unlock, twist the button in the clockwise direction and pull up. This will disengage the emergency stop button.

In emergency situations where a user is pinned between the robot and a workpiece and the robot needs to be moved to release the trapped user. Do not power on the robot!

WARNING

If a user is pinned down by the robot, do not power on the robot

To free a user who is pinned by the robot, immediately cut power by pressing the emergency stop button. The EC66 can implement the function of forcing joint movement in the opposite direction in an emergency, pushing or pulling the robot arm forcefully to force the joint to move. In this case, the joints of the robot may be damaged, but the safety and health of all personnel is more important. If needed, seek medical attention. If the robot cannot be backdriven for whatever reason, the appropriate joint cover can be removed and the brake retaining solenoid pin can be released to allow the joint to spin freely. For more information on how to remove the joint covers and where to find the brake solenoid refer to the maintenance manual.

Although the EC66 does have a collision detection function, it is not a guarantee of safety. If the robot is moving fast and collides with an object or individual, the robot will stop, but injury can still occur. Caution should still be exercised when operating the robot with the collision detection activated.

Chapter 2 Transporting

Each robot comes with a default packing program. By running this program, the robot will move to the original packaging position. The robot can then be placed in its original packaging in the proper configuration. If the original packaging is no longer available, users must ensure that all components of the robot are well supported and protected to avoid damage to the arm or controller while in transit.

Please ensure that the mounting surface is prepared before unpacking the robot. Placing the robot on the floor or work surface is not recommended. Install the robot in the desired mounting position immediately after removing it from its original packaging to avoid any damage.

An original package should be kept upon completion of the installation. The packaging material should stay dry, in case of repackaging the robot in the future.

CAUTION

1. Please make sure that your back or shoulder not overloaded when lifting the robot.
2. All regional and national guidelines should be followed. Elite Robotics Co., Ltd. is not responsible for the damage caused during the transportation of the equipment.
3. Make sure that the robot is installed in accordance with the installation instructions.
4. The storage temperature for the robot system typically ranges from -25~50 Celsius.
5. The robot equipment sent oversea may not be able to deliver battery products due to the restrictions of air transportation. So that the 3V button battery on the main board in the controller box may not be able to delivered together with the Controller. If the battery is missing, it will cause the incorrect system time. Please insert 3V battery before power on.

Chapter 3 Hardware Composition

The EC66 robotic system is composed of three main parts:

1. Controller
2. Robot Arm
3. Teach Pendant

The system also includes three cables:

1. Main Power Cable
2. Robot Cable
3. Teach Pendant Cable

Setup and assembly of the system is discussed in Chapter 5. This chapter will briefly describe each of the system components.

3.1 Robot Arm

3.1.1 Components

Figure 3-1 : EC66 robot system

The robot arm is shown in **Figure** 3-1 . The robot has six degrees of freedom, or in other words, the robot has six joints that rotate independently. **Figure** 3-2 shows the robot joints including a base (joint 1), a shoulder (joint 2), an elbow (joint 3), and three wrist joints.

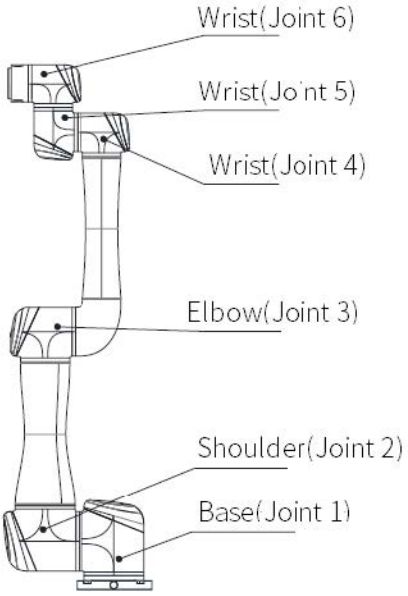


Figure 3-2 : EC66 Robot joints

3.1.2 Dimensions

The physical dimensions of the EC66 robot are shown in **Figure** 3-3 .

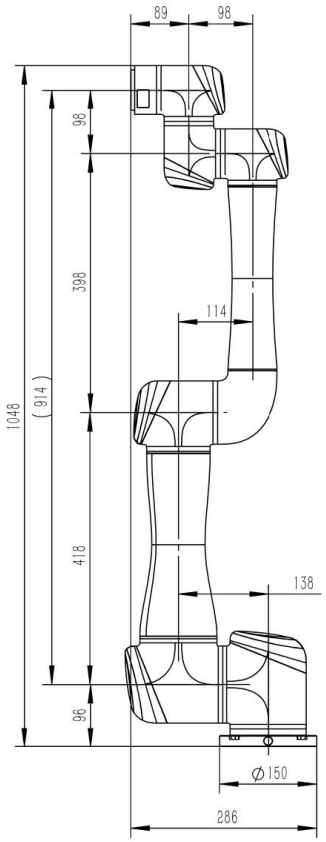


Figure 3-3 : Mechanical dimensions of the EC66 robot, with unit of mm

The dimensions of the base and the mounting bolt pattern are shown in **Figure** 3-4.

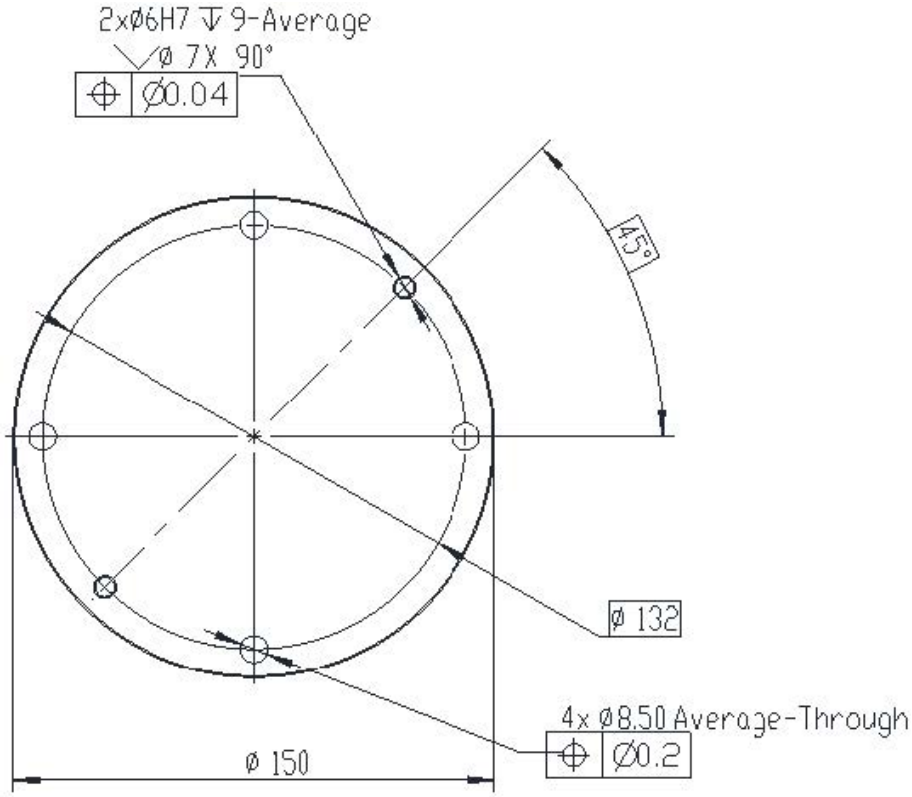


Figure 3-4 : Dimensions of installation holes on the base in millimeters

The tool flange is where tools can be mounted to the robot's end effector. The dimensions of the tool flange are shown in **Figure** 3-5 .

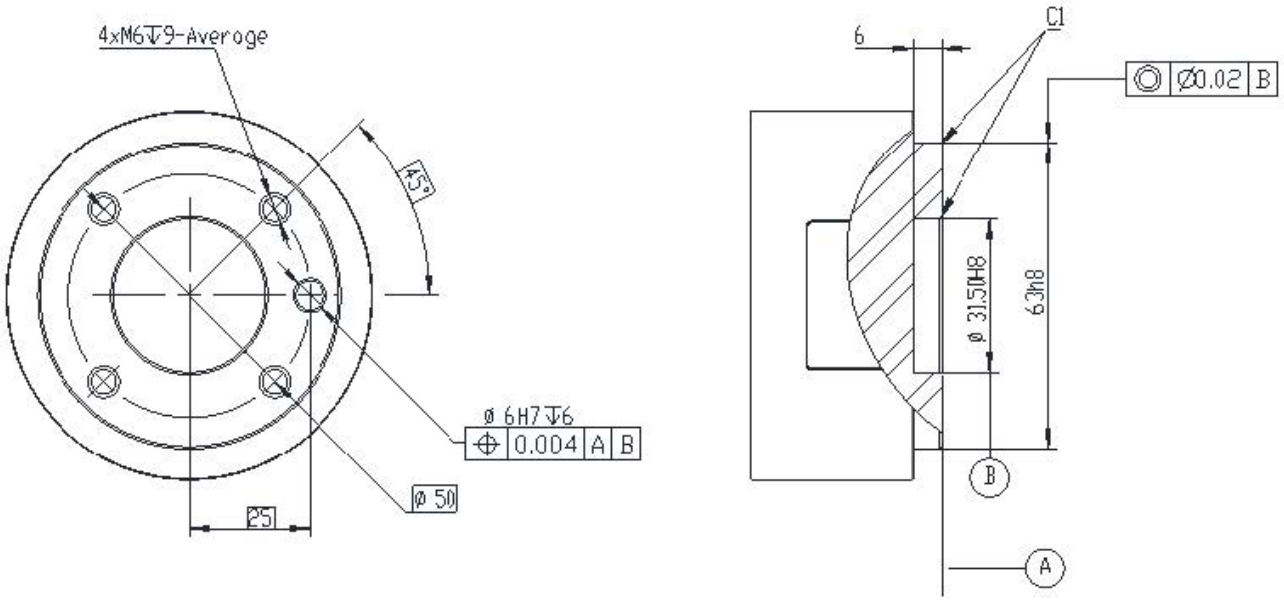


Figure 3-5 : Mechanical dimensions of the tool flange of the robot in millimeters

The tool I/O port is located on the side of the robot end effector as shown in **Figure** 7-16 . To access the tool I/O port, remove the gray cover.

Figure 3-6 : Location of the Tool I/O plug

3.1.2.1 Workspace

Figure 3-7 shows the shape of the EC66's workspace, comprised of a sphere with a radius of 624mm. The cylindrical space directly above and below the base is a singularity zone. Singularities are positions where the robot loses a degree of freedom due to its configuration, or where the commanded velocity of the trajectory causes the joint speeds to exceed safe limits. Singularities should be avoided when programming the robot, as they can cause sudden or rapid movements or disrupt program execution.

Figure 3-7 : workspace of the manipulator

The robots joints cannot rotate continuously and are limited to specified r anges. The rotational joint limits are listed in table **Table** 3-1 . It is important to note that these ranges may be adjusted if desired. Modifying the joint ranges is discussed in Subsection 12.3.3.

Table 3-1 . The EC66's joint limits

Joint	Min Angle	Max Angle
Joint 1	-360°	360°
Joint 2	-360°	360°
Joint 3	-158°	165°
Joint 4	-360°	360°
Joint 5	-360°	360°
Joint 6	-360°	360°

3.1.2.2 DH Parameters

Denavit-Hartenberg parameters, i.e. DH parameters, are the tradition way of representing the forward kinematics of robotic arms. They are used to indicate the position of the tool center point, or TCP, in the base coordinate system given the joint angles of the robot arm, as shown in **Figure** 3-8 .

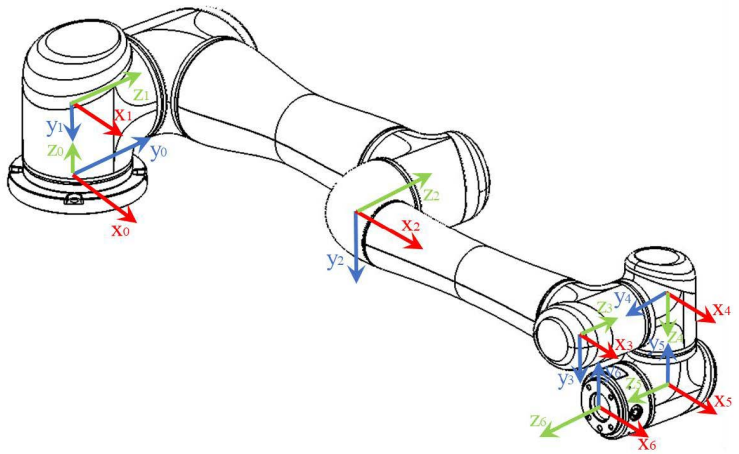


Figure 3-8 : Robot DH diagram

The DH parameters of the EC66 are given in table **Table** 3-2 .

Table 3-2 . EC66 DH Parameters

Kinematics	θ	a	d	α
Joint 1	0.0	0.0	0.096	-π/2
Joint 2	0.0	0.418	0.0	0.0
Joint 3	0.0	0.398	0.0	0.0
Joint 4	0.0	0.0	0.122	-π/2
Joint 5	0.0	0.0	0.098	-π/2
Joint 6	0.0	0.0	0.089	0.0

3.2 Controller

The controller contains the control board, power supplies, and general I/O ports including safety, digital and analog I/O's.

3.2.1 Components

The controller is identified in **Figure** 3-9 .

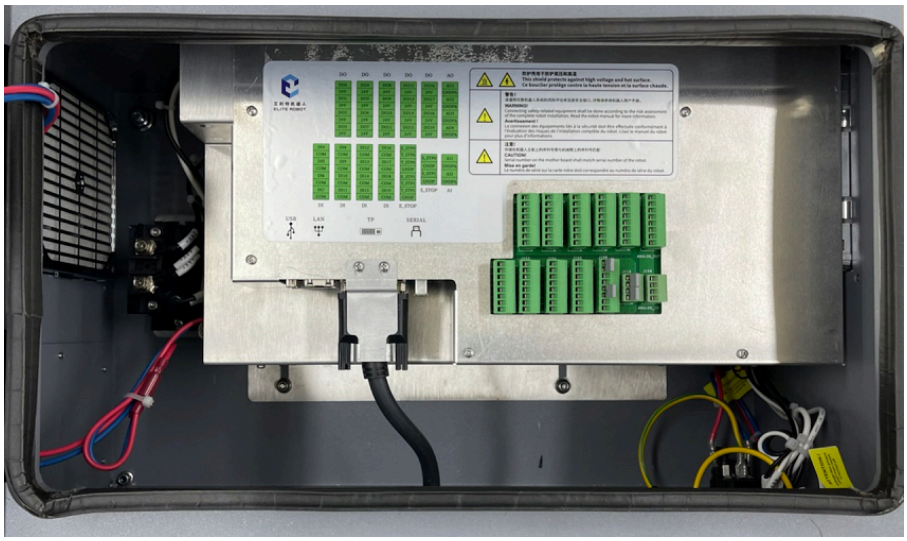


Figure 3-9 : ERB2E series controller

3.3 Teach Pendant

The EC-serie's teach pendant is a handheld multifunctional device that has a touch screen and physical buttons. Users can perform many functions, i.e., setting, monitoring the acquired data, and program-

ming the robot. The physical buttons around the touch screen can activate other options or functions.

3.3.1 Pendant Layout

The front view of the teach pendant is shown in **Figure** 3-10 .

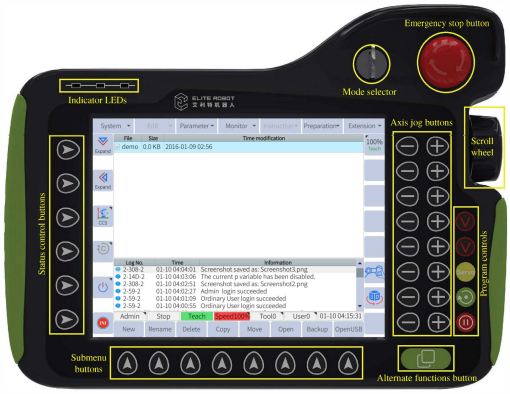


Figure 3-10 : Layout of teach pendant (front)

The following is a description of each feature running counter clockwise from the emergency stop button:

1. Emergency stop button - used whenever an emergency occurs. The user can press it to cut power to the robot arm.
2. Mode selector - used to set the mode to PLAY, TEACH, or REMOTE. If this switch is moved from PLAY to TEACH, the current running program will end immediately.
3. Indicator LED - notify the user if the power is on, if there is an active alarm, or if the robot servos can be actuated.
4. Status control buttons - used to select items from the status control menu without using the touch screen.
5. Submenu buttons - select menu items from the submenu without using the touch screen.
6. Alternate functions button - the user must press and hold it to see the available alternative functions on the current screen and select a suitable function from the submenu.
7. Program controls - allow users to control the robot program. These buttons can be used only when the mode selector switch is at PLAY mode.
   (a). The orange buttons, V+ and V-, are used to increase and decrease the running speed of the robot.
   (b). The yellow servo button is used to activate the servos before running a program. The robot cannot run programs unless this button is pressed and the yellow servo indicator LED is lit.

(c). The green play button is used to run a program or step through a program (see Section 6.8). It is also used to move to a recorded waypoint to check its position.

(d). The red button is used to pause the running program. Double click the pause button within 1 sec and the running program will stop.

8. Axis jog buttons - used to move the robot arm relative to the current coordinate system.
9. Scroll wheel - used to scroll through the mouse. It is disabled by default. To enable scrolling simply press the scroll wheel in toward the teach pendant. To disable the scroll feature press the scroll wheel again.

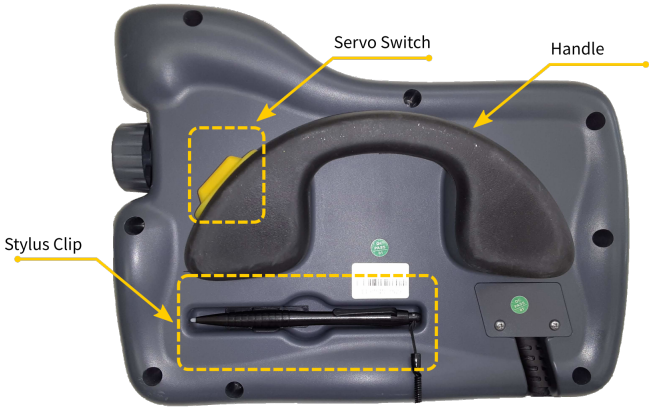


Figure 3-11 : Layout of teach pendant (back)

The servo switch (**Figure** 3-11) on the back of the teach pendant is used to activate the servo motors. The user must take hold of the handle and hold down the three-position switch until the servo indicator LED is on. After that, the robot can be moved. In addition, the mode must be set to TEACH. There is also a stylus clip on the back of the teach pendant.

Chapter 4 Quick Start

This chapter focuses on getting started quickly. It is not a comprehensive startup guide. Please refer to the appropriate sections for more information on setup and programming.

4.1 Setup

The following steps are the order that should be taken when setting up the robot:

1. Mount the robot arm to a stable platform or surface with 4*M6 bolts
2. Connect the robot cable to the controller
3. Connect the main power cable to the controller
4. Mount any tools necessary to the tool flange and connect the appropriate I/O's of the tool
5. Plug main power cable into an appropriate outlet
6. Make sure that the workspace of the robot is clear of personnel and safety hazards before operating

7. Perform a risk assessment

4.2 Power On

To power on the robot, ensure that all cables are connected correctly and the controller is plugged into a suitable power source. Locate the power switch on the controller. Switch the teaching mode (see **Figure** 3-10) from PLAY or REMOTE to TEACH first before turning off the system supply. When the robot completely stops, turn the power switch on the controller to the off position.

4.3 Initialization

Once the teach pendant is powered on, press and hold down the three-position switch on the back of the teach pendant and click the imprecise button so that the robot is in an initialized state. The user can calibrate the encoder at the time. If it is failed to finish the calibration, please manually move each axis until the robot is in the precise mode, as shown in **Figure** 4-1.

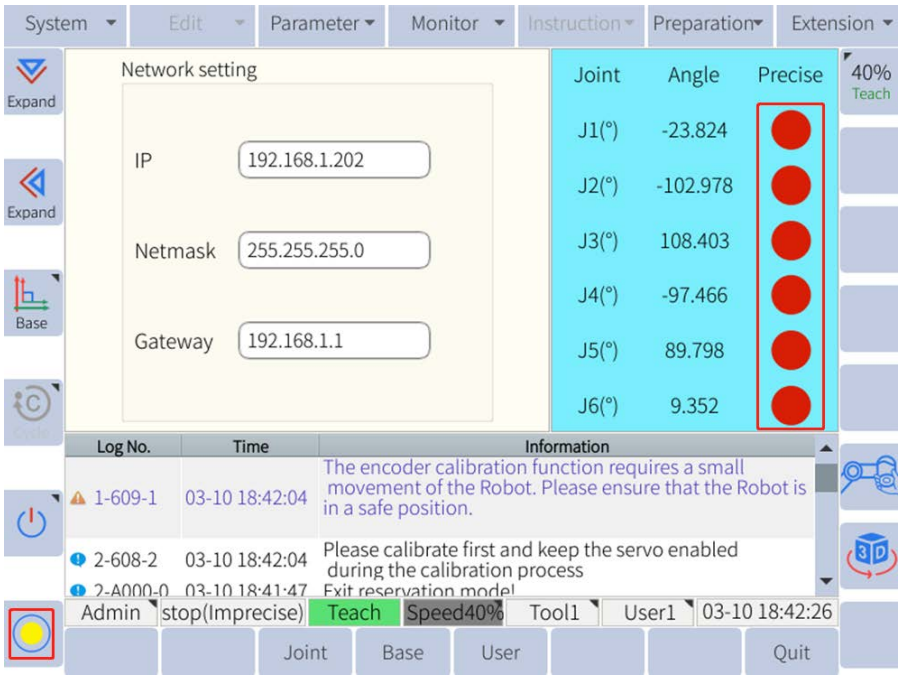


Figure 4-1 : Move each axis until the robot is in the precise mode

Once the alarm is clear, set up the mount config of the robot (see Subsection 12.2.2). In the main menu at the top of the screen, navigate to **Preparation -> Mount config**.

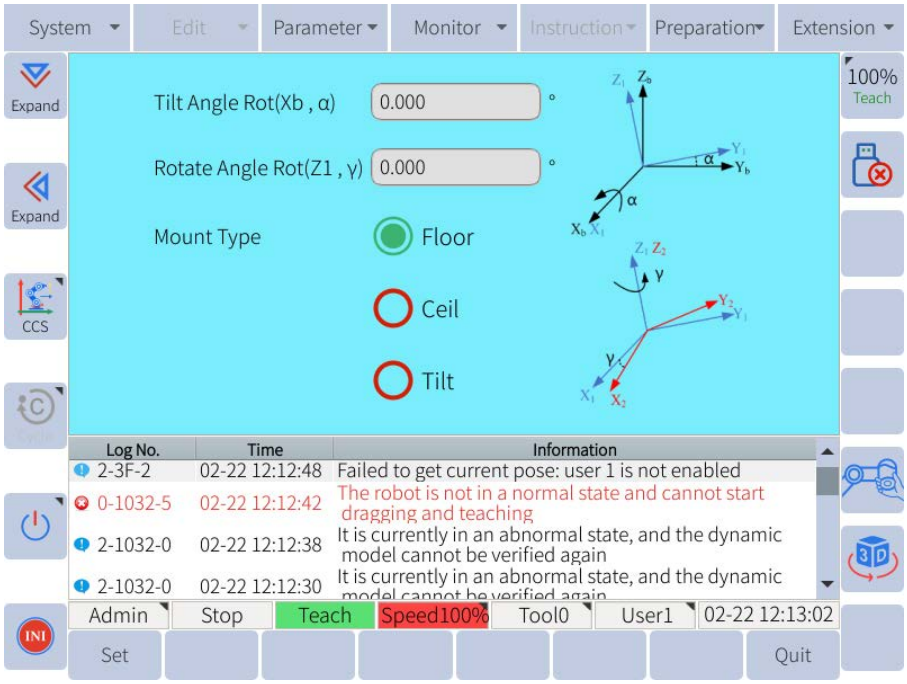


Figure 4-2 : Mount config page for initial setup

Once the correct information has been entered, press the set button at the bottom of the screen in the submenu and save the settings.

NOTICE

Mount config are not saved unless the ”set” button is pressed after entering information.

WARNING

If the correct mounting method is not used, the hand guiding function will not work properly and the robot will drift in an unexpected manner.

4.4 Tool Setup

If a tool is installed on the end effector of the robot, it must be set up in the software. In the main menu navigate to **Preparation -> Tool Config** (see **Figure** 4-3). There are a total of 8 tools that can be stored in the software’s memory. They are kept track of by number.

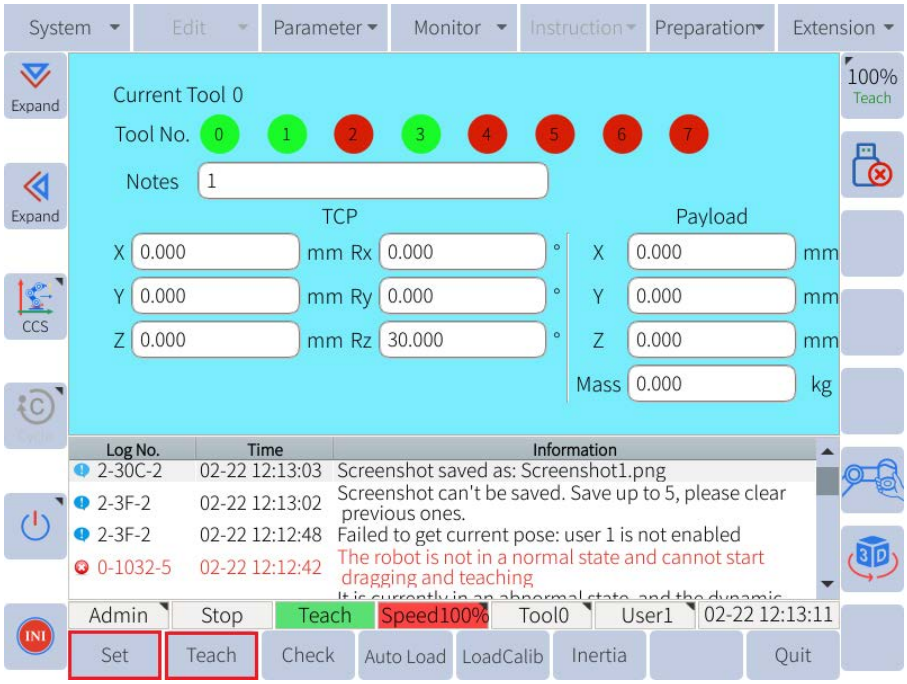


Figure 4-3 : Tool coordinates setting

Select the tool number you wish to configure and enter the offsets of the tool center point (TCP) from the tool flange origin. Enter the center of mass and mass itself of the tool. Remember to click ”Set” in the submenu. See Subsection 6.11.3 for more information on setting up a tool.

CAUTION

If the tool information is not saved or the incorrect tool is selected, the robot gravity compensation will not work correctly

4.5 Jog Axes

Once the system is turned on, the robot can be moved in various ways. To jog the robot using the teach pendant:

1. Click the coordinate on the left menu of the teach pendant screen and select the joint button
2. Stand clear of the robot
3. Press and hold the servo switch on the back of the teach pendant - the servo indicator LED will light up
4. Press the +/- button of the desired axis jog button (see **Figure** 3-10)

Users can also move the robot by hand. To activate the hand guiding feature of the robot, locate the hand guide enable button located on the side of the tool flange (see **Figure** 4-4).

Figure 4-4 : Hand guide enable button

The user must press and hold the hand guiding button while they guide the robot to the desired location. To stop hand guiding, simply release the hand guide enable button. Do not press the servo switch while hand guiding.

4.6 Program

4.6.1 Create Program

To create a program, click “New” and an interface will pop up as shown in **Figure** 4-5.

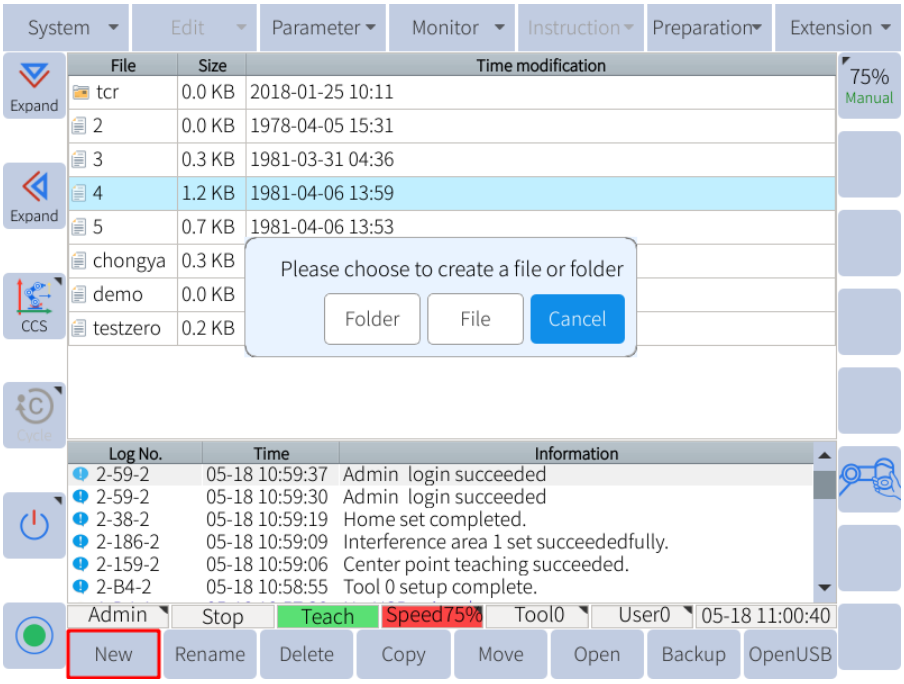


Figure 4-5 : New Program File

After clicking “File”, enter the desired file name in the input field and click “OK”.

To open an existing file, select the program and click “Open” to open the program to the editing interface (**Figure** 4-6).

NOTICE

Programs are saved automatically while a program is being edited

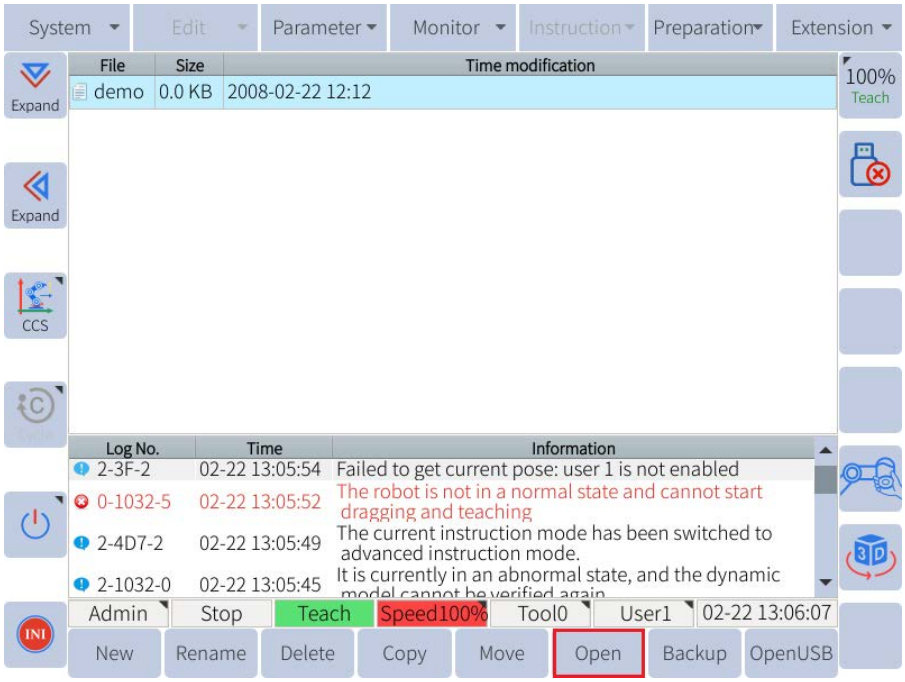


Figure 4-6 : Open program file

4.6.2 Inserting Commands

To insert a command, locate and click the “Instructions” tab in the main menu bar. The following command categories are available:

Input and putput/Logic control/Mathmatic/Set and get/Lua control/Others/Motion

The methods of inserting all instructions are identical except the move instruction.

1. In the program editing page, move the cursor to the line immediately before the line where the instruction needs to be inserted.
2. Then press “Instruction” under the main menu or “Custom” in the submenu area to select the instruction to be inserted, as shown in **Figure** 4-7.

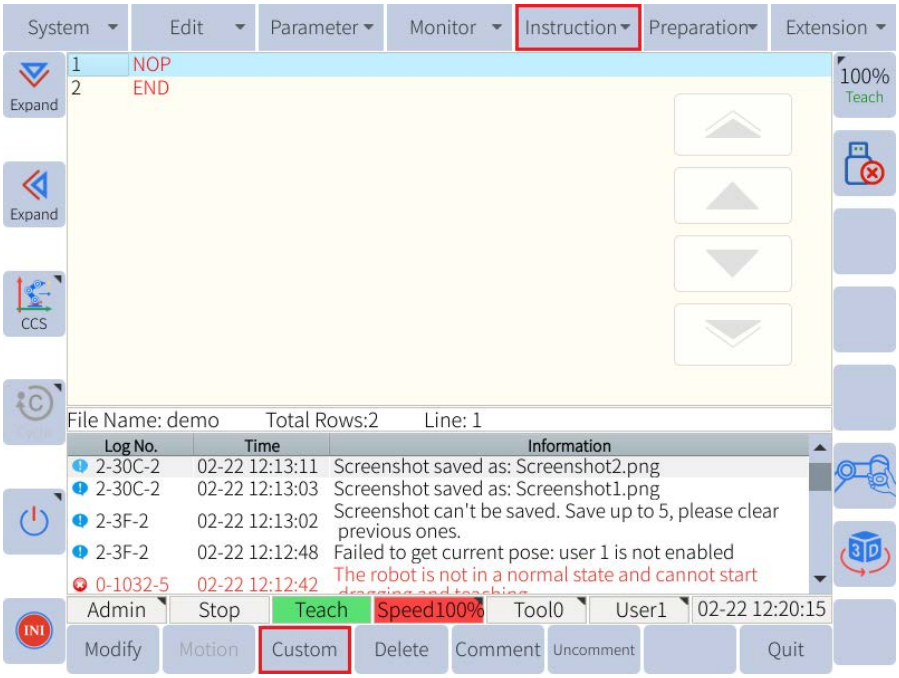


Figure 4-7 : Inserting other instructions

3. After editing the parameters, press “OK” to insert the instruction.

The “Custom” tab in the submenu area contains only some of the instructions, but all instructions can be found by pressing “Instructions” in the main menu bar.

4.6.3 Inserting Move Commands

When inserting a move instruction without using P variables, the current position of the manipulator is recorded into the move instruction. Be sure to press the servo safety switch to successfully insert the movement command.

The procedure for inserting a move command is as follows:

1. Move the manipulator to the desired position using hand guiding or the jog axis buttons.
2. Move the program cursor to the line immediately before the position where a move instruction is to be inserted.
3. Press and hold the servo switch - the ”SERVO” indicator light will turn on.
4. Click “Motion” in the submenu bar or select **Instruction -> Move Instruction**, and select the desired move method on the drop down menu, as shown in **Figure** 4-8.

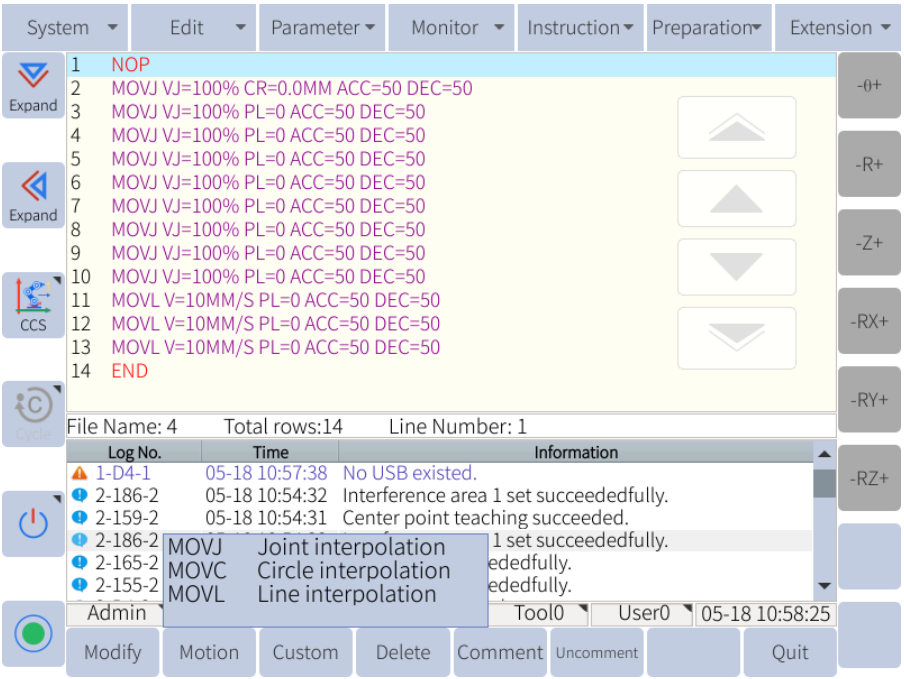


Figure 4-8 : Selecting the move instruction

5. After selecting the move instruction, edit the parameters and press “Confirm” to insert it.

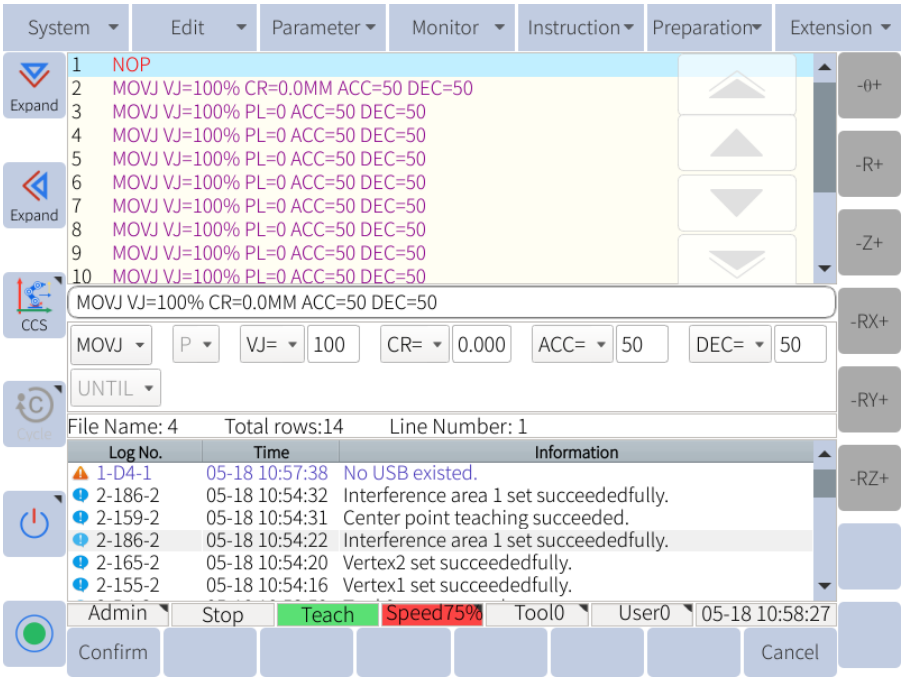


Figure 4-9 : Inserting the move instructions

NOTICE

The servo switch must be held when inserting the move instructions. Otherwise, the move instruction **will not** be inserted.

4.6.4 Run Program

Switch to PLAY mode using the mode selector at the top of the teachpendant. Press the icon 

in the status control area to select one of three types of manipulator operation cycles:

1. SINGLE STEP: Executes only one line of instruction when pressing the running button each time. Any non-motion instructions will not be executed.
2. SINGLE CYCLE: Executes a program once.
3. CONTINUOUS CYCLE: Repeat to execute the program continuously.

After completing all above preparations, first press “SERVO ENABLE” button 

on the bottom right corner of the teachpendant. The SERVO ON lamp lights up when the servo is enabled. Then, press “PROGRAM START” button  , and the program will start running automatically.

4.7 Power Off

When the user is ready to power off the system, first turn the teach pendant mode (**Figure** 3-10) switch from PLAY or REMOTE to TEACH to stop the current program.

The user can select  , and then click ”OK” to power off the robot.

When the robot has come to a complete stop, turn the power switch on the controller to the off position, as shown in **Figure** 4-10 .

Figure 4-10 : Power switch on the controller

Chapter 5 Setup and Assembly

5.1 Important Safety Instructions

DANGER

Before installation, please ensure the serial number of the robot matches with the controller. The arm parameters need to correspond to the controller parameters. A warning message will be sent out and the robot cannot move if there is a mismatch.

Environmental conditions for installation:

- No corrosive gas or liquid
- No dust or metal powder
- No radioactive material
- No oil mist
- No mechanical shock and vibration
- Low humidity
- Less than 1200m above sea level
- Avoid long periods of direct sunshine (prevent the robot from being used outdoors)
- No salt mist
- No electromagnetic noise
- No flammable materials

Ambient temperature: 0°C ~ 50°C

Operating humidity: 5%~95% (without dewing)

5.1.1 Bearing Surface

The robot should be installed on a hard surface. The bearing surface must be able to bear at least ten times the resulting torque of the base joints and at least five times the weight of the robot arm. In addition, the surface should be free of vibrations. The safety assessment must be implemented upon completion of each installation of the robot, and the instructions in Chapter 1 should be strictly followed.

WARNING

The risk assement must be performed after setting up the robot and before operation

5.2 Materials Needed

The following is a list of materials needed for installation:

1. 4*M6 bolts (base). See **Figure** 3-4.
2. 4*M6 bolts (tool). See **Figure** 3-5.
3. Torque wrench.

5.3 Electrical Specifications

5.3.1 Controller

The power supply in the controller should be equipped with the following:

1. Ground connection.
2. Mains fuse.
3. Residual current device.

It is recommended to install a mains switch to the power supply of all equipment in the robot application, in order to facilitate lockout and tagout during repair.

The electrical requirements of the external power supply are shown in **Table** 5-1 .

Table 5-1 . Electrical specifications of the mains connection

Parameter	Min	Typ	Max	Units
Input voltage (Normal version)	90	-	264	VAC
External mains fuse (when the voltage is 90-130V)	8	-	16	A
External mains fuse (when the voltage is 200-240V)	8	-	16	A
Input frequency	47	-	63	Hz
Input voltage (M version)	19	-	72	VDC
External mains fuse (when the voltage is 24V)	64	-	100	A
External mains fuse (when the voltage is 48V)	32	-	64	A
Rated operating power	100	250	1600	W

DANGER

1. Please make sure that the robot is grounded correctly (electrical connection to ground). The grounding conductor should have at least the rated current of the max system current.
2. Make sure that the input current of the controller is protected with the residual current device (RCD) and the appropriate fuse.
3. The lockout and tagout should be implemented for all power supplies when robot maintenance is required. The robot I/O should not be powered by other equipment when the system is being repaired.
4. Please make sure that all cables are connected correctly before the controller is powered on. Always use the original power cord.

5.3.2 Tool

For more information regarding tool I/O's refer to Section 7.7.

5.4 Assembly

5.4.1 Mounting the Robot Arm

The robot can be installed in the various positions as shown in **Figure** 5-1 . Ensure that the robot position is set up according to the installation instructions. (see Subsection 12.2.2)

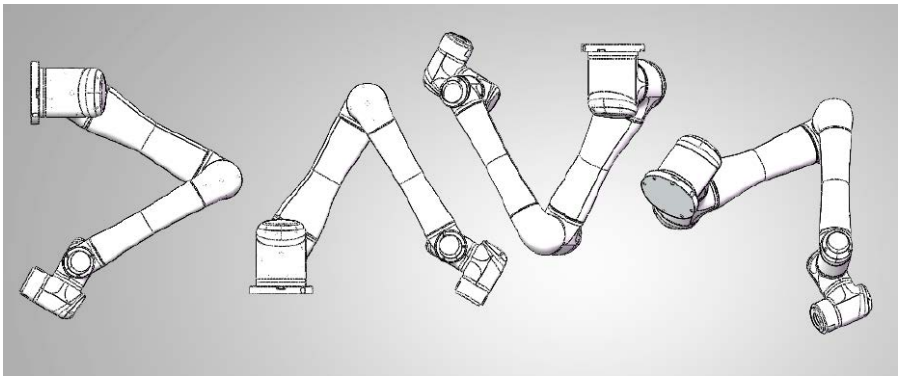


Figure 5-1 : Schematic diagram of different installation poses

When installing the robot arm, the robot body is fixed to the mounting surface with four M8 bolts. The bolts must be tightened with 20 Nm of torque. It is recommended that integrators install the dowel pins in the two locating holes to improve the installation accuracy. The dimensions of the mounting hole pattern are shown in **Figure** 3-4 .

The bearing surface should be strong enough to bear at least 3500Nm torsional force and a weight of at least 100kg. The surface should be free of vibrations.

CAUTION

Make sure the robot arm is correctly and securely installed before operation

CAUTION

If the robot is installed on a moving platform, acceleration should be low to avoid triggering the collision function of the robot

WARNING

It is recommended to use a bearing surface material with strong heat dissipation performance, such as aluminum. This is especially important when operating temperatures are greater than 35°C

5.4.2 Connecting the controller

The main power cable of the controller need to insert into the controller power port and plug the other end into an appropriately grounded and protected socket. Please refer to **Figure** 5-2 .

Figure 5-2 : Main power plug

CAUTION

The longest customizable cable distance between the robot and the controller is 6 meters.

The robot cable also has a heavy-load rectangular plug at the end shown in **Figure** 5-3 . Insert the heavy-load rectangular plug into the controller robot cable port and lock the connector into place.

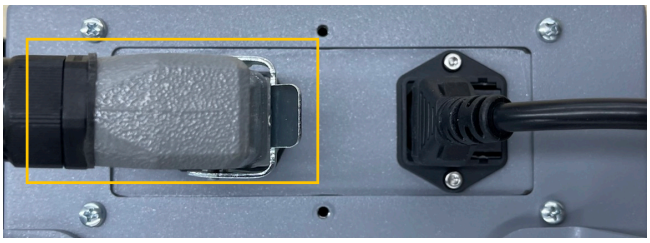


Figure 5-3 : Connection of the robot cable to the controller

The front of the controller is a switching power supply, as shown in **Figure** 5-12 , turn it clockwise 90 degrees to turn on the power.

CAUTION

It is recommended that the height of the controller is: the switch of the controller should be 0.6-1.5m away from the ground, and the power port should be 0.2m above the ground.

5.4.3 Install 3V button battery (optional)

Robot equipment sent outside may be restricted by air transportation and cannot ship battery products. Users need to install and configure it by themselves.

The specific operation steps are as follows:

1. Make sure the controller is powered off.
2. Open the cover of the controller, unplug all the terminals on the IO board, use a screwdriver to remove the fixing sheet metal of the teach pendant plug, lightly twist the fixing screws at both ends of the teach pendant plug, and pull out the teach pendant plug, as shown in **Figure** 5-5 .

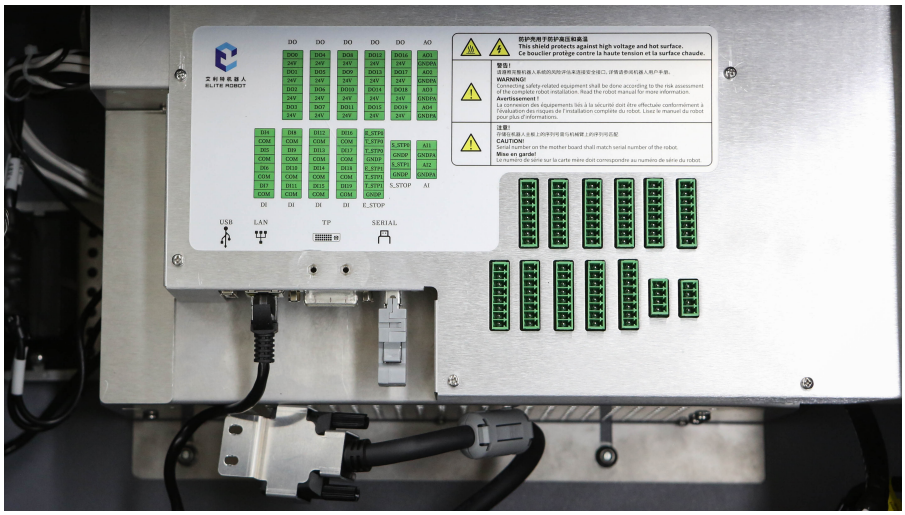


Figure 5-5 : Dismantling the controller

3. Use a Phillips screwdriver to remove the 5 fixing screws protecting the sheet metal on the core board, remove the sheet metal, and find the installation position of the 3V button battery on the core board, as shown in **Figure** 5-6 .

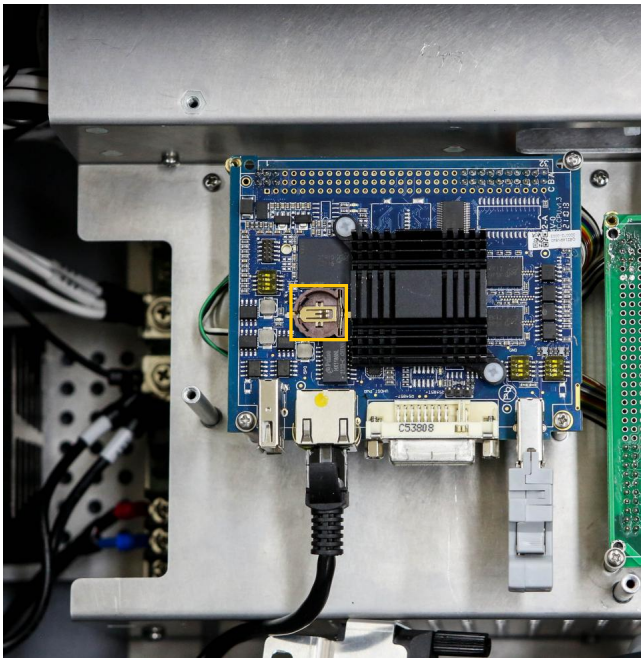


Figure 5-6 : Battery installation position

4. Put the electromagnetic positive pole of the 3V button upward, insert one end into the position where the battery slot has a buckle, and press down gently until the battery slot card can catch the battery, as shown in **Figure** 5-7 .

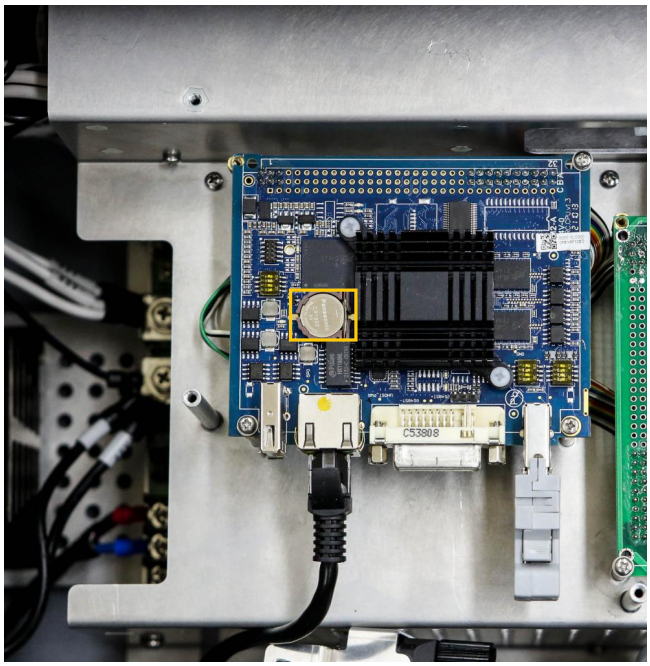


Figure 5-7 : Battery installation completed

5. Put the protective sheet metal in the original position, and fasten 5 screws, align the plug of the teach pendant and insert the screws on both sides and fasten the fixed sheet metal screws.
6. Insert the terminals on the IO board as they are, as shown in **Figure** 5-8 .

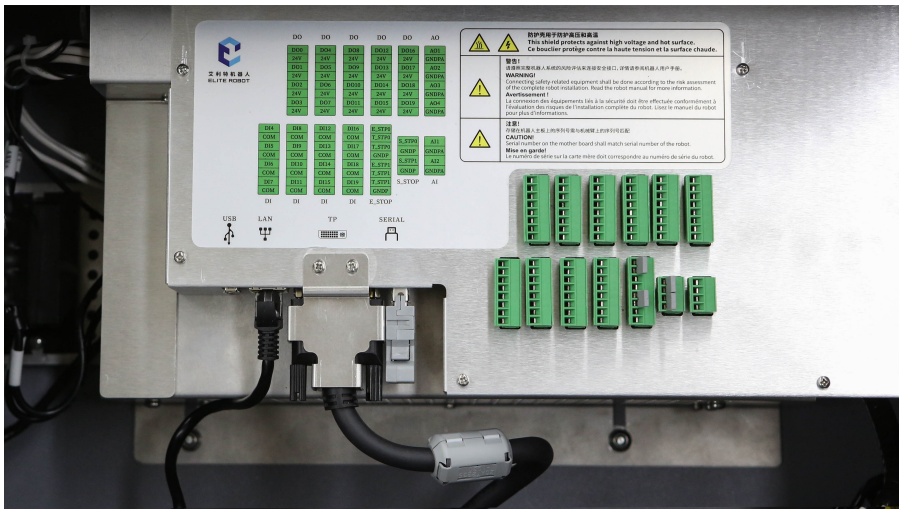


Figure 5-8 : Restore controller

CAUTION

Please wear an electrostatic wristband for battery installation.

5.4.4 Mounting the Tool

The EC66 has a max payload rating of 6kg during normal operation. The center of gravity of the payload must be located less than 260mm from the central axis of the tool flange.

The tool flange has four M6 threaded holes and one ϕ6 locating hole for increased installation accuracy. The M6 bolts must be tightened with 8 Nm torque. The mechanical dimensions of the tool flange are shown in **Figure** 3-5 .

CAUTION

Make sure the tool is correctly and securely installed

The max payload diagram is shown in **Figure** 5-9 . This diagram is to show how large a payload the robot can handle based on how far the center of gravity of the tool is from the center of the tool flange.

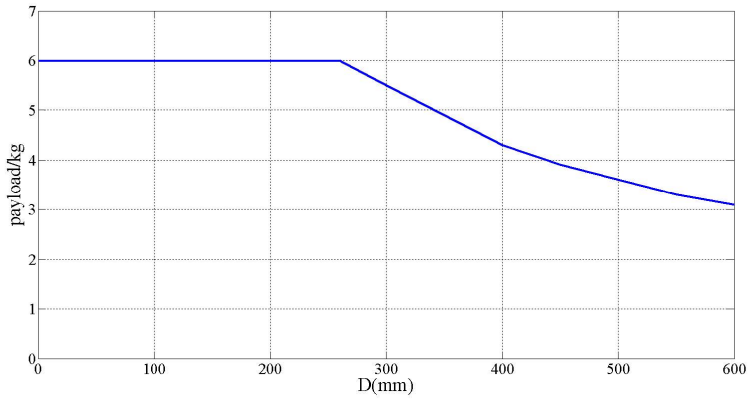


Figure 5-9 : payload diagram

The horizontal axis represents how far the center of gravity of the tool is from the center of the tool flange. The vertical axis represents the max allowed payload. The farther the center of gravity of the payload is from the center of the tool flange, the smaller the allowed payload becomes.

CAUTION

1. The payload shown in the diagram indicates a maximum payload. It must not be exceeded under any circumstance
2. The robot may be damaged if the payload exceeds the allowable value

5.5 Initialization

Once the robot is setup and all cables are properly installed, the robot can be powered on.

CAUTION

Always stand clear of the robot while it is booting up

To power on the robot, ensure that all cables are connected correctly and that the controller is plugged into a suitable power source. Locate the power switch on the controller. Insert the key provided into the power switch and turn the switch to the on position. If the controller is powered the cooling fans will turn on and the teach pendant power LED indicator will light up. The teach pendant screen will also turn on.

Once the teach pendant is powered on, press and hold down the three-position switch on the back of the teach pendant and click the imprecise button so that the robot is in an initialized state. If it is necessary to change the settings of the robot installation, please navigate to **System -> System Configuration -> Installation Settings** and set up the mounting pose (see Subsection 12.2.2).

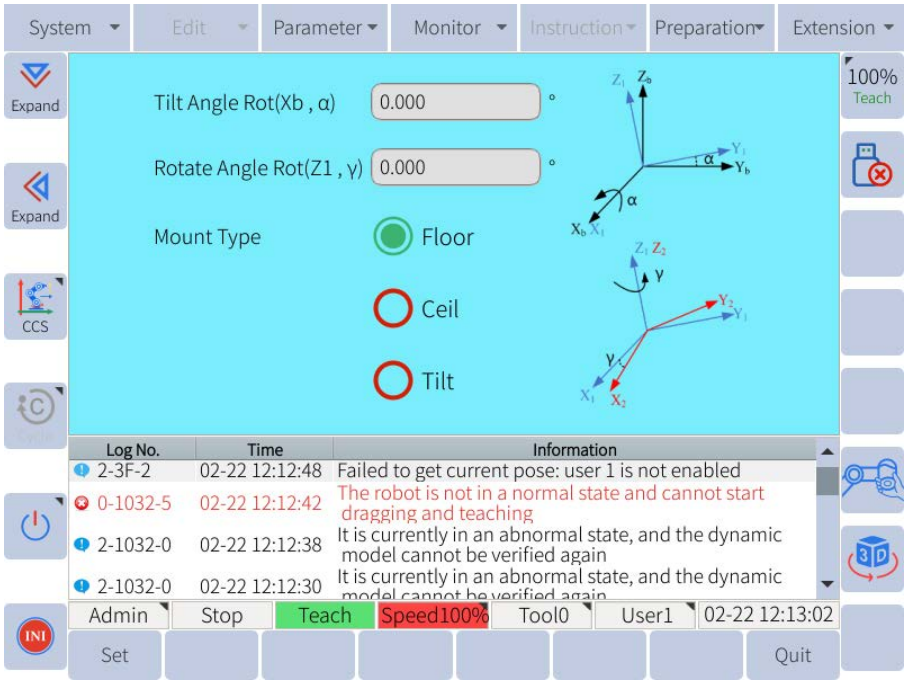


Figure 5-10 : Mount config page for initial setup

Once the correct information has been entered, press the save button at the bottom of the screen in the submenu.

NOTICE

Mount config are not saved unless the ”save” button is pressed after entering information

WARNING

If the correct mounting position is not used, the hand guiding function will not work properly and the robot will drift in unexpected directions

5.6 Tool Setup

If a tool is installed on the end effector of the robot, it must be set up in the software. In the main menu navigate to **Preparation -> Tool Coordinate** and set up the tool (see Subsection 6.11.3 for more information).

CAUTION

If the tool information is not set up or the incorrect tool is selected, the robot gravity compensation will not work correctly

Chapter 6 Programming the Robot

This chapter will describe the process a user will take to program the EC66. Each element of the layout will be described in detail. How to create a program and run a program will also be discussed.

6.1 System Startup

To power on the robot, ensure that all cables are connected correctly and that the controller is plugged into a suitable power source. Press the power switch on the controller.

Once the teach pendant is powered on, press and hold down the three-position switch on the back of the teach pendant and click the imprecise button so that the robot is in an initialized state. If it is necessary to change the settings of the robot installation, please navigate to **Preparation -> Mount config** and set up the mounting pose (see Subsection 12.2.2).

WARNING

If the correct mounting position is not used, the hand guiding funciton will not work properly and the robot will drift in unexpected directions

If a tool is installed on the end effector of the robot, it must be set up in the software. In the main menu navigate to **Preparation -> Tool config** and set up the tool (see Subsection 6.11.3 for more information)

CAUTION

If the tool information is not set up or the incorrect tool is selected, the robot gravity compensation will not work correctly

6.2 Robot Modes

There are three modes that the robot can operate in:

1. TEACH
2. PLAY
3. REMOTE

odes can be selected by turning the mode selection switch (**Figure** 6-1) to any of these three modes.

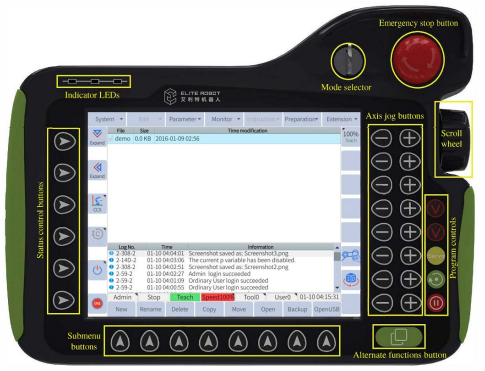


Figure 6-1 : Layout of teach pendant(front)

REMOTE mode is used when the robot is being controlled through an external method that does not use the teach pendant. This can be direct control through the EC66 software development kit (SDK). In this situation commands would be sent from a computer through the ethernet port on the controller.

TEACH mode is the mode that the robot must be in when creating a program or modifying variables or I/O's. If the robot is not in TEACH mode, changes cannot be made to programs or settings. To make changes move the mode selection switch to TEACH.

PLAY mode is used when a program has been created and the user is ready to execute the program.

CAUTION

Use caution when approaching the robot in REMOTE or PLAY mode. If the robot is stationary ensure that a program is not running or that the robot is not being controlled remotely before entering the robot's workspace.

6.3 UI Layout

The general user interface layout is shown in **Figure** 6-2 . There are also subwindows for various functions such as monitoring variables and I/O's and system settings that can be displayed.

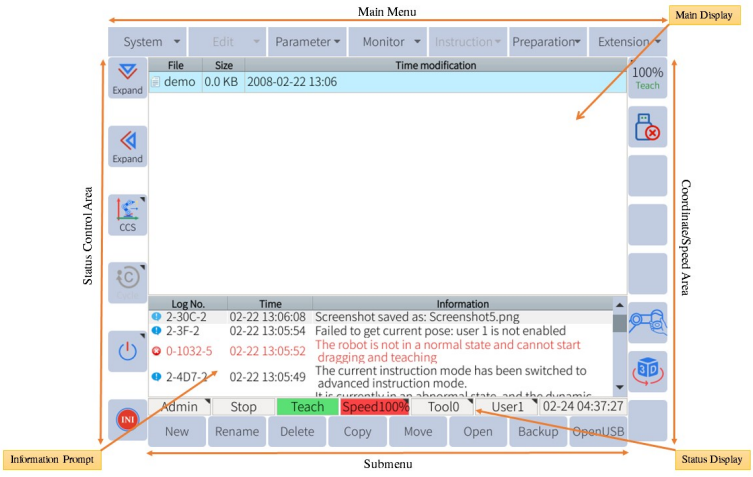


Figure 6-2 : Layout of user interface

6.4 User Levels

Certain functions and settings can only be accessed by users with the proper user level. There are four user levels:

1. Operator
2. Expert User
3. Super User
4. Administrator

All levels require a password to activate except for the Operator level.

Different users have different operation access. The default passwords for higher-level users are shown in **Table** 6-1 .

Table 6-1 . Default password

User Type	Default Password
Expert user	111111
Super user	222222
Administrator	333333

6.5 User Interface

6.5.1 Main Menu

The Main Menu is the toolbar at the top of the user interface, where a user can configure the settings, insert commands, or access variables and I/O's. Not all settings are available to normal operators. Some settings can only be accessed through the administrator level.

The main operations of ordinary users are: log backup, and the program cannot be modified. The main operations of expert users are: run and modify programs, backup data and modify variables. The main operations of the super user are: security configuration and so on. The administrator level has the highest authority.

The following table summarize the main menu setting and the required user level to view and/or modify it:

System		
Main Menu	**Submenu**	**User Rights**
File Backup	Log Backup/Parameter Backup	Ordinary user
	Global VAR Backup	Expert user
	IO Notes Backup	
	PLC Backup/User Data	
	Fieldbus Configuration	
	Script Backup/Delete	
	ID File Backup/Delete	
	Translation Backup	
	Global VAR Notes Backup	
	Migration/Zero Position Data Backup	Administrator
File Recovery	Variable/ JBI File Import	Expert user
	IO Notes Update	
	Script Update/Boot Screen	
	ID File/Translation Import	
	Global VAR Notes Update	
	Parameter/PLC Update/User Data	Super user
	Migration Recovery	Administrator
System Update		
System Setting	Language Setting	Ordinary user
	Network Setting	Expert user and above can edit
	VNC Setting	Super user and above can edit
	Remote Password	Administrator and above can edit
Mechanism Info		Ordinary user
System Info		

Edit		
Main Menu	**Submenu**	**User Rights**
Copy	Line Copy/Block Copy	Expert user
Cut	Line Cut/Block Cut	
Paste		
Delete	Line Delete/Block Delete	
Find		Ordinary user
Replace		Expert user
Custom Collection		

Parameter		
Main Menu	**Submenu**	**User Rights**
Kinematics		Expert user and above can edit
Controller		
Soft Limit		Super user and above can edit
DH Parameter/ Jog Parameter/ Joint Servo		Administrator and above can edit
Permission	User Switch	Ordinary user and above can edit
	Password	Super user and above can edit

Monitor		
Main Menu	**Submenu**	**User Rights**
Position	Joint/Base/User	Ordinary user
Global Variable	Var_B/Var_I/Var_D/Var_P/Var_V	Ordinary user can read only, expert user can edit (Note that it is impossible to edit the virtual input.)
Input and Output	Digital Input/Digital Output	
	Virtual Input/Virtual Output	
	Analog Input/Analog Output	
Motor Data	Motor Speed/Raw Pulse/Motor Torque	Expert user
Reservation/Runtime Position/Cycle Statistics		Ordinary user
Joint Temperature		Expert user

Instruction		
Main Menu	**Submenu**	**User Rights**
Input and Output	DIN Digital Input	Expert user and above can edit
	DOUT Digital Output	
	MIN Virtual Input	
	MOUT Virtual Output	
	AIN Analog Input	
	AOUT Analog Output	
	PULSE Pulse Output	
Logic Control	IF IF Condition Start	
	ELSEIF Condition Branch	
	ELSE Condition Branch	
	ENDIF IF Condition End	
	WHILE Loop Start	
	BREAK BREAK, Jump Out Loop	
	CONTINUE Jump to Next Loop	
	ENDWHILE Loop End	
	JUMP Jump to Label or Subprogram	
	CALL Call Subprogram	
	LABEL Label for Program Position	
	TIMER Timer	
	RET Subprogram Return	
	PAUSE Pause Executing	
	WAIT Wait for a Condition	
	MCWAIT MCWait	
Mathmatic	INC Increment/DEC Decrement	
	ADD Addition	
	SUB Subtraction	
	MUL Multiplication	
	DIV Division	
	MOD Surplus	
	AND And/ OR Or	
	NOT Not	
	XOR XOR	
	DIST Point Distance	
	POSETOJOINT Inverse Kinematics	
	JOINTTOPOSE Forward Kinematics	
	POSEMUL Pose Multiply	
	POSEINV Pose Inverse	
	GETINTERPOSE Get Interpose	
	POSESUB Calculate Pose Variation	

Instruction		
Main Menu	**Submenu**	**User Rights**
Set and Get	SET Primitive Assignmenmt	Expert user and above can edit
	SETJOINT Joint Assignment	
	SETPOSE Pose Assignment	
	GETPOS Get Current Position	
	GETTOOLFRAME Get Tool Coordinate	
	SETTOOLFRAME Set Tool Coordinate	
	GETUSERFRAME Get User Coordinate	
	SETUSERFRAME Set User Coordinate	
	GETTOOLNUMBER Get Tool Number	
	SETTOOLNUMBER Set Tool Number	
	CCOOD Coordinate Switch	
	MFRAME Create Coordinate	
	SETPAYLOAD Set Payload	
	GETTCPFORCE Get TCP Force	
	GETJOINTTORQUE Get Joint Torque	
	GETACTUALTCP Get Actual Tcp	
	GETTARGETTCP Get Target Tcp	
	GETACTUALJOINT Get Actual Joint	
	GETTARGETJOINT Get Target Joint	
Palletizing	PALLET Palletizing Process	
Lua Control	STARTLUA Start Lua/STOPLUA Stop Lua	
	RESTARTLUA Restart Lua	
	GETLUASTATE Get Lua Status	
Others	// Comment	
	SAVEVARP Save P Variables	
	TPWRITE Log Info Print	
	CLEAR Clear Variables	
	STARTFORCEMODE Start Force Mode	
	ENDFORCEMODE End Force Mode	
	ZEFOFT Clear Sensor Values	
Motion	MOVJ/ MOVEJ Move in Joint Space	
	MOVC/MOVEC Move Circle	
	MOVL/MOVEL Move Linear	
	MOVEML Move in Micro Segment	
	MOVEDRAG Hand Drag Recording	
	TTINIT TT Init	
	TTSTARTJOINT TT Start	
	TTSTARTJOINT TT Add Points	
	TTSTOP TT Stop	
	LOADML Load Movml File	
	UNLOADML Unload Movml File	

Preparation		
Main Menu	**Submenu**	**User Rights**
Tool Config		Expert user and above can edit
User Config		
Interference Zone		
Home Position	Mechanical Home	All users can read only
	Program Home	Ordinary user can read only, expert user can edit
	Zero Calibration	Administrator and above can edit
Main Program		Ordinary user can read only, expert user can edit
Mount Config		Super user and above can edit
Safety Config	Safety Limit/Collision Detection	
Process Config		Expert user and above can edit
Hand Drag		Super user and above can edit

Extension		
Main Menu	**Submenu**	**User Rights**
User PLC		Administrator and above can edit
Flange IO	Drag Setting	Expert user and above can edit
	Button Setting	
Palletizing	Parameter Config	
	Program Config	
Reservation		
Lua Script		
Modbus Slave		
Force Control		Administrator and above can edit
Name of Profinet		

6.5.2 General Purpose Display Area

The general-purpose display area is mainly used to display the program list, program editing interface, and various system setting interfaces. Most of the operations and settings of the system are displayed and configured in this general-purpose display area. The following figures shows examples of interfaces that appear in the general-purpose area.

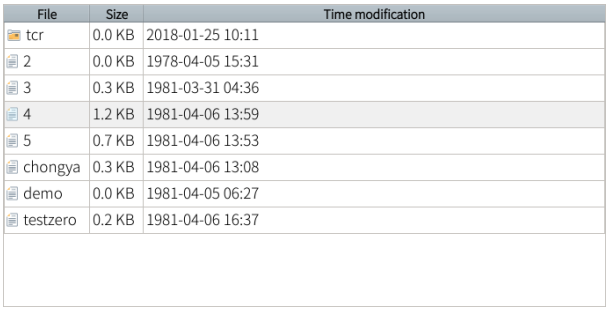


Figure 6-3 : Program list interface

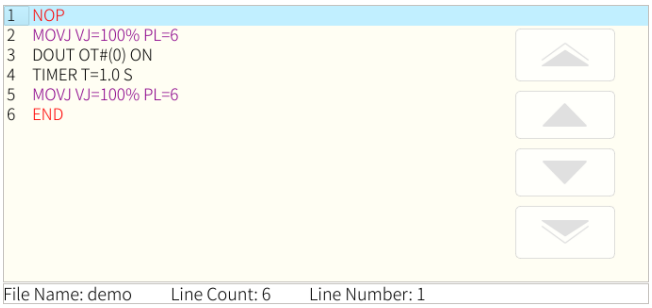


Figure 6-4 : Program editing interface

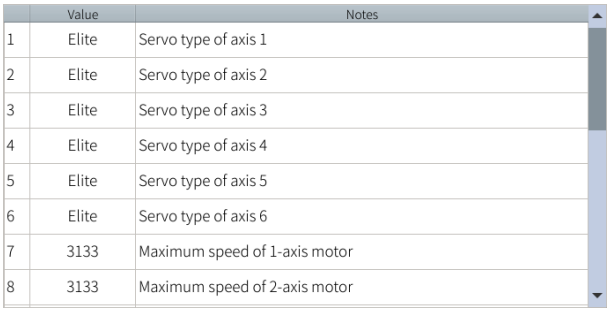


Figure 6-5 : Parameter setting interface

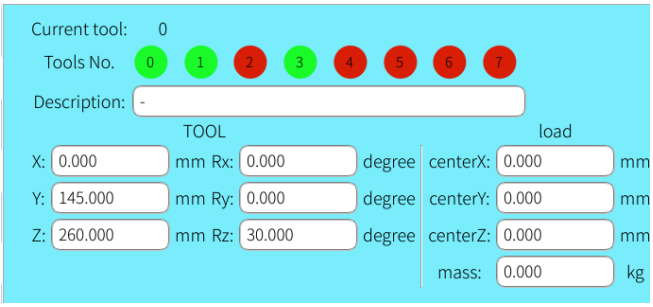


Figure 6-6 : Tool coordinate setting interface

6.5.3 Monitoring Area

The monitoring area is mainly used to display the robot coordinates, variable values, IO port status, motor running status, etc. All the options under the “Monitor” menu are displayed in the monitoring area, as shown in the following figure (the half-width display and full-frame display of the monitoring area).

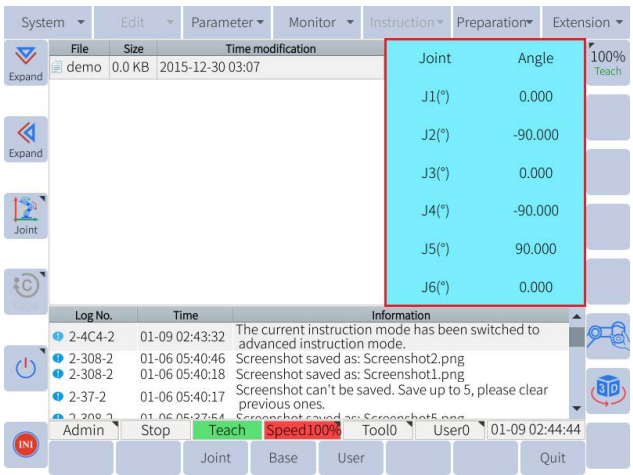


Figure 6-7 : Half display of the monitoring area

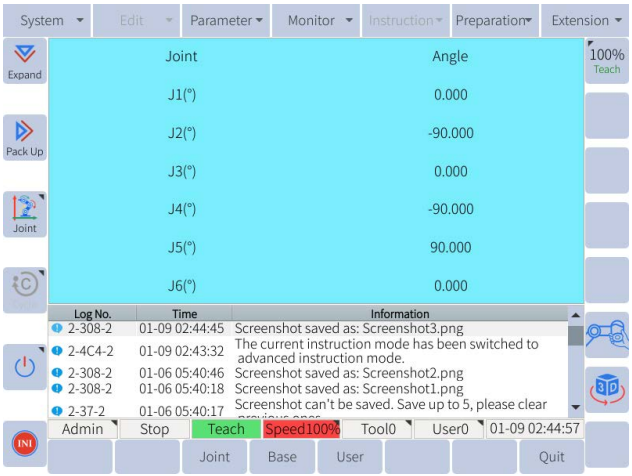


Figure 6-8 : Full display of the monitoring area

6.5.4 Information Log

The information prompt area is mainly used to display work information, alarms, prompts, and robot logs, as shown in **Figure** 6-9 . Please note that the file is not written into the file system in real-time. If the robot is immediately powered off after the alarm occurs, the latest alarm message may be lost.

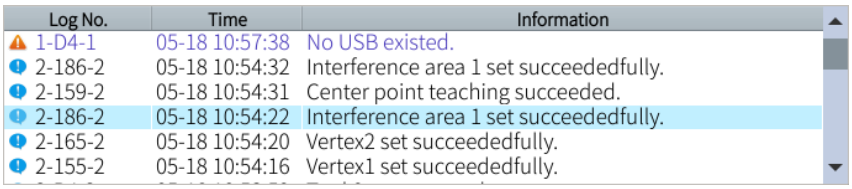
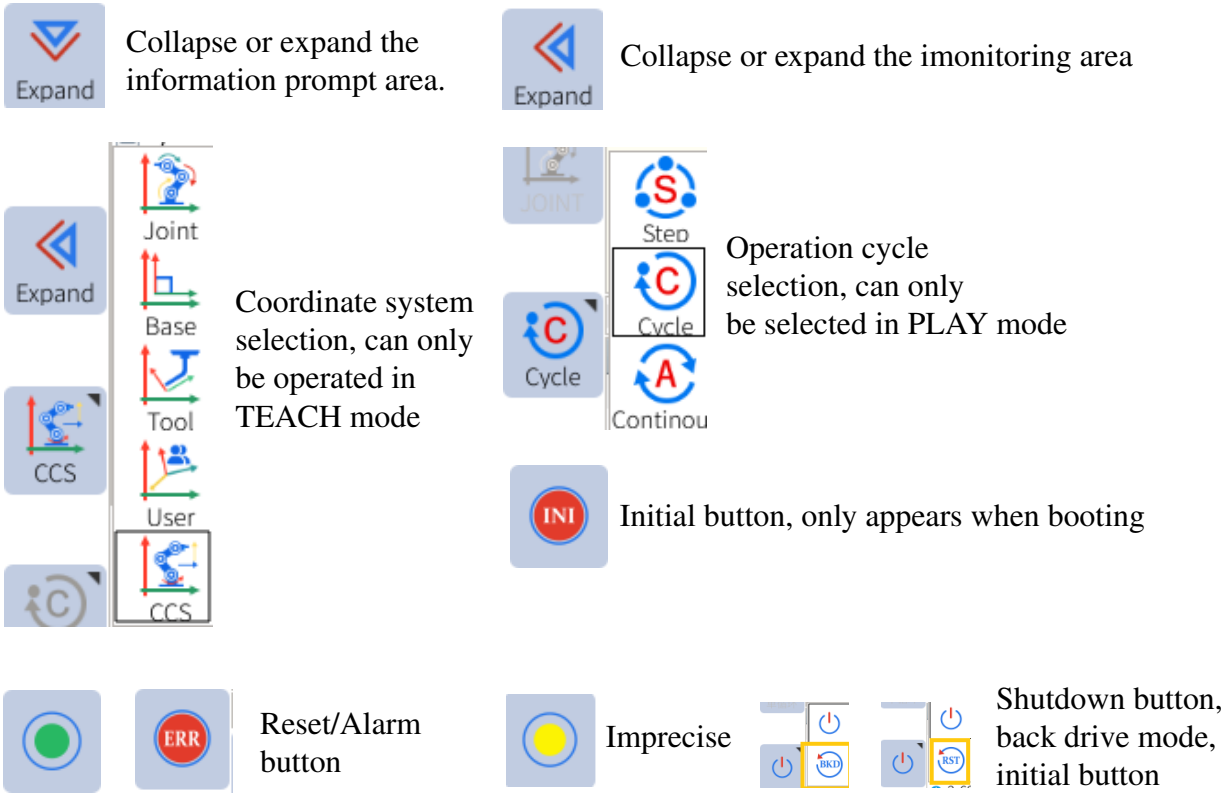


Figure 6-9 : Information prompt area

6.5.5 Status Control

The status control area mainly contains state control related to the robot, such as area expand/minimize subwindow, coordinate system selection (joint, base, tool, user, cylinder), operation cycle selection (single step, single cycle, continuous cycle), initial, reset, etc.

The area can be operated by directly clicking the icon or clicking the corresponding physical button. The coordinate and operation cycle need to be selected when a small pop-up window is displayed and can only be selected by pressing on the icon.



Some windows in the system can be displayed in both full size mode and half-size mode. The selected window can be expanded by pressing the “Expand” button. This allows multiple windows to be displayed during program execution.

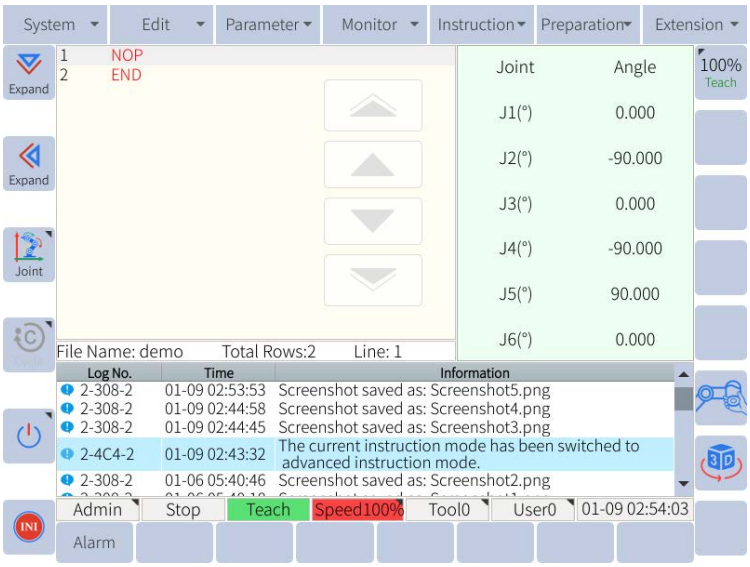


Figure 6-10 : Multi-window display

6.5.6 Coordinate Control Area

To set the desired coordinate system, the user may select the coordinate system from the status control menu. The coordinate area will display the corresponding icon according to the selected coordinate system. The user can only jog the robot when the robot is in TEACH mode. The following sections are descriptions of the various types of coordinate systems available to the user.

6.5.6.1 Joint Coordinates

Joint coordinates allow the user to move each joint individually. For “joint coordinates” the controls from top to bottom are -J1+, -J2+, -J3+, -J4+, -J5+, -J6+, as shown in **Figure** 6-11 . When the move type is set to MOVEJ, the robot will move each joint to the commanded joint position. There are no singularities when moving in the joint space of the robot.

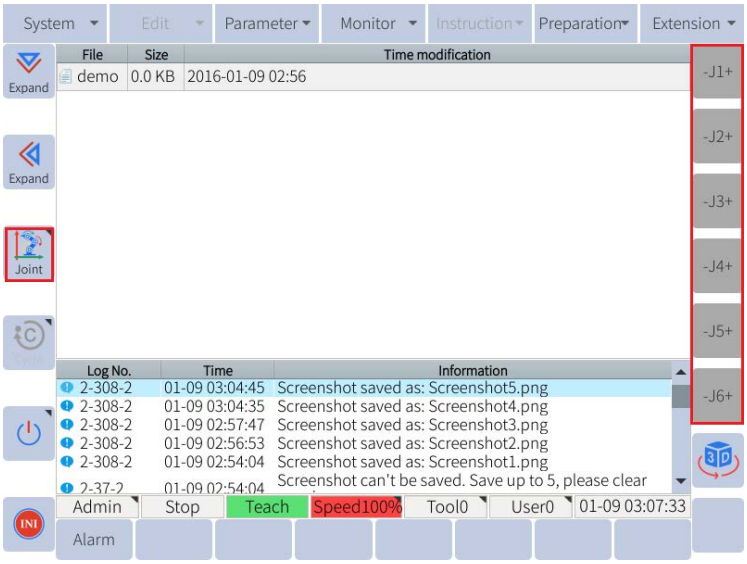


Figure 6-11 : Joint coordinates

6.5.6.2 Base Coordinates

Base coordinates are positions and directions in the robots XYZ or world frame. For “Base/Tools/User Coordinates” the controls from top to bottom are -X+, -Y+, -Z+, -RX+, -RY+, -RZ+, as shown in **Figure** 6-12 .

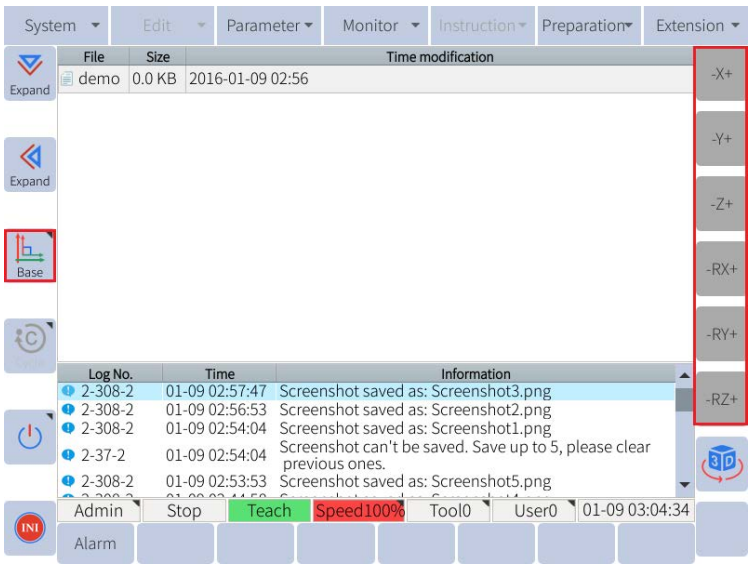


Figure 6-12 : Base/Tools/User coordinates

Moving in a base frame allows the robot to move in a linear fashion along specified coordinate axes. For example, if the robot is commanded to move along the positive X axis, it will move in a linear motion along the robot’s X axis. There are singularities in the base space. Occasionally the robot may loose manipulability depending on the robot’s orientation and commanded direction.

Taking a manipulator of 6 axes as an example, the directions of motion are as shown in **Figure** 6-13 .

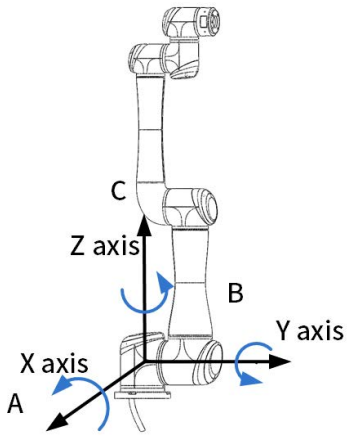


Figure 6-13 : Movement direction of the 6-axis robot(outlet: the negative direction of the X axis)

6.5.6.3 Cylindrical Coordinates

Cylindrical coordinates are related to base coordinates, but the robot can only move along the surface of a theoretical cylinder. For cylindrical coordinates the coordinate options are -θ+, -R+, -Z+, -J4+, -J5+, -J6+, as shown in **Figure** 6-14 .

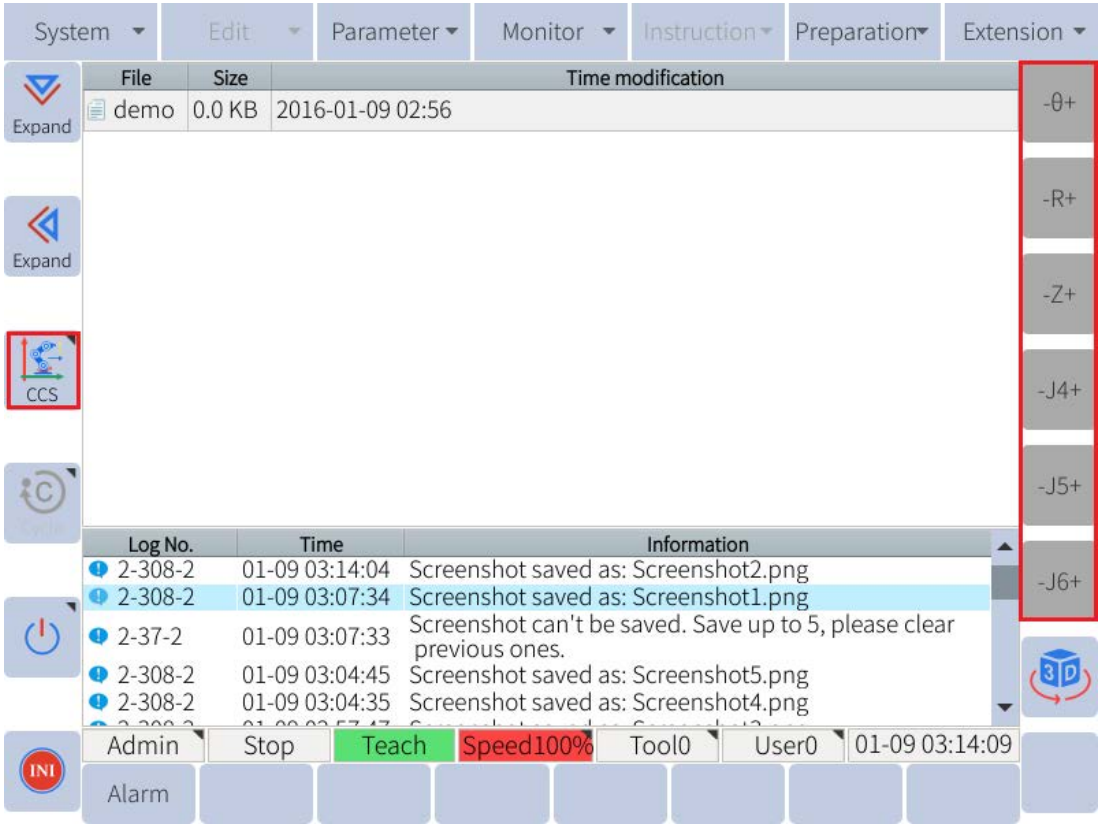


Figure 6-14 : Cylinder coordinates

θ represents the angle from 0 and controls the rotation of the robot about the Z axis of the world frame. R represents the radius of the cylinder and will move the TCP towards the Z axis or away from the Z axis. The Z parameter controls the up and down movement of the TCP parallel to the world's Z axis. RX, RY, and RZ will change the orientation relative to the World frame in the same manner RX, RY, and RZ are used in base coordinates. See **Figure** 6-15 for an example of cylindrical coordinates.

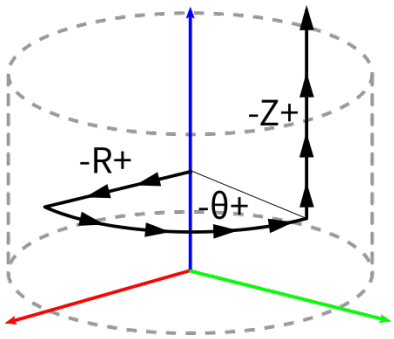


Figure 6-15 : An example of cylindrical coordinates

6.5.6.4 User Coordinates

User coordinate systems are the same as base coordinate systems. They have XYZ axes, but are oriented differently from the base coordinate system as shown in **Figure** 6-16 .

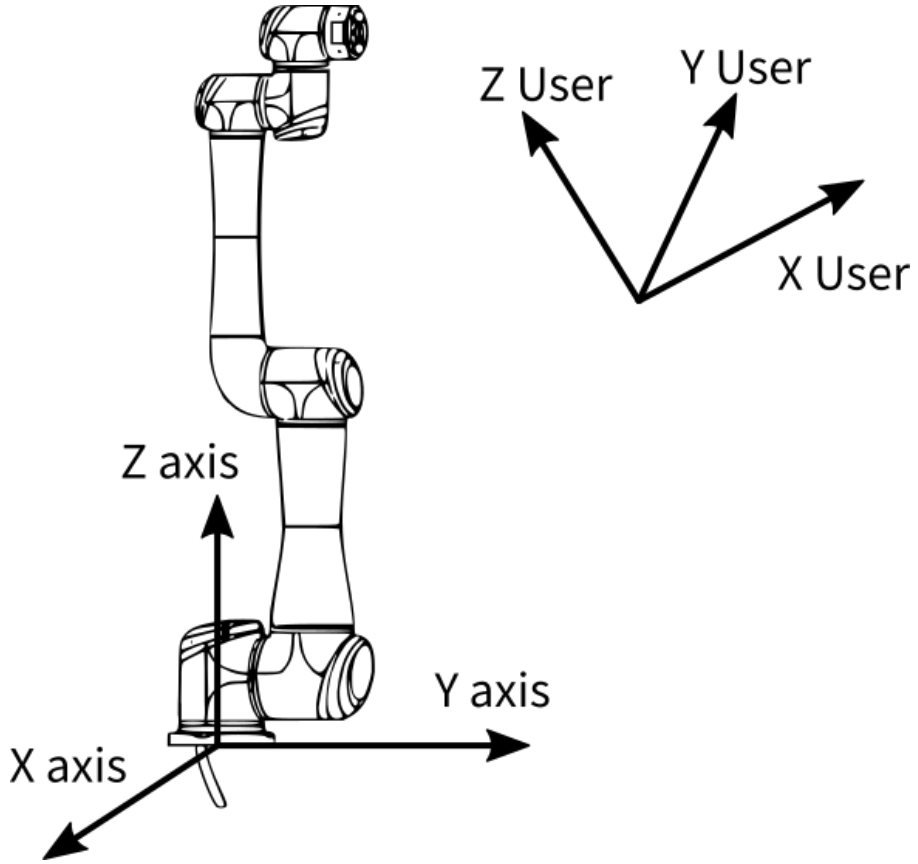


Figure 6-16 : example of a user frame(outlet: the negative direction of the X axis)

If a user selects a user coordinate frame, and jogs the robot along the X axis, the robot will move in a linear fashion along the X axis of the selected user frame instead of the X axis of the base coordinate frame.

6.5.6.5 Tool Coordinates

The tool coordinates are defined at the tip of the tool, assuming that the effective direction of the tool mounted on the manipulator wrist flange is the Z-axis. Therefore, the tool coordinates axis direction moves with the wrist.

In tool coordinates motion, the manipulator can be moved using the effective tool direction as a reference regardless of the manipulator position or orientation. These motions are best suited when the manipulator is required to move parallel while maintaining the tool orientation with the workpieces.

User can set the tool coordinates number 0~7 according to the actual tool conditions, as shown in **Figure** 6-17 .

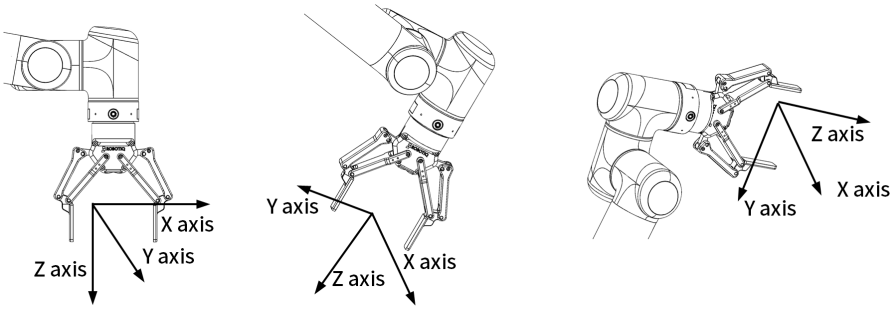


Figure 6-17 : Tool coordinates eaxmples

6.5.7 Backdrive mode

The reverse drive mode is mainly used to manually move the manipulator to a safe position after power-on. For example, the power-on exceeds the soft limit, the brake cannot be released by itself for encoder calibration, or some joints cannot be moved.

Here's how to enter backdrive mode:

Users can click  , then click  , and click "OK" on the pop-up page to enter the reverse drive mode, as shown in **Figure** 6-18 .

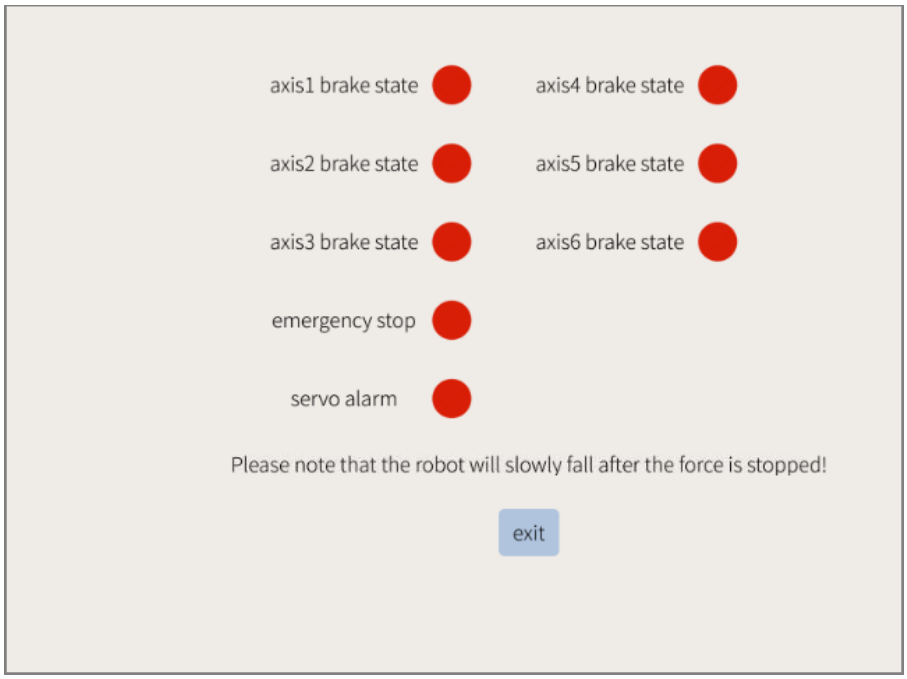


Figure 6-18 : back drive mode interface

Note: Backdrive mode can only be entered when the robot is initialized.

After entering the reverse drive mode, the user can drag the robot directly.

6.5.8 3D View

The 3D view is mainly used to display the robot motions in the jog mode and during the running program. The user can enter the display in the following way.

1. How to enter the display?

The user can enter the display by clicking the second-to-last 3D shortcut on the right side of the teach pendant screen. The icon will change from to after the click. The display is shown as in **Figure** 6-19:

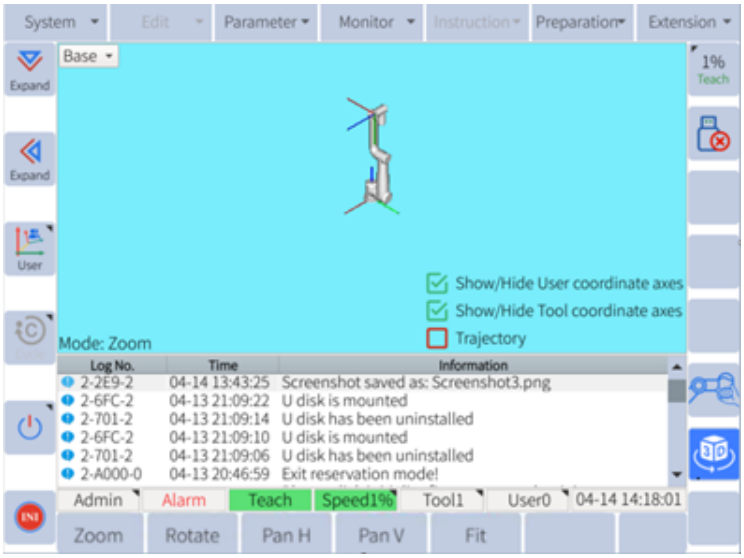


Figure 6-19: 3D view display

2. Selections

2.1 Selecting a coordinate

2.1.1 After entering the display, the user can select the base coordinate, user coordinate and tool coordinate in the top left corner, as shown in **figure** 6-20:

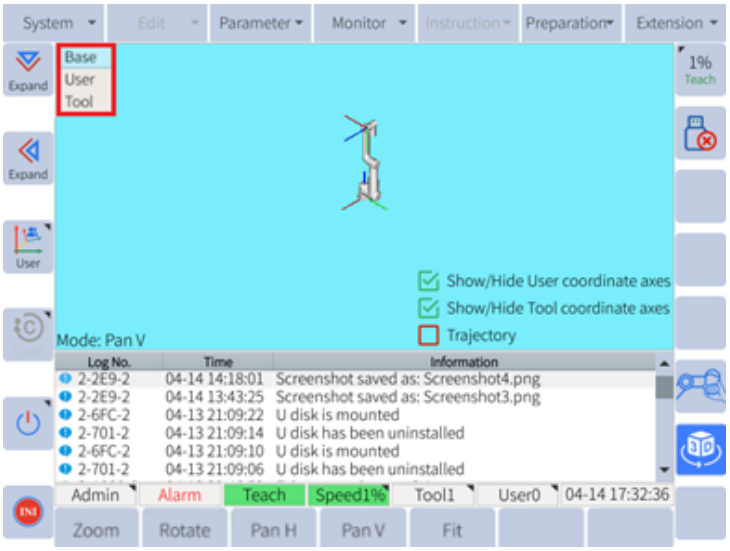


Figure 6-20: Coordinates

Note: For more details about the coordinates, please refer to Chapter 6.5.6.

2.1.2 The user can customize the coordinates as required and any modifications on coordinates will cause the deviation of the position and angle. The custom methods will be outlined as below:

a. Click “Preparation>Mount config” in the top menu to modify the gravimetric coordinates (tilt angle α and rotate angle γ)

b. Click “Tool”and “User” in the bottom menu to make changes in the user coordinate settings and tool coordinate settings, as shown in **Figure** 6-21:

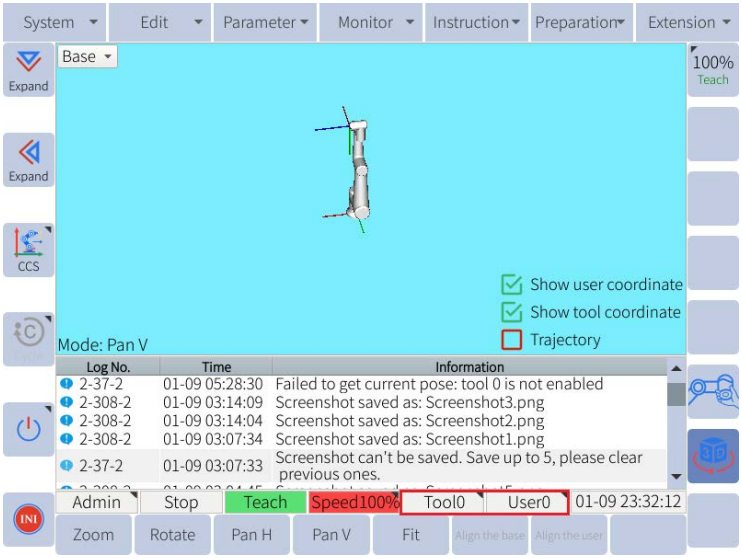


Figure 6-21: Tool and user

2.2 Funtional buttons

Note: All functional buttons are active only with the scroll wheel (see **Figure** 6-22) on the right side of the teach pendant screen.

Figure 6-22: Scroll wheel

2.2.1 Buttons at the bottom, as shown in **Figure** 6-23：

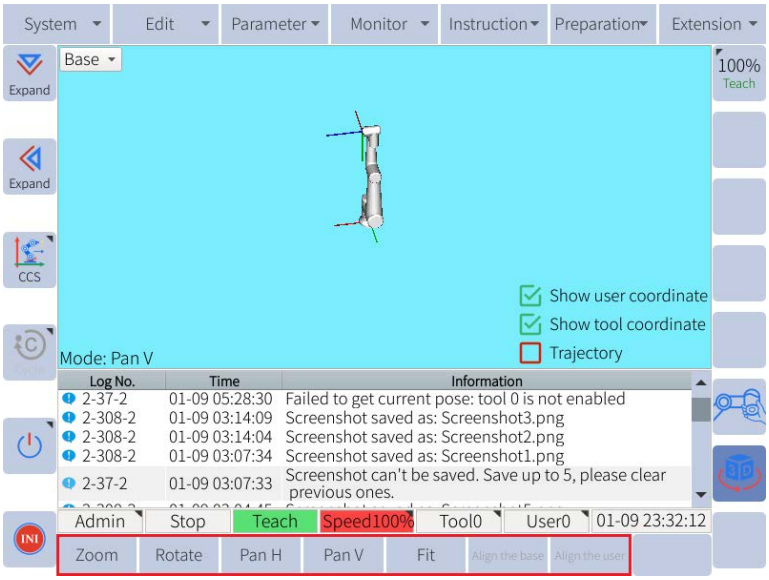


Figure 6-23: Buttons at the bottom

Zoom: Click “Zoom” button and turn the scroll wheel clockwise to zoom in the robot-icon, or turn the scroll wheel anti-clockwise to zoom out the robot-icon;

Rotate: Click “Rotate” button and turn the scroll wheel clockwise or anti-clockwise to flip the robot-icon horizontally;

Pan H: Click “Pan H” button and turn the scroll wheel clockwise or anti-clockwise to horizontally move the robot-icon to left or right;

Pan V: Click “Pan V” button and turn the scroll wheel clockwise or anti-clockwise to vertically move the robot-icon upward or downward;

Fit: Click “Fit” button and return the robot-icon to its original position with the scroll wheel.

Align the base: Press the three-position switch and click “Align the base” button to parallel the tool coordinate system with the base coordinate system;

Align the user: Press the three-position switch and click “Align the user” button to parallel the tool coordinate system with the user coordinate system.

2.2.2 Options are displayed as shown in **Figure** 6-24:

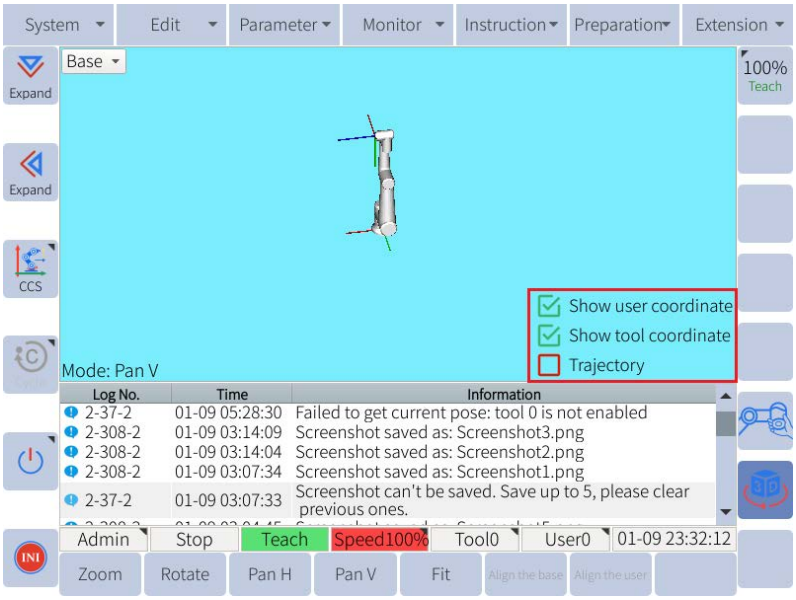


Figure 6-24: Options

Display user coordinate: Select the checkbox, the color of the checkbox will change from red to green and the user coordinate will appear in the display;
Display tool coordinate: Select the checkbox, the color of the checkbox will change from red to green and the tool coordinate will appear in the display;
Display trajectory: Select the checkbox and the color of the checkbox will change from red to green. Press the servo safety switch on the teach pendant or click Ctrl button (servo) in the web version. Move the robot to the desired position by dragging the teach pendant or pressing the axis jog controls. The trajectory will appear in the display, as shown in **Figure** 6-25:

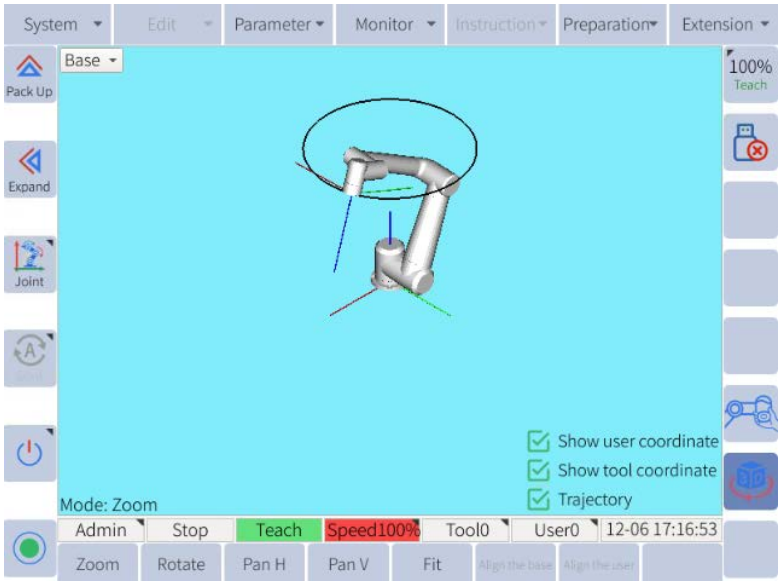


Figure 6-25: Trajectory

2.2.3 Mode is displayed as shown in **Figure** 6-26:

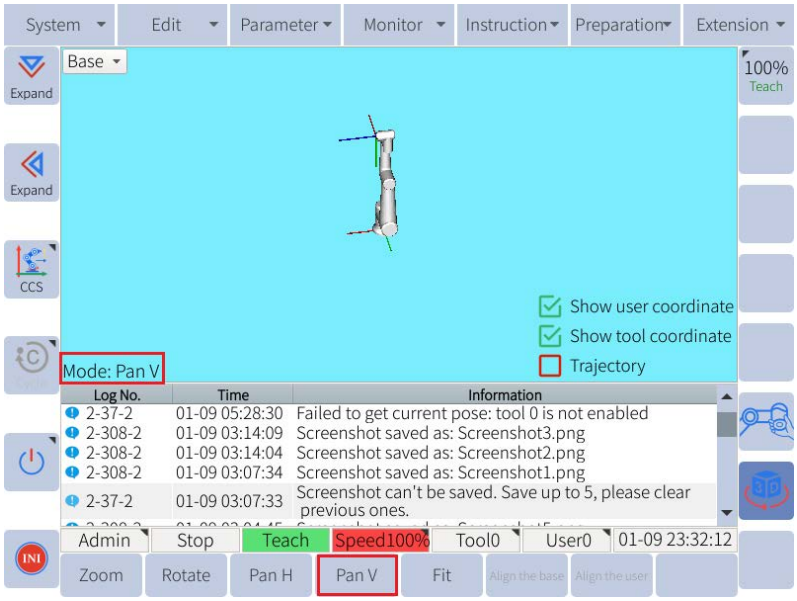


Figure 6-26: Mode

"Mode" will remind the user of the current mode in accordance with the options at the bottom. For example, when the user clicks "zoom" button, "mode" will synchronously display "zoom". When the user clicks "rotate" button, "mode" will synchronously display "rotate".

6.5.9 Force control function

In the currently developed force control mode, the terminal end of the robot is equipped with a six-dimensional force sensor for the purpose of detecting the force being applied by the environment on the robot. With the appropriate control schemes, it is possible to adjust the desired running trajectory of the robot and the external contact force. The mode is mainly designed for the surface grinding and the peg-in-hole assembly.

Please complete the following steps before use.

(a) Install and configure the sensor
(b) Calibrate the sensor
(c) Identify the payload

For details, please read the following operating instructions.

6.5.9.1 Installation and configuration of the sensor

The flange IO at the robotic terminal end must be updated to v8.2.727 and above.

1. Installation: There are no specific requirements for the installation of the sensor. After the installation is complete, however, the user needs to set up some parameters in the parameter settings. The details are shown as follows.
2. Configuration

- Before the configuration, please make sure that the user right has been changed to the administer. Users can click **Preparations->Process config** to select “Flange IO” and “Torque sensor” in the settings and save it, as shown in **Figure** 6-27. After the setting, the prompt “Take effect after restart, continue?” will appear in the display. Please click “Ok” and restart the robot.

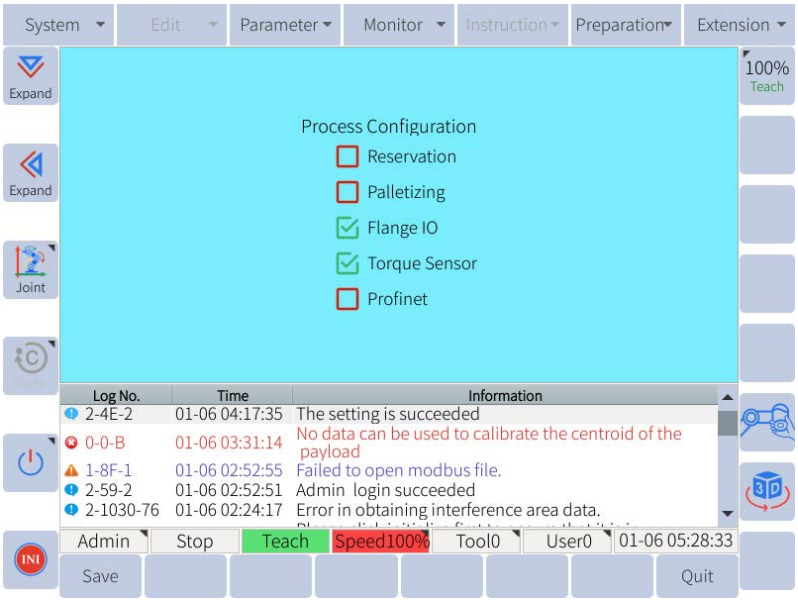


Figure 6-27 : Selecting “Flange IO” and “Torque sensor”

- Users can click **Extension>Forcecontrol** to select the data source. When selecting "Unknown data source", the force control mode will be disabled. When selecting "Internal data source", it indicates that the internal estimated force/moment of force is used. When selecting "LUA data source", the force control data received by the parsed RS485 communication is transferred via the LUA interface, when selecting "SDK data source", the parsed force control data is transferred via the SDK interface. Users can edit the "Data intervals" (data entry period, unit: ms) and "Tolerance" as required. We recommend to set the product of "Tolerance" and "Data intervals" to 1000. Please note that errors may occur if the actual interval exceeds the product of "Tolerance" and "Data intervals". When selecting “Back-end data source” and clicking the "Set" button, the configuration of the force sensor is complete, as shown in **Figure** 6-28.

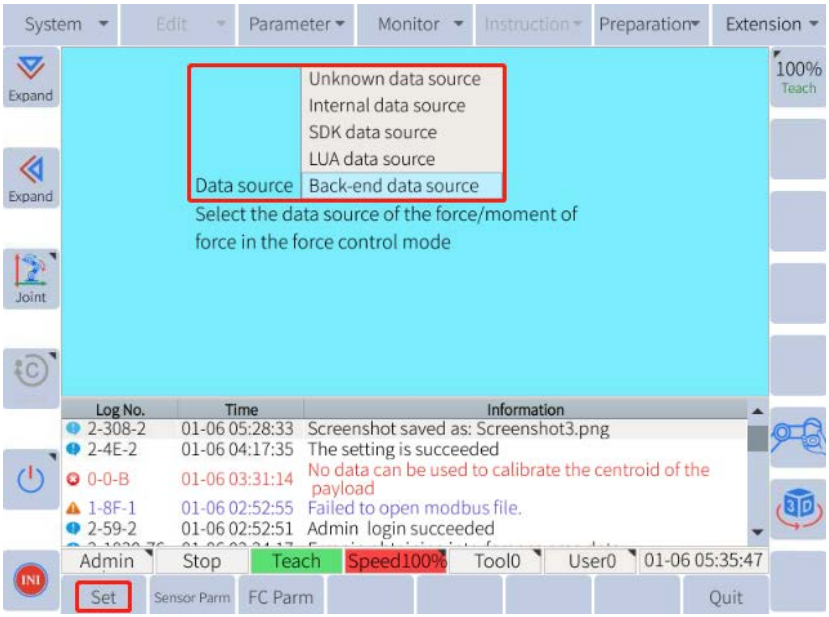


Figure 6-28 : Selecting the data source

- Users can click **Extension->Force control->Sensor param** to set up the parameters in the settings.
  1. Select "Kg" or "N" from the drop-down list of Data unit, as shown in **Figure** 6-29. Note that the unit selected must be same as that of the sensor. For instance, the original data unit of KUNWEI sensor is Kg. The user must select "Kg" if a KUNWEI sensor is used.
  2. Click the drop-down list of Thickness and enter the value. If there is an adapter plate, then the thickness here includes that of an adapter plate.
  3. Click the drop-down list of Mass and enter the value. If there an adapter plate, then the mass here includes that of an adapter plate (mass of the payload is excluded).
  4. Select "Random" or "Front-installed" from the drop-down list of Installation method. "Random" means that the sensor coordinate system cannot be converted to the flange coordinate system only through the Z-direction rotation. The user needs to enter the values of X, Y, Z, Rx, Ry and Rz to convert the sensor coordinate system to the flange coordinate system. "Random" means that the sensor coordinate system can be converted to the flange

coordinate system only through the Z-direction rotation. The angle value can be manually set up by the users or automatically set up by the algorithm. For the latter, users need to select "Mount ang" and click "Calculate" when calibrating the payload.

5. Select "Point to flange" or "Away from flange" from the drop-down list of Axis Z direction. Generally, the sensor reading means that in the sensor coordinate system. Please refer to the Sensor Manual for the confirmation of Axis Z direction in the sensor coordinate system. Note that it is necessary to select Axis Z direction only when the sensor is front-installed. The user does not need to make a selection when the sensor is randomly installed. Please select "Away from flange" from the drop-down list if a KUNWEI sensor is used and it is front-installed.

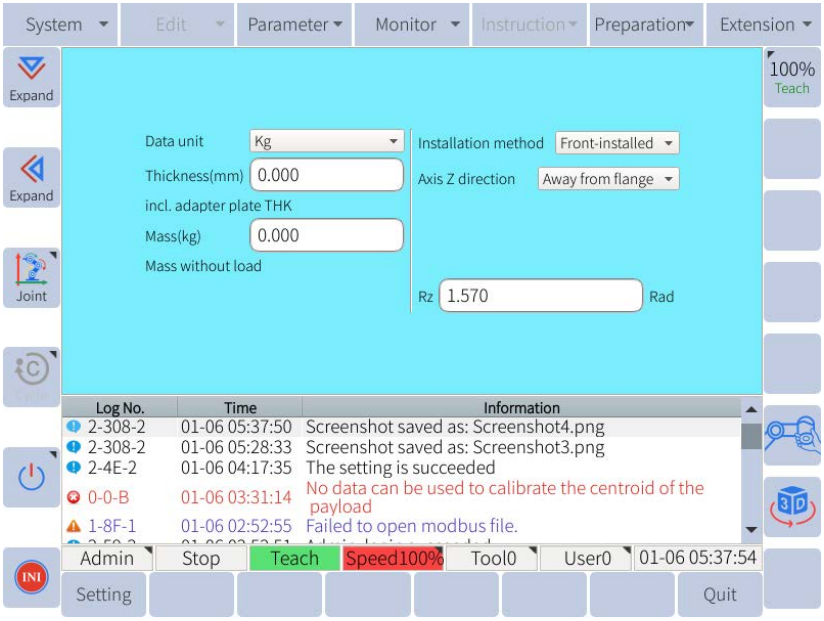


Figure 6-29 : Sensor parameter settings

- Users can click **Extension->Force control->FC Parm** to set up the parameters in the force control gain display. Users can enter a random number between 0 and 1, as required, and click "Settings", as shown in **Figure** 6-29. Please note that the higher the force tracking value, the heavier the payload. This will cause an obvious jitter of the robot.

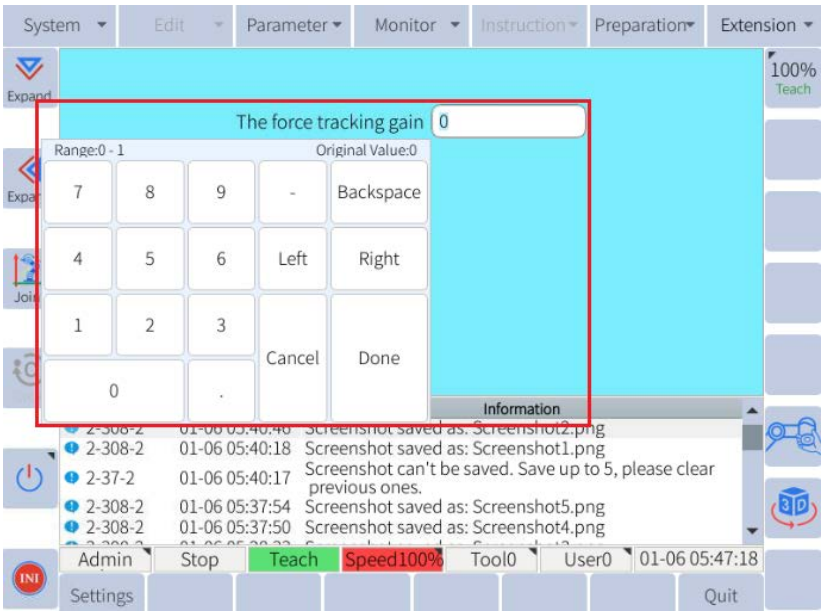


Figure 6-30: Force control parameter settings

6.5.9.2 Calibration of the sensor

1. Steps

a. Click **Preparations->Toolconfig** in the top menu bar, as shown in **Figure** 6-30.

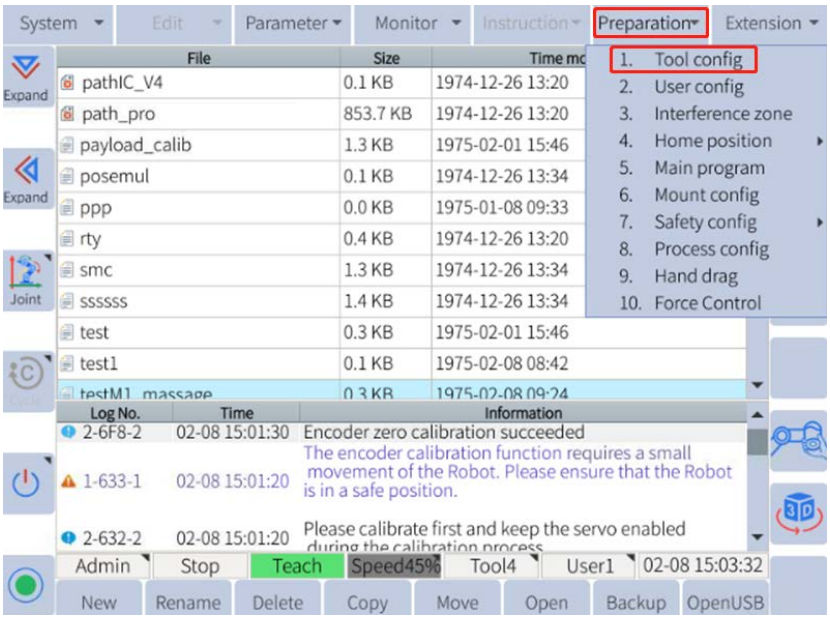


Figure 6-30 : Preparations->Tool config in the top menu bar

b. Click **LoadCalib** at the bottom, as shown in **Figure** 6-31.

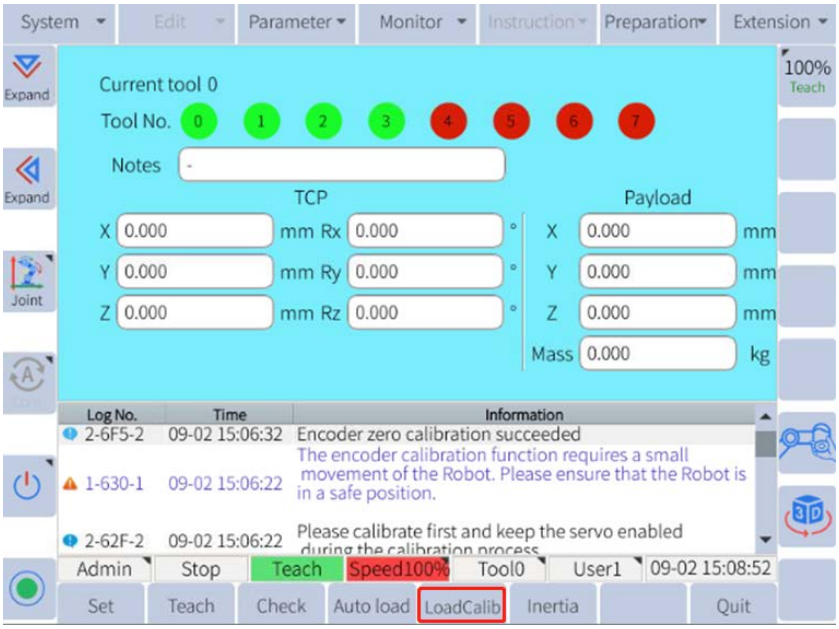


Figure 6-31: LoadCalib at the bottom

c. Press the servo button and click **Sensor calibration.** When holding the servo, the robot will start to move. Don't release the servo until "Robot has reached the target point" appears in the display, as shown in **Figure** 6-32.

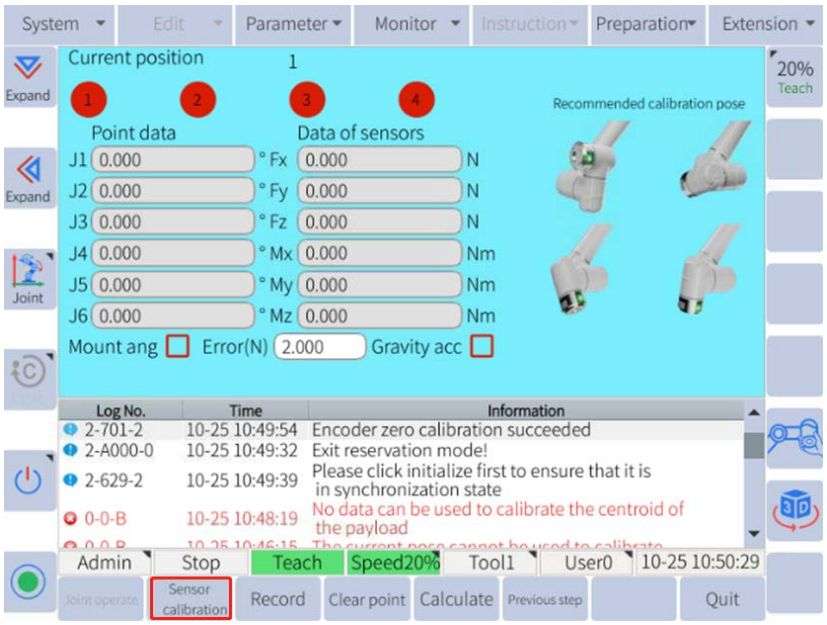


Figure 6-32: Calibration interface

d. When "Robot has reached the target point" appears in the display, please click **Sensor calibration** again until "Sensor calibration is complete" appears in the display, as shown in **Figure** 6-33 (If the pose is influenced in the automatic operation, please release the servo and manually operate the 4th, 5th and 6th joint. After changing the robotic pose, you can hold the servo and click **Sensor calibration** again.).

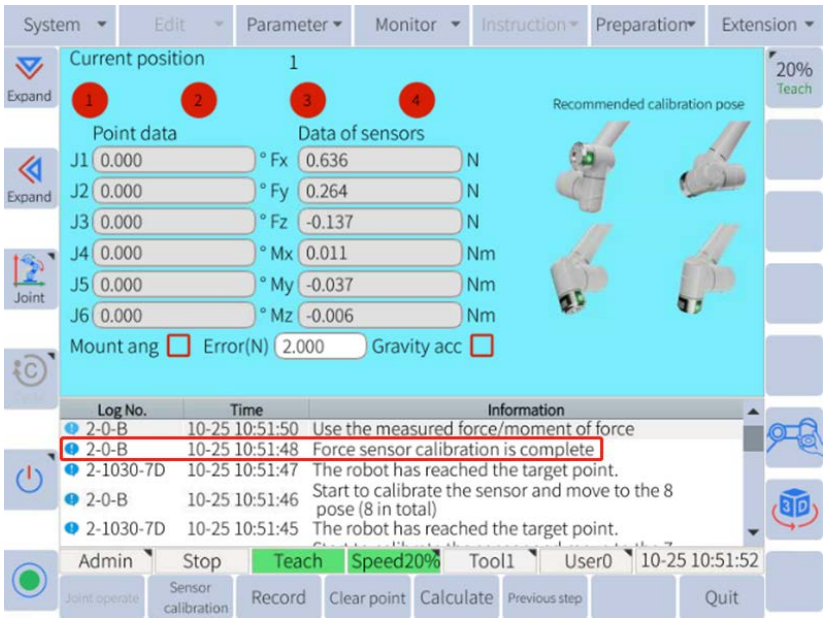


Figure 6-33 : Sensor calibration is complete

2. Special note

When you use the six-dimensional force sensor for the first time or there is a data deviation of the six-dimensional force sensor, please calibrate the sensor first. During the calibration of the sensor, the speed is regularly 20% and it is impossible to change it.

It is not possible to install a payload until the sensor is calibrated. During the calibration of the sensor, users can release the servo before reaching the point. This will not affect the results.

6.5.9.3 Identification of the payload

1. Click **Preparations->Tool config** in the top menu bar, as shown in **Figure** 6-34.

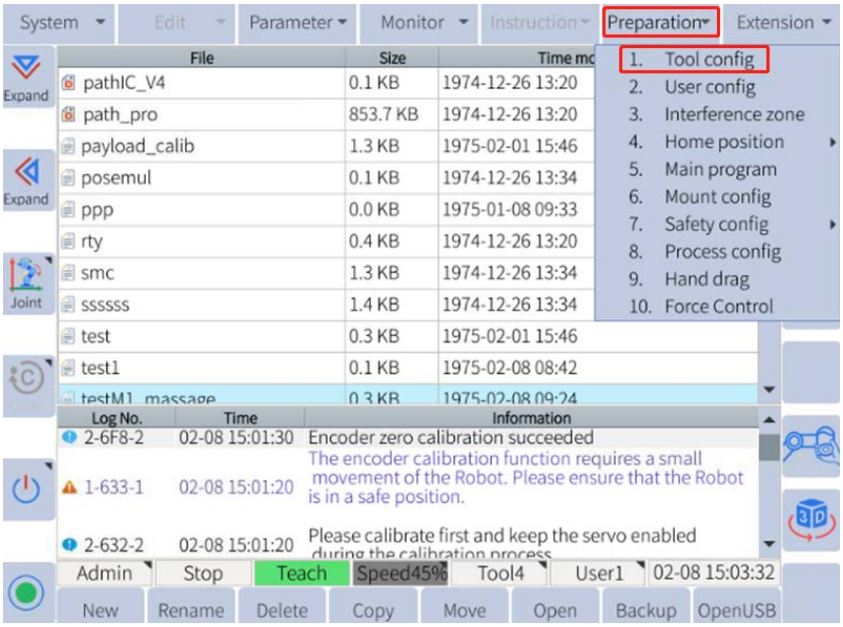


Figure 6-34: Preparations->Tool config in the top menu bar

2. Select a tool number and click **LoadCalib** at the bottom, as shown in **Figure** 6-35.

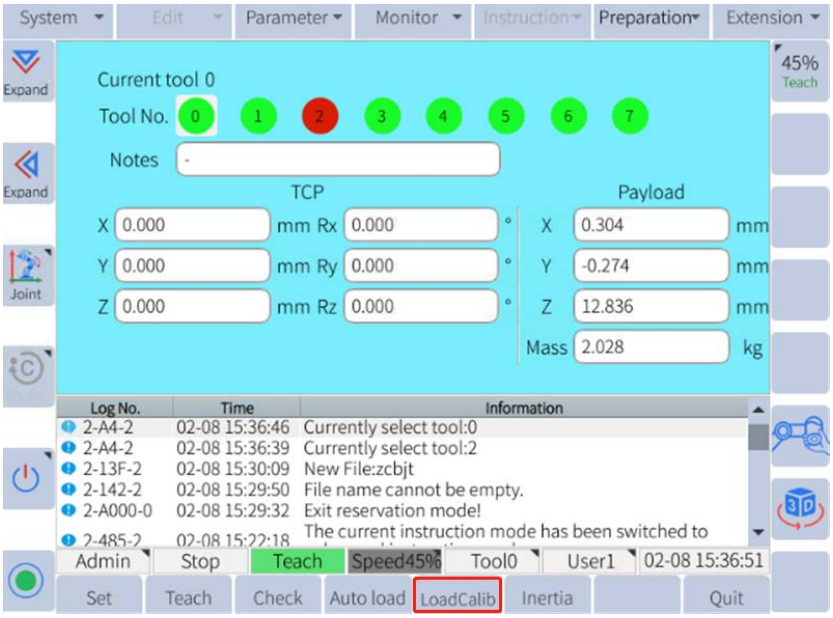


Figure 6-35 : LoadCalib at the bottom

3. Mount the payload in the back-end of the force sensor, as shown in **Figure** 6-36, 6-37 and 6-38.

Figure 6-36 : Payload

Figure 6-37: Back-end of the sensor

Figure 6-38 : Installation is complete

4. Teach the points (4 in total), and record the position of the points and the data of the force sensor. The steps are as follows:
   (a) Click 1 (by default) and enter the pose adjustment display. Hold the servo and adjust the pose to be reasonable by turning around the joint (mainly the 4^{th}, 5^{th} and 6^{th} joint). Click **Record** in the bottom menu bar, as shown in **Figure** 6-39.

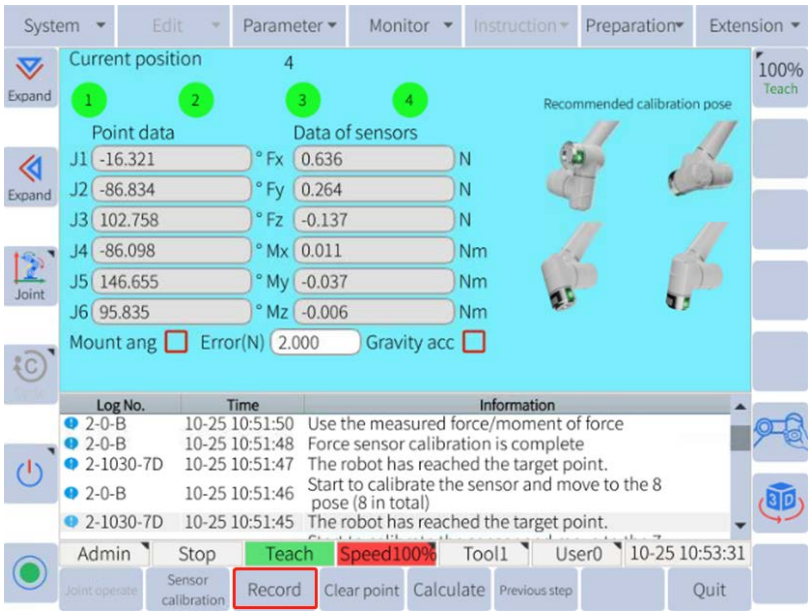


Figure 6-39: Record

(b) Click 2 and enter the pose adjustment display. Hold the servo and adjust the pose to be reasonable by turning around the joint (mainly the 4th, 5th and 6th joint). Click **Record** in the bottom menu bar, as shown in **Figure** 6-39.

(c) Repeat the steps above and record the position of the point 3 and 4 and the data of the force sensor. After finishing all records, the display is shown in **Figure** 6-40.

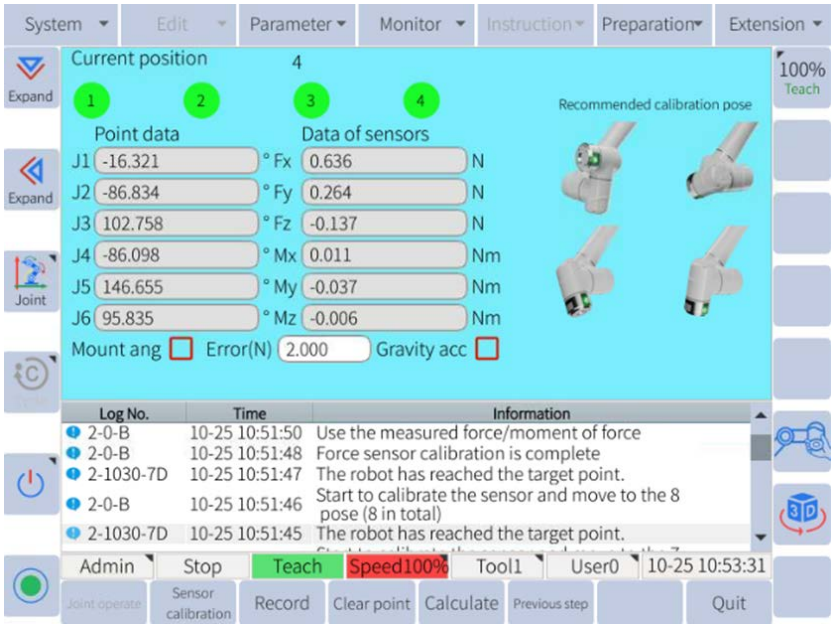


Figure 6-40: Point data recording interface

5. Click **Calculate** in the bottom menu bar to work out the payload quality and the centroid position. Users can check the calculations by clicking the “Previous step”, as shown in **Figure** 6-41.
6. Click **Set** in the bottom menu bar and record the current payload quality and the centroid position onto the corresponding tool, as shown in **Figure** 6-41.

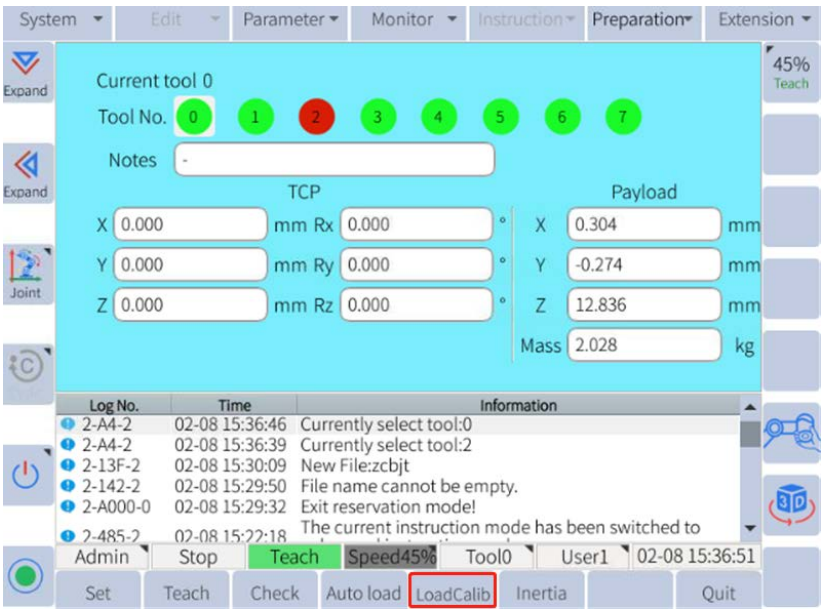


Figure 6-41: Calculations

7. Result verification of the payload identification
   After completing the payload identification and the tool settings, the user can click **LoadCalib->Sensor calibration** (Do not hold the servo) to verify if the results are correct, as shown in **Figure** 6-42.

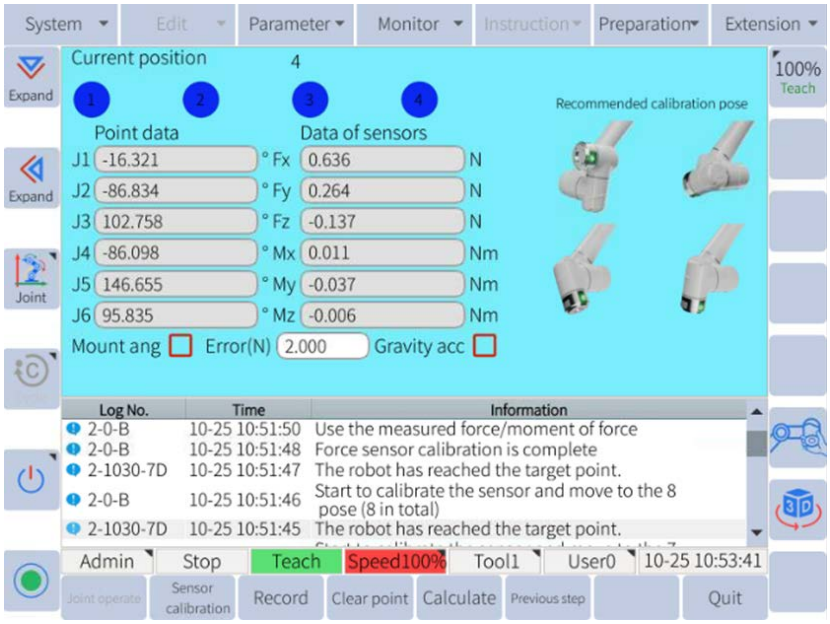


Figure 6-42 : Result verification interface

In the verification interface, the user can observe if the data of the sensor [Fx Fy Fz Mx My Mz] is approaching to 0. If the values are less than 1, then the data after the payload identification is comparatively accurate. Note that the algorithm has a feature of pose and sensor data verification. When recording the current point data and it is found that the pose or the sensor data of the current point is very close to that of the previous ones, the following display will appear, as shown in Figure 6-43. Then it is necessary to change the pose of the current point.

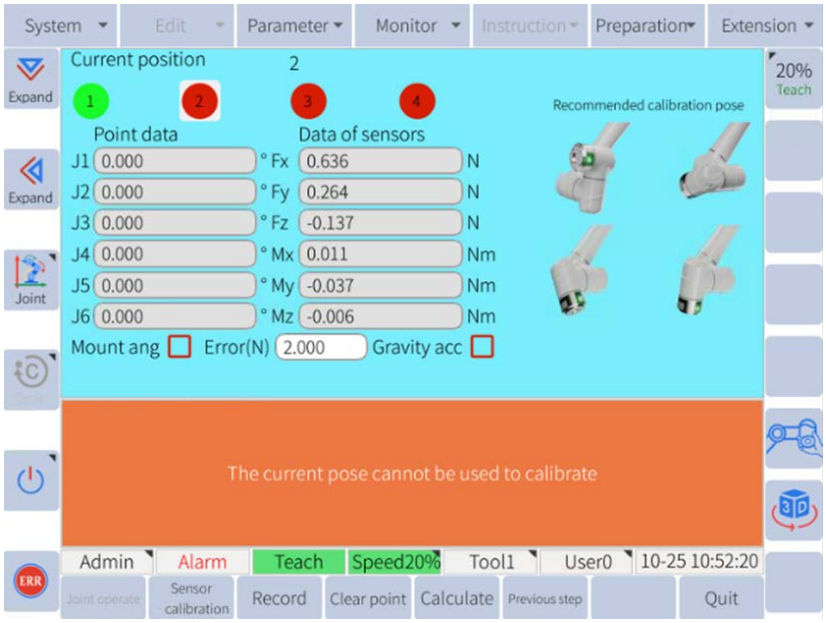


Figure 6-43: Failed to verify the pose of the point

CAUTION

When the sensor is front-installed, the angle value can be automatically calculated by the algorithm. The payload mass is min. 1kg. The larger the value is, the more accurate the calculation is. After finishing all 4 records, the user can select "Mount ang" and click **Calculate** to work out the angle value.

When it is the first time for the user to install or reinstall the sensor, or after the robot is changed from being front-installed to inclined-installed, the user needs to select "Mount ang" if it is not manually set up. Otherwise, the calculation will be inaccurate. In other cases, it is unnecessary to select "Mount ang". Otherwise, the calculation will be updated.

CAUTION

The error range is 2N by default and it can also be set up by the user. When calculating the mount angle, the system will verify the calculation. If the actual error exceeds the set value, it will prompt that the calculation has failed. Please increase the value and calibrate it again. Note that the larger the error range is, the harder it is to prompt the calibration failures. The larger error range will cause an increment of the calculation error. Therefore, we recommend users to use the default value.

CAUTION

After the robot is changed from being front-installed to inclined-installed, the user needs to select "Gravity acc". Otherwise, the sensor reading will be probably inaccurate.

Note: When the sensor is reinstalled or after the installation method of the robot is changed, please In other cases, it is unnecessary to select "Mount ang". Otherwise, please the calibrate the sensor first and then identify the payload.

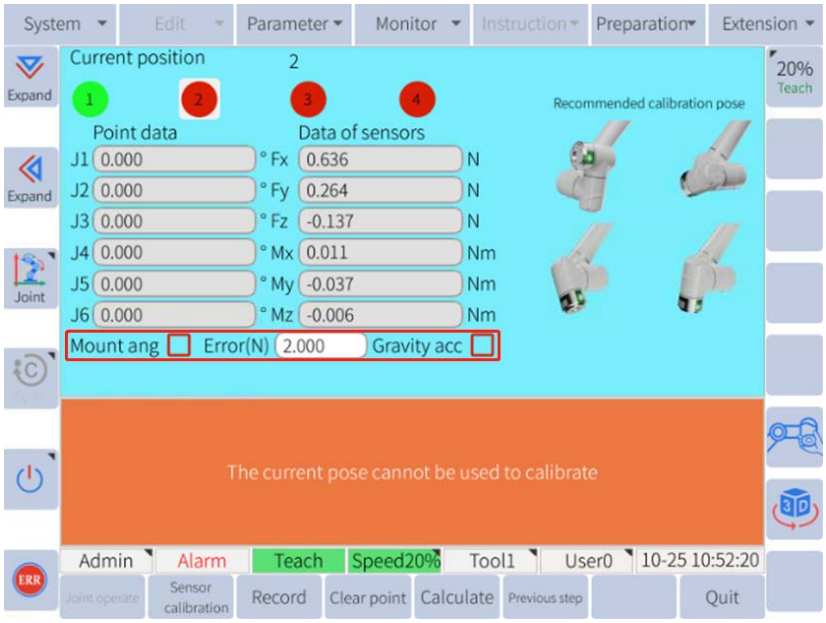


Figure 6-44: Mount ang and Gravity acc

6.5.9.4 Identification of the payload inertia

1. Click **Preparations->Tool config->Inertia** in the top menu bar, as shown in **Figure** 6-45.

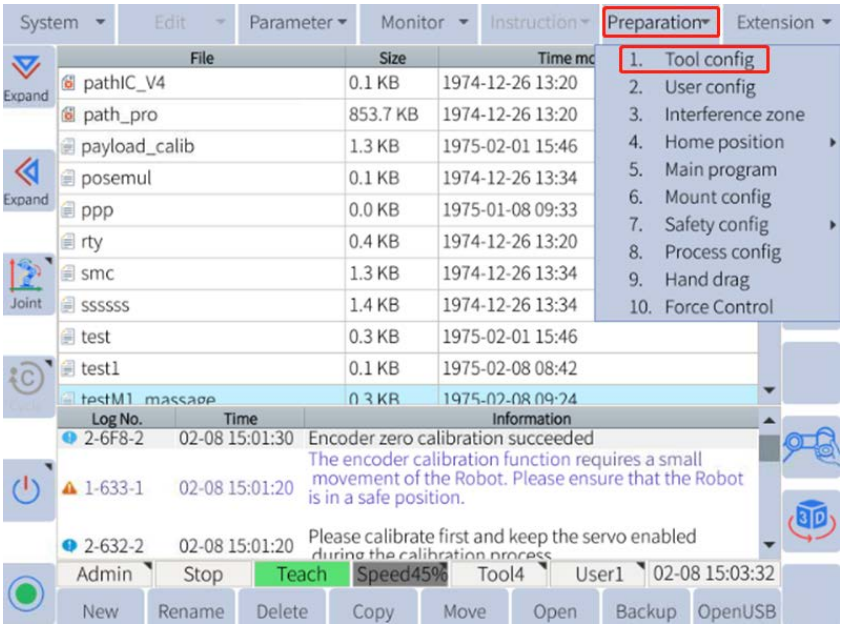


Figure 6-45: Inertia identification display

2. Remove the payload and move the robot to a non-singular orientation (initial pose as recommended). We recommend that the angle of the first axis is set as 80°, as shown in **Figure** 6-46.

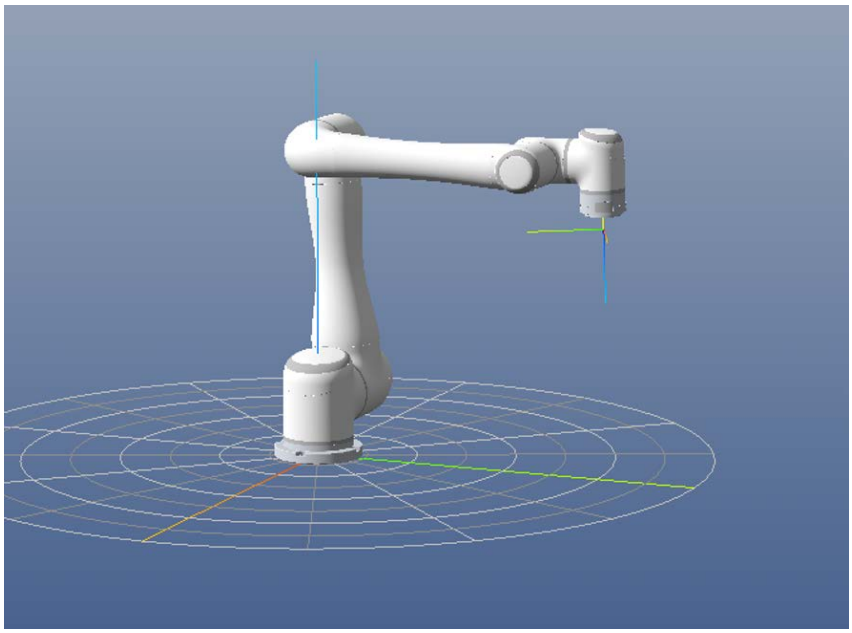


Figure 6-46 : Recommended initial pose

3. Switch to the “Play” mode and turn on the servo. Press the window switch key and click "Inertia ID". The user will be prompted for the confirmation of removing the payload. Please click "Ok" and the robot will automatically run.
4. After stopping running, it will prompt the user that the motion is complete. Please install the payload and confirm that x, y and z of TCP have been set to be the center of mass.
5. Switch to the "Play" mode and turn on the servo. Press the window switch key and click "Inertia ID". It will prompt the user that the payload has been installed. Please click "Ok" and the robot will automatically run.
6. After the calibration is complete, the result will appear in the display of the inertia ID. If everything is okay, please click "Confirm" and save it.

Note: If the payload is not calculated, please complete the calculation first. Please make sure that the tool position has been set to be the center of mass. If the thickness of the sensor is L and the center of mass is x, y and z, then x, y and z of TCP will be set to be x, y and z +L.

6.5.9.5 Concepts of the force control

1. Mode description
   Currently, there are 2 modes, i.e. fixed mode and TCP mode. Users can select the desired mode by clicking “Mode” in the drop-down list. The details are as follows.
   (a) Fixed mode: Users can select the flexibility of any DOF and the desired force or torque. The force control coordinate system is the user-specified coordinate system. For instance, if a DOF is flexible, then the user can adjust its force or torque.
   (b) TCP mode: In the mode, the force control coordinate system will be concentric with the TCP coordinate system. In the process of the force control, the algorithm will maintain the desired force of the Z axis of the force control coordinate system unchanged. The motion of the X axis and Y-axis will be controlled by the MOV instructions.
2. Mask of the DOFs: The TCP end-back motion has a total of 6 DOFs, 3 DOFs of the position and 3 DOFs of the angle. It is important to note that the angle is not referred to the Euler angle but the DOF spinning around the X, Y and Z-axis. Users can select different states by clicking the drop-down list of the DOFs as required. Currently, there are 2 states available for each DOF, i.e. motion control and force tracking.
   (a) Motion control: The DOF does not contain the force control and it is only controlled by the MOV instructions.
   (b) Force tracking: The DOF maintains the given desired force or torque. For instance, set the Z-axis direction to the force tracking and set the desired force to 10N. Then the controller will maintain the force at 10N, that is, constant force control.
3. Target torque: In the force tracking state, the target torques in all directions are the ones expected to be track.

6.5.9.6 Use of the force control mode

1. JBI command of the force control

After finishing the sensor calibration and the payload calculations, the user can start and end the force control through STARTFORCEMODE and ENDFORCEMODE commands. The user can find these two commands by clicking **Instruction->Others** in the top menu bar and then edit the parameters in the display, as shown in **Figure** 6-47.

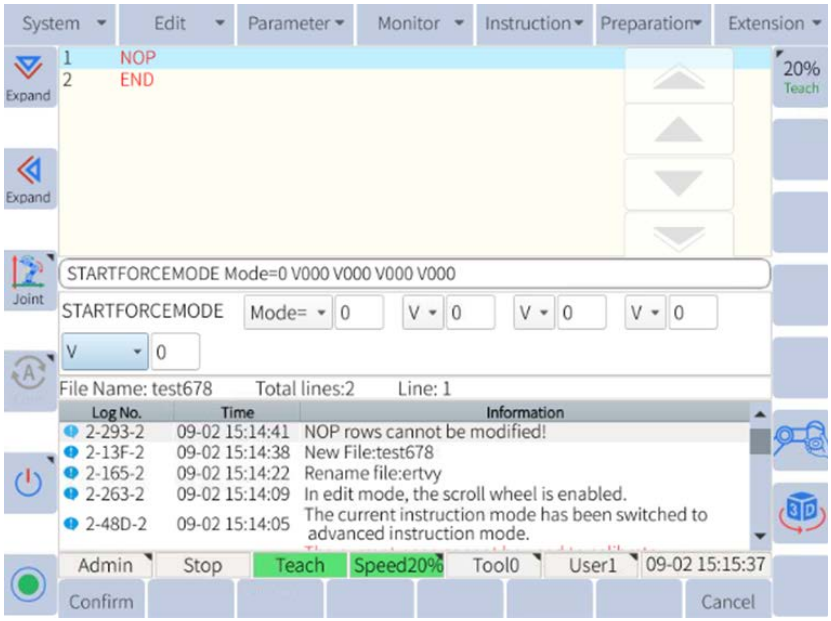


Figure 6-47: Setting the parameters of the force control

- The user can select different modes by changing the value of the “Mode”. When mode is equal to 0, it indicates that the robot is in the fixed mode. When mode is equal to 3, it indicates that the robot is in the TCP mode.
- The user can also change “V” to “ConstV” by clicking the drop-down list, as shown in **Figure** 6-48.

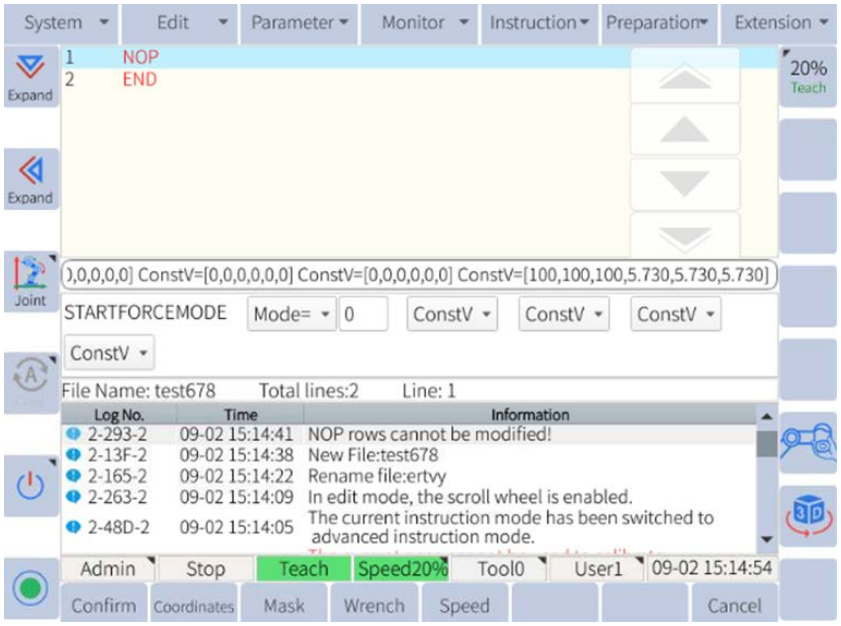


Figure 6-48: Modify the variable "V" to "ConstV"

- After changing the variable "V" to "ConstV", four buttons like **coordinate**, **mask**, **force** and **speed** will appear in the bottom menu bar of the teach pedant (The user can also set the parameters of the force control through changing the variable V/LV.). The user can set the force control coordinate system by clicking the **coordinate** button. In this display, there are 3 parameters of the position and 3 parameters of the rotation axis. A pose matrix indicating the transformational relations between the user-specified force control coordinate system and the base coordinate system can be worked out with the parameters. If all the parameters are set to 0, it indicates that the force control coordinate system is concentric with the base coordinate system, as shown in **Figure** 6-49.

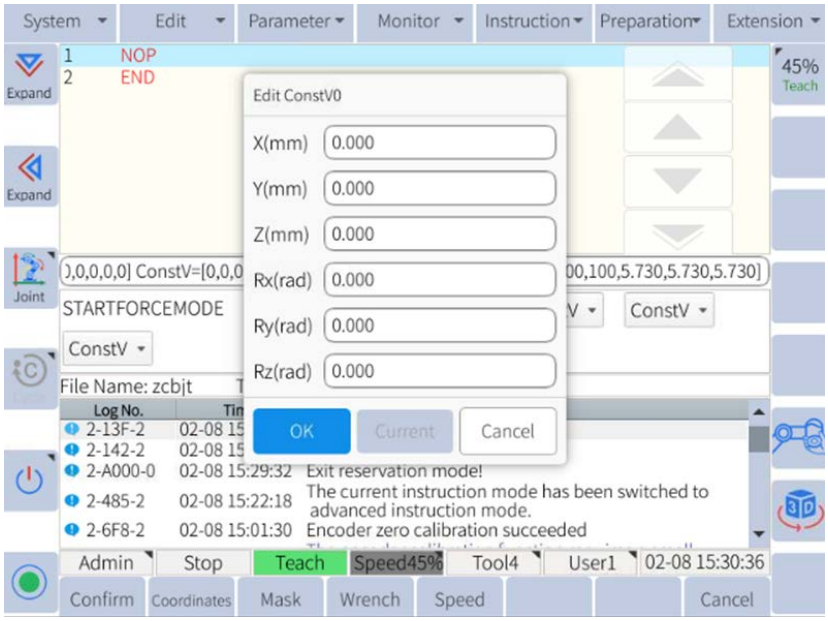


Figure 6-49: Setting the parameters of the force control coordinate system

- The user can set the mask of the DOFs by clicking the **Mask** button. Each mask contains motion control (series no.: 0) and force tracking (series no.: 1), as shown in **Figure** 6-50 (The mask 001000 indicates that the Z-axis direction of the current force control coordinate system is force tracking.).

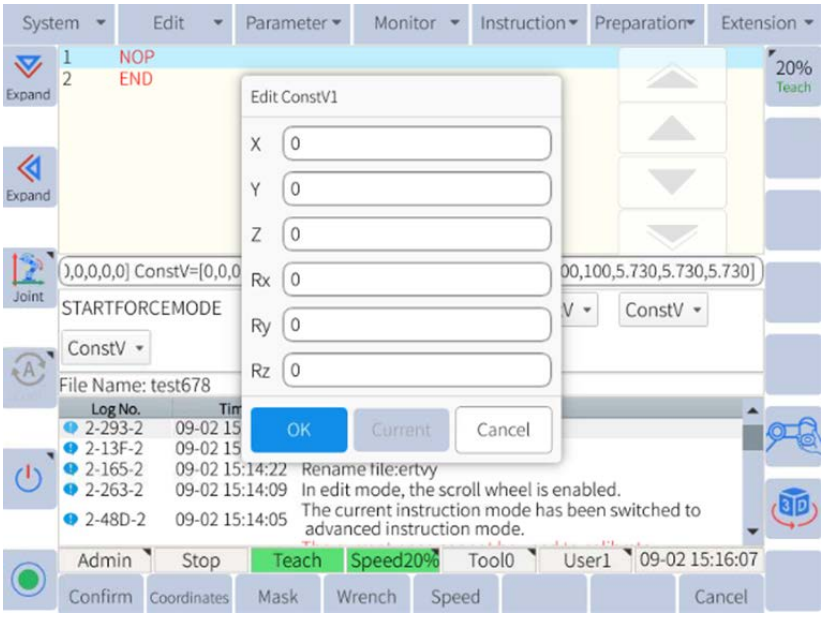


Figure 6-50: Setting the masks of the DOFs

- The user can set the desired force/torque in the direction of the DOFs of the force control coordinate system by clicking the **Force** button, as shown in **Figure** 6-51.

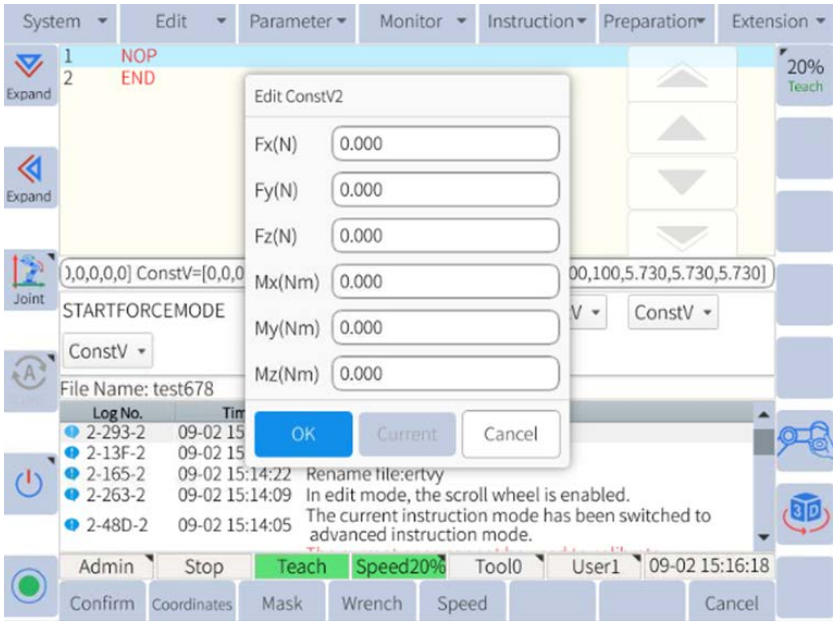


Figure 6-51: Setting the desired force/torque in the direction of the DOFs

- The user can set the maximum speed in the direction of the force control in the current force control coordinate system, as shown in **Figure** 6-52 (The default is the maximum speed, unit of x, y and z is mm/s, unit of Rx, Ry and Rz is °/s).

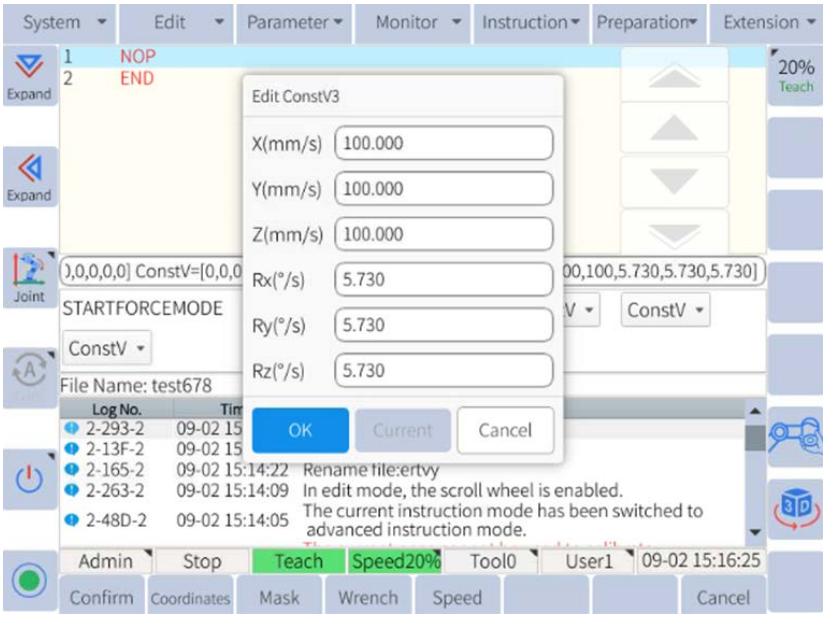


Figure 6-52: Set the maximum speed in the direction of the force control

After clicking the **Confirm** button, the settings of the force control parameters are complete.

2. Examples of the force control JBI command

The robot enters the force control mode through the JBI command, as shown in **Figure** 6-53. Please set the robotic force control mode to the fixed mode and set the force control coordinate system to the base coordinate system. Please also set the Z-axis direction of the force control coordinate system to the force tracking and set the other directions to the motion control. The desired torque in the direction of the Z-axis is set to -5N and the speed limit is the default speed limit.

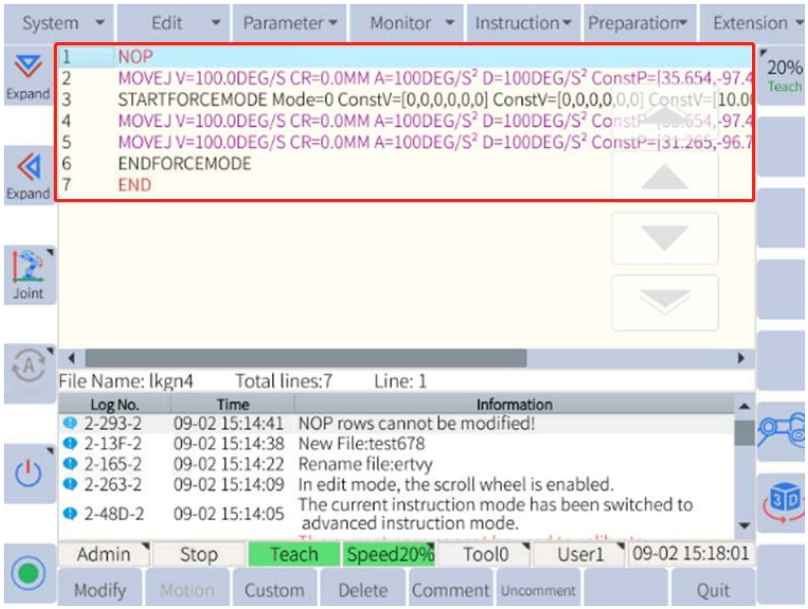


Figure 6-53: Examples of the force control JBI command

6.5.10 Status Display

6.5.10.1 Status Display Area

The status display area is mainly used to display the current status of the robot, including permissions, running status/mode/speed, current tool coordinate number, current user coordinate number, system time, external axis, etc., as shown in **Figure** 6-54 .

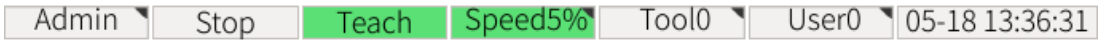


Figure 6-54 : Status display area

Permissions: Display the current permissions, can open the permission settings window by touching screen

Running status: Display the current running status of the robot, including stop, pause, run, alarm, stop(Imprecise), etc.

Running mode: Display the current running mode of the robot, including TEACH, PLAY, REMOTE mode

Speed: Display the current speed. The same speed in PLAY and REMOTE mode while a separate speed in TEACH mode, you can click to pop up the speed control window

Current tool coordinate: Display the current tool coordinate number, which can be opened by clicking the tool coordinate setting page

Current user coordinate: Display the current user coordinate number, which can be opened by clicking the user coordinate setting page

System time: Display the current time of the system, click to pop up the modify system time page

6.5.11 Submenu

The submenu area is mainly used as an auxiliary button for the focus area, which changes depending on the focus area. The submenu area can be operated by clicking the icon or by the corresponding key. The submenu area shows as **Figure** 6-55 when program list is focused.

Figure 6-55 : Submenu area

6.5.11.1 Additional Options

There are several functions that are not seen when the robot is first started up. To view these additional options in the submenu area press and hold the Additional Options button (see **Figure** 6-56).

Figure 6-56 : Layout of teach pendant (front)

Several additional options will appear in the submenu area corresponding to different convenience functions. The conventional key combination functions include screen validation, screenshot, normal mode,advanced mode, etc. There are different options available for different user processes depending on what is being shown in the general purpose display area or subwindow.

6.5.12 Speed Selection

There are three different types of speed parameters that can be modified: manual (teach) speed, play speed and remote speed. The play speed and remote speed are the same. There are three ways to adjust the speed:

1. Press the icon [20% manual] in the coordinate area 

and select the speed or drag the slider to adjust speed directly in the pop-up dialog box.

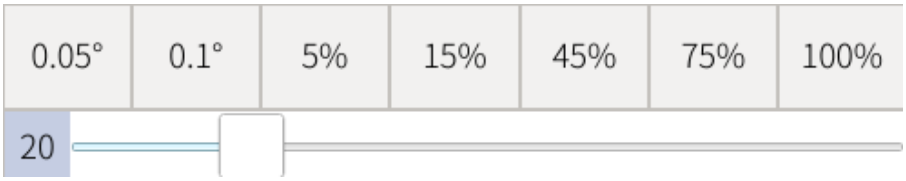


Figure 6-57 : manual speed

2. Press the icon 

in the status display area and select or drag the slider to adjust the speed in the pop-up dialog box. When the speed of the area is within 0.05~30%, the icon is displayed in green (safe speed) 

. When the speed is within 31%~70%, the icon is gray (normal speed) 

. when the speed is within 71%~100%, the icon is displayed in Red (alert speed) 

.

3. Press the speed adjustment button   on the right side of the pendant to adjust the running speed.

6.6 Moving the Robot Arm

There are various ways to move the robot; using the teachpendant or moving the robot by hand. These methods will be discussed in the following sections.

6.6.1 Servo Switch

If a user wishes to jog the robot, the servo switch must be engaged. The servo switch is a three state button for safety purposes. If the user presses down on the servo switch it will click once. This means that the servo switch is in the correct position to enable servo motion. If the switch is pressed down harder, it will click a second time. This disables the servos. The switch must be held in the middle position to enable to servos.

6.6.2 Jog Position

The following steps describe how to jog the robot axes:

1. Set the robot mode to TEACH
2. Make sure the reset button is green.
3. Select the desired coordinate system
4. Hold the servo switch on the back of the teach pendant
5. Press and hold the desired jog axis button next to the coordinate display area
6. Release the button when the desired position is reached.

CAUTION

Ensure the robot workspace is clear before jogging the robot

6.6.3 Hand Guide

To more easily position the robot in a desired configuration, users can also move the robot by hand. To activate the hand guiding feature of the robot, locate the hand guide enable button located on the

side of the tool flange (see **Figure** 6-58).

Figure 6-58 : Hand guide enable button

The user must press and hold the hand guiding button while they guide the robot to the desired location. To stop hand guiding, simply release the hand guide enable button.

NOTICE

The user **does not** need to hold the servo switch on the back of the teachpendant while hand guiding

6.7 Creating a Program

6.7.1 JBI

JBI is the programming language used to control the robot. JBI (short for Job Instruction) files for Elite collaborative robots can be created via the teach pendant or created and edited on a PC. JBI is a text based command language that can be directly translated into robot motion and events through the ELITE Robot software. Elite robot controllers use a Linux-based operating system and comes with an sFTP server. You can access the files with the .jbi extension by logging into /rbctrl folder with FTP software (e.g. FileZilla, with username: root, password:elite2014, port:22.) Some free text editors, such as notepad++, come with an sFTP plug-in for remote online editing.

The following list shows the available JBI instructions. For more detailed information on the following instructions please visit Elite Robot's website for the JBI user manual.

Instruction Group	Instruction	Description
Input and output	DOUT	Digital output
	MOUT	Virtual digital output
	DIN	Digital input
	MIN	Virtual digital input
	PULSE	Pulse output
	AOUT	Analog output
	AIN	Analog input
Logic control	JUMP	Jump to the specified label
	CALL	Call a subprogram
	IF	If statement
	ELSEIF	else if statement
	ELSE	Else statement
	ENDIF	End if statement
	WHILE	While loop statement
	BREAK	Jump out of loop statement
	CONTINUE	Skip this loop statement
	ENDWHILE	End while statement
	LABEL	Instruction tag
	TIMER	A timer
	RET	Subprogram return
	PAUSE	Program pause
	WAIT	Wait
	MCWAIT	Temporarily cancel collision

Instruction Group	Instruction	Description
Mathmatic	CCOOD	Specify the coordinate
	INC	Variable plus one
	DEC	Variable minus one
	ADD	Add operation
	SUB	Subtraction operation
	MUL	Multiplication operation
	DIV	Division operation
	MOD	Mod operation
	AND	Logic AND operation
	OR	Logic OR operation
	NOT	Logic NOT operation
	XOR	Logic XOR operation
	DIST	Calculate the distance between the two points

Instruction Group	Instruction	Description
	SETPOSE	Pose assignment
	SET	Variable assignment
	SETJOINT	Position assignment
	GETPOS	Get the current position
	GETTOOLFRAME	Get tool coordinates
	SETTOOLFRAME	Set tool coordinates
	GETUSERFRAME	Get user coordinates
	SETUSERFRAME	Set user coordinates
	GETTOOLNUMBER	Get tool number
Set and get	MFRAME	Establish a coordinate
	POSETOJOINT	Inverse kinematics
	JOINTTOPOSE	Forward kinematic
	POSEMUL	Position multiply
	POSEINV	Pose inversion
	SETPAYLOAD	Set payload
	SETTOOLNUMBER	set tool number
Palletizing	PALLET	Pallet process

Instruction Group	Instruction	Description
Motion	MOVDRAG	Free drive repeat
	MOVJ	Joint interpolation
	MOVC	Circular interpolation
	MOVL	Linear interpolation
	TTINIT	Transparent transmission initiate
	TTSTARTJOINT	Transparent transmission start
	TTTARGETJOINT	Transparent transmission add target
	TTSTOP	Transparent transmission end
	LOADML	Load script file
	UNLOADML	Unload script file
	MOVML	Micro-interpolation
Lua control	STARTLUA	Run script
	STOPLUA	stop script
	RESTARTLUA	script reload
	GETLUASTATE	Get script status
Others	CLEAR	Clear the variable
	//	A comment
	SAVEVARP	Save P variable
	TPWRITE	Print

6.7.2 Initial Setup

When the program list is showing in the general purpose display, the options for program file operation appear in the submenu area, as shown in **Figure** 6-59 . If the general purpose display is showing a page other than the program list, the user can press the quit button at the bottom of the teach pendant screen until the program list is displayed.

Figure 6-59 : Options for program file operation

All waypoints and robot instructions are stored in the program file, so you should first familiarize with the various operations of the program file before teaching. To create a program, click ”New” and an interface will pop up as shown in **Figure** 6-60 .

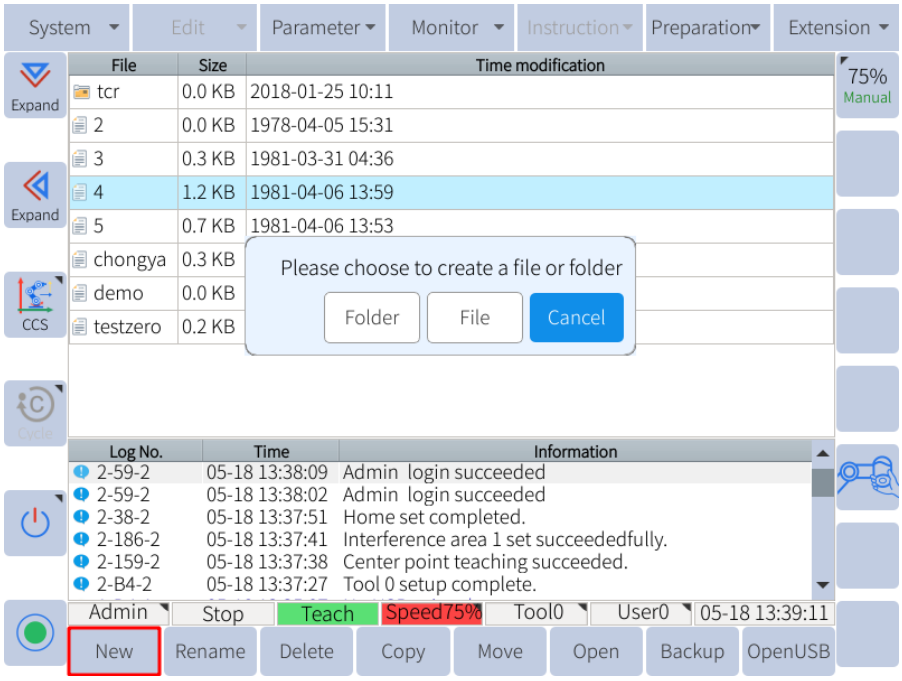


Figure 6-60 : New Program File

After clicking “File”, in the file name input interface, enter the desired file name and click “OK”.

To open an existing file, select the program and click “Open” to open the program to the program editing interface (**Figure** 6-67).

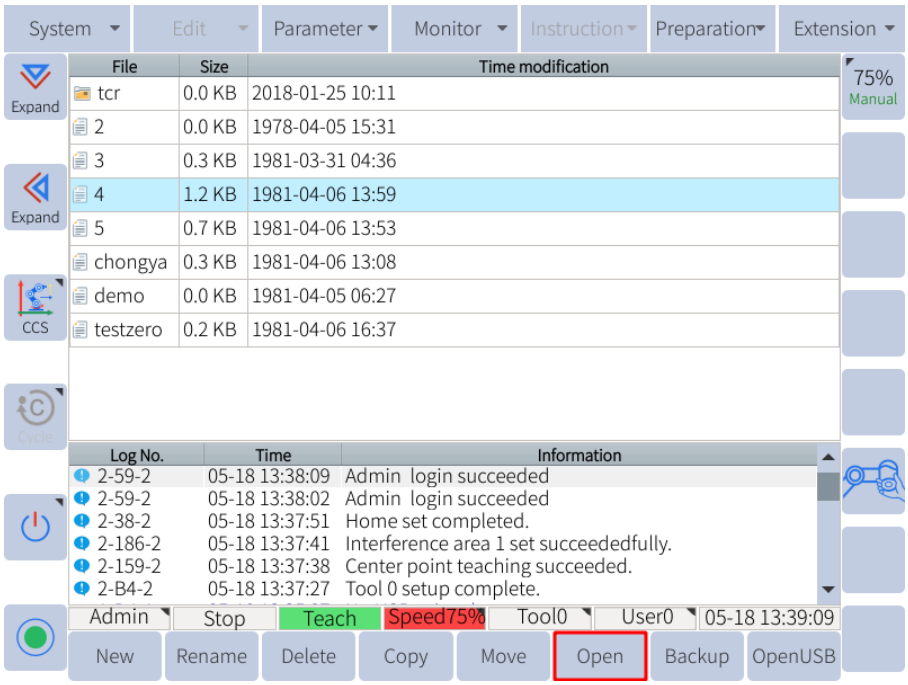


Figure 6-61 : Open program file

6.7.2.1 Navigating through the Program

There are two ways to navigate through the program lines. The first way is using the navigation arrows to the right of the program text shown in **Figure** 6-62 . The outer arrows jump to the top or the bottom of the program and the inner arrows move up or down a single line.

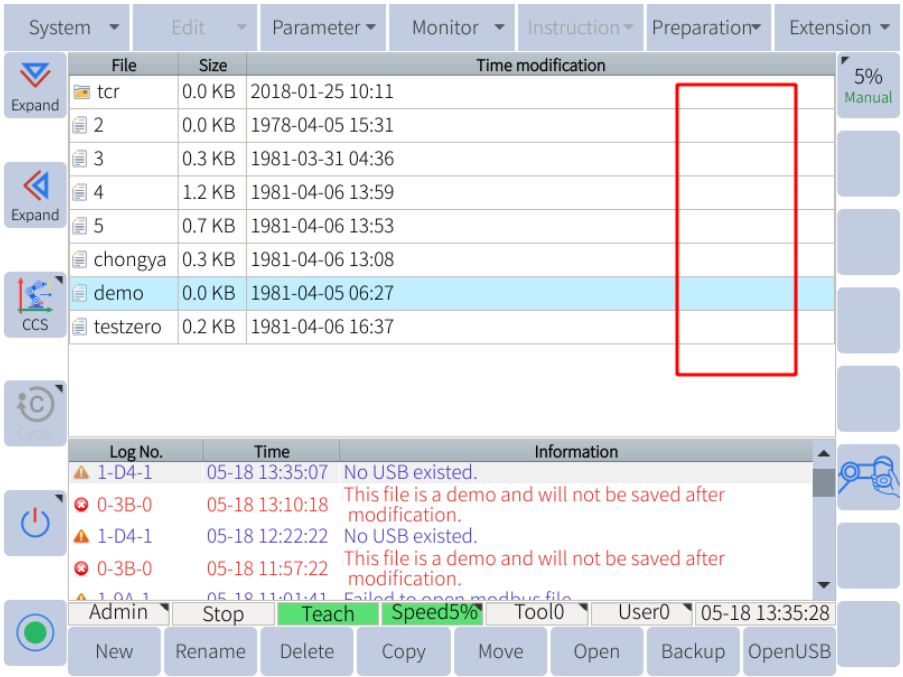


Figure 6-62 : Program navigation arrows

The second way to navigate through the program is to use the scroll wheel located on the right side of the each pendant. The scroll wheel is disabled by default after booting. Push the scroll wheel inward to enable the scrolling feature. To disable press inward a second time.

6.7.3 Inserting Commands

To insert a command, locate the main menu bar at the top of the screen and click on the “Instructions” tab. The following command categories are available:

Input and putput/Logic control/Mathmatic/Set and get/Lua control/Others/Motion

The methods of inserting all instructions except for the move instruction are identical. The steps for inserting commands are as follows:

1. In the program editing page, move the cursor to the line immediately before the position where the instruction is to be inserted.
2. Press “Instruction” under the main menu (or “Custom” in the submenu area) to select the instruction to be inserted (see **Figure** 6-63)

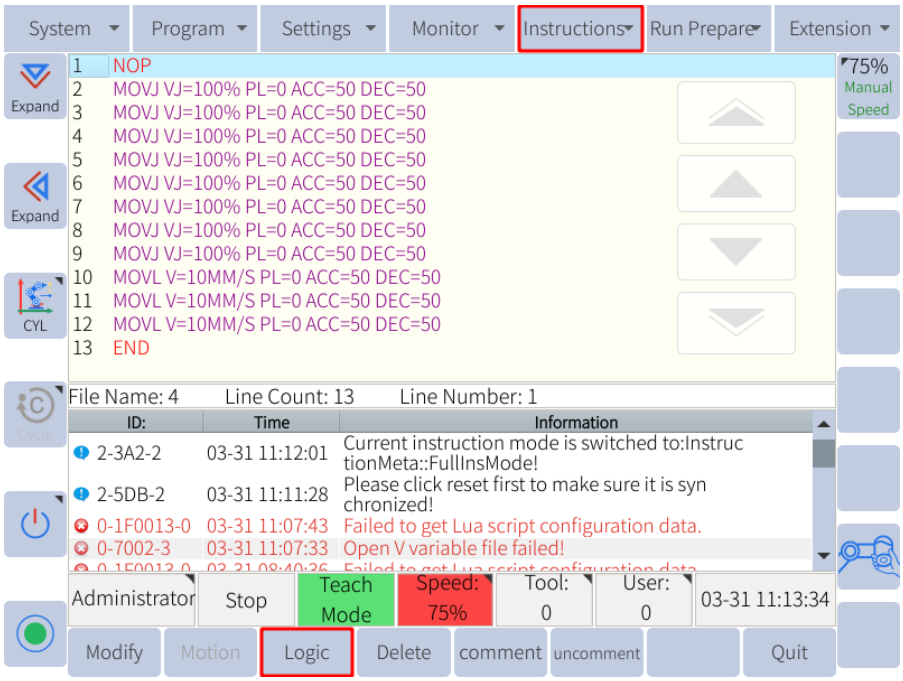


Figure 6-63 : Inserting other instructions

3. After editing the additional parameters, press “OK” to insert the instruction.

The “Logic” tab in the submenu area contains only some of the instructions, but all instructions can be found by pressing “Instructions” in the main menu bar.

NOTICE

Programs are saved automatically while a program is being created

6.7.4 Inserting Move Commands

When inserting a move instructions without using P variables, the current position of the manipulator is recorded into the move instruction. Be sure to press the servo safety switch to successfully insert the movement command.

The detailed procedure for inserting a move command is as follows:

1. Move the manipulator to the desired position using hand guiding or the jog axis buttons
2. Move the program cursor to the line immediately before the position where a move instruction is to be inserted.
3. Press and hold the servo switch - the ”SERVO” indicator light will turn on.
4. Click ”Motion” in the submenu bar, as shown in **Figure** 6-64 , or select **Instruction -> Move-Instruction**, and select the desire move method on the drop down menu.

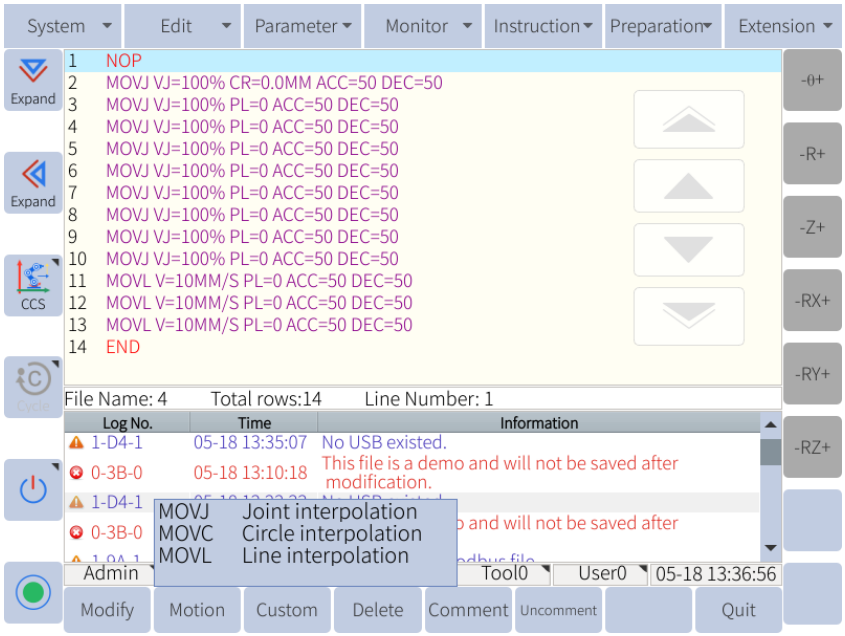


Figure 6-64 : Selecting the move instruction

5. After selecting the move instruction, edit the parameters and press “Confirm” to insert it.

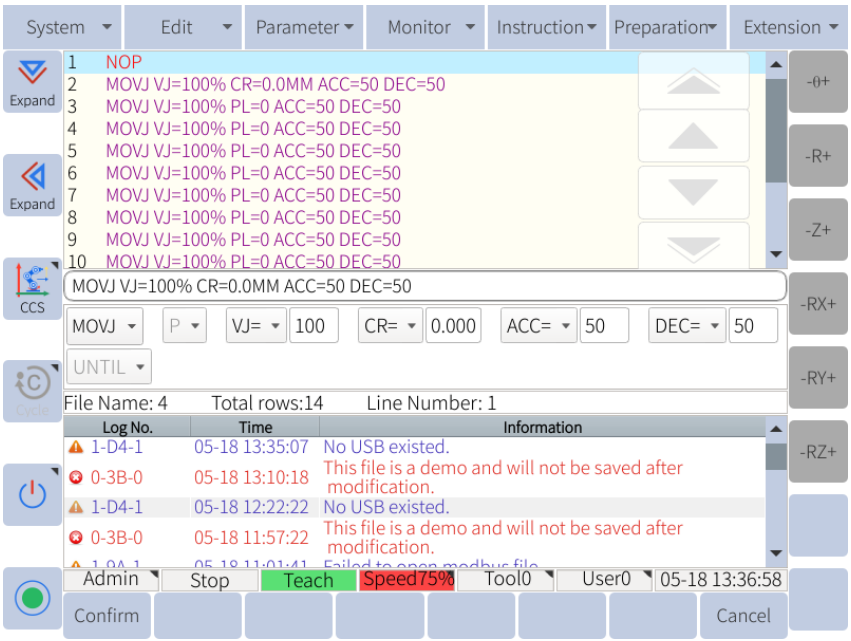


Figure 6-65 : Inserting the move instructions

NOTICE

The servo enable switch must be held when inserting the move instructions. Otherwise, the move instruction **will not** be inserted.

6.7.4.1 Checking Steps

After completing the program editing, the manipulator can be moved to the recorded waypoint in

order to check whether the recorded waypoint is correct. The following steps describe how to move the manipulator to a previously recorded waypoint:

1. Switch to TEACH mode using the mode selector switch
2. Set manual speed at an appropriate level for safety
3. Select the move instruction the user wishes to verify
4. Press and hold the servo enable Switch
5. Press and hold the “PROGRAM START” button  on the bottom right corner of the teach pendant
6. When the manipulator reaches the target step point, the information prompt area will display the following message: “The manipulator reaches the target point”

NOTICE

The manipulator will stop moving when it has reached the selected waypoint or if the user releases the ”Program Start” button

6.7.5 Advanced Functions

There are two types of program instruction mode in this system: normal mode and advanced mode. The normal mode is used by default after booting.

In the normal mode, only the basic items for each instruction are available for editing. After enabling the advanced mode, all commands will be available while inserting program instructions.

Advanced mode can be enabled as follows: Press and hold the Additional Options button  . The submenu area will change to show the additional options available. The “Advanced Mode” button will appear.

Figure 6-66 : Mode conversion interface

While holding the additional options button, click “Advanced Mode” and enter the advanced robot instructions.

6.7.6 Editing a Program or Command

6.7.6.1 Manage Programs

The user can create files or folders to better organize their programs. To create a folder, select “New” in the submenu area, click on “folder” in the pop-up window, and enter a name for the newly created file. Programs can also be managed in the following ways:

Rename

Select the program that needs to be renamed, click “Rename”, enter the new file name in the pop-up interface, and click “OK”.

Delete

Select the program to be deleted, click “Delete”. A confirmation prompt box will pop up. Click “OK”.

CAUTION

The program opened last time is active and cannot be deleted. You need to open a different programs before deleting.

Copy

Select the program to be copied, click “Copy”, enter the new file name in the pop-up window, and click “OK”.

Move

The move operation is used for moving the program file into and out of the folder. Select the program file that needs to be moved, click “Move”, select the desired folder, and click “OK”.

Open

Select the program and click “Open” to open the program to the program editing interface, as shown in **Figure** 6-67 .

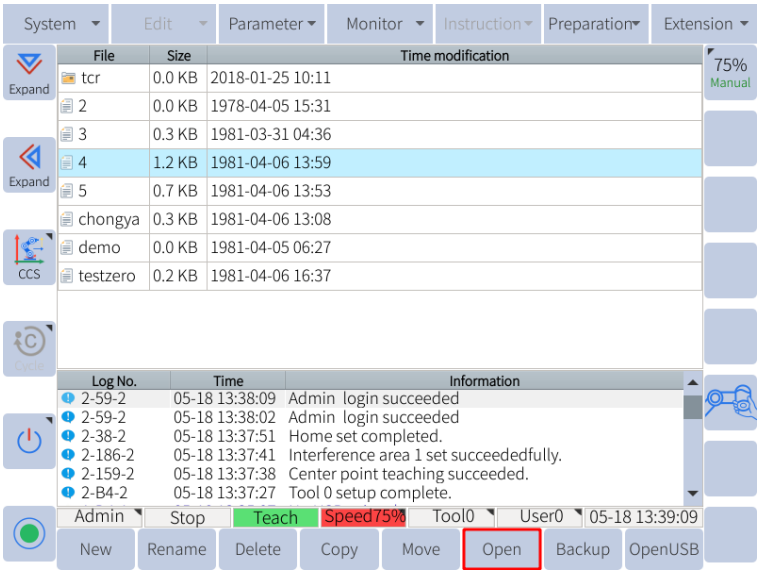


Figure 6-67 : Open program file

NOTICE

After opening the program file, “Program” and “Instructions” will become available in the main menu area.

Backup

When a USB device is connected with the controller, select the program that needs to be backed up, and click “Backup” to store the program in the USB.

Open USB Device

Connect a USB device with the controller and click “OpenUSB” to display the existing programs in the USB. Select the desired program and click “Usb 2 local” at the bottom left of the interface to import the program file.

6.7.6.2 Updating Instruction Parameters

Instruction parameters can be updated by selecting the instruction with the program cursor and clicking on “modify” in the submenu. The user can then make the desired changes. To save the changes, click on “update parameters” at the bottom of the screen. The changes will then be saved in the program. If the user decides if the user decides not to save the changes, press “quit” in the submenu.

6.7.6.3 Modifying Programs

Once a program has been opened, then, a user can take the following actions to reorganize or modify the lines of the program:

Copy

There are two types of copy operations: “Line copy” and “Piece copy”.

Line copy: Only copy the instruction line selected by the cursor (Note that the NOP and END lines cannot be copied).

Piece copy: Press “Piece copy”, and the dialog box will pop up for specifying the range of the instruction lines to be copied. Press “OK” to complete the copy operation.

Cut

There are two types of cut operations: “Line cut” and “Piece cut”.

Line cut: Only cut the instruction line selected by the cursor (Note that the NOP and END lines cannot be cut).

Piece cut: Press “Piece cut”, and the dialog box will pop up for specifying the range of the instruction lines to be cut. Press “OK” to complete the cut operation.

Paste

After performing a copy operation or a cut operation, move the cursor to the line immediately before the desired position in the program editing page. Press “Paste” to complete the paste operation. It allows users to paste repeatedly.

NOTICE

The instruction lines are inserted in the next line of the cursor line.

Delete

There are two types of delete operations: “Line delete” and “Piece delete”.

Line delete: Only deletes the instruction line selected by the cursor (Note that the NOP and END lines cannot be deleted).

Piece delete: Press “Piece delete”, and the dialog box will pop up for specifying the range of the instruction lines to be deleted. Press “OK” to complete the delete operation.

Find

Press “Find” and the search window will pop up. The items can be searched are the additional items of each instruction. Note that the items displayed for each instruction in the normal instruction mode and advanced instruction mode are different. Select the item to search, and input the corresponding value. Then press “Find” in the submenu area to find the instruction line that meets the requirements in the current program. The cursor will move to the line automatically, as shown in **Figure 6-68**.

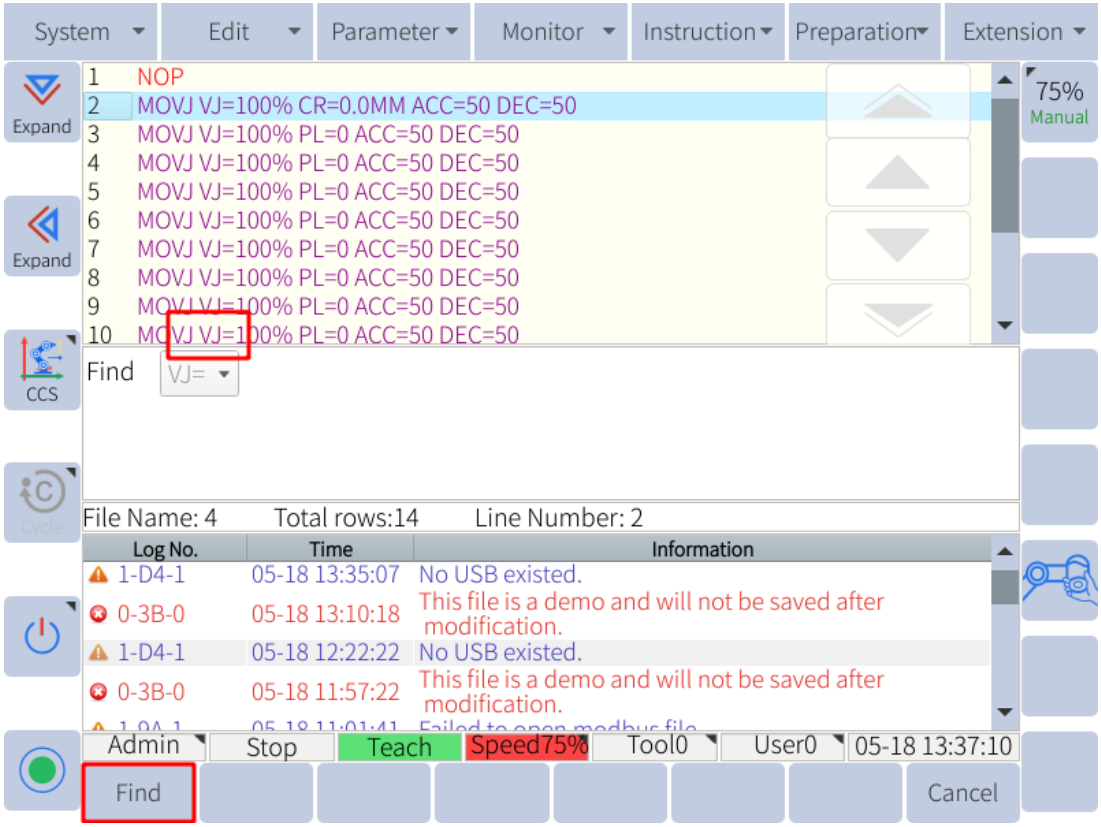


Figure 6-68 : Searching

Replace

The replace operation is used to replace the additional item value that meets the search requirements with the given value. Press “Replace”, then the submenu area displays three new options: “Replace”, “Skip” and “Replace all”.

“Replace” can be used to sequentially replace the value of the matching item with the specified value one by one.

“Skip” can be used to skip the current matching item.

"Replace all" can be used to replace the values of all matching items in the program with the specified value at once.

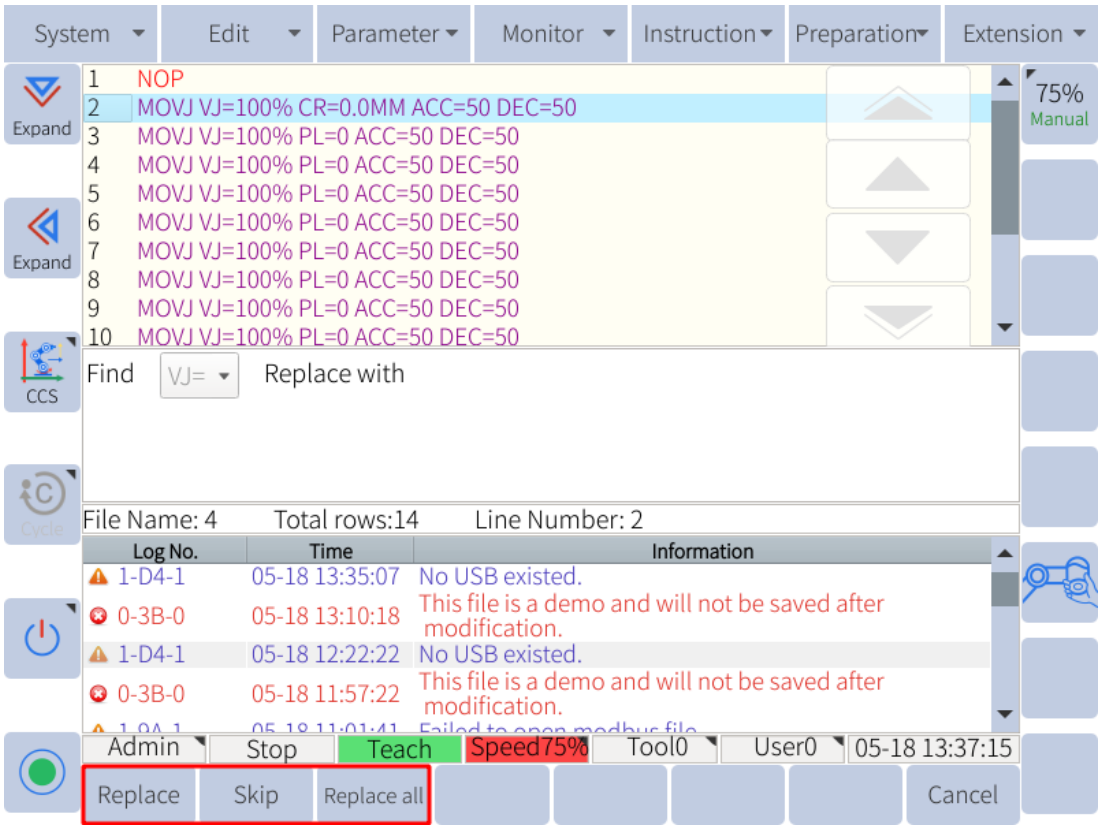


Figure 6-69 : Replacing

Custom collection

To customize the Quick Instructions see Subsection 6.7.7

6.7.7 Customizing Quick Access Commands

The custom tab in the submenu bar can be customized to contain the users most frequently used robot instructions. The frequently used instructions can be added to the quick instructions for easy use. To customize the "Logic" menu, navigate to **Edit -> Custom collection** to enter the customizing page. Select the desired instruction in the left instruction selecting window, and press the right arrow to add the selected instruction to the quick instructions list.

Select the desired instruction in the right quick instruction window, and press left arrow to remove the selected instruction from the list, as shown in **Figure** 6-70 .

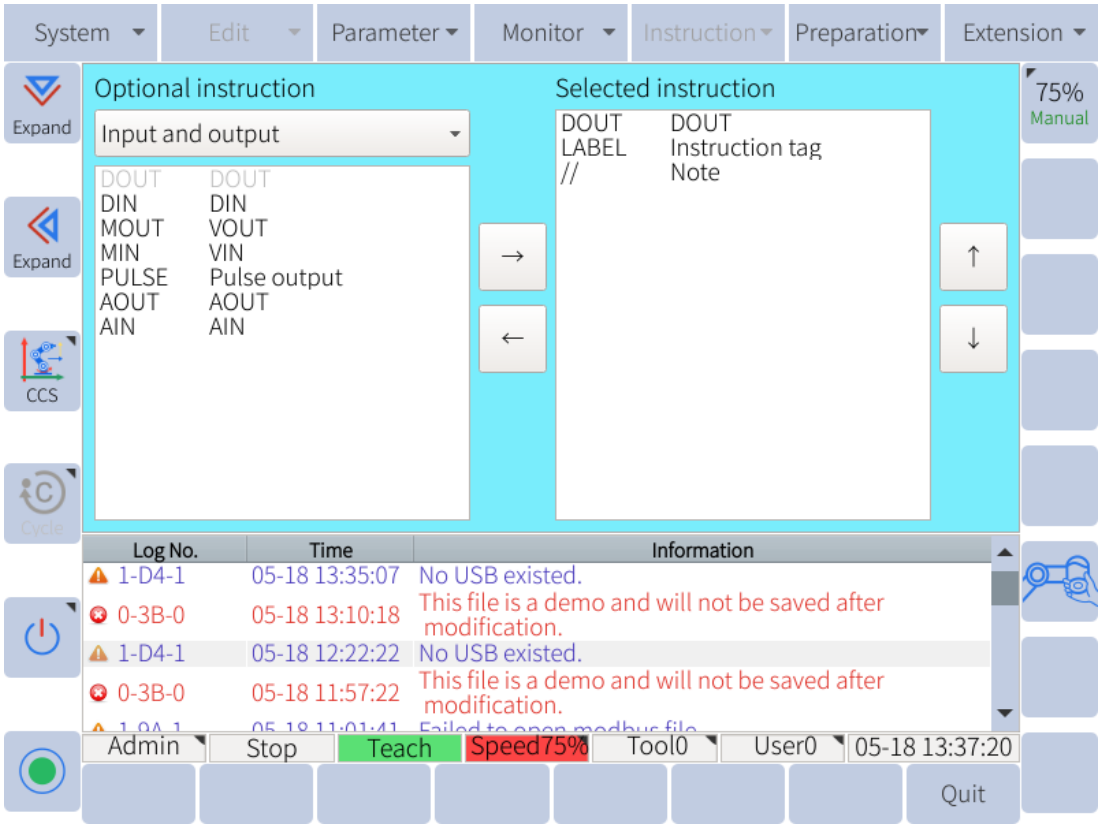


Figure 6-70 : Customizing quick instructions

6.8 Running a Program

6.8.1 Program Execution

6.8.1.1 Selecting Programs

Before performing a program, select the desired program file in the list and press “OPEN” in the submenu area to open the programming interface. Move the cursor to the starting line of the program. Generally, the program is executed from the NOP line.

CAUTION

The program starts from the position highlighted by the cursor. If the program was stopped in the middle of the program and is restarted, the program will continue from where the cursor is.

6.8.1.2 Selecting Operation Cycle

Switch to PLAY mode, press the icon in the status control area to select one of three types of manipulator operation cycles:

SINGLE STEP: Executes only one line of instruction when pressing the running button each time. Any non-motion instructions will not be executed.

SINGLE CYCLE: Executes a program once. The program will be executed again if "PROGRAM START" button is pressed.

CONTINUOUS CYCLE: Repeats a program continuously.

6.8.1.3 Startup

After completing all above preparations, first press "SERVO ENABLE" button 

on the bottom right corner of the teachpendant. The SERVO ON lamp lights up when the servo is enabled. Then, press "PROGRAM START" button  , and the program will start running automatically.

6.8.1.4 Modifying Play Speed

The TEACH mode and PLAY mode use different speed values. After switching to PLAY mode, the speed can be modified to an appropriate level by following the instructions shown in Subsection 6.5.13.

6.8.2 Pause, Run, and Stop

Program Pause Operation

In PLAY mode, if the program pause operation is executed, the program will pause at the current line, and the manipulator will slow down and stop.

Emergency Stop Operation

If the emergency stop operation is executed, the servo power will be turned OFF and the manipulator will stop immediately.

There are two methods for executing emergency stop operation:

1. Press "EMERGENCY STOP" button on the programming pendant.
2. Use external emergency stop.

After an emergency stop, first correct the cause of the alarm and then reset "EMERGENCY STOP" button. The alarm can then be reset by pressing the alarm reset button at the bottom left of the teach pendant screen. To restart the program, press the green button ().

NOTICE

After the emergency stop, the program call relations between the main program and the subprogram will be cleared.

Stop Caused by Alarm

Except for program pause and emergency stop, when other system alarms occur during program runtime, the program execution will end, and the manipulator will stop immediately. The information log will display an alarm message and the alarm LED indicator will light up. For a description of error codes see Section 13.6.

Other Stops

In addition to the above stop methods, there are three ways to stop the program:

1. Switch the mode.
2. The PAUSE instruction is executed in the program.
3. Double click the PAUSE button () and the program will end.

6.8.3 Monitoring

The monitoring options in the main menu area are mainly used to view the current working status of the manipulator and the variables of various data types. The system can monitor the following contents: coordinates, variables, IO (input and output), motor, reservation, operational monitoring, etc.

6.8.3.1 Position

The coordinate monitors are used to monitor coordinate data, including joint coordinates and base coordinates.

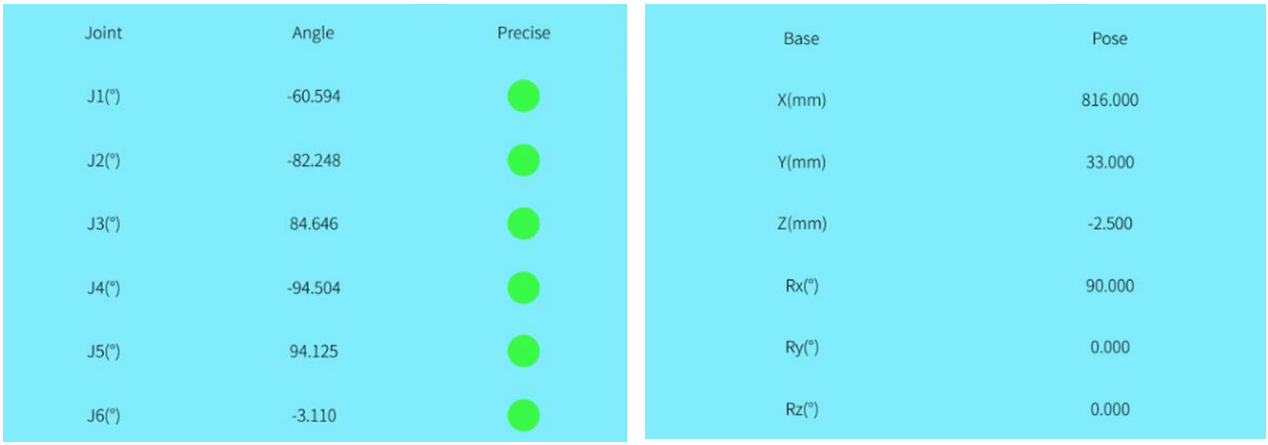


Figure 6-71 : Coordinate monitor page

6.8.3.2 Input and output

The input and output monitor page includes: digital input, digital output, analog input, analog output, virtual input, and virtual output. Select the desired option to open the corresponding monitor page, as shown in **Figure** 6-72.

In the “TEACH” mode, select the output signal and click “Modify” at the bottom left to force the “0” of the output signal to be changed to “1”.

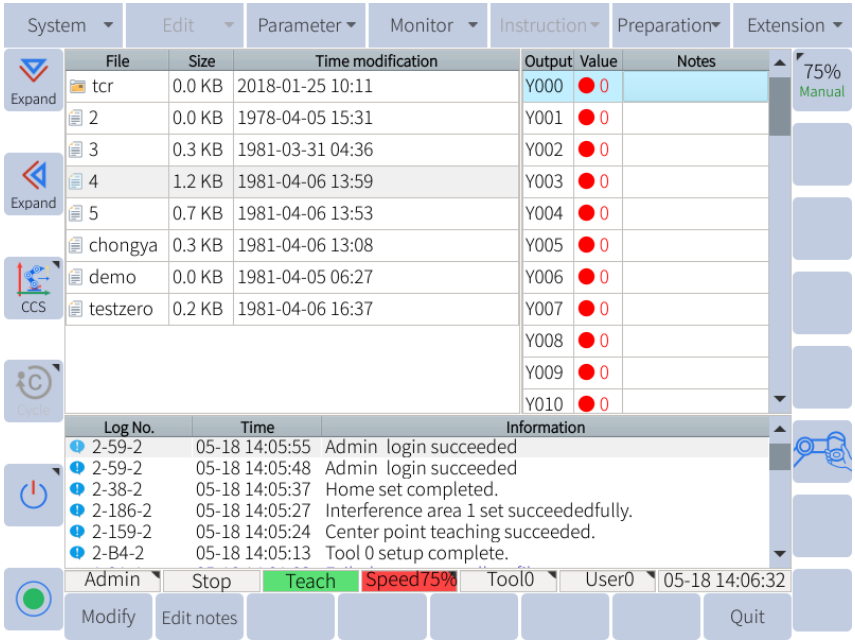


Figure 6-72 : I/O monitor page

Each option parameter is shown in **Table** 6-3 :

Table 6-3 . Option parameter

Position	Type	Hardware Interface	Variable Address Range
Control cabinet	Digital input	X4~X19 has	X0~X63
	Digital output	Y0~Y19 has	Y0~Y63
	Virtual input	No	M0~M399
	Virtual output	No	M400~M799
	Analog input	Yes	AI001~AI002
	Analog output	Yes	AO001~AO004
Terminal	Digital input	Yes	X48~X51
	Digital output	Yes	Y48~Y51
	Virtual input	No	No
	Virtual output	No	No
	Analog input	Yes	AI003
	Analog output	Yes	AO005

The digital inputs and virtual inputs can only be used to monitor the changes of state.

Note that the digital outputs and the virtual outputs with red labels are used by the system, and their states cannot be modified. For instance, the user can reverse the state from 0 to 1 or 1 to when selecting Y000 with the cursor and clicking "Modify" in the submenu.

6.8.3.3 Global variables

The content displayed in the global variable interface includes variable data of B, I, D, P and V. The variable parameters are shown in **Table** 6-4 :

Table 6-4 . Variable parameter

Variable	Types	Total Number	Power Retention	Visible	Value Input Range
B	int	0~255	Maintained	visible	[0,2147483647]
I	int	0~255	Maintained	visible	[-32767,32767]
D	double	0~255	Maintained	visible	[-1e+09,1e+09]
P	double array	0~255	Maintained	visible	each axis is [-360,360]
V	double array	0~255	Maintained	visible	xyz unlimited, rx,ry,rz are [-180,180]

To modify a variable navigate to **Monitor -> Global variable** and select the type of variable the user wishes to modify. Press “Modify” button in the submenu area assign a value to the variable using the pop-up box. Note that the values in the variable monitor page can only be modified in TEACH mode.

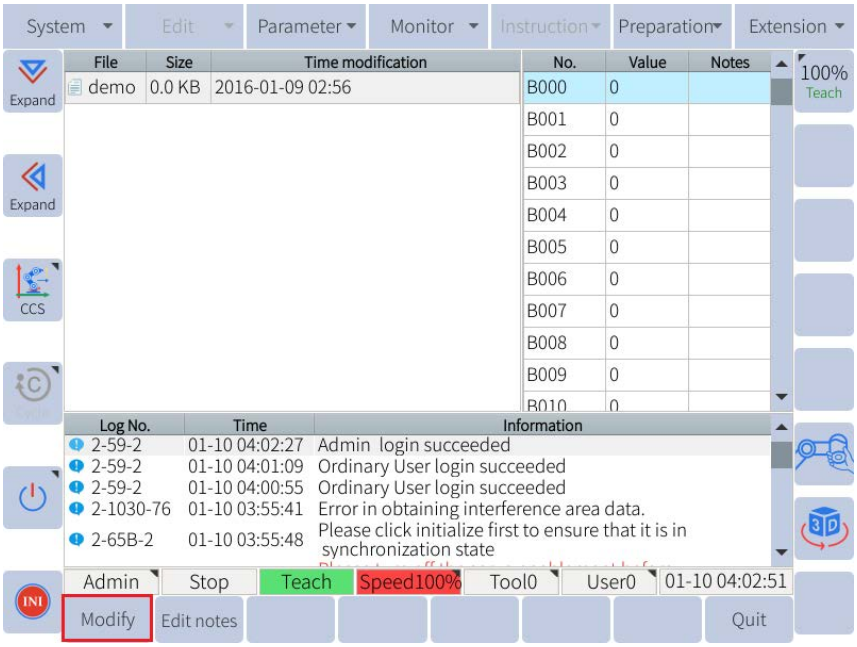


Figure 6-73 : Variable monitor page

The P variable is the position type variable. Select the desired P variable using the cursor in the variable monitor page. Press “Check” to view its value in the information prompt area. Press “Modify” to record the current position of the robot into the selected P variable, as shown in **Figure** 6-73. After the modification, please click "Current" and "Set" to save the joint angle in the current base coordinate into the P variable. The "Raw" button is used to save the P variable when the robot is not in the joint state.

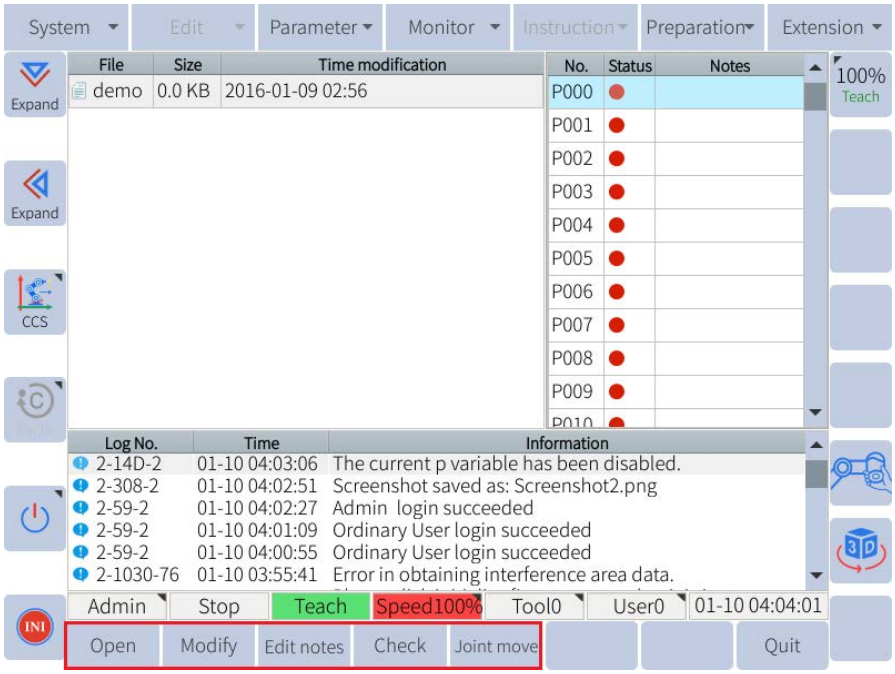


Figure 6-74 : P variable

For the V variable, the user can click "Current" and "Set" to save the current TCP into the variable V. The "Raw" button is used to save the V variable when the robot is not in the pose state.

6.8.3.4 Motor data

The motor options include three options: raw pulse, motor speed and motor torque. The raw pulse monitor page displays three items: the sending pulse counting, the feedback pulse counting and the difference.

For pulse motors, if there is a movement position deviation, you can monitor the changes of various values on this interface to find out the cause. This monitor option is hardly used by the general users.

Joint	Tx	Rx	Diff.
J1	0	0	0
J2	0	0	0
J3	0	0	0
J4	0	0	0
J5	0	0	0
J6	0	0	0

Figure 6-75 : Raw pulse monitor page

In the motor speed monitor page, the real-time rotational speed of each axis can be viewed according to the actual requirements.

Joint	Realtime	Maximum
J1(rpm)	0	0
J2(rpm)	0	0
J3(rpm)	0	0
J4(rpm)	0	0
J5(rpm)	0	0
J6(rpm)	0	0

Figure 6-76 : Speed monitor page

The motor torque monitoring interface reflects the ratio per thousand of the rated torque, the unit is‰.

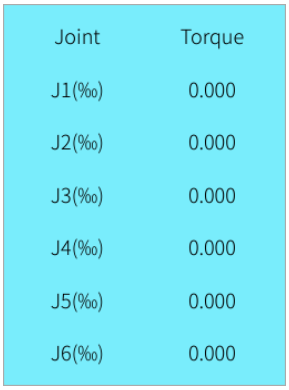


Figure 6-77 : Motor torque monitoring interface

6.8.3.5 Runtime position

In the runtime position page, the coordinate values of the current position and the coordinate values of the target position can be viewed. The joint coordinates are displayed by default, which can be switched to the Base coordinates by pressing "Joint/Base" button in the submenu area. In the program editing window, use the cursor to select the desired move instruction, and the coordinate values of the target point corresponding to the instruction will be displayed in the operational monitor page.

6.8.3.6 Joint temperature

Users can check the current temperature values of each joint in the joint temperature interface, the unit is ℃.

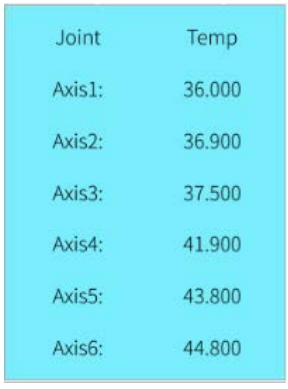


Figure 6-78 : Joint temperature interface

6.9 File Backup

Insert a USB device in the USB port of the controller

The **System -> File Backup** option includes:

- **Log Backup**
  Backup system information Log.
- **Parameter Backup**
  Backup all parameter settings, including speed parameters, system parameters, limit parameters, servo parameters, mechanism parameters, and other parameters.
- **Global VAR Backup**
  Backup global variable.
- **IO Notes Backup**
  Backup comment files for input, output, virtual input and virtual output.
- **PLC Backup**
  Backup the user and system PLC program files.
- **User Data**
  Include parameter backup, IO annotation backup, and PLC backup. In addition, backup all program files, user coordinates files, tool coordinates files, user processes files and screenshots, etc.
- **Fieldbus Configuration**
  Backup Modbus function configuration file.
- **Script Backup/Delete**
  Backup or delete scripts.
- **ID File Backup/Delete**
  Backup or delete dynamics identification file.
- **Translation Backup**
  Backup the system translation files.
- **Global VAR Notes Backup**
  Backup the comment files for global variable.
- **Migration**
  Backup user data, zero data and lap information, variable data, etc.
- **Zero Position Data Backup**
  Backup the zero position data.

When performing “File Backup” operation, if there is no folder called ”rbctrl” in the root directory of the USB flash disk, the system will automatically generate the folder and save the backup file in it. If the folder exists in the root directory, the backup file will be saved in it directly.

6.10 File Recovery

The **System > File Recovery** option includes Global VAR Update, JBI File Import, IO Notes Update, Script Update, Boot Screen, ID File, Translation Import, Global VAR Notes Update, Parameter, PLC Update, User Data and Migration Recovery.

When performing “File Recovery” operation, a folder named “rbctrl” must exist in the root directory of the USB drive. Select **System > File Recovery** and click on the type of data the user wants to import. Selecting ”User Data” will import the following:

1. Global VAR Update: Import global variable.
2. JBI File Import: Import JBI files.
3. IO Notes Update: Update the input and output notes.
4. Script Update: Update the scripts.
5. Boot Screen: Update the boot screen.
6. ID File: Import the dynamics identification files.
7. Translation Import: Import the system translation files.
8. Global VAR Notes Update: Import the comment files for the global variable.
9. Parameter: Upgrade all parameter settings, including speed parameters, system parameters, limit parameters, servo parameters, mechanism parameters, and other parameters.
10. PLC Update: Upgrade the user and system PLC program files.
11. User Data: Include parameter, IO annotation and PLC upgrade. In addition, upgrade all program files, user coordinates files, tool coordinates files, user processes files and screenshots, etc.
12. Migration Recovery: Recover user data, zero data and lap information, variable data, etc.

CAUTION

Encryption operations can be performed when importing .jbi and .lua files, but the operation is irreversible.

DANGER

Do not move the robot during the ”migration backup” and ”migration recovery” process.

6.11 Advanced Setup

6.11.1 End Effector Button Configuration

There are blue and green LED buttons on either side of the end effector, or the user has an external button, and every button has three functional states: Drag, Record, and Disable. The user can click **Extension -> Flange IO -> Button setting** to set the function.

The function status of every button can be set independently without affecting each other. For example: All buttons can be defined as “drag”, as shown in **Figure** 6-79 .

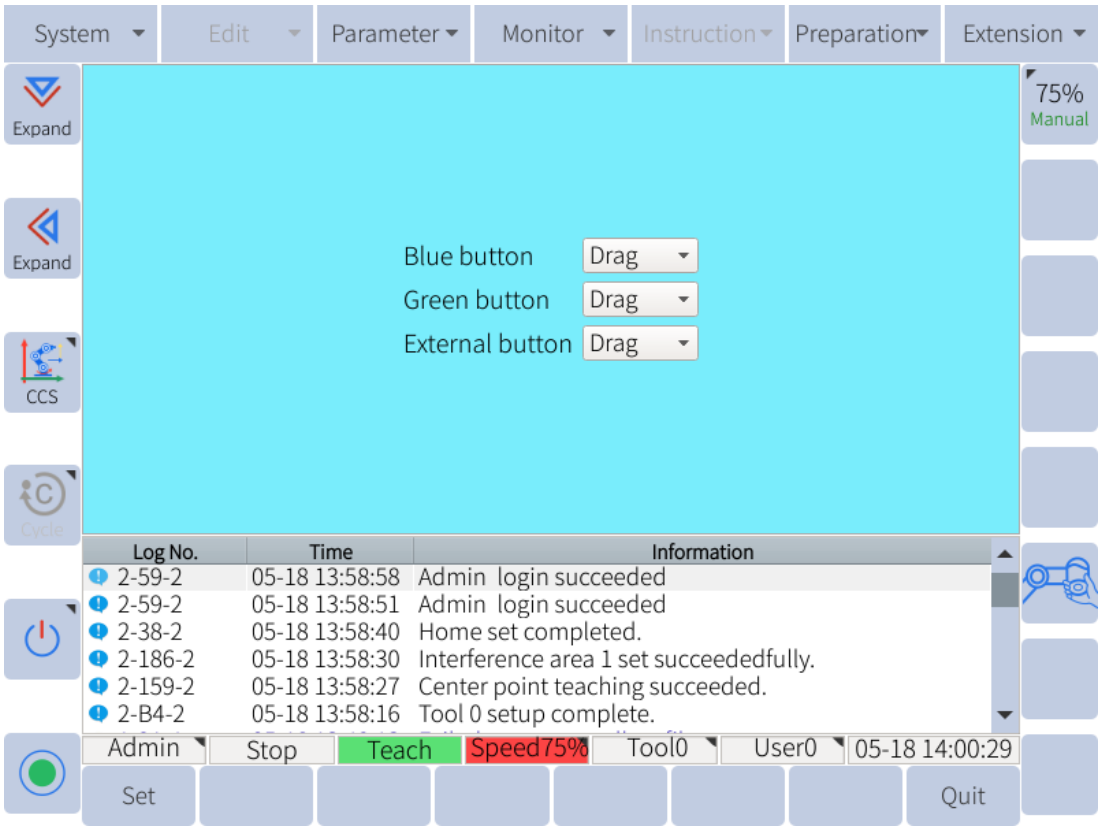


Figure 6-79 : Button Configuration

6.11.2 Recording

6.11.2.1 Record Track

Users may prefer to manually move the robot along a complicated trajectory for a continuous path. Users may run a path for playback in their program.

The operation steps are as follows:

1. Click **Preparation -> Hand drag** to enter the drag teaching interface, as shown in **Figure** 6-80 .

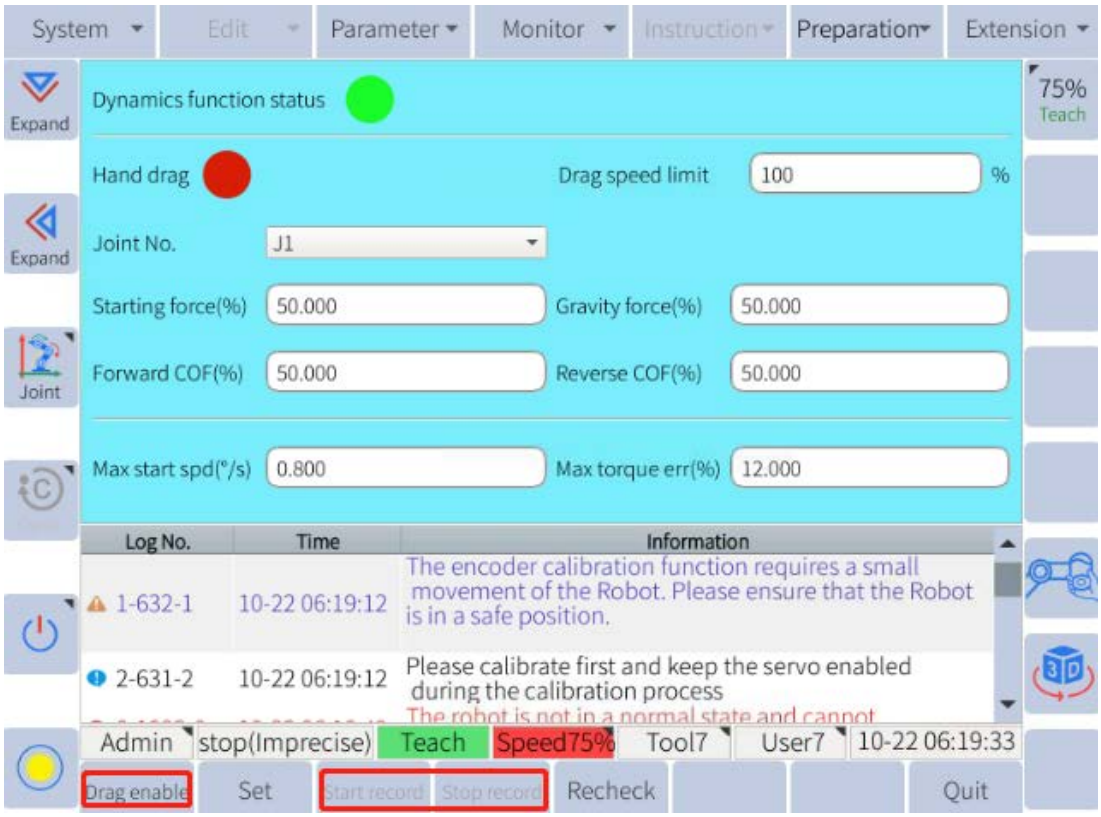


Figure 6-80 : Drag and teach

2. Enable Dragging:
   The user can click “Enable drag” at the bottom or click the icon configured as “drag” ( ) in the right side to enable the drag mode. After the click, the drag enable status light will turn green.
3. Click “Start recording” to start drag recording, which can record up to 20 minutes.
4. After dragging is finished, click “Stop recording” or release the drag enable button.
5. Enter a file name and click “OK”.
   Note: This file cannot be opened. You can use the “MOVEDRAG” JBI command into a program to reproduce the drag track.

When the force control status is green, the user can perform normal dragging, collision detection and use the safety restriction function. When the force control status is red, the above functions are not available.

NOTICE

1. After normal automatic identification, the dynamics functional status is green.
2. After the installation method is changed, the dynamics functional status will turn red. The user needs to click “Recheck” and re-identify it.
3. After changing the drag parameters, the user can also click “Recheck”. If everything is okay, then the modifications are right.

6.11.2.2 Record Waypoints

Users can quickly switch to drag mode and record points through the buttons located on the end effector. The file created using this method can be called from another program using the CALL instruction, or it can be run as a stand alone program.

The specific steps for recording a set of waypoints are as follows:

1. Select **Extension -> Flange IO -> Drag setting**, as shown in **Figure** 6-81.

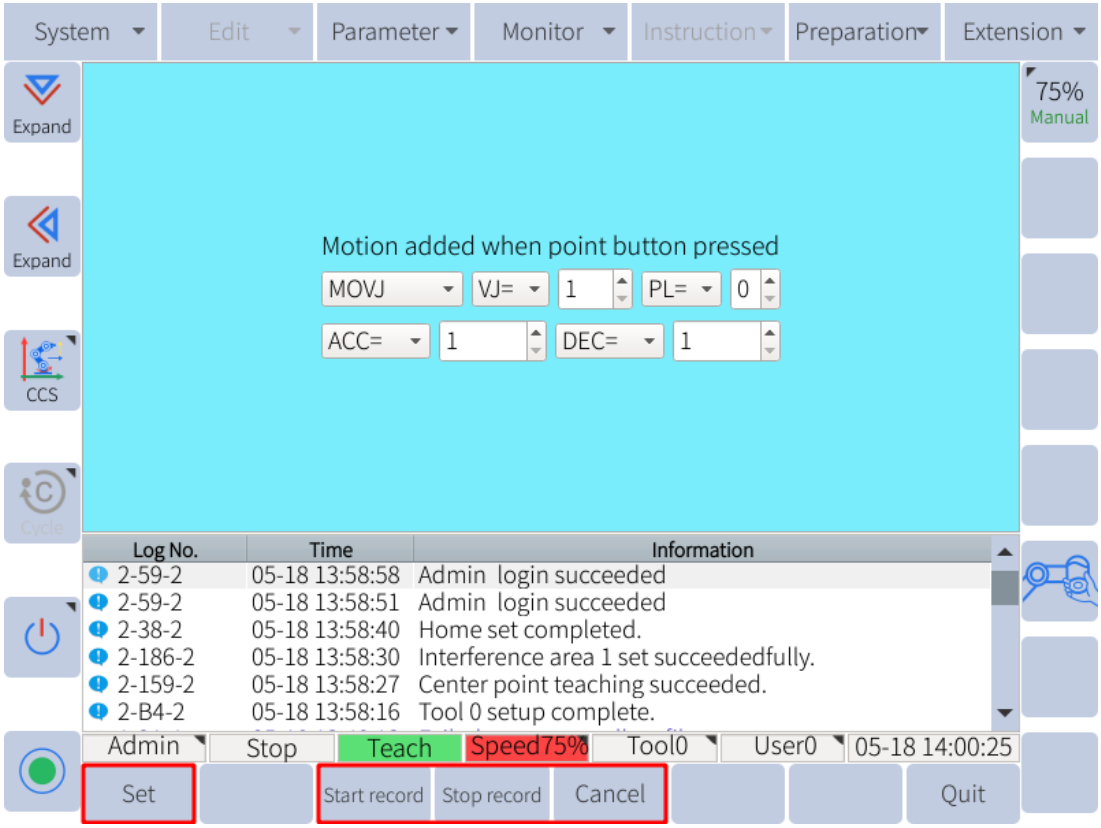


Figure 6-81 : Drag to mark

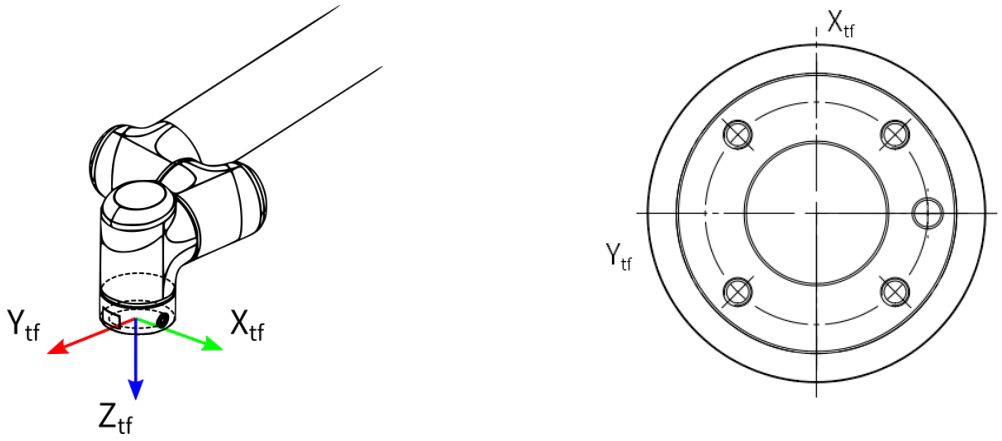
2. Set the parameters on the screen to the desired settings for all recorded moves
3. Click “Record start”, press and hold the “Drag” button of the end IO, and drag the robot to the desired position

4. Click the “Record” button of the end IO, the system will prompt “Current record points”
5. Repeat steps 2 and 3 to record other points
6. After finishing the point recording, click “Record stop”
7. Enter the file name and click “OK”

6.11.3 Tool Setup

To ensure that the manipulator can perform motion type operations such as linear and circular motion type correctly, accurate dimensional information on tools must be set and the position of the Tool Center Point (TCP) must be defined. The tool coordinates are measured from the origin of the tool flange to the location of the TCP. They are recorded with respect to the tool flange coordinate frame.

The tool flange frame and its orientation relative to the tool flange is show in below(the positioning pin hole is in the negative direction of the Y axis).



6.11.3.1 Manual Setup

There are 8 tool coordinates numbered from 0 to 7 that can be set in the system. Go to the page of **Preparation -> Tool config**, and select the tool coordinate n umber. The TCP can be calculated by inputting the tool coordinate values (the position of TCP and the tool frame orientation in the flange coordinates. Click “Save” in the submenu bar, and the message prompt bar will prompt “The tool coordinate is successfully set!”, as shown in **Figure** 6-82.

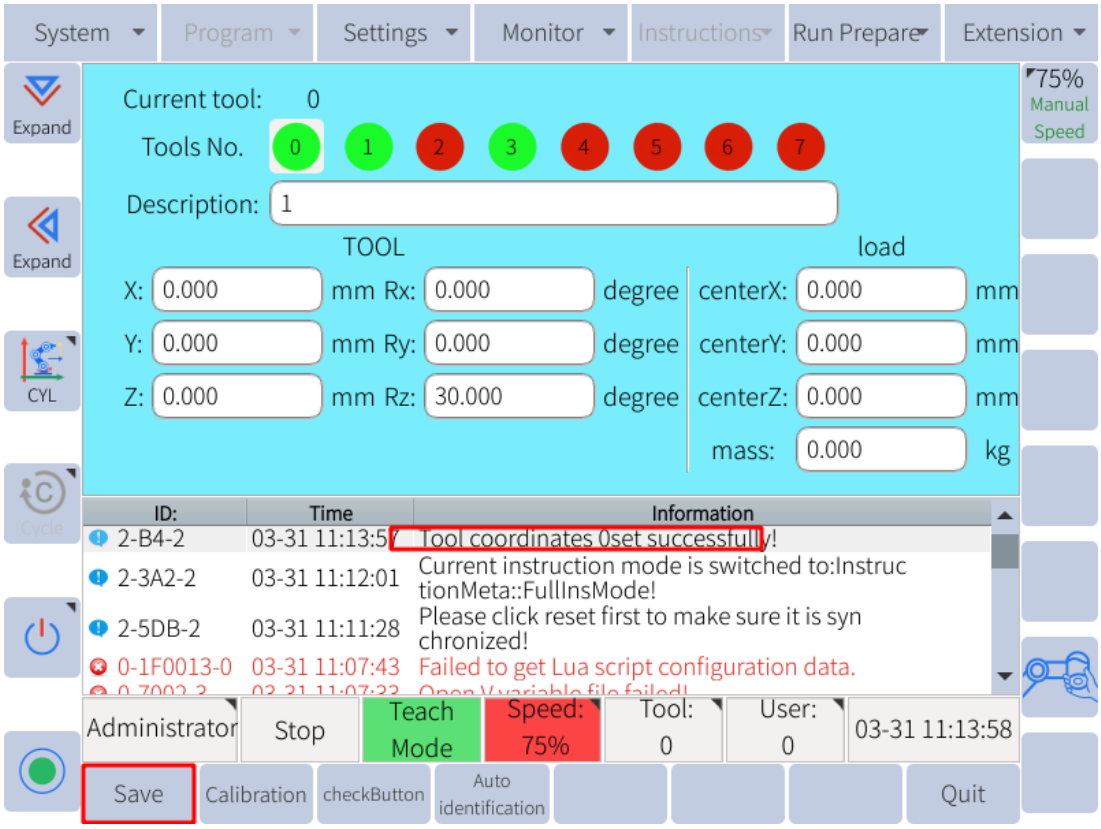


Figure 6-82 : Setting coordinate successfully

Three cases are given as examples for registering the coordinate data:

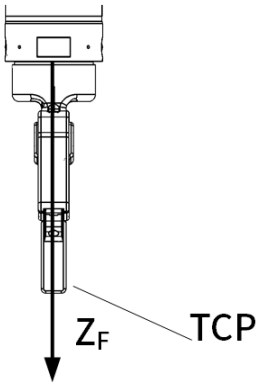


Figure 6-83 : Tool A

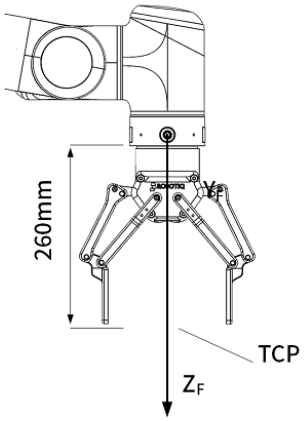


Figure 6-84 : Tool B

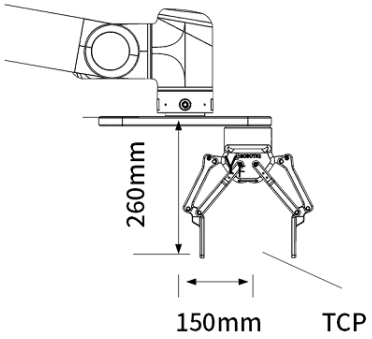


Figure 6-85 : Tool C

Cases of Tool A, B:

X, Y, Rx, Ry, Rz are 0, and Z is 260.

Cases of Tool C:

X, Rx, Ry, Rz are 0, Y is 150, and Z is 260.

6.11.3.2 TCP Estimation - 7 Point Calibration

If the user does not know the exact offsets of the TCP, they can perform a TCP estimation procedure using seven distinct points. In order to perform the seven-point tool calibration, seven points with different postures must be taught with the TCP as the reference point. The tool dimensions are automatically calculated using these seven points.

1. In the page of tool coordinates, press “Calibration” in the submenu area to open the seven-point tool calibration window.
2. Record seven points numbered from P1 to P7 according to the schematic diagram. The postures of the four points P1-P4 are as different as possible; when teaching P5, the desired z axis of the tool must be kept in a straight line with the calibration device; The vector between P5 and P6 is used to determine the direction of tool X coordinate, and vector between P5 and P7 is used to determine the direction of tool coordinate Z. When teaching, P7 can move a certain distance in the direction of tool coordinate Z based on P6.
3. First select the target point in the window, then press “Save” to record the current position of the manipulator. After that, the color corresponding to the point will change from red to green.
4. Record the seven points respectively. After selecting the taught point, “Running point” button can be pressed to move the manipulator to the point, and “Clear point” button can be used to clear the point data.
5. After teaching all points, press “Calculation” to generate the desired tool coordinate.

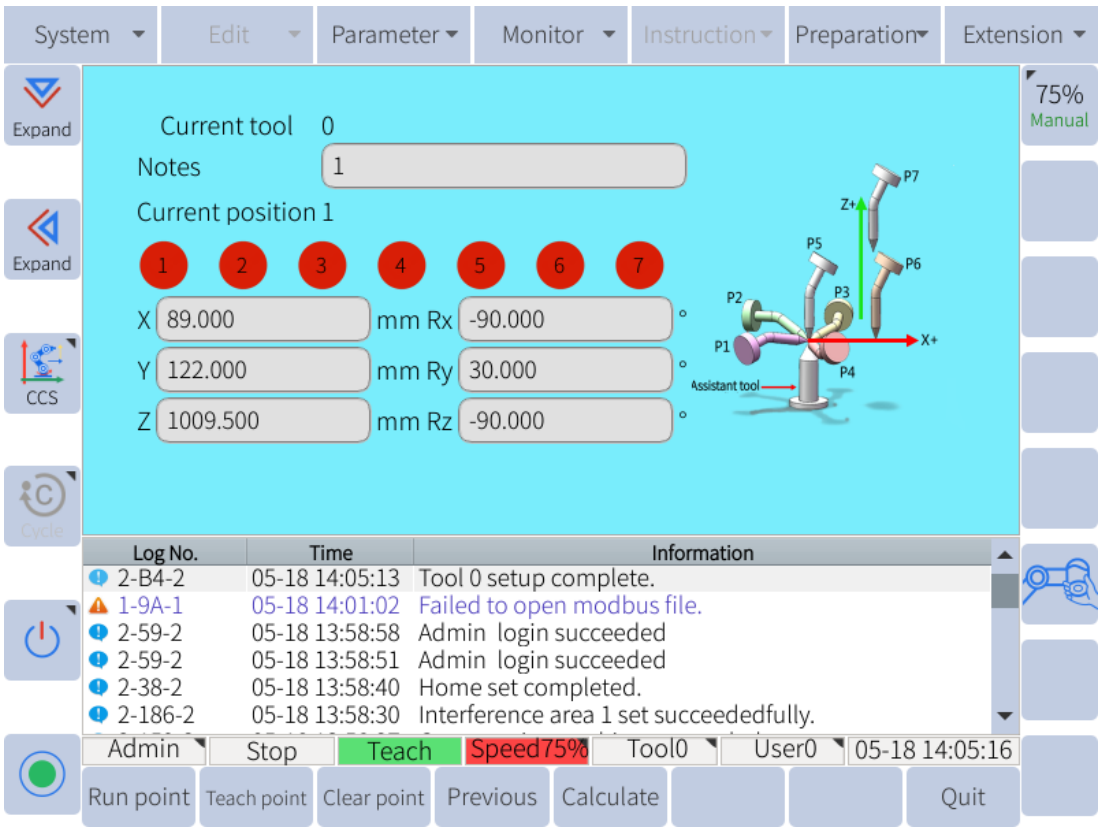


Figure 6-86 : Seven-point tool calibration

6.11.4 Set load parameters

When the robot end is equipped with a load, and the drag operation is required, the load parameters need to be set first.

If the mass of the center of mass of the load is known, the user can click “Preparation -> Tool coordinate”, directly input the center of mass and mass on the tool interface, and click “Save” to complete the setting of the load parameters.

If the mass of the mass center of the load is unknown, the load identification needs to be carried out. The specific steps are as follows:

1. Confirm that the robot is not equipped with a load, and click “Preparation -> Tool config” to ensure that the load parameter is 0.
2. Set the loop mode to “single loop”.
3. Turns the key to PLAY mode and turns the servo on.
4. Long press the window switch key  , click “Payload Motion”, and wait for 3 minutes.
5. Assemble the load, repeat the previous step again.
6. Turn the key to teach mode, click ”Preparation > Tool config” to enter the tool setting interface.
7. Click ”Auto identification”, click “OK” on the pop-up page, wait patiently for 2 minutes, and the system will calculate the center of mass and mass corresponding to the load and display it.
8. Click “Save” to drag the robot.
   Note: There will be a certain error between the calculated value and the actual value, please pay attention to safety when dragging the robot.

6.11.5 User Coordinate System

The user coordinate settings allow easy teaching and programming in various situations, as shown in **Figure** 6-87 . When multiple positioners are used, manual operation can be simplified by setting the user coordinates for each fixture.

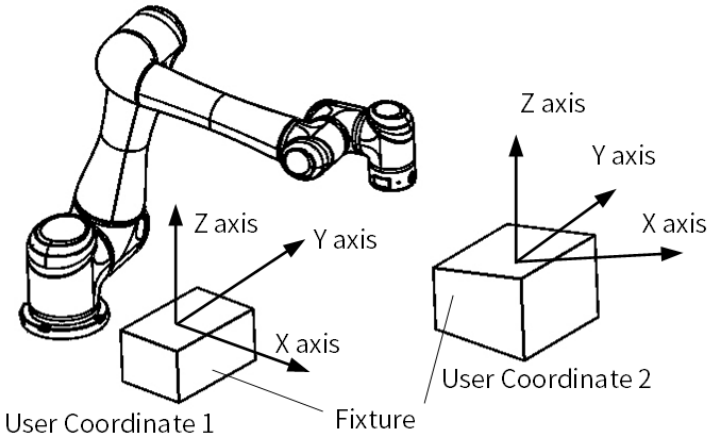


Figure 6-87 : Setting user coordinates for fixture

As shown in **Figure** 6-88 , User coordinates are defined by three points that have been taught to the manipulator through axis operations. These three defining points are RORG, RXX, and RXY. These three points of positional data are registered in a user coordinate file.

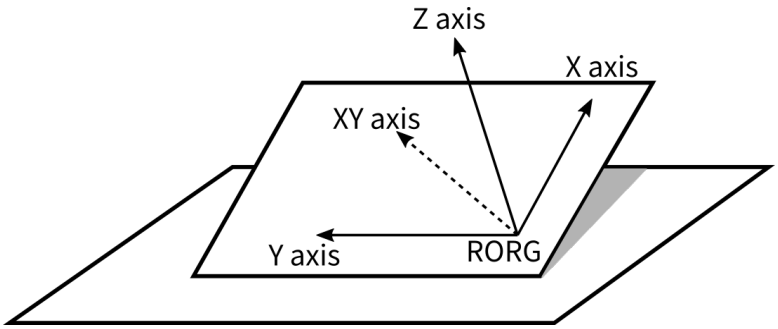


Figure 6-88 : Three defining points

A user coordinate is defined as follows: RORG is the origin of the coordinate system, and RXX is a point on the X-axis. RXY is a point on the XY plane of the user coordinate. The directions of Y and Z axes are determined by point RXY. Note that it is important that the two points RORG and RXX be taught accurately.

The setting steps are:

1. Choose **Preparation -> User config** to open the user coordinate setting page.
2. First select the user coordinate number to be set.
3. Select the point “RORG” on the interface with the cursor, and teach the required point.
4. Click “Record” in the submenu bar to complete the recording of the point (the point where the recorded position will change from red to green).
5. Complete the recording of RXX and RXY points in sequence.
6. Click “Calculation” to generate the corresponding user coordinates.

When holding the three-position switch, “RUN RORG”, “RUN RXX” and “RUN RXY” in the submenu area can be used to move the manipulator to the each point used to create a new frame for verification.

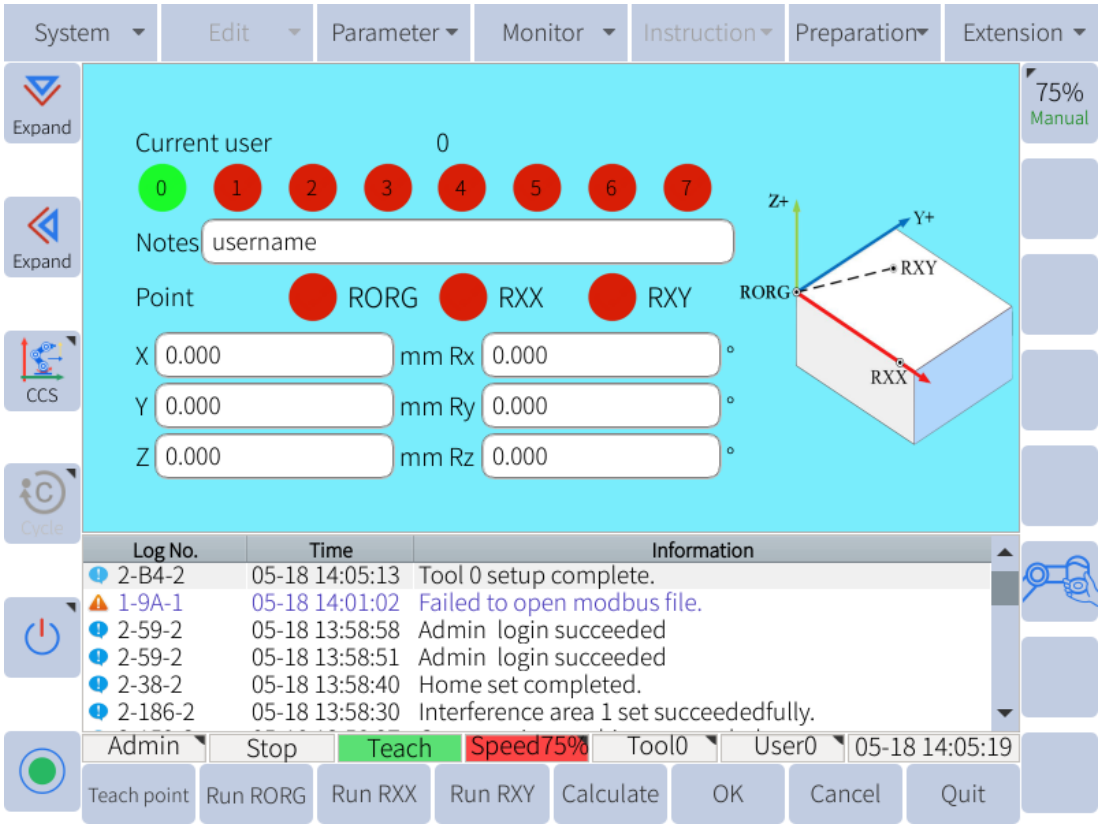


Figure 6-89 : User coordinate setting interface

6.11.6 Interference Zones

The interference area is a function that prevents interference between multiple manipulators or the manipulator and a peripheral device. There are 16 total interference zones that can be configured. There are two types of interference areas:

cubic interference area
joint interference area

The output signals of the interference area 1 to 16 are corresponding to the virtual outputs M440 to M455 respectively. If the TCP moves into a designated area, or a joint enters a certain range, the signal will go HIGH. Once it leaves the interfence zone the signal will return to LOW. If the signal needs to be output to the external device, the corresponding virtual output should be mapped to the actual output Y by modifying the PLC program (see Chapter 10).

6.11.6.1 Cubic Interference Zones

This area is a rectangular prism relative to the base coordinate (Base coordinate) system. The software determines whether the TCP of the manipulator is inside or outside this area, and outputs this status as a signal. (ON: inside, OFF: outside)

There are two ways to set cubic interference areas:

Cube - Corner to corner

1. Select **Preparation -> User config**
2. Set “Type” to “Cube” and “Mode” to “Vertex”
3. Choose “Vertex1”, move the robot to the position of vertex 1 of the cube and click “Position 1” in the submenu
4. Choose “Vertex2”, move the robot to the position of vertex 2 of the cube and click “Position 2” in the submenu
5. Click ”Save” in the submenu bar, and the target cubic interference area will be set

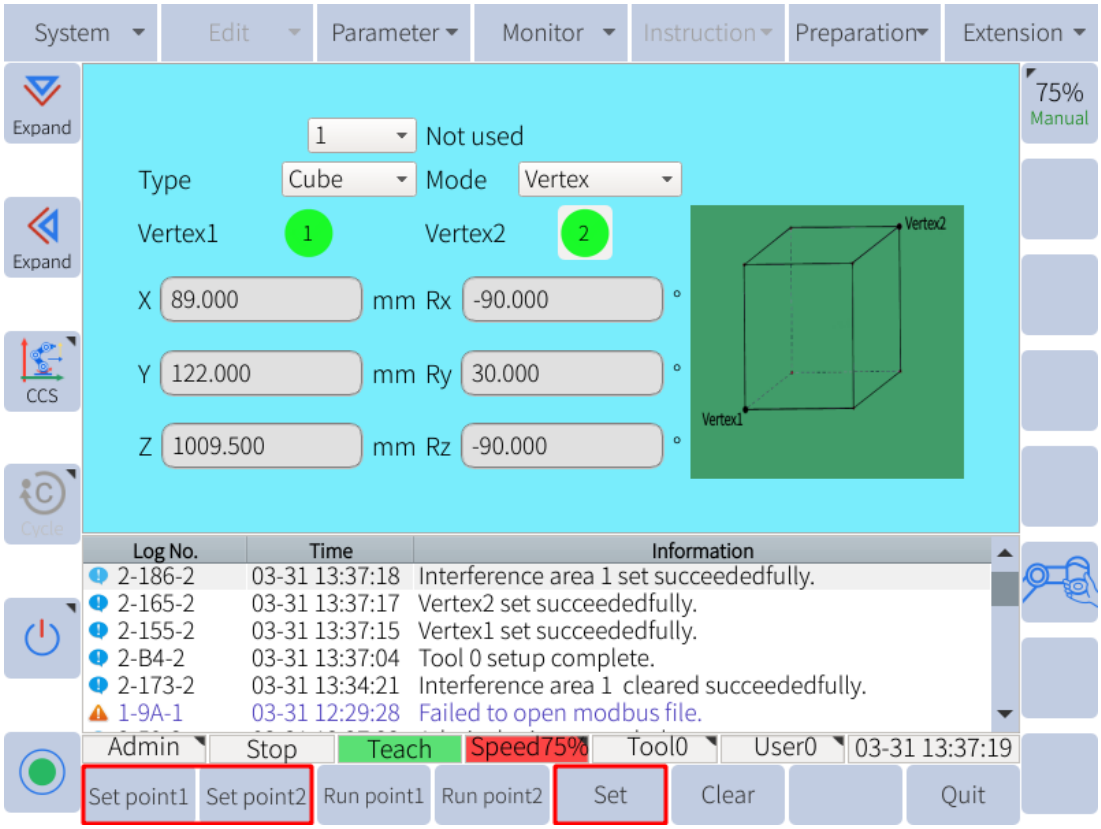


Figure 6-90: Teaching corner

Cube - Center with Dimensions (length, width, height)

1. Select **Preparation -> User config**
2. Set “Type” to “Cube” and “Mode” to “Center”.
3. Choose “Center point”, Move the manipulator to the center point of the cube and click “Position 1” in the submenu
4. Enter the length, width, and height of the cube
5. Click ”Save” in the submenu bar, and the target cubic interference area will be set

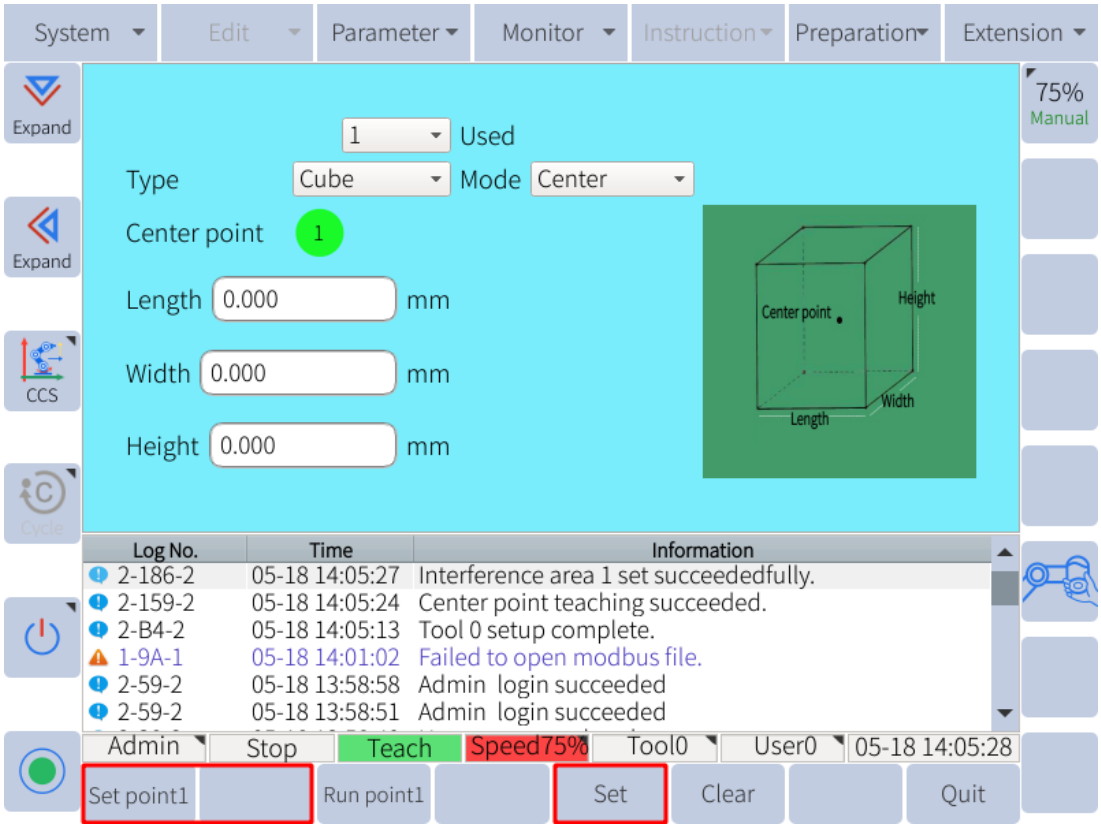


Figure 6-91 : Number Input of the Side of Cube and Teaching Center

6.11.6.2 Joint Interference Zones

The axis interference area is a function that determines whether the current position of each axis lies within a specified r ange. Once the maximum and minimum joint angles have been set for a specific joint (axis), a signal indicating whether the current position of the joint is inside or outside this range is output. (ON: inside, OFF: outside)

1. Select **Preparation -> User coordinate**
2. Set “Type” to “Joint”.
3. Select the desired axis number.
4. Select ”Min”, move the joint to the minimum joint angle and click ”Set point 1”.
5. Select ”Max”, move the joint to the maximum joint angle and click ”Set point 2”.
6. Record the points be pressing “Set” in the submenu area, as shown in **Figure** 6-92 .

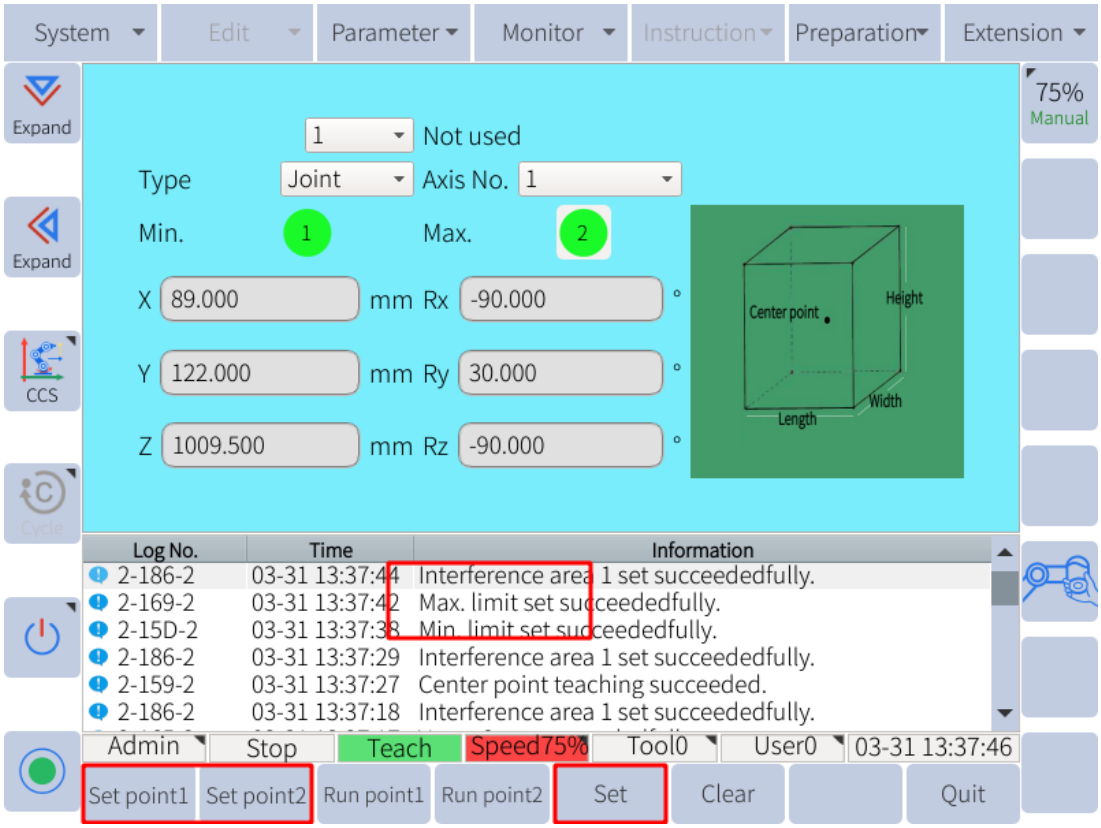


Figure 6-92 : Axis interference area

6.12 Mechanical Home

The Mechanical Home position represents the zero positions of each of the manipulator's joints. To manually change the zero position of the joints navigate to **Preparation -> Home position -> Mechanical home**. Although the mechanical home position is calibrated prior to shipment from the factory, the following cases may require the calibration to be performed again.

Change in the combination of the manipulator and cabinet.
Replacement of the motor or absolute encoder.
Mechanical home position deviation caused by collision.

NOTICE

Changing the mechanical home position will change the zero positions of the joints. Do not attempt unless the process and purpose of changing the mechanical home position is fully understood.

After each axis is adjusted to the zero position manually, the manipulator record its posture for the home position by pressing the "Record" button for each axis in the mechanical home position page. The zero position can also be directly modified by changing the pulse counts of the mechanical home position, as shown in **Figure** 6-93 .

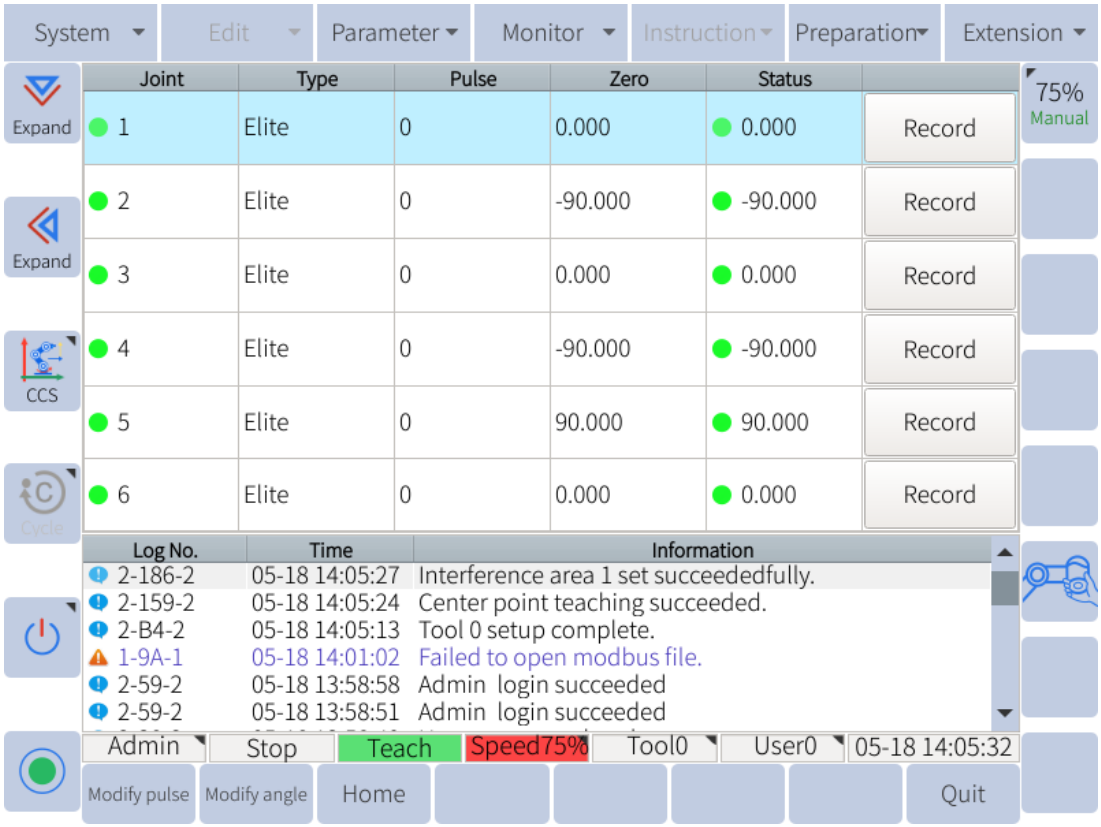


Figure 6-93 : Mechanical home position page

6.12.1 Zero Calibration

The zero calibration of the manipulator body and the accuracy of TCP can be calibrated by using the home position calibration function.

CAUTION

Do not re-calibrate the robot unless the calibration process is well understood and the user has consulted with ELITE Robot technical support engineers

While performing this calibration, use a sturdy mounting surface with little to no deflection, and attach a long pointed tool to the end effector. The operation procedures are described as follows:

1. Create a program with 20 positions. These positions must all be distinct from one another. This is done by placing the tip of the TCP on a fixed point and recording the position of the TCP. Lift the TCP move the robot to a different pose and place the TCP back on the exact same point and record the position of the TCP again. Repeat this process until the program has 20 distinct poses where to TCP of each pose is located at the exact same position for each pose. For a simplified means of recording multiple waypoints into a single progam refer to Subsection 6.11.2.2.

2. Go to **Preparation -> Home Position -> Zero Calibration**, as shown in **Figure** 6-94 .

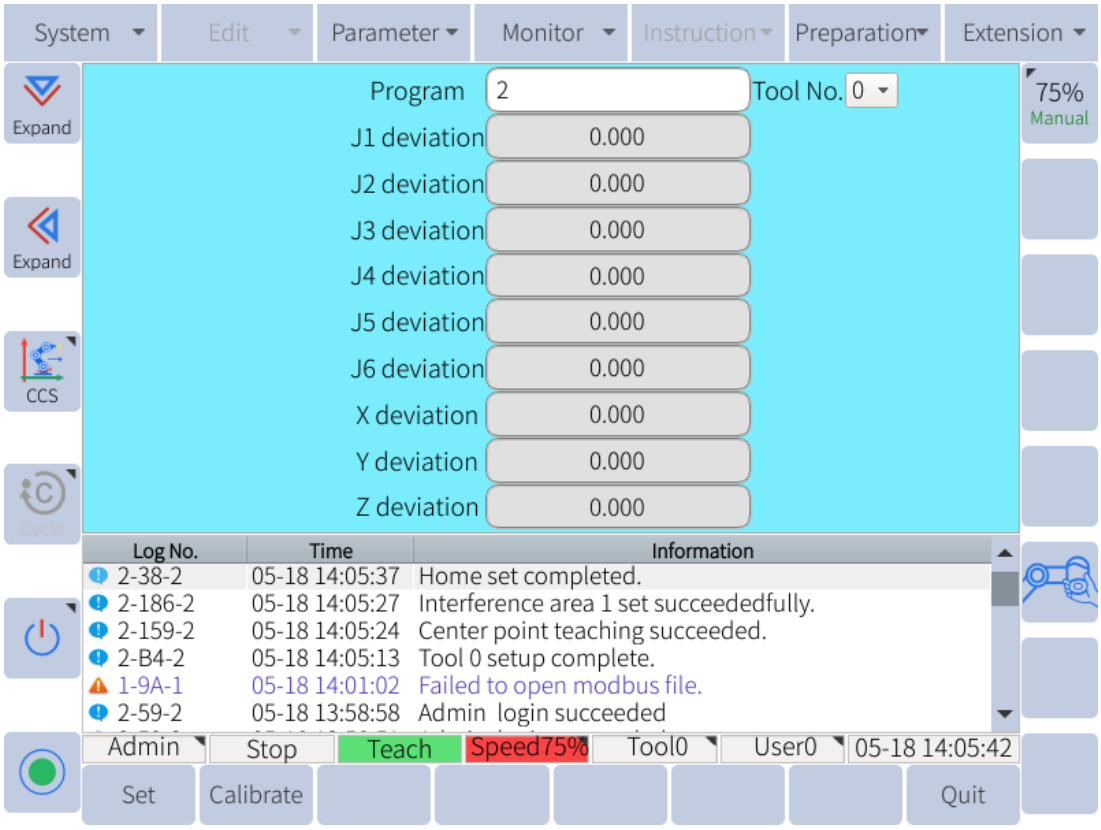


Figure 6-94 : Home position calibration

3. Select the program that was just created
4. Set the tool number to the TCP that was used for recording the 20 waypoints
5. Press “Save” button, and if the calibration data is valid, the information prompt area will display the following message:”The mechanical home position is calibrated successfully!”
6. Press “Calibrate” button
7. Go back to **Preparation -> Home Position -> Mechanical Home**
8. Hold the servo enable switch, and press “Home” to move the manipulator back to the mechanical home position
9. Then press “Record” to record the home position for each axis respectively

NOTICE

If the TCP is not set correctly or the incorrect calibration file was used when the user clicks ”calibrate”, the same calibration file cannot be used again. A new calibration file must be created, becase the old calibration file was made relative to the old mechanical home position.

6.13 Program Home

The program home position is the starting position for programs. It can prevent interference with peripheral devices by ensuring that the manipulator starts from a known position.

Move the robot to the desired program home position. Navigate to **Preparation -> Home position -> Program home**, press the “Save” button to set the current position of the manipulator as the program home position.

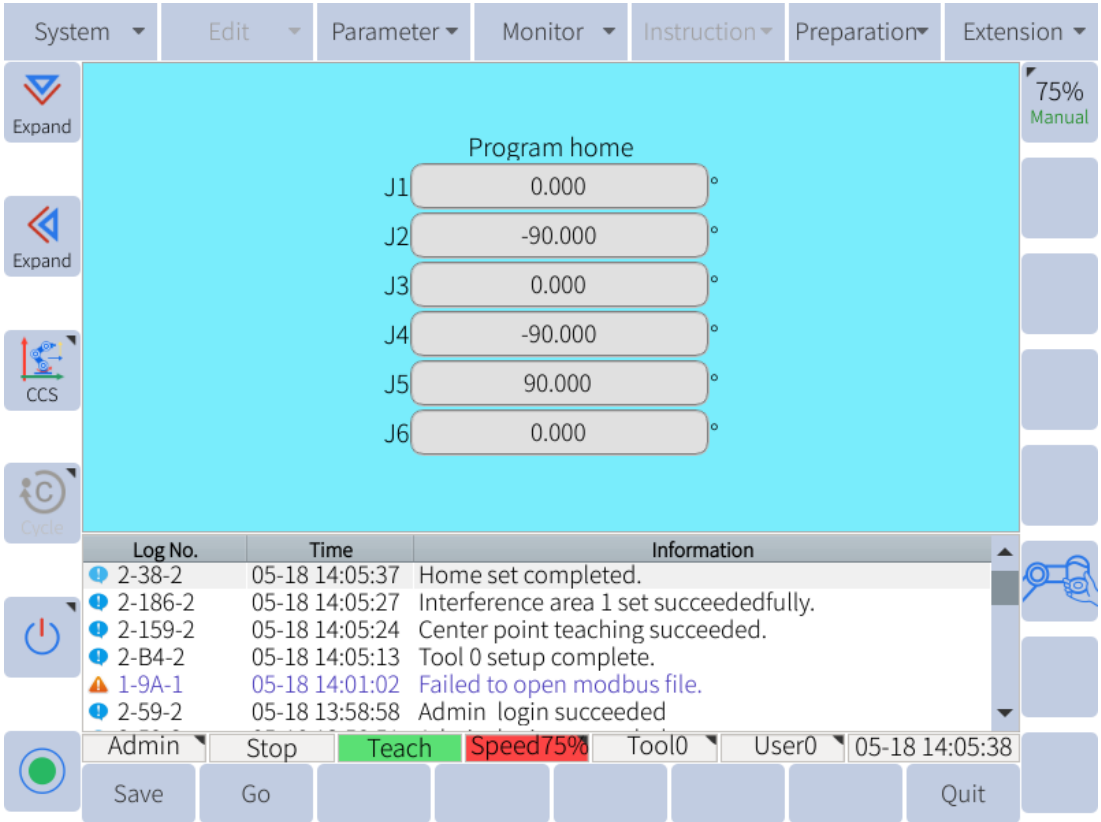


Figure 6-95 : Program home position page

When the manipulator is located at the program home position, the value of the virtual output M401 is 1. The program home position can be set and used according to the requirements of the production line.

6.14 Reservation start

Reservation start refers to the function of starting the program on each tool in the order of reservation through the start button on each tool.

For example, in the case where three toolings handle different workpieces, the user should do the following preparations in advance:

On Tooling 1, edit Program 1 of Tooling 1.

On Tooling 2, edit Program 2 of Tooling 2.

On Tooling 3, edit Program 3 of Tooling 3.

When running, switch to ”remote” mode, after preparing workpiece 1, press the start button on tooling 1, and the robot executes program 1. When executing program 1, prepare workpiece 2 and workpiece 3, and then press the start buttons on tooling 2 and tooling 3 in turn. At this time, even if the program 1 is still running, because the start button is pressed, the program 2 and the program 3 are also scheduled for work in order, and the programs will be executed sequentially in the reserved order.

CAUTION

1. There cannot be a ”RET” command at the end of each reservation program, otherwise the next reservation program cannot be performed.
2. Before the reservation function can be used, it must be ensured that each program can function properly. The
3. system can make reservations for up to 8 toolings.

6.14.1 Set reservation start valid

1. Click “Extension > Reservation” to enter the reservation start interface.
2. Select the reservation file to be set, and then click the “Select/Cancel” button in the lower right corner to set the reservation file.
   At this time, the circle in front of the corresponding reservation file turns green, indicating that the reservation has been opened.
3. Connect corresponding input and output signals to each tool. Each tooling usually has a “start” button, a “run” indicator, and a “pause” button.
   “Start” button: one for each tool. The corresponding auxiliary relays are M8-M15 (corresponding to 8 stations), the factory default PLC program, X1 has been set to correspond to scheduled start 1, and X2 to correspond to scheduled start 2.
   “Run” indicator: one for each tool. The corresponding auxiliary relays are M408-M415 (corresponding to 8 stations), the factory default PLC program, Y1 corresponds to the reservation 1 running command light, and Y2 corresponds to the reservation 2 running indicator. When the corresponding tooling is successfully reserved, the running indicator

will flash; when the tooling program is being executed, the running indicator will remain valid.

"Pause" button: one for each tool, and finally each tool is used in parallel. The corresponding auxiliary relay is M4, and the factory default PLC program has corresponded to EXT-HD and X5.

4. switches to "remote" mode and the servo is automatically turned on.
5. Long press (not less than 2 seconds) the start button of the installed workpiece tooling, and the robot will run the program corresponding to the tooling.

CAUTION

1. After setting the reservation function to be valid, the reservation function can only be executed in the "remote" mode.
2. When the program is running, the start button indicator light of the tooling is on. The necessary preparation of the workpiece on the tooling should be done before pressing the start button.
3. During the program running of a certain tooling, press the start button of other tooling programs (hold for 2 seconds), the corresponding program is reserved and enter the startup waiting state, at this time the tooling running indicator is flashing. The programs are reserved in the chronological order of the tooling button presses, and then executed in the reserved order.
4. For the tool that is running the program, the job reservation cannot be made even if the start button is pressed.

6.14.2 Clear Appointment Status

CAUTION

A running program cannot clear its reservation status.

If you want to cancel the reservation of a certain tooling, you need to press and hold the start button on the tooling again for more than 2 seconds, the reservation status will be canceled, and the corresponding running indicator will turn off.

Chapter 7 System I/O

7.1 Overview

This chapter describes all electrical interfaces of the collaborative robot. Examples are given for most types of I/O. The term “I/O” refers to both digital and analog control signals.

1. Controller I/O
2. Tool I/O
3. Serial Communication
4. Ethernet

The digital I/O’s, analog I/O’s, and all safety I/O’s of the controller are shown in **Figure** 7-1

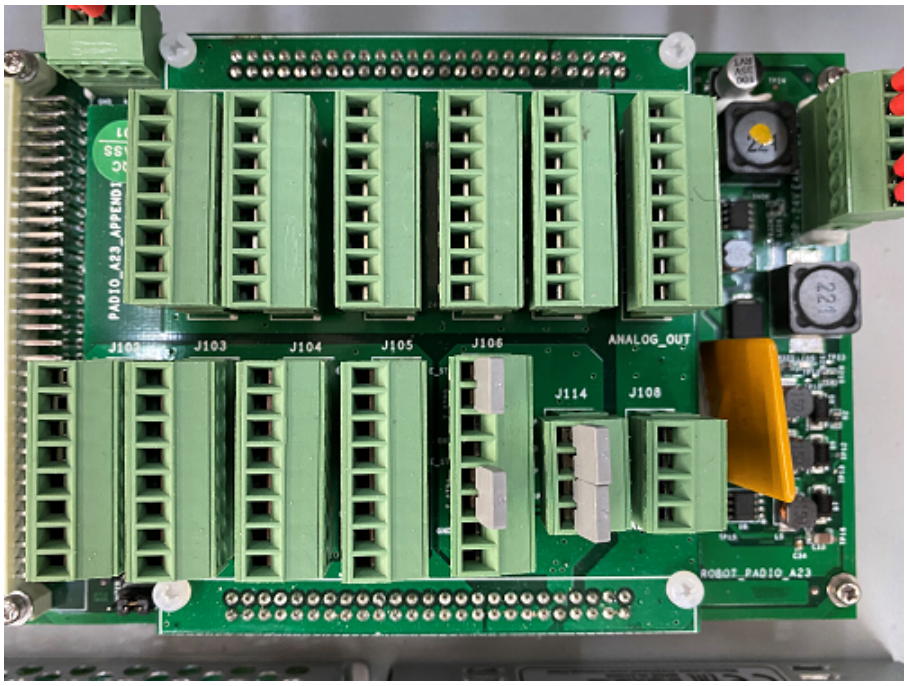


Figure 7-1 : The controller I/O interface

A schematic of the controller I/O interface is shown in **Figure** 7-2 .

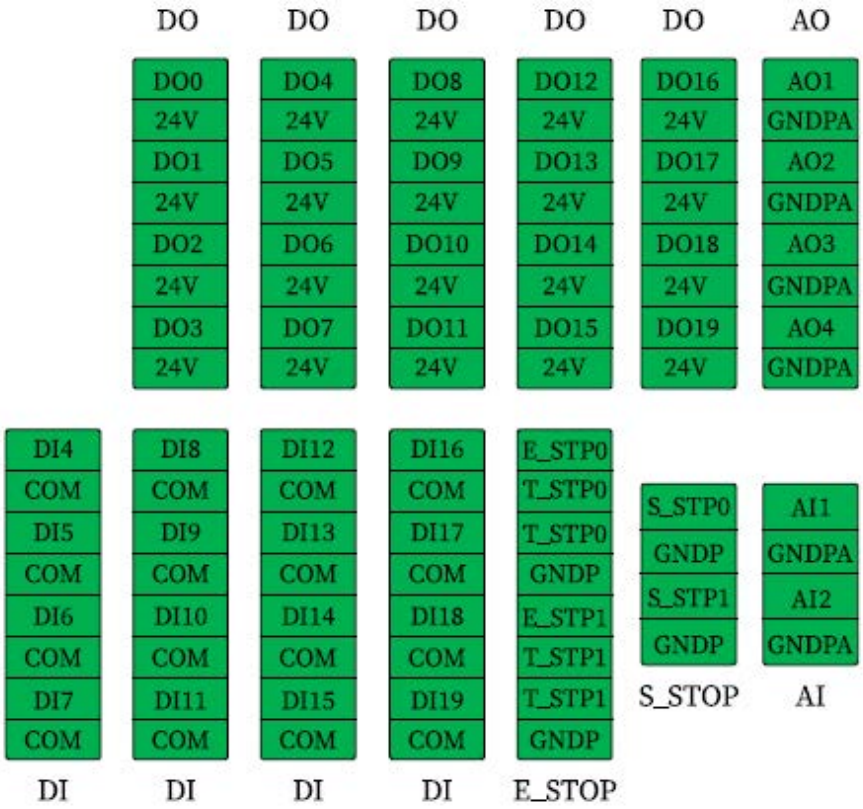


Figure 7-2 : The layout of the electrical interfaces inside the controller

NOTICE

It is recommended that the IO wiring length does not exceed 3m.

7.2 Safety

Observe the following warnings and cautions when working with the EC66's electrical systems, and when performing maintenance.

DANGER

1. Never connect the safety signals to a PLC that is not a safety-related PLC with the proper safety level. Failure to follow the warning may result in serious injury or even death as certain safety stop function may fail.
2. Do not use general I/O signals as safety I/O signals.
3. All safety related signals are dual channel (two independent channels). Keep the two channels independent so that a single failure would not lead to a loss of the safety function.
4. Some I/O inside the controller may be configured as normal I/O or safety-related I/O.
5. Any input device used to start automatic operation must be installed outside the safety area.

WARNING

1. Make sure that all equipment is kept dry. If water enters into the product, please turn off the power supply and contact your provider for assistance.
2. Only use the original cables supplied with the robot. Do not use the robot in applications where the cables are subjected to flexing. Contact the service provider if a longer cable or a flexible cable is needed.
3. Please be careful when installing the interface cable to the robot I/O.
4. Please remove the metal cable management plate before drilling holes.

CAUTION

1. The robot has been tested in accordance with international IEC standards for electromagnetic compatibility (EMC). EMC signals with levels higher than those defined in the IEC standards may cause unexpected behaviours of the robot. Very high signal level or excessive exposure may damage the robot permanently. The EMC problems can occur during activities such as welding. EMC error messages will appear in the error messages in the log. ELITE shall not be held responsible for any damages caused by EMC problem.
2. The cable for connecting the controller I/O to other machinery and factory equipment may not be longer than 30m, unless extensive tests are performed.

NOTICE

All voltages and currents are direct current (DC), unless otherwise specified. Use of the digital I/O should comply with IEC 61131-2-2007.

7.3 Internal Power Supply

The internal 24V power supply provides power to the digital I/O. The J14 Terminal is where the internal power supply connects to the I/O board inside the controller (**Figure** 7-3).

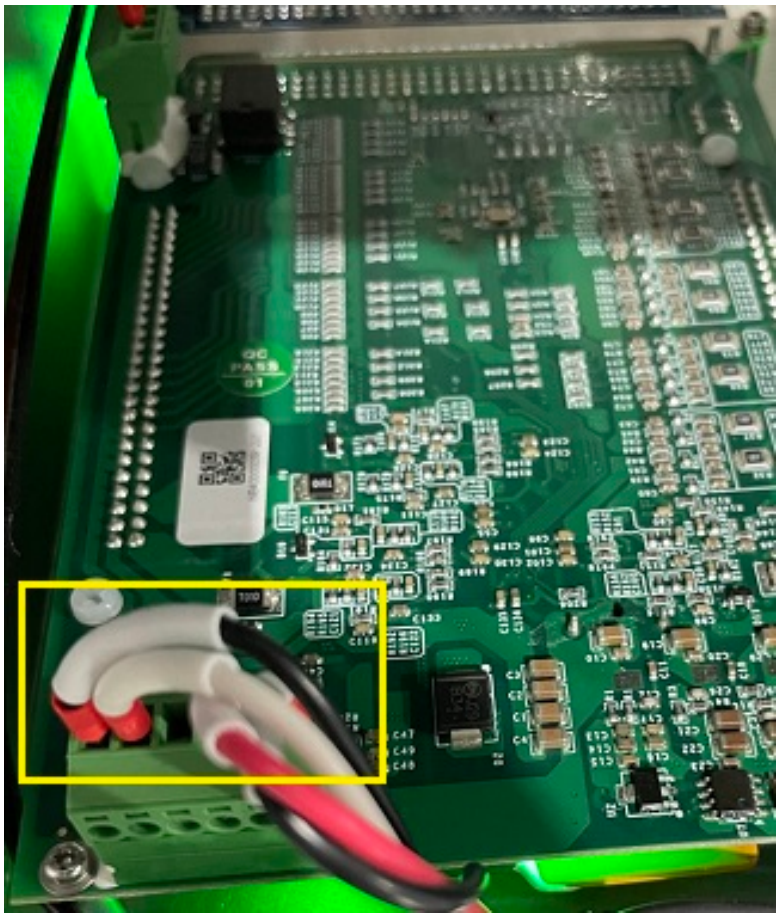


Figure 7-3 : J14 power supply terminal

The electrical specifications of the internal power supply is as shown in **Table** 7-1 .

Table 7-1 . Electrical specifications of the internal power supply

Terminal	Parameter	Min	Typ	Max	Unit
Internal 24V power supply					
24V - GNDP	Voltage	22.8	24	26.4	V
	Current	0	-	4	A

When the internal 24V power supply is insufficient, an external 24V supply can be used, as shown in **Figure** 7-4 . Disconnect the internal 24V power supply wires from the J14 terminal and cap the wires. Then connect the external power supply to J14.

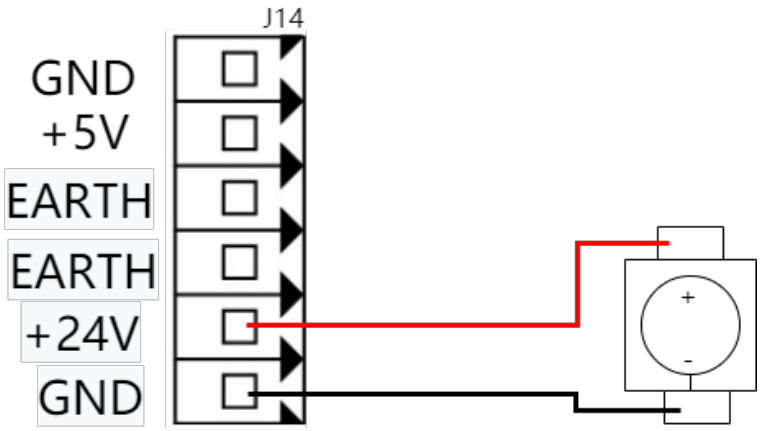


Figure 7-4 : external 24V power supply

CAUTION

The external 24V power supply current must not exceed 5A

CAUTION

Ensure that internal power supply wires are capped if an external power supply is used

7.4 Safety I/O

This section introduces the dedicated safety inputs. Please observe the specifications in Subsection 7.4.1. The safety device and equipment must be installed in accordance with the safety instructions and the risk assessment in Chapter 1. All safety I/O are dual-channel (redundant) and two separate wires must be used. A single failure should not cause loss of the safety function. There are two permanent inputs: emergency stop and safeguard stop.

The emergency stop input should only be used with safety rated emergency stop equipment. The safeguard stop input should also be used with safety-related protective equipment. The functional differences between the emergency stop and the safeguard stop are listed in **Table** 7-2 .

Table 7-2 . Difference between emergency stop and safeguard stop

	Emergency stop	Safeguard stop
Motion stop of the robot	Yes	Yes
Program execution	Stop	Pause
Power supply of motors	Off	On
Reset	Manual	Automatic or manual
Frequency of use	Infrequent	Once within each cycle
Stop category (IEC 60204)	1	2
Performance level (ISO 13849-1)	PLd	PLd

The emergency stop input and other safety I/O functions may be set with the digital inputs in conjunction with the internal PLC. Some examples about how to use the safety I/O are given in sections Subsection 7.4.2 and Subsection 7.4.3.

DANGER

Safety functions must be verified before putting the robot into operation. Safety functions must be tested regularly.

7.4.1 Safety Electrical Specifications

The electrical specifications of the safety inputs are as shown in **Table** 7-3 .

Table 7-3 . Safety input electrical specifications

Terminals	Parameter	Min	Typ	Max	Unit
Safety inputs					
	Voltage	-3	-	30	V
	OFF region	-2	-	2	V
	ON region	8	-	30	V
	Current (8-30V)	2	-	8.5	mA
	Function	-	NPN	-	Type
	IEC 61131-2	-	3	-	Type

7.4.2 Emergency Stop

The E_STOP terminal can be connected to the external emergency stop button (see **Figure** 7-2). The emergency stop button on the teach pendant will be enabled only when the controller is connected by default. If it is necessary to disable the emergency stop button on the teach pendant, please refer to **Figure** 7-7. For connecting the external emergency stop button, see **Figure** 7-6. The connection methods are outlined as follows:

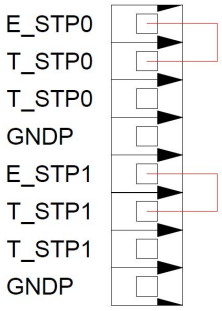


Figure 7-5 : Default connection method

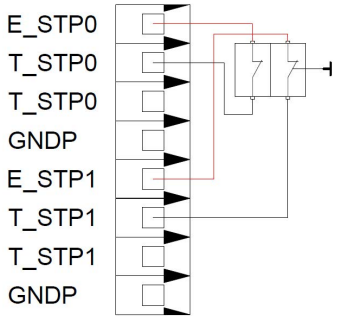


Figure 7-6 : Connecting to the external emergency stop button

CAUTION

If it is connected as shown in **Figure** 7-6, the emergency stop button on the teach pendant will be enabled along with the external emergency stop button. The user can press any buttons to activate the device emergency stop function.

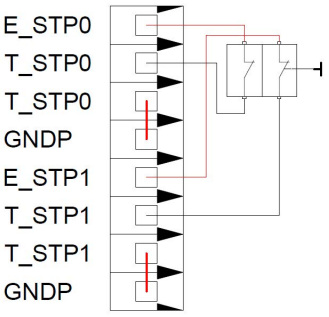


Figure 7-7 : Disabling the emergency stop button on the teach pendant

The user can disable the emergency stop button on the teach pendant by connecting T_STP0 to GNDP and T_STP1 to GNDP.

DANGER

If it is connected as shown in **Figure** 7-7, the emergency stop button on the teach pendant will be disabled. The user needs to provide extra emergency stop buttons to protect the operators. If not necessary, please do not disable the emergency stop button on the teach pendant.

Stopping distance and stopping time of emergency stop

The table below shows the stopping distance and the stopping time measured when the emergency stop is triggered. These measuring results correspond to the following configurations of the robot:

- Extension: 100% (the robot arm is completely extended horizontally)
- Speed: 10%, 50%, 100%
- a maximum payload (6kg) that can be handled by the robot connected to TCP.

The Joint 1 test was carried out by performing a horizontal movement, where the rotational axis was perpendicular to the ground. During the Joint 2 and Joint 3 tests, the robot followed a vertical trajectory, where the rotational axes were parallel to the ground, and the stop was performed while the robot was moving downward.

Table 7-4 . EC66 Emergency stop stop speed

Emergency stop angle (rad)	10% speed	50% speed	100% speed
Joint 1	0.00212649	0.0507745	0.181914199
Joint 2	0.00206342	0.0472514	0.186870007
Joint 3	0.00256917	0.0565973	0.221164466

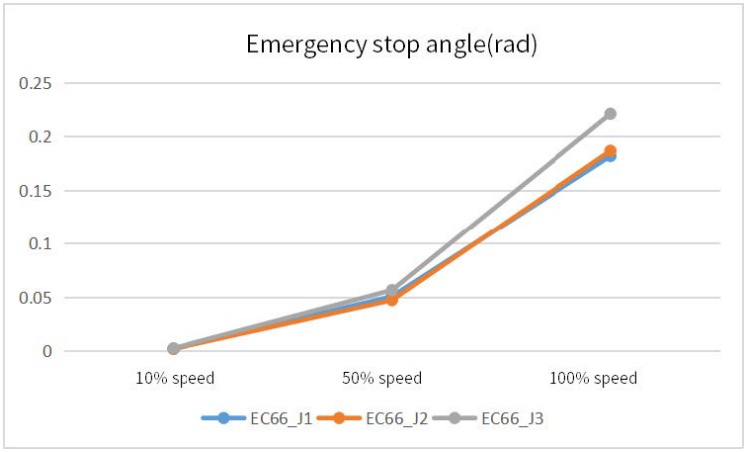


Figure 7-8 : EC66 Emergency stop angle

Table 7-5 . EC66 Emergency stop stop time

Emergency stop time (s)	10% speed	50% speed	100% speed
Joint 1	0.018	0.076	0.144
Joint 2	0.017	0.074	0.145
Joint 3	0.018	0.074	0.145

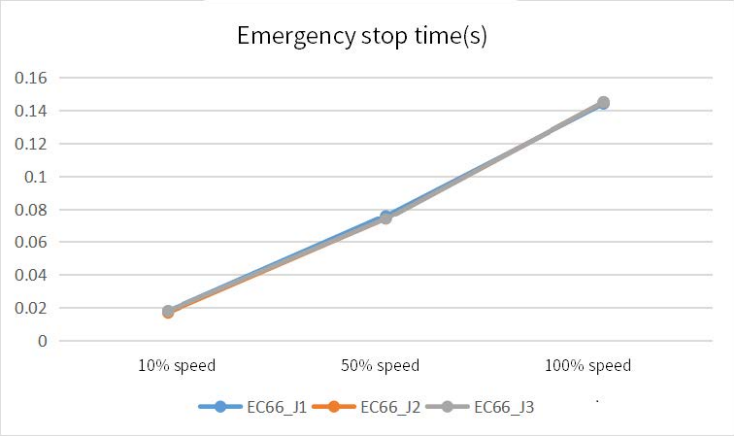


Figure 7-9 : EC66 emergency stop time

7.4.3 Safeguard Stop

The safeguard stop will pause a program temporarily. By default, the user must press the green play button on the teach pendant to resume the program execution. The safeguard stop can be configured to automatically resume when the signal is LOW. This is done by using the internal PLC discussed in Chapter 10 User PLC.

Figure 7-10 shows an example of how basic safeguard stop equipment is set up.

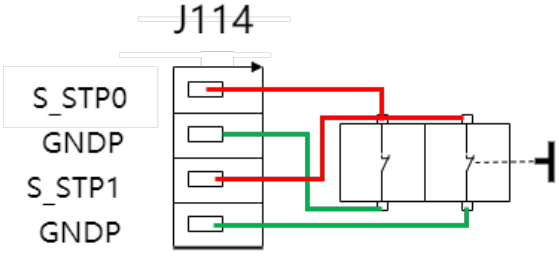


Figure 7-10 : Setup of dual-channel safeguard stop

DANGER

The robot may (if configured) resume motion automatically when the safeguard signal is re-established. Do not use this configuration if the signal can be re-established from inside the safety perimeter.

7.5 Digital I/O

7.5.1 Digital Electrical Specifications

The electrical specifications of the digital I/O are shown in **Table** 7-6

Table 7-6 . Digital input electrical specifications

Terminals	Parameter	Min	Typ	Max	Unit
Digital outputs					
	Current	0	-	0.7	A
	Voltage drop	0	-	1	V
	Leakage current	0	0	0.1	mA
	Function	-	NPN	-	Type
	IEC 61131-2	-	1	-	Type
Digital inputs					
	Voltage	-3	-	30	V
	OFF region	-2	-	2	V
	ON region	8	-	30	V
	Current (8-30V)	2	-	8.5	mA
	Function	-	NPN/PNP	-	Type
	IEC 61131-2	-	3	-	Type

7.5.2 Digital Input

This example shown in **Figure** 7-11 demonstrates how to connect a simple button to a digital input.

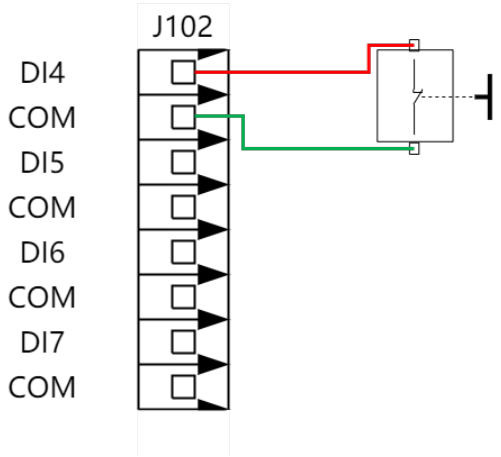


Figure 7-11 : Two-wire sensor

Similarly, the connection method of a three-wire sensor is shown in **Figure** 7-12 .

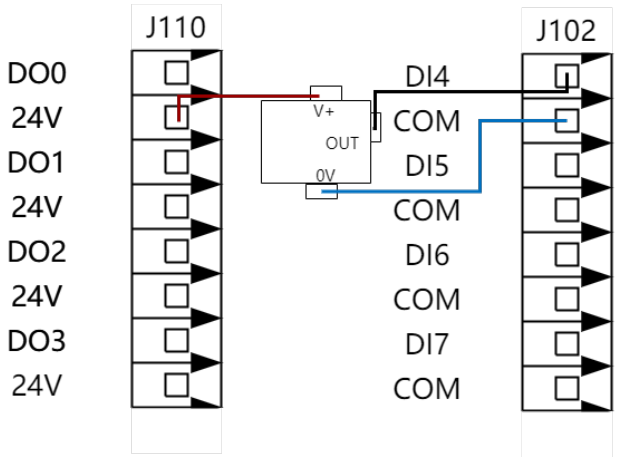


Figure 7-12 : Three-wire sensor

The digital inputs may be configured to two input modes including NPN and PNP. The digital inputs can be configured to NPN or PNP by changing the jumper on terminal J22 (**Figure** 7-13) or J25.

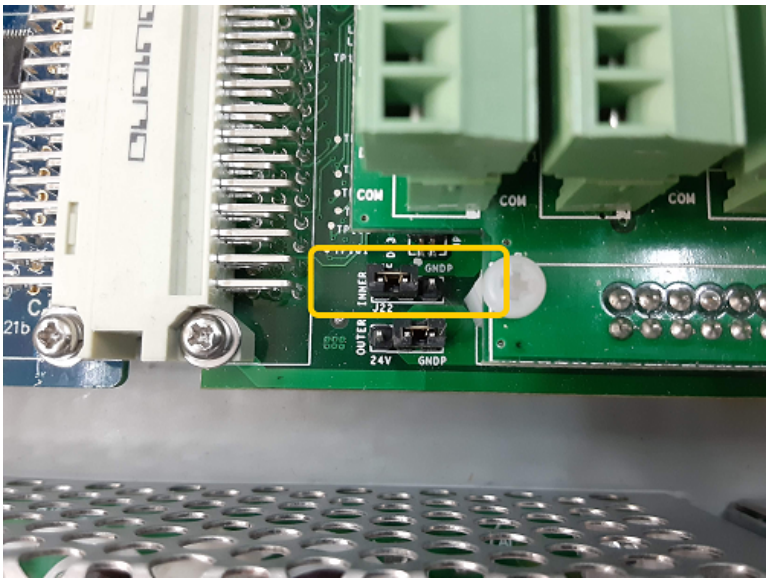


Figure 7-13 : Jumper j22 for configuring digital input

Table 7-7 describes where to place the jumpers for NPN or PNP type inputs.

Table 7-7 . Jumper connection in different modes

Input type	J22 connection method	J25 connection method	Remarks
high level effective	GNDP	24V	2/3 wire sensor
		GNDP	only connect to three-wire sensor
low level effective	24V	24V	2/3 wire sensor
		GNDP	only connect to three-wire sensor

At the same time, the user can change the high and low levels of the com port through J25. J25 is connected to GND by default, and the output of the com port is 0V. If J25 is connected to 24V, the com port output is 24V at this time.

7.5.3 Digital Output

All digital outputs are NPN and are not configurable. When a digital output is HIGH it is connected to ground. When the digital output is LOW it is open circuit.

This example shows how to connect a load controlled by the digital output (**Figure** 7-14).

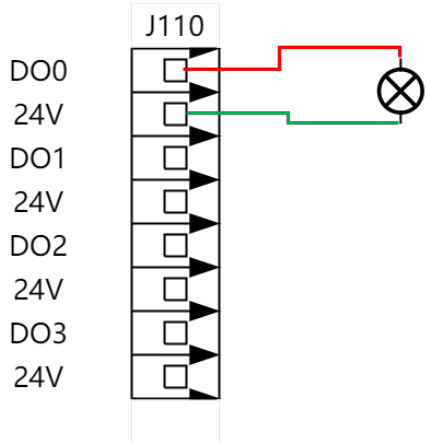


Figure 7-14 : Drive solenoid wiring case (increase the power of the solenoid valve)

7.6 Analog I/O

The analog I/O interface can be used to set or measure the voltage (-10V~10V) in and out of other equipment.

In order to acquire a high accuracy for analog readings, it is recommended to comply with the following instructions:

Use the GNDPA terminal closest to the I/O. The I/O pair shares a common mode filter.
Use the same GND (0V) for the equipment and the controller. The analog I/O is not galvanically isolated from the controller.
Use a shielded cable or twisted pair. Connect the shielded cable to the “GNDP” terminal on the “Power” terminal.

7.6.1 Analog Electrical Specifications

The electrical specifications are shown in **Table** 7-8 .

Table 7-8 . Electrical Specifications of Analog I/O

Terminal	Parameter	Min	Typ	Max	Unit
analog input					
	Voltage	-10	-	10	V
	Resistance	-	100	-	K ohm
	Resolution	-	12	-	bit
analog output					
	Voltage	-10	-	10	V
	Resistance	-	10	-	ohm
	Resolution	-	12	-	bit

7.6.2 Analog Input

The example in **Figure** 7-15 illustrates how to connect an analog sensor to the analog input.

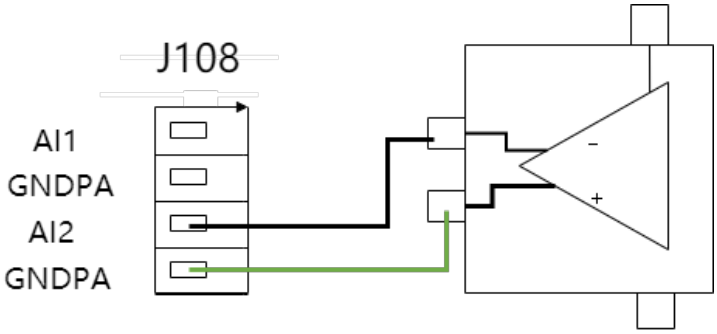


Figure 7-15 : Connecting with an analog sensor

7.6.3 Analog Output

The example in **Figure** 7-16 illustrates how to control the welding current of a welder with an analog input.

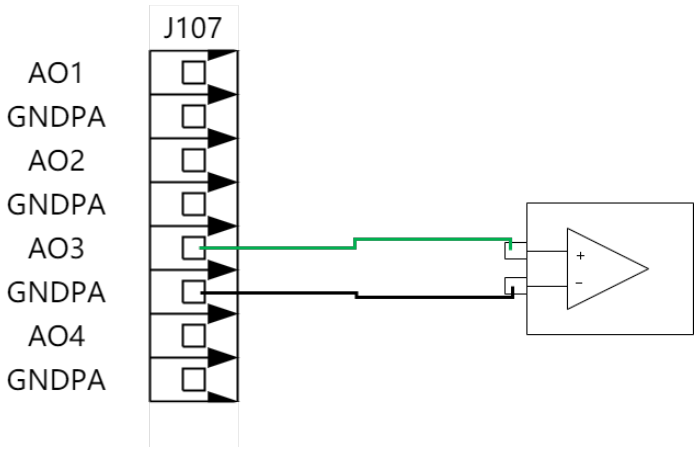


Figure 7-16 : General purpose analog output

7.7 Tool I/O

The tool flange of the manipulator has a 12 pin connector, which can be used to control various grippers and sensors, as shown in **Figure** 7-17 .

Figure 7-17 : Tool I/O connector

NOTICE

The tool connector must be manually tightened to a force of no more than 0.4Nm.

Use **Table** 7-9 for a pinout of 12 connecting pins of an aviation plug:

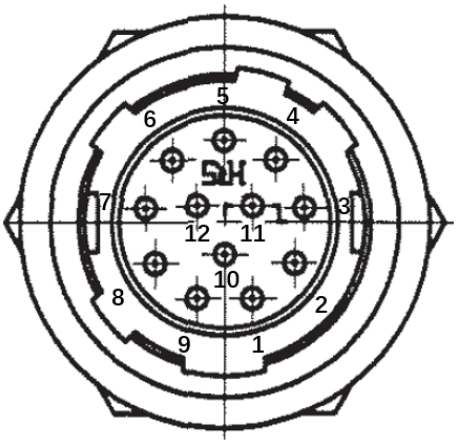


Figure 7-18 : 12-pinned connector

Note: the model of the aviation plug is HR10A-10R-12P of HRS company

Table 7-9 . Function list of connector

Pin No.	Function description
1	Digital ground (GND)
2	Terminal digital output 1 (Y048)
3	Terminal digital output 2 (Y049)
4	Terminal digital input 1 (X048)
5	Terminal digital input 2 (X049)
6	Analog input interface (AI003)
7	Analog output interface (AO005)
8	RS485+
9	RS485-
10	+24V power output
11	+24V power output
12	Digital ground (GND)

The tool's digital outputs 1 and 2 are controlled using Y048 and Y049 in the teachpendant. Digital inputs 1 and 2 are read using X048 and X049 in the teachpendant interface.

7.7.1 Tool Electrical Specification

The electrical specifications of the digital input ports are shown in **Table** 7-10 :

Table 7-10 . Electrical specifications of digital input interface

Parameter	Min	Typ	Max	Unit
Input voltage	-0.5	-	26	V
Logical low voltage	-	-	10	V
Logical high voltage	22	-	-	V

The electrical specifications of the digital output ports are shown in **Table** 7-11 :

Table 7-11 . Electrical specifications of tool digital output interface

Parameter	Min	Typ	Max	Unit
Voltage when open	-0.5	-	26	V
Voltage when sinking 1A at 25 °C	-	0.19	0.24	V
Sinking current	0	600	1000	mA

The tool analog input is a non-differential input, with voltage (0-10V). The electrical specifications are shown in **Table** 7-12 .

Table 7-12 . Electrical specifications of tool analog input

Parameter	Min	Typ	Max	Unit
Input voltage	-0.5	-	24	V
Input resistance	-	-	>100	M ohm
Resolution	-	10	-	Bit

The tool analog output is a non-differential output, with voltage (0-10V). The electrical specifications are shown in **Table** 7-13 .

Table 7-13 . Tool analog output

Parameter	Min	Typ	Max	Unit
Output current	-	17	-	mA
Output short circuit current	-	60	-	mA
Resolution	-	10	-	Bit

7.7.2 Power

The tool I/O of the Elite collaborative robot can provide the external tool with a 24V power, as shown in **Figure** 7-19 .

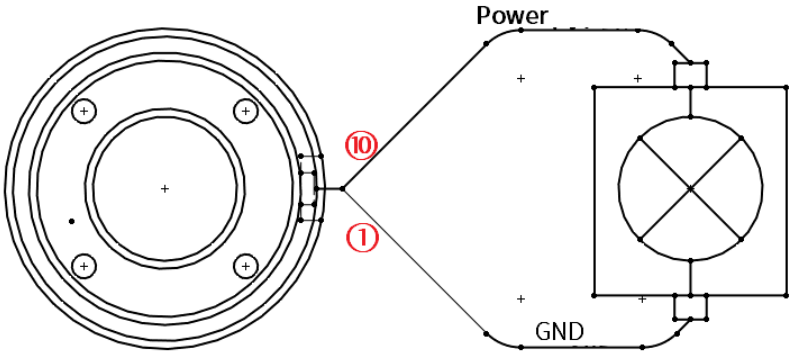


Figure 7-19 : Tool power supply

7.7.3 Digital I/O

The implementation mode of the digital input interface is shown in the **Figure** 7-20 .

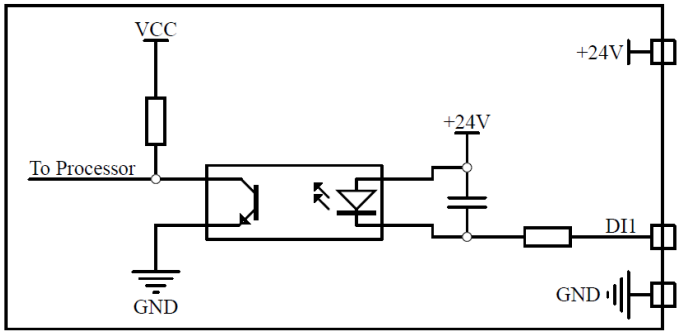


Figure 7-20 : Digital input interface

This example illustrates how to connect with a simple button, as shown in **Figure** 7-21 .

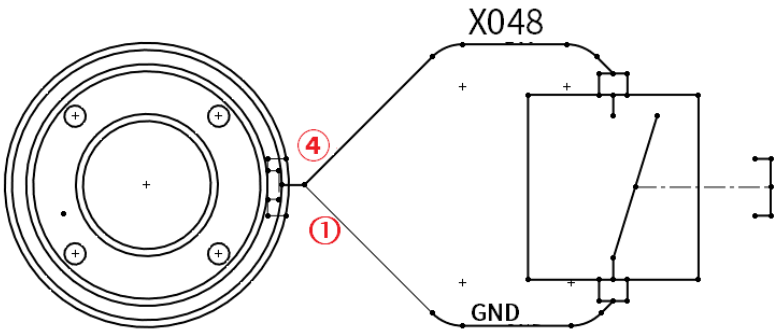


Figure 7-21 : Connection with a simple button

Figure 7-22 shows how to turn on the load using 24V internal power supply.

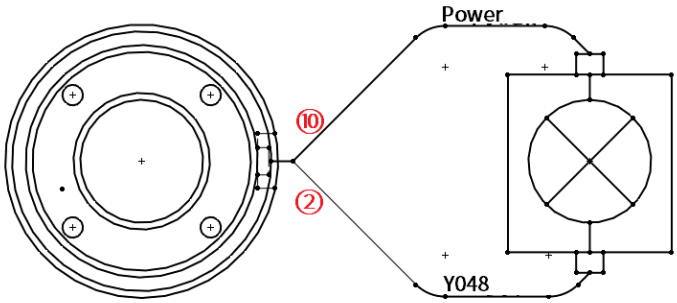


Figure 7-22 : Opening a load of the internal power supply

It is recommended to use a protective diode for the inductive load, as shown in the **Figure** 7-23 .

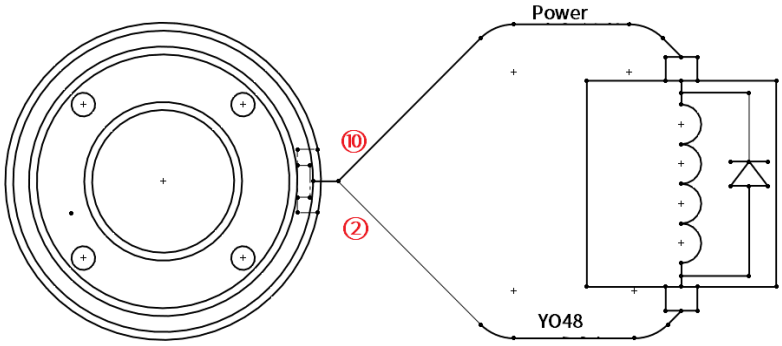


Figure 7-23 : Protective diode

CAUTION

Even when a tool is not mounted on the robot, 24V is still supplied to the tool connector.

7.7.4 Analog I/O

Two examples of how to use the analog input are illustrated in the following section.

Using the tool analog input - non-differential

This example illustrates an analog sensor connection with a non-differential output, as shown in **Figure** 7-24 .

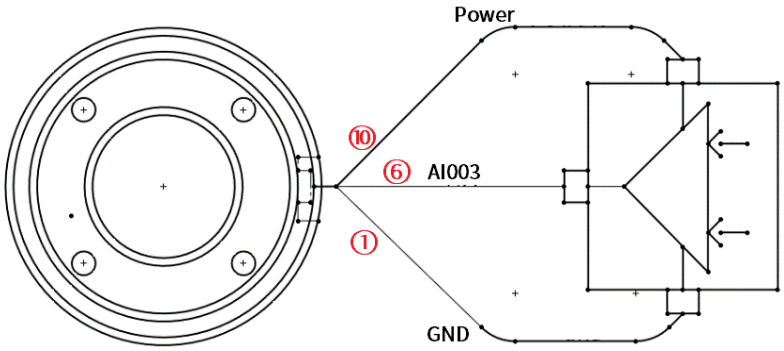


Figure 7-24 : Analog sensor connection with a non-differential output

Using the tool analog input - differential

This example illustrates an analog sensor connection with a differential output. This works in the same way as the non-differential sensor after connecting the negative output end to the GND (0V).

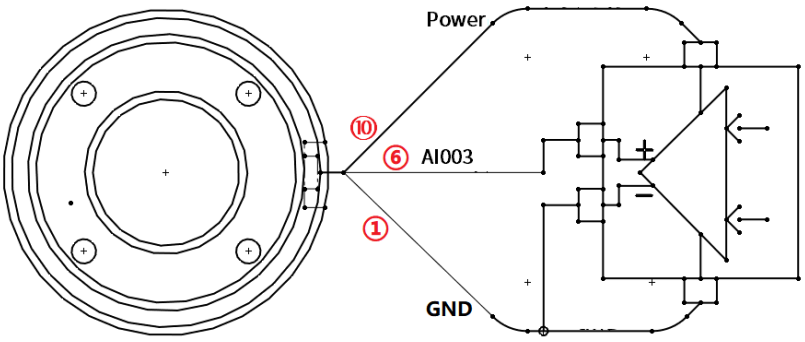


Figure 7-25 : analog sensor connection with a non-differential output

The examples of how to use the analog output are illustrated in the following section.

Using the tool analog output

This example illustrates a method of connecting to an analog signal with a non-differential output, as shown in **Figure** 7-26 .

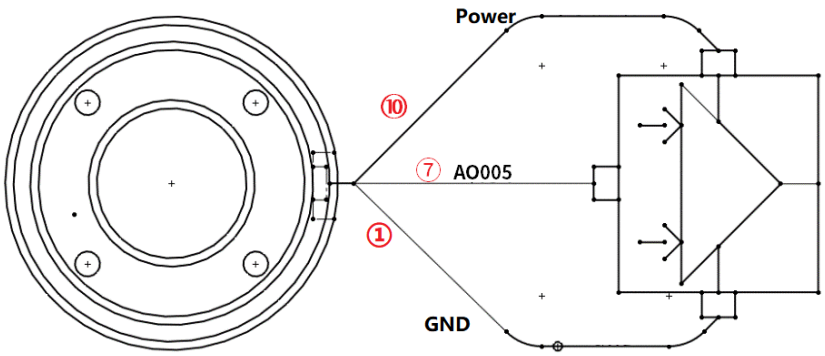


Figure 7-26 : Analog signal with a non-differential output

7.7.5 Communication I/O

The tool connector also provides a serial interface for communicating to a tool using the RS485 protocol. While using the communication I/O keep in mind the following:

Signal requests: RS485 signals use internal fail-safe biasing. If the connected device is not compatible with this fail-safe, the signal biasing must either be done in the connected tool, or added externally by adding a pull-up resistor to RS485A and a pull-down resistor to RS485B. The latency is 2ms to 4ms from writing in data to be sent on a robot controller to the start of sending the data on the RS485. The latency is 2ms to 4ms from the start of receiving the data on the RS485 to receiving of the data by the robot controller and the start of handling.

Table 7-14 shows the available settings of the RS485 interface.

Table 7-14 . Tool communication I/O

Setting	Options
Baud rate	2.4k,4.8k,9.6k,115.2k
Stop bit	1, 2
Parity bit	Null, Odd, Even

7.8 Serial Communication Port

Users can perform serial communication from the controller by connecting an RS485 device to the black connector shown in **Figure** 7-27 .

In order to set up the RS485 connector in the controller, the serial port connector must be disassembled and RS485 wires should be soldered to the metal contacts on the back of the black connector (**Figure** 7-28). The front and back sides of the black plastic device are marked with PIN “1 3 5” and “2 4 6”

respectively. PIN3 should be soldered to RS485B and PIN4 should be soldered to RS485A. The maximum supported baud rate of this interface is 2 Mbits/sec.

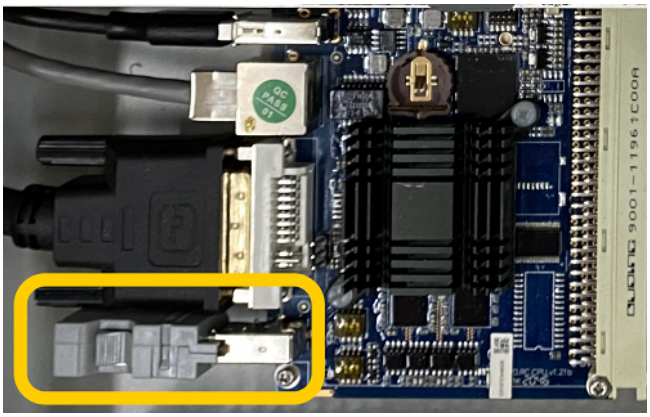


Figure 7-27 : Controller RS485 connector

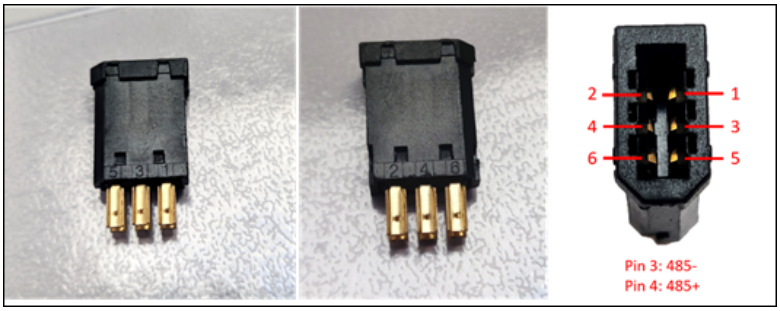


Figure 7-28 : Black device

7.9 Ethernet Port

The Ethernet port can be found on the top of the controller. Please refer to **Figure ??**. The Ethernet port is used to send and receive information or commands using the SDK or through Lua scripts (see Chapter 9. When the ethernet port is used to control the manipulator externally using the SDK, the robot mode switch at the top of the teach pendant must be set to REMOTE. The ethernet port can also be used for Modbus TCP which is discussed in Chapter 8.

NOTICE

It is recommended that the length of the network cable does not exceed 3m.

Chapter 8 Modbus

Modbus is an industrial protocol used for serial communication between master and slave devices. A modbus master will send messages to slaves using specific addresses encoded in the messages and the slaves will respond with the requested information.

Table 8-1 shows the object types provided by a Modbus slave device that can be accessed by a Modbus master device.

Table 8-1 . Description of Modbus object types

Object type	Access	Size	Address Space
Coil	Read-write	1 bit	00001 - 09999
Discrete input	Read-only	1 bit	10001 - 19999
Input register	Read-only	16 bits	30001 - 39999
Holding register	Read-write	16 bits	40001 - 49999

Click **Extension -> Modbus Slave**, the user can choose to use Modbus RTU or Modbus TCP.

Modbus RTU uses the RS485 interface discussed in Section 7.8. This interface requires the user to configure the slave ID, baud rate, number of bits, parity, and stop bits (see **Figure** 8-1).

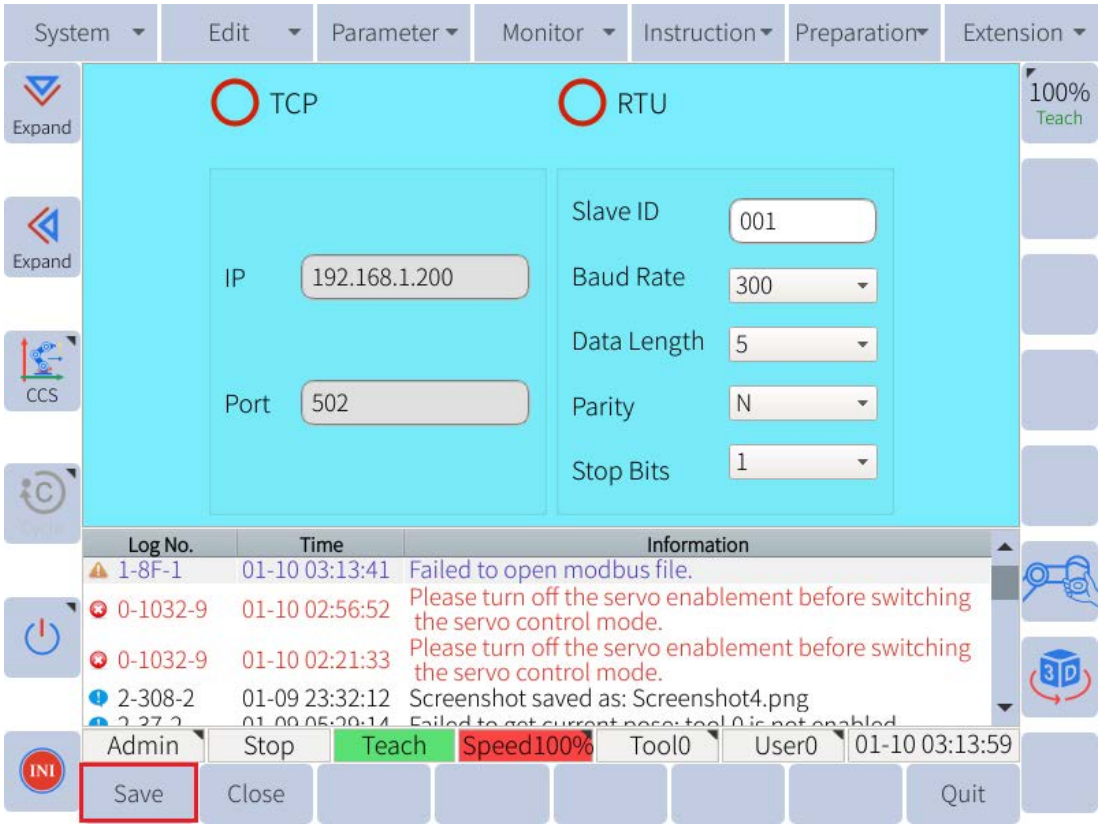


Figure 8-1 : Modbus configuration page

Modbus TCP uses the ethernet port at the top of the controller. Only the IP address of the modbus TCP settings can be modified. The default port for modbus TCP is 502. The IP address can only be modified from the network configuration page. To modify the IP address navigate to **System -> System setting -> Network Configuration** and set the IP address, netmask, and gateway.

The modbus coils and registers of the system are listed in **Table** 8-2

Table 8-2 . Function code

Variables	Coil Address	Register Address	Supported Function Code	Read and Write Authority
M0-M527	0x0000-0x020F	0-0x41(8bit) 0-0x20(16bit)	0x01,0x03,0x04	read only
M528-M1471	0x0210-0x05BF	0x42-0xB7(8bit) 0x21-0x5B(16bit)	0x01,0x03,0x05, 0x06,0x0F,0x10	read/write
M1472-M1535	0x05C0-0x05FF	0xB8-0xBF(8bit) 0x5C-0x5F(16bit)	0x01,0x03,0x04	read only

NOTICE

1. M0-M527 is used by the system and can only read the status. The range of M variables that can be modified through the teach pendant is M528-M799.
2. The coil address of the M variable is the serial number address of the variable. The register address of the
3. Modbus selected in compatible mode: M variable starts from M0, and every 16 consecutive M variables form a register address, such as M0-M15, the register address is 0x0000; M16-M31, the register address is 0x0001, and so on.
   Modbus unselected in compatible mode: M variable starts from M0, and every 8 consecutive M variables form a register address, such as M0-M7, the register address is 0x0000; M8-M15, the register address is 0x0001, and so on.
4. In the Modbus protocol, a register is a 16-bit variable, so when operating on a register address of the M variable, the actual operation is a continuous 16 M variables.

For more information on using the modbus interface please refer to the Modbus Script Manual on the ELITE Robot website or forum.

Chapter 9 Lua Scripting

Lua is a scripting language that can be embedded in an application. Lua is used to extend the programming functionality of a program such that a user can use simple commands to perform complicated tasks. Lua is lightweight and fast.

For EC66 system, more advanced users may find Lua helpful in creating more complex tasks that cannot be easily achieved using the JBI robot instructions. These Lua scripts can be started, restarted, or stopped directly from a JBI program, or they can be started immediately when the system boots. These scripts run in the background parallel to a JBI program.

Scripts must be loaded into the /rbctrl/luadir folder from a USB device or through an FTP server. To load from a USB device, create the Lua script and place it in the /rbctrl/luadir folder on the USB drive.

If the /rbctrl/luadir folder does not exist, create one and place the Lua script inside. Insert the USB drive into the controller and navigate to **System -> Load from USB -> Script Update** and click "OK". Next navigate to **Extension -> Lua Script** (see **Figure** 9-1).

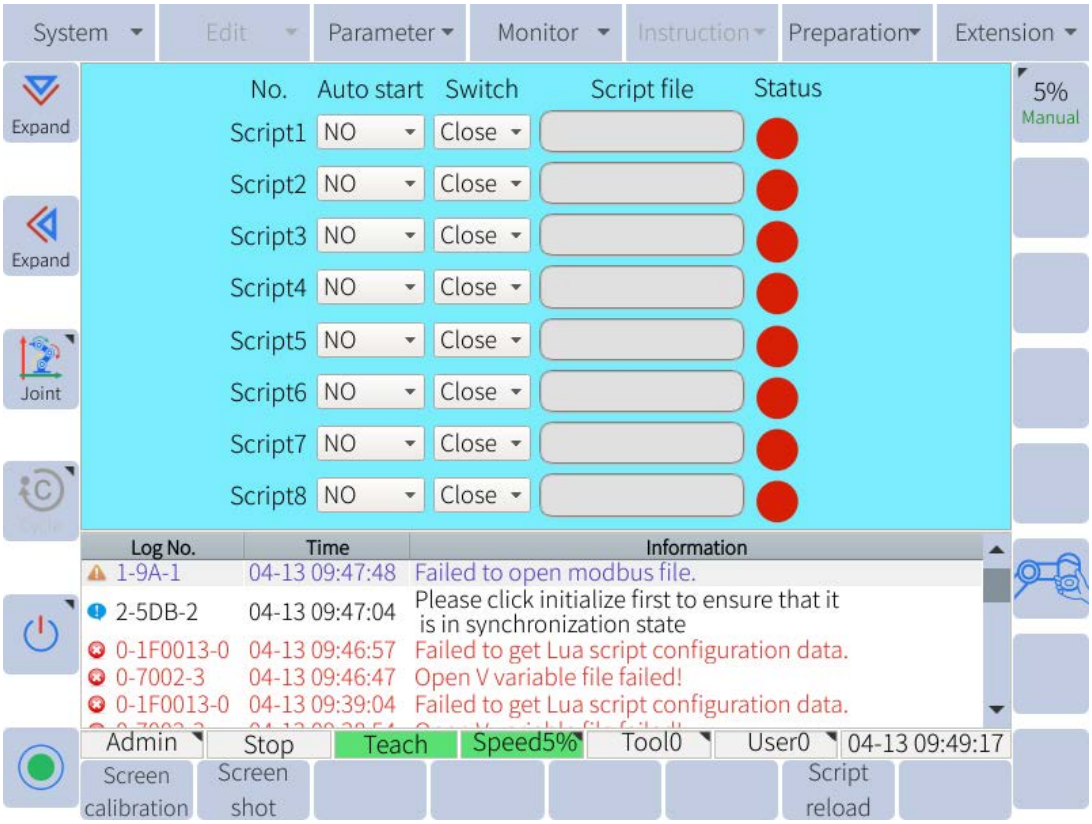


Figure 9-1 : Lua script setup page

Scripts are identified by indices. There are 8 total indices that can be assigned a Lua script. Once the Lua scripts are uploaded from a USB device, click on the box under the File column, and select the desired script from the list that appears.

To run the desired Lua scripts, click on the dropdown menu in the Switch column and select “Open”. Once the user has selected “Open” for all the scripts they want to run, click “Save” in the submenu, then click “Run”. All scripts with the dropdown showing “Open” will run. Click “Stop” in the submenu to stop the running scripts.

Please note that the robot needs to sleep for at least 20 secs if the user expects to print the texts when starting via Lua scripts.

To start Lua scripts from the JBI program, the user needs to enable the JBI advanced functions (see Subsection 6.7.5). In the main menu bar navigate to **Instructions -> Script** and select STARTLUA, STOPLUA, RESETLUA, or GETLUASTATE.

For more information on Lua scripting, please refer to the Lua scripting manual found on the ELITE Robot website or forum.

Chapter 10 User PLC

The User PLC is a PLC program that always runs in the background. The PLC uses ladder logic, which is a graphical programming language. Each line is called a rung, and the PLC executes one rung at a time, starting from the top to the bottom rung. Once all the ladder's rungs have been executed, the PLC program returns to the top rung and again executes the program line by line. The PLC supports up to 200 lines or rungs.

To access the user PLC navigate to **Extension -> User PLC**. You will see the screen shown in **Figure** 10-1 .

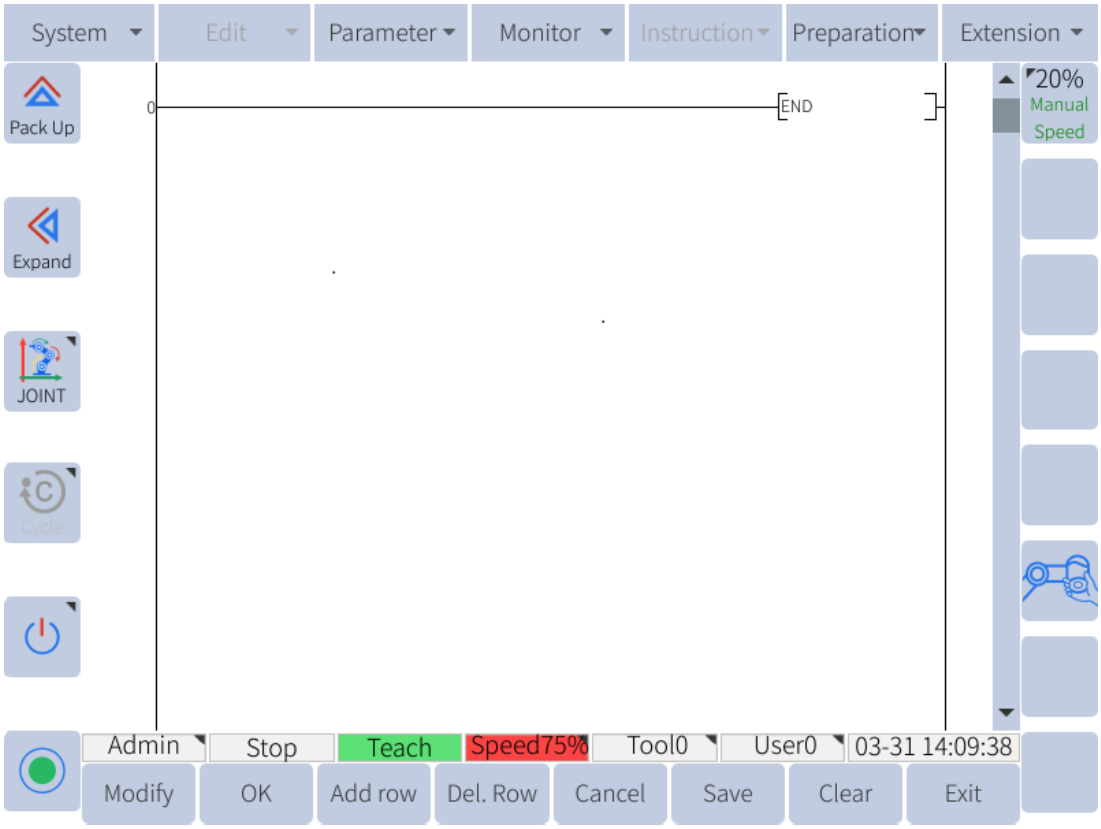


Figure 10-1 : User PLC

To add a rung to the ladder select a row and click "insert row". A new row will be inserted above the selected row. Once the rung has been inserted, select the row and click "Modify" (see **Figure** 10-2).

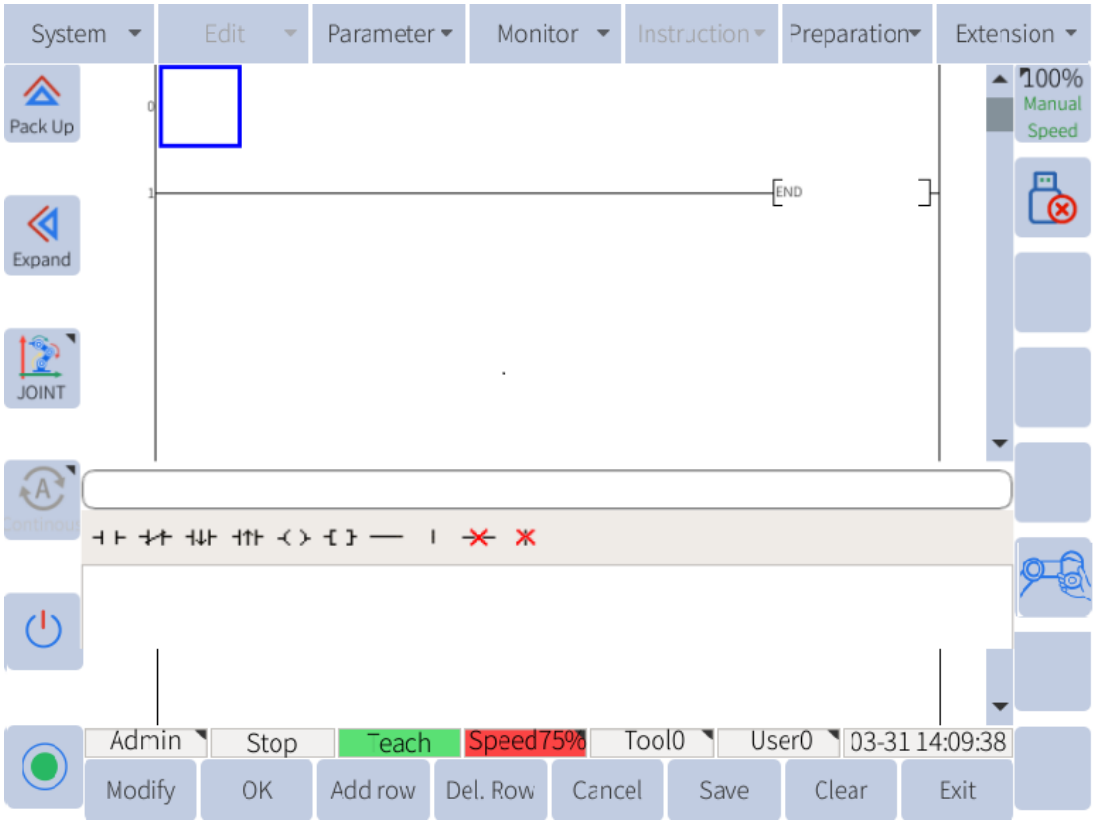


Figure 10-2 : Programming elements of the PLC program

By clicking the “modify” button, the user can see various logic symbols used to create ladder programming. (**Figure** 10-2). The various symbols are described as follows:

- Normally open contact. When the I/O or variable associated with the symbol is LOW, the signal will not pass through. If the I/O or variable is HIGH, the signal will pass through.
- Normally close contact. When the I/O or variable associated with the symbol is HIGH, the signal will not pass through. If the I/O or variable is LOW, the signal will pass through.
- Set the associated I/O or variable to HIGH.
- If configured to “Reset”, set the associated I/O or variable LOW. If configured to “Set”, set the associated I/O or variable HIGH
- Allows signal to pass through if the associated I/O or variable is toggle from LOW to HIGH.
- Allows signal to pass through if the associated I/O or variable is toggle from HIGH to LOW.
- Insert a horizontal line.
- Insert a vertical line. Useful for creating “OR” logic.
- Delete an existing horizontal line.
- Delete an existing vertical line.

Example: if a user wants to connect virtual input M485 to digital output Y004 so that Y004 outputs HIGH when M485 is HIGH, they can do the following:

1. Insert new row by clicking on the “end” row and pressing “insert row” in the submenu.
2. click on the left side of the newly created row and click “Modify” in the submenu.
3. select the normally open contact icon.
4. From the drop down box select the I/O type to be M for virtual input.
5. Enter ’485’for M485 in the text box next to the dropdown menu.
6. Click “OK” in the submenu and the new normally open contact will be inserted.
7. Click on the row again next to the newly inserted contact and click “Modify”
8. Select the Set ⊣( )⊢ contact.
9. In the dropdown menu select “Y” for digital output and in the text box enter “004” for Y004.
10. Click “OK” in the submenu.
11. Click save to save the new PLC setup. The system will restart automatically.

Safety related relays of the User PLC can be controlled or reset using the ⊣( )⊢ symbol. The safety relays control safety related functions such as external emergency stop, external start, external suspension, servo ON, clear alarm, reduced speed, automatic recovery, etc. The User PLC signal mapping for the safety relays and generic I/O’s is shown in **Table** 10-1 .

Table 10-1 . PLC Signal Mapping

PLC Signal	Function	Trigger Mode	Remarks
S0	external emergency stop	low level effective	
S1	external start (program)	active on rising edge	hold time at least 300ms
S2	external pause button(active during operation)	high level effective	
S3	external servo power up	active on rising edge	hold time at least 200ms
S4	external clear alarm	active on rising edge	hold time at least 400ms
S5	external stop (program)	high level effective	
S6	return to the first line of the main program	active on rising edge	hold time at least 400ms
S7	servo off	high level effective	
S9-S16	appointment procedure	high level effective	
S17/S18	reduced mode enabled	low level effective	any signal triggers
S19	guard stop program auto re-set settings	high level effective	
S20	external button function trigger	high level effective	

PLC Signal	Function	Trigger Mode	Remarks
S21	clear collision warning	active on rising edge	hold time at least 200ms
S22	encoder calibration	active on rising edge	hold time at least 200ms
S23	reset system	active on rising edge	hold time at least 200ms
S24	enter reverse drive	high level effective	low exit
S25	collision detection enable/disable	high level effective	hold time at least 100ms
S26	clear the booking queue	high level effective	hold time at least 100ms
T100-T149	100ms timer		
C100-C149	16-bit storable counter		
X0-X19	digital input (decimal)		corresponding to DIN4-DIN19, X0-X3 have been occupied by safety IO
Y0-Y19	digital output (decimal)		corresponding to DO0-DO19
M0-M1535	virtual signal register		for details, please refer to Section 14.1

10.1 PLC example(S0-S4/S6)

Figure 10-3 shows an example of a PLC program, the user can create this program to run the main program.

The operation steps are as follows:

1. Wire the three switches to input 4-input 9, namely DI4-DI9. (This is only a sample, it can be connected to other input points according to actual needs.)
2. Select "**Preparation -> Main program**" and select 3.jbi.
3. Click "Setting", and when a prompt box pops up, click "OK" to set 3.jbi as the main program.
4. Select "**Extension -> User PLC**", edit the following PLC sample program, as shown in **Figure** 10-3 :

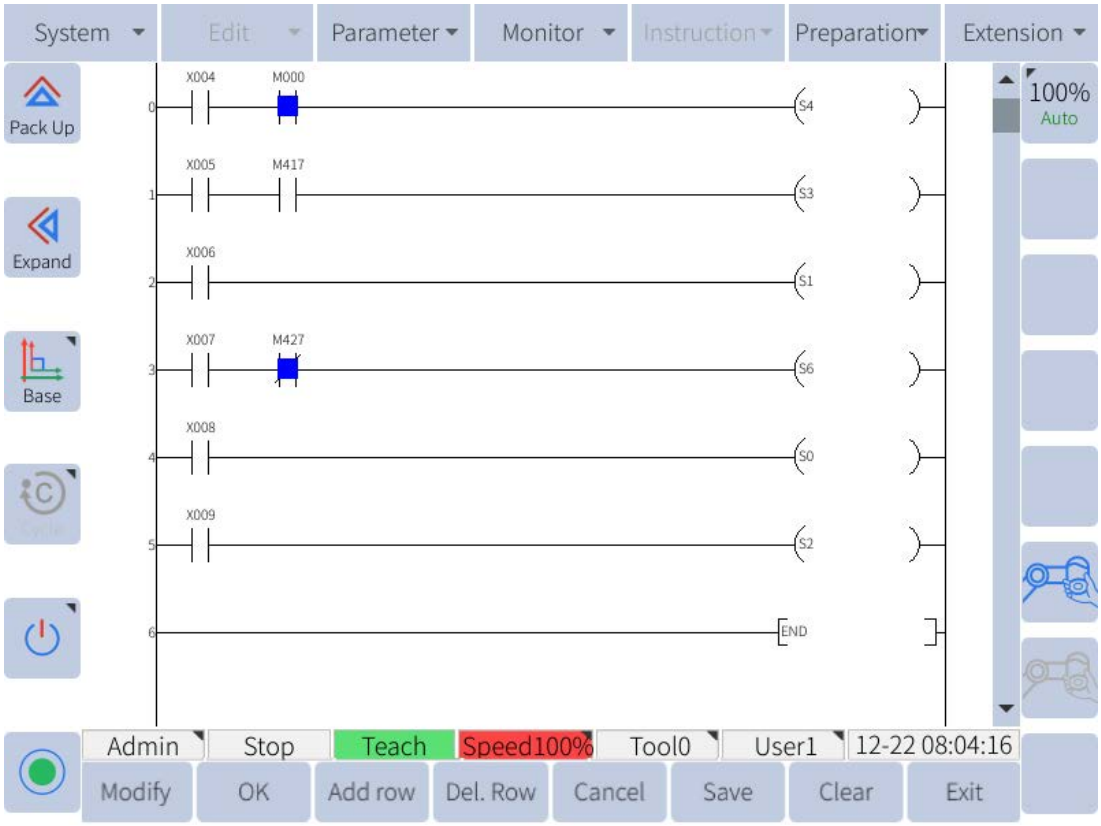


Figure 10-3 : Example of how to set the PLC to make the robot jump to the main program

The PLC program is explained as follows:

Line 0: Press the switch of input 4 (X004), if there is no internal emergency stop (M0), the alarm will be cleared and synchronized.

Line 1: Press the switch of input 5 (X005), and the robot is in PLAY mode (M417), then the upper servo is enabled.

Line 2: Press the switch of input 6 (X006) to start the robot.

Line 3: Press the switch of input 7 (X007), the robot is not running (M427), jump to the first line of the main program.

Line 4: Press the switch of input 8 (X008), external emergency stop.

Line 5: Press the switch for input 9 (X009), and the program pauses.

5. After finishing editing, click “Save” at the bottom right, as shown in **Figure** 10-4 :

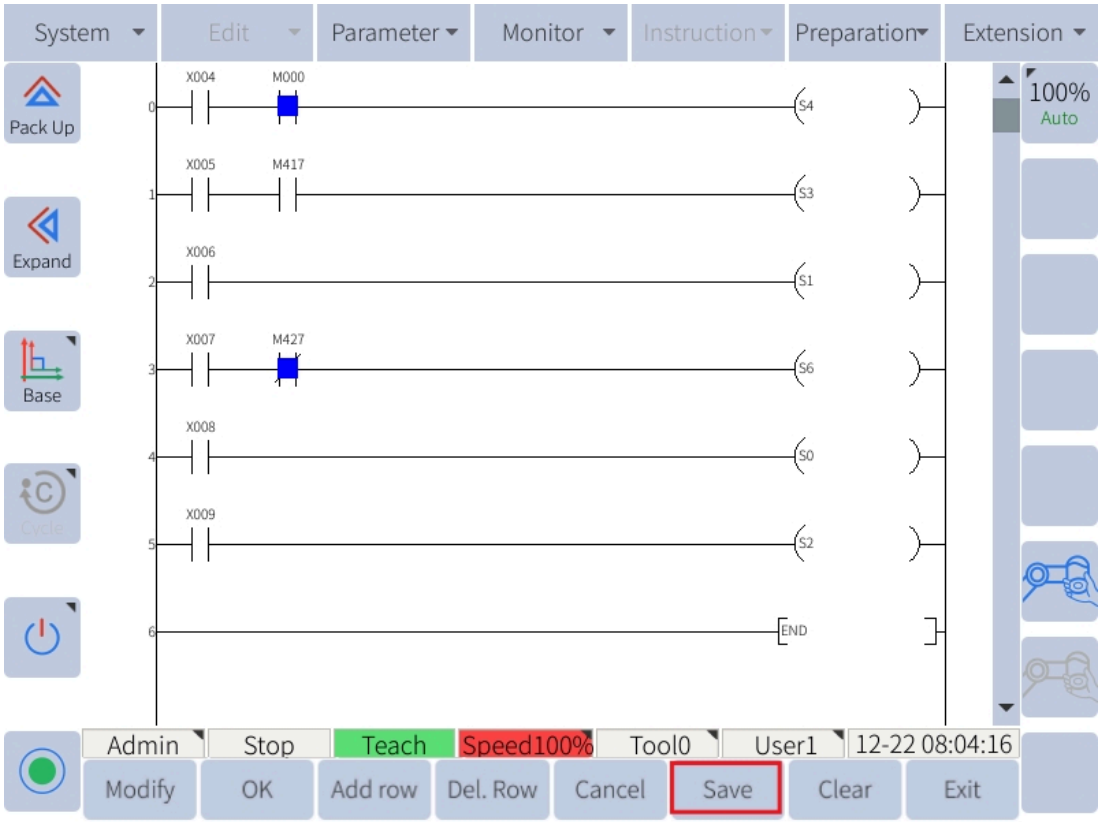


Figure 10-4 : save the program

6. After the prompt box pops up, click “OK” to restart the robot.
7. During or after the restart, you can turn the mode switch (key switch) to PLAY mode.
8. At this time, the teach pendant interface will automatically jump to the main program interface.

The results are verified as follows:

1. Press the button of input 4 to clear the alarm information and synchronize,
2. Press the button of input 5, the SERVO status light in the upper left corner of the teach pendant lights up.
3. Press the button for input 6, and the robot starts.
4. Press the button for entering 7 to jump to the first line of the main program.
5. Press the button of input 8, and the robot stops in an emergency.
6. Press the button to enter 9 to pause the main program. If you need to continue running, you can press the button to enter 6 again.

CAUTION

The PLC program is only a sample, and the corresponding user PLC program needs to be written according to the actual situation when using it.

10.2 PLC example (S7)

As shown in **Figure** 10-5 is an example of a PLC program where the user can close the servo.

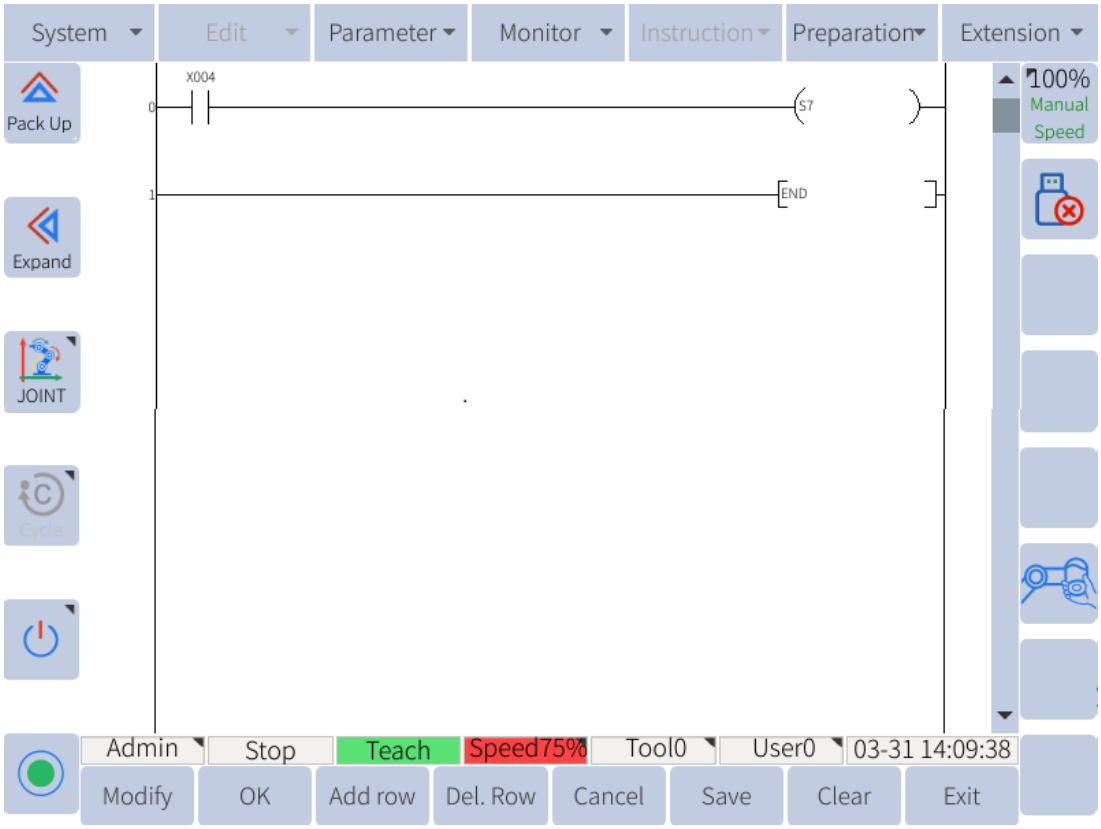


Figure 10-5 : Closeservo PLC example

In this example, X004 is a digital input connected to an external button, The user presses a button to turn off the servo.

10.3 PLC example (S17/S18)

Figure 10-6 is an example of a PLC program the user can create to trigger reduced speed mode.

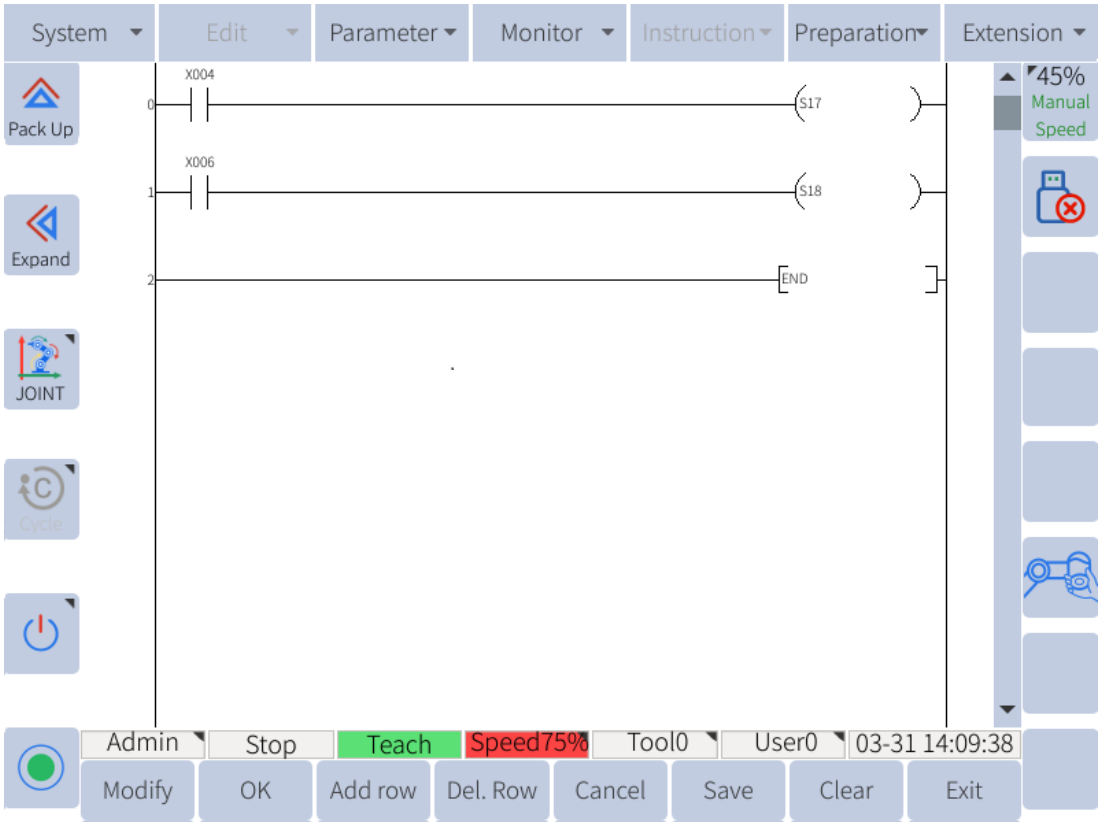


Figure 10-6 : An example of how to set up the PLC so the robot will enter reduced speed mode

In this example, X004 and X006 are digital inputs connected to two external buttons. When the two buttons are pressed, S17 and S18 are set. If the robot is running a program, when the buttons are pressed S17 and S18 are triggered and the robot speed is reduced. Make sure that the collaborative function of the robot is enabled and the reduced speed is set lower than the normal speed (see Subsection 12.2.3).

10.4 PLC example (S19)

Figure 10-7 shows an example of a PLC program that the user can create to protect the automatic recovery after stopping.

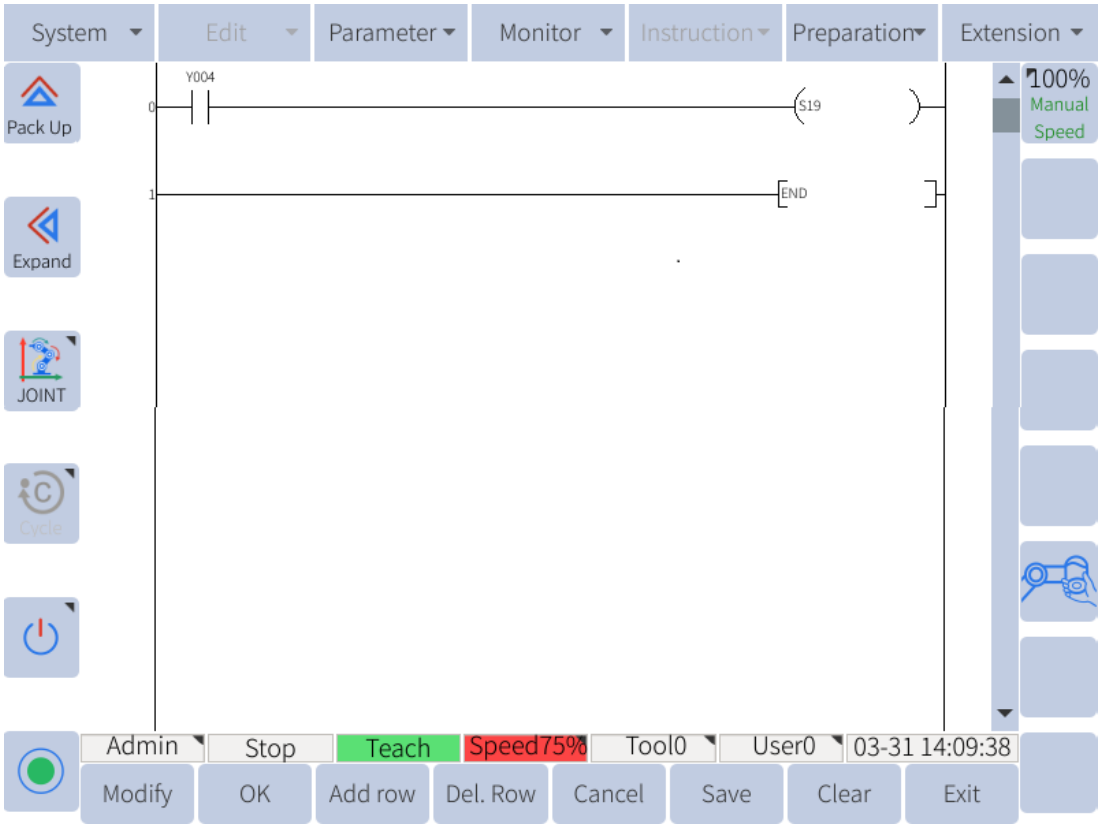


Figure 10-7 : Example of a PLC that automatically recovers after the protection stops

In this example, when Y004 is set to 1, after the protection is stopped and suspended, the task can automatically resume running.

CAUTION

A pause caused by a non-protective stop has no such effect. Such as: pause button on the teach pendant, external pause, program pause, etc.

10.5 PLC example (S20)

Figure 10-8 shows an example of a PLC program where the user can connect an external button to mark, drag or record the robot.

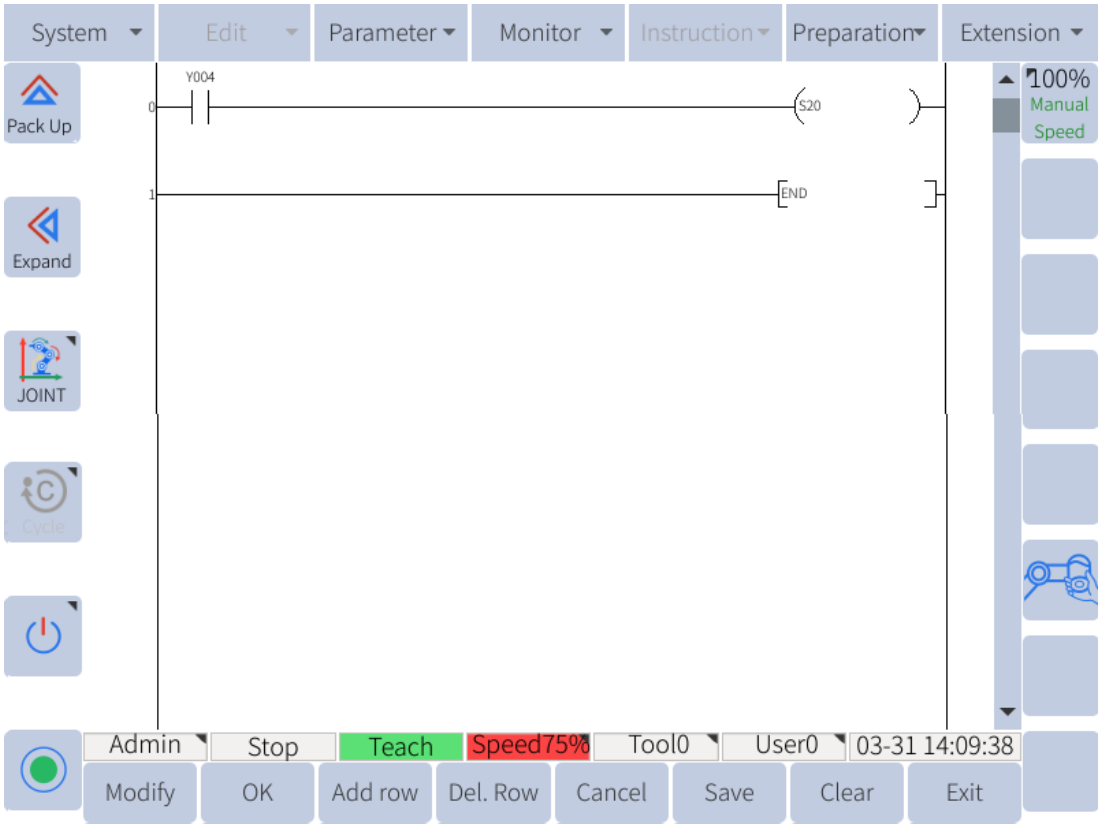


Figure 10-8 : PLC example of external button

In this example, Y004 is a digital output connected to an external button, The user can configure the functions of the external buttons in the "**Extension -> EndingIO-> Button Configuration**" interface. After configuration, just press the button.

CAUTION

If the user uses the teach pendant to turn off the drag function in the middle, the external button will be invalid. You need to click "Preparation > Drag Move settings" to re-enable the drag function. The external buttons only work after turning it back on.

10.6 PLC example (S21)

As shown in **Figure** 10-9 , it is an example of a PLC program that the user can clear the collision alarm.

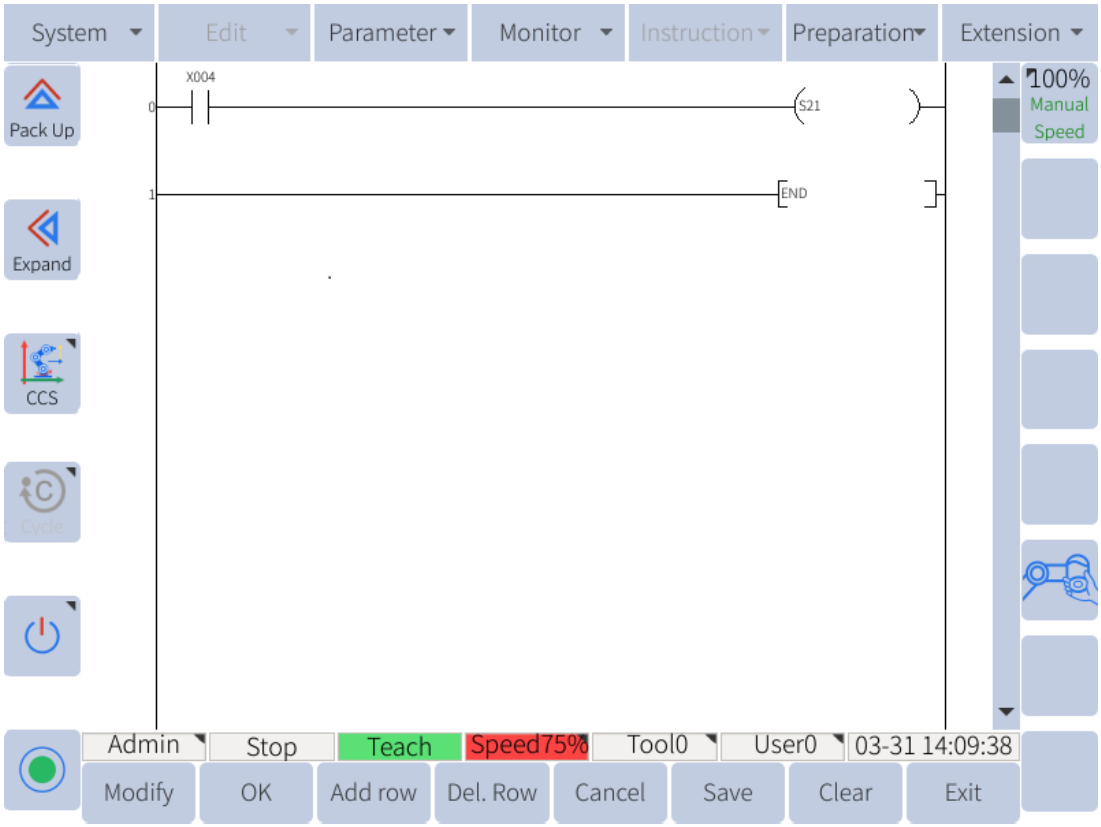


Figure 10-9 : PLC example for clearing collision alarm

In this example, X004 is a digital input connected to an external button, The user presses the button to clear the collision warning.

10.7 PLC example (S22)

Shown in **Figure** 10-10 is an example of PLC program where users can calibrate the encoder.

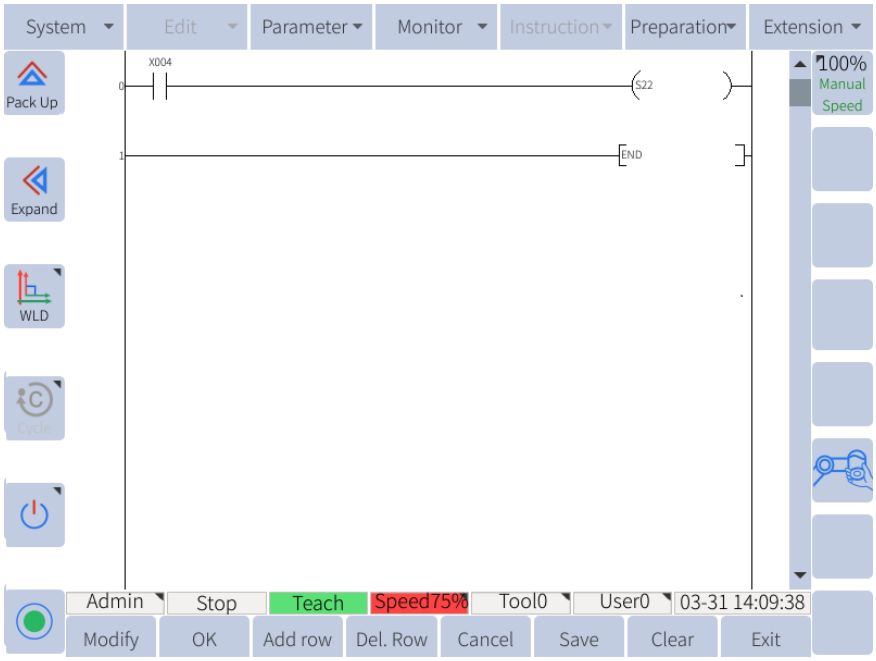


Figure 10-10 : PLC example of encoder calibration

In this example, X004 is a digital input connected to an external button, The user can perform encoder calibration at the push of a button.

10.8 PLC example (S23-S24)

The user can enter the reverse drive mode through the two PLC registers S23 and S24. First, the S23 register is initialized, and then the S24 register is used to enter the backdrive mode.

As shown in **Figure** 10-11 is an example of a PLC program where the user can enter backdrive mode.

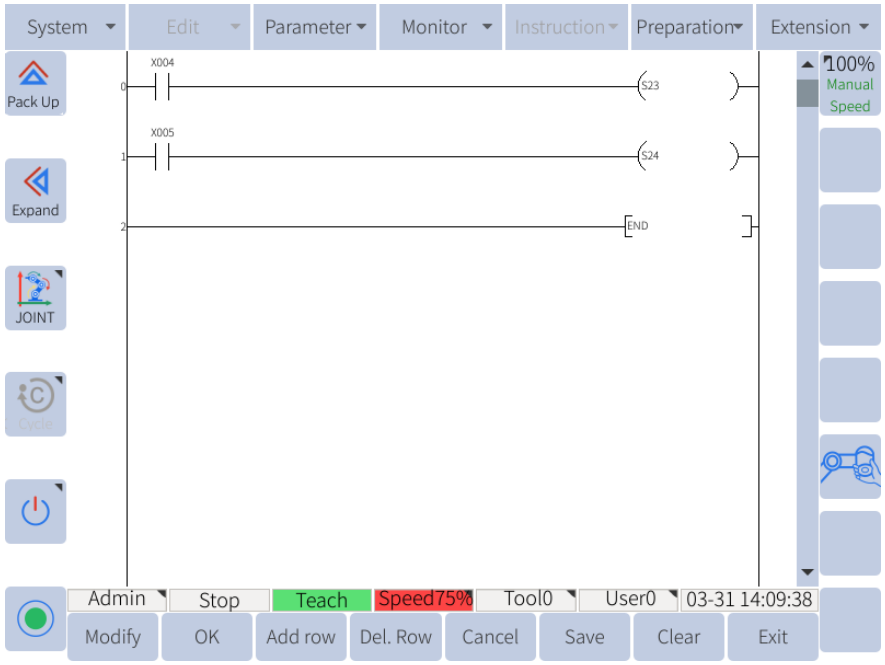


Figure 10-11: PLC example in backdrive mode

In this example, X004 is a digital input connected to an external button, the user presses the button and the robot becomes initialized. X006 is a digital input connected to an external button, the user presses the button and the robot goes into backdrive mode.

CAUTION

When entering backdrive mode, the robot must be in an initialized state.

10.9 PLC example (S26)

As shown in **Figure** 10-12 , it is an example of a PLC program that the user can clear the booking queue.

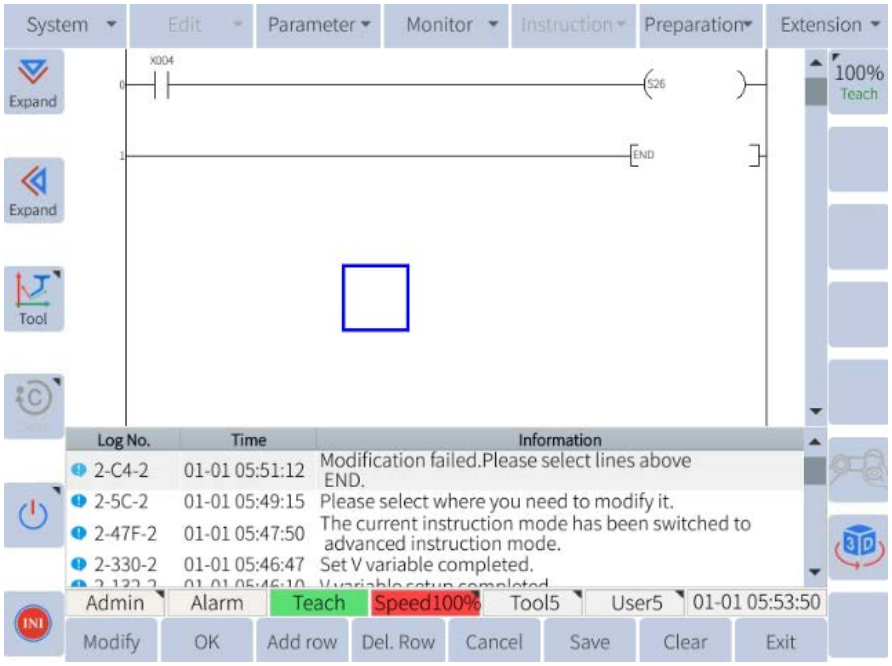


Figure 10-12: PLC example of clearing booking queue

In this example, X004 is a digital input connected to an external button, The user can clear the booking queue when pressing the button.

Chapter 11 Webpage remote control robot

Elite Robot supports users to log in to the website and perform remote control of the robot, such as VNC display, file management, etc.

The specific flowchart is shown in **Figure** 11-1 :

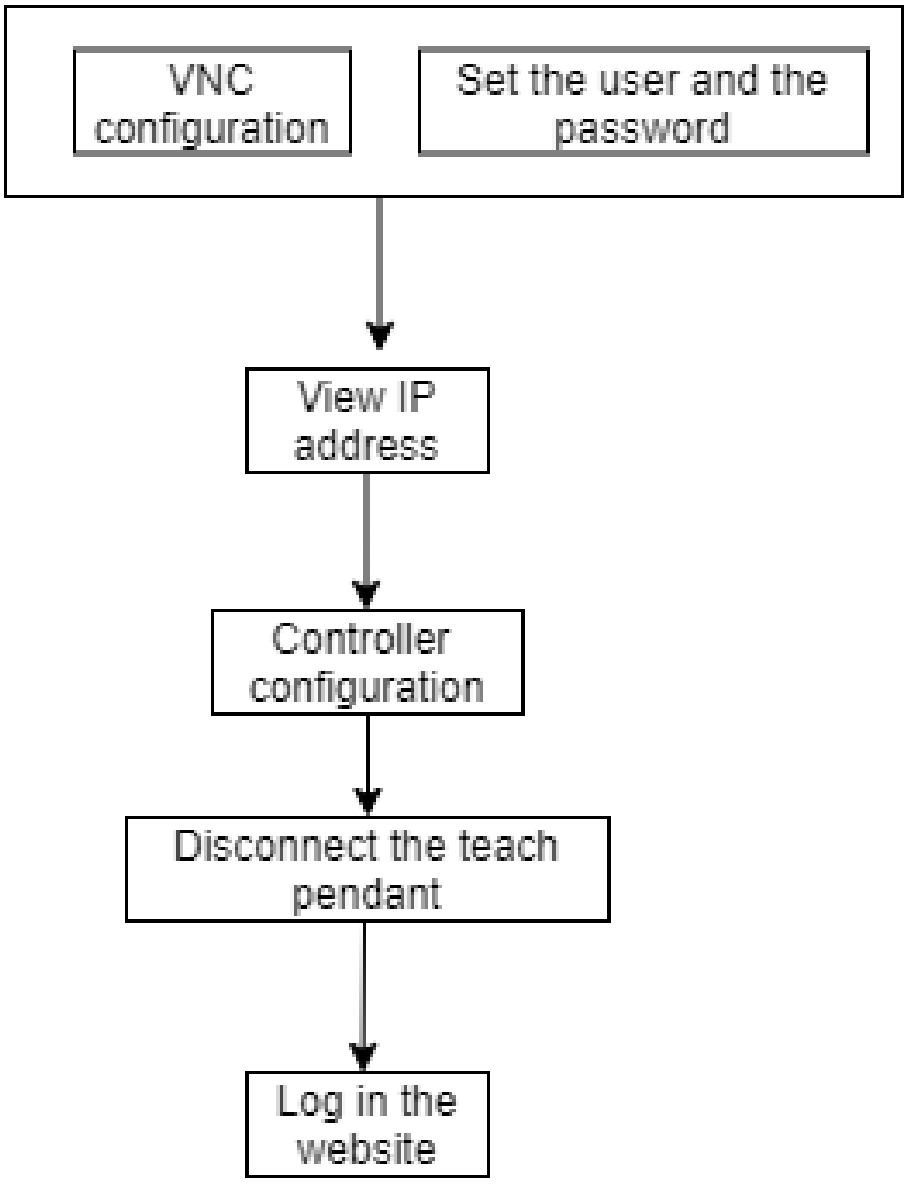


Figure 11-1 : flowchart

11.1 Configure VNC

After the user configures the VNC, the robot can be remotely controlled on the website. The specific steps are as follows:

1. Choose System > System setting > VNC setting.
2. Set “Auto start” to “Yes”, click “Set”.
3. Click “Restart” to start VNC, as shown in **Figure** 11-2 .

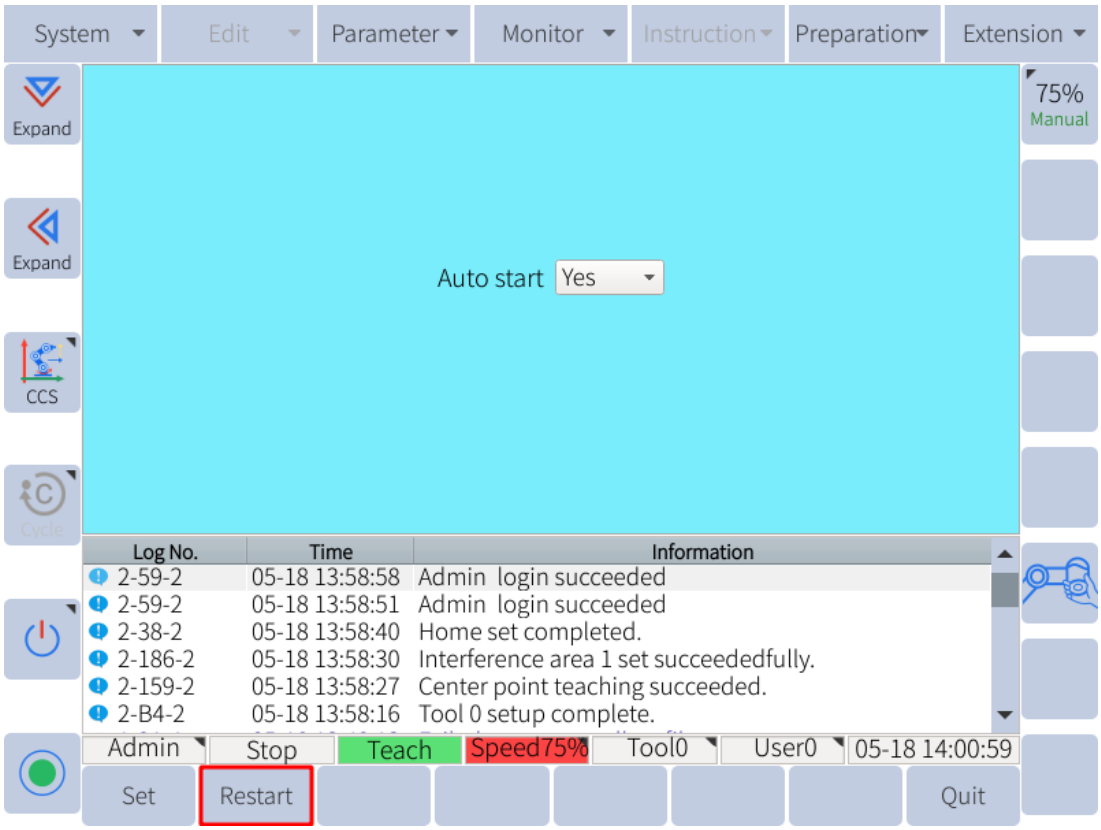


Figure 11-2 : VNC setting page

11.2 Set username and password

1. Choose System > System setting > Remote password.
2. Set the type of the password as “RTP”.
3. Enter the username and password, which is used to log in the website, as shown in **Figure** 11-3 .

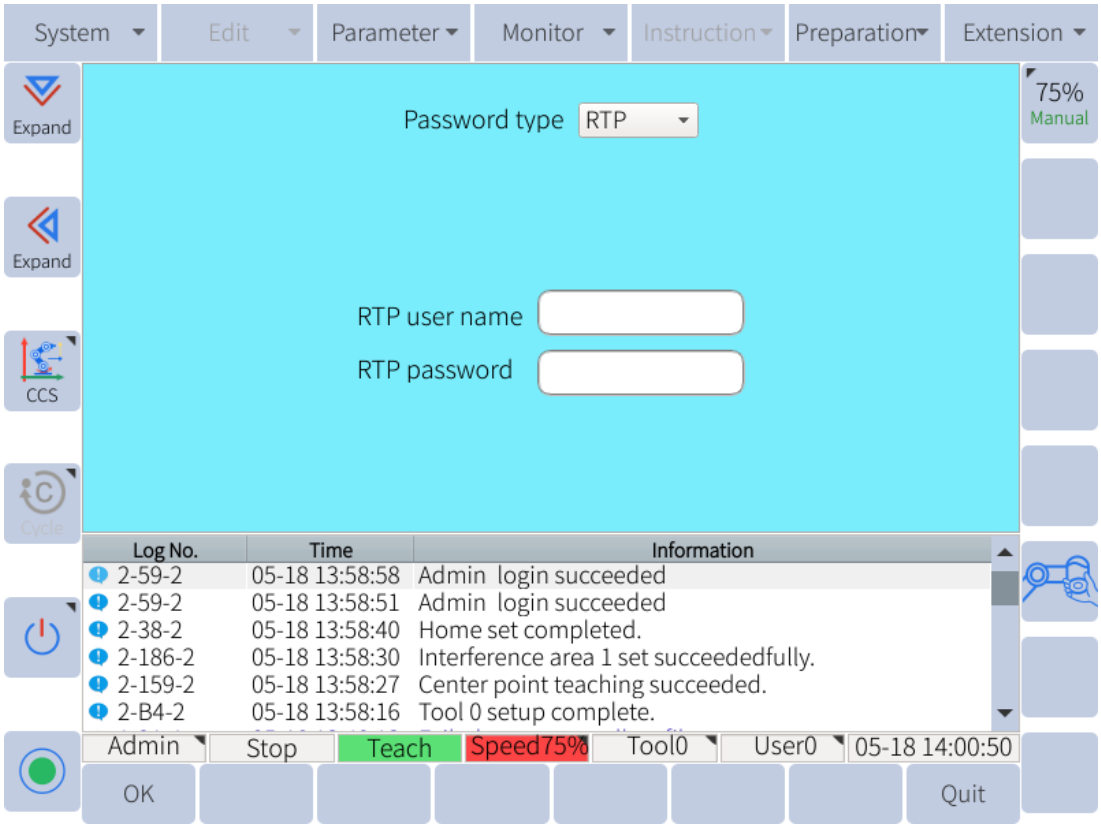


Figure 11-3 : set username and password

11.3 View IP address

Choose System > System setting > Network Configuration to check the IP address of the device, as shown in **Figure** 11-4 .

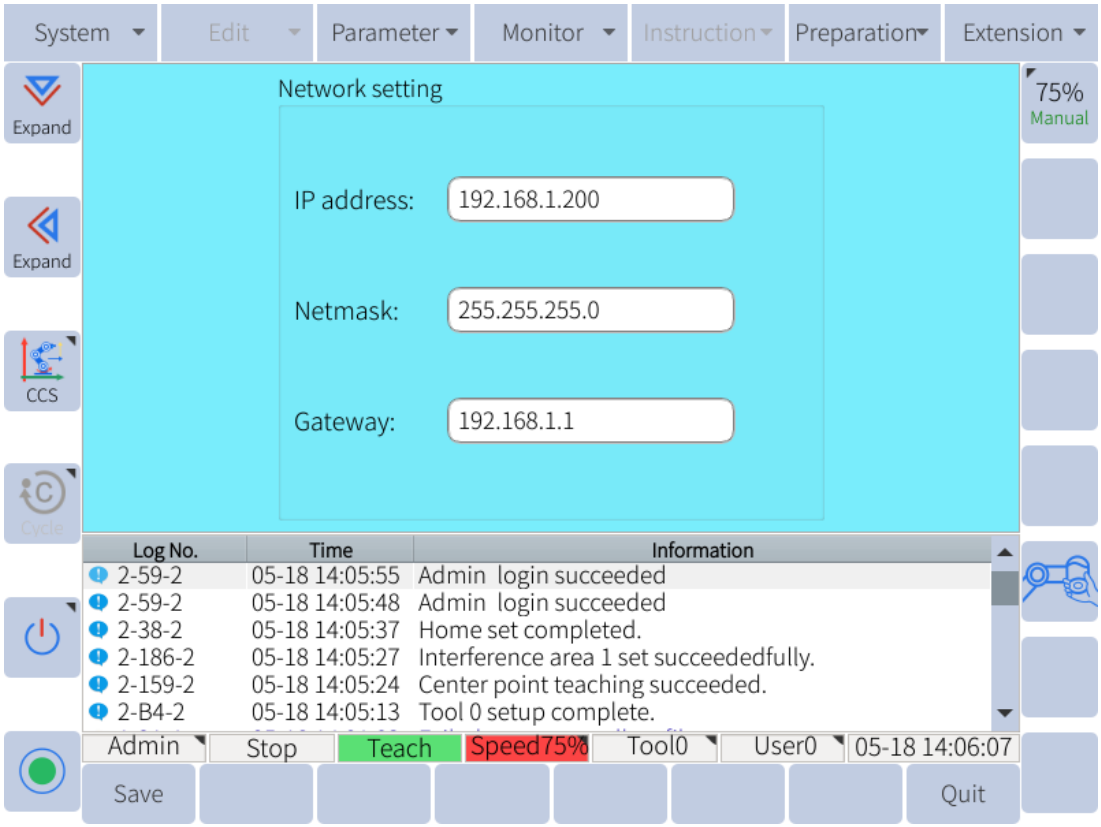


Figure 11-4 : Network Configuration Page

11.4 Setup Controller

1. Select “Parameter > Controller”.
2. Move down to the “Teach Pendant Connection State” row and click “Modify”.
3. Set “Teach Pendant Connection State” to “Disconnect”, disconnect the Teach Pendant connec-tion status.

11.5 Remove the teach pendant

1. Disconnect the teach pendant from the robot power supply.
2. The external emergency stop button must be connected while not using the emergency stop device of the teach pendant. The steps are outlined as below:
   2.1 Connect E_STOP0 and the nearest T_STP0 (J106: 1-2PIN) to the channel interface (0) of the external emergency stop. Connect T_STP0 and GNDP (J106: 3-4PIN) to the interface of the short circuit.
   2.2 Connect E_STOP1 and the nearest T_STP1 (J106: 5-6PIN) to the channel interface (1) of the external emergency stop. Connect T_STP1 and GNDP (J106: 7-8PIN) to the interface of the short circuit.
3. After removing the teach pendant, press the switch button again to restart the robot, and then the robot can be controlled remotely through the web page.

11.6 Remote control robot

11.6.1 Operation prerequisites

1. Install windows system
2. Install Google Chrome, recommended version 97 or above
3. Install graphics driver
4. It is not recommended to use the translation plugin that comes with the browser

Users can log in to the website through a browser and control the robot remotely. It is recommended to use Google Chrome or Firefox.

1. Open the browser, enter the URL: http://current device IP address:6680/, and press Enter.
2. Enter the user name and password, click “Login” to enter the webpage.

11.6.2 Select view mode

On the menu bar at the top left of the website, users can click “Console view” and select the appropriate view mode from “Default view”, “Teach pendant view”, “Manipulator view”, as shown in **Figure** 11-5 .

Figure 11-5 : view mode

Teach Pendant View: Only the teach pendant interface is displayed, and the user can monitor the teach pendant and simulate clicking on the teach pendant screen.
Robot arm view: Only the interface of the robot arm is displayed, and the user can simulate the rotation or translation of the robot to observe the state and movement trajectory of the robot.
Default view: both the teach pendant view and the arm view.

11.6.2.1 Teach pendant view

The user can perform the following operations in the teach pendant view:

Simulate the actual teach pendant, simulate the actual teach pendant screen through the virtual screen, and operate the robot.
simulates the actual teach pendant, and the status of the robot can be observed through the virtual LED.
simulates the actual teach pendant, which can be set to PLAY, REMOTE.TEACH mode through the virtual key bit.
simulates the actual teach pendant, which can be simulated as clicking the button of the real teach pendant through the virtual button.
In teach mode, the servo can be enabled or disabled by pressing the CTRL key on the keyboard or by clicking the “CTRL (servo)” virtual button.

11.6.2.2 Robot view

The user can perform the following operations in the robotic arm view:

The virtual scene can observe the real-time state of the physical robot arm and observe and clear the movement trajectory of the robot.
Drag the virtual robot arm with the left mouse button to simulate a rotating physical robot and observe it from different angles.
Drag the virtual arm with the right mouse button to simulate a translational physical robot.

11.6.3 File management

Users can click “File Management” in the upper menu bar to enter the “File Management” interface.

CAUTION

The file management function is only supported in teach mode.

In the interface, the following operations can be implemented:

1. Click the upper right button menu to create a new folder, upload a file, and create a new file, as shown in **Figure** 11-6 .
   Note: The format of the uploaded file can only be .jbi and .lua.

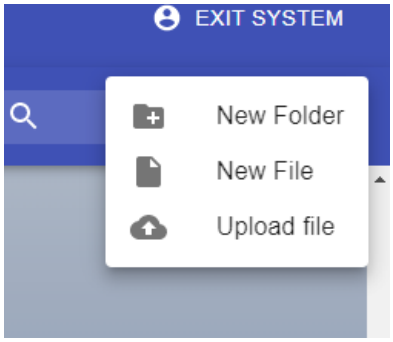


Figure 11-6 : button related operations

2. After selecting a folder, right-click the mouse to open, move, rename, and delete the folder, as shown in **Figure** 11-7 .

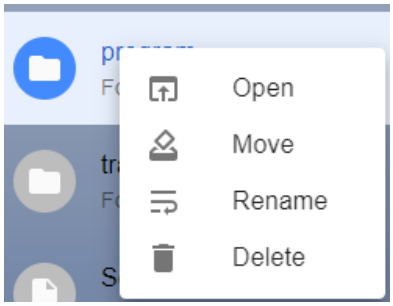


Figure 11-7 : operations on folders

3. After selecting the file, right-click the mouse to download, edit, copy, move, rename, delete the file, as shown in **Figure** 11-8 .

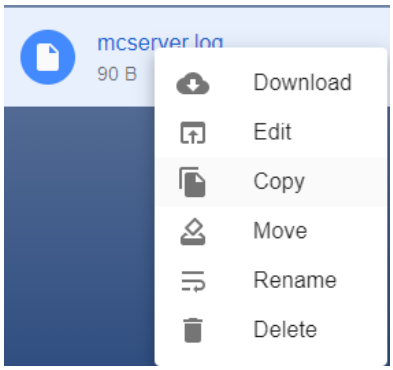


Figure 11-8 : operation on file

4. Double-click the files with the suffixes .jbi and .lua to edit the files online.

Figure 11-9 : online edit page

11.6.4 System upgrade

Users can upgrade the system through the web teach pendant. The specific operation steps are as follows:

1. Confirms that the teach pendant is in “Teach” mode.
2. Click “System > Flash Upgrade”.
3. Click “Upload File”.
4. Click “Select File” and select the software upgrade package “firmware.bin”, as shown in **Figure** 11-10 .

Figure 11-10 : Select file

5. Click “Upload”, upload the file, and wait patiently for the system to upgrade.

11.6.5 Exit system

Users can click the “Exit System” menu on the upper menu bar to exit the web system. After logging out of the web system, if you want to continue using it, you need to enter your username and password to log in again.

Chapter 12 System Settings

12.1 System Settings

12.1.1 Network Configuration

To set up the network for the EC66 navigate to **System -> System setting -> Network Configuration**. **Figure** 12-1 shows the network configuration page. Enter the IP address, netmask, and gateway addresses. Make sure to click “Save” in the submenu to apply any changes. The system does not need to be restarted for changes to take affect.

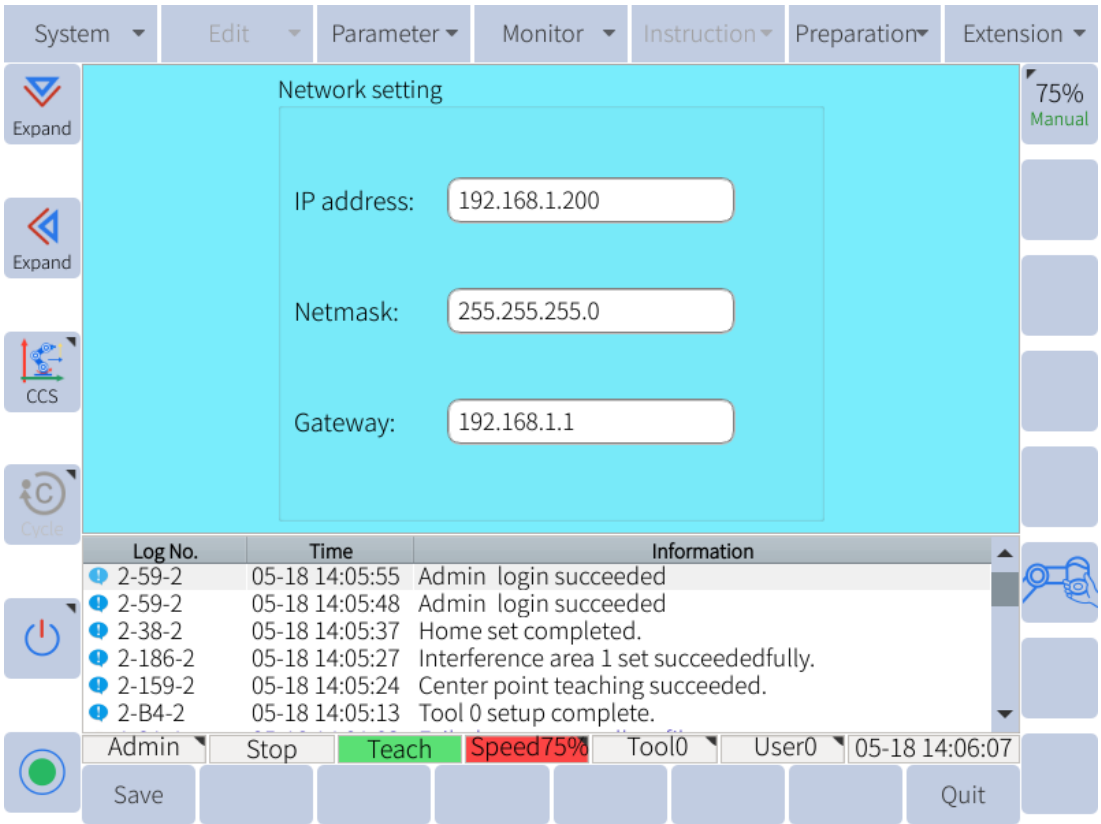


Figure 12-1 : The network configuration page

12.1.2 Language Configuration

To select the desired language navigate to **System -> System setting -> Language setting**. **Figure** 12-2 shows the language configuration window. Select the appropriate language and click “OK”.

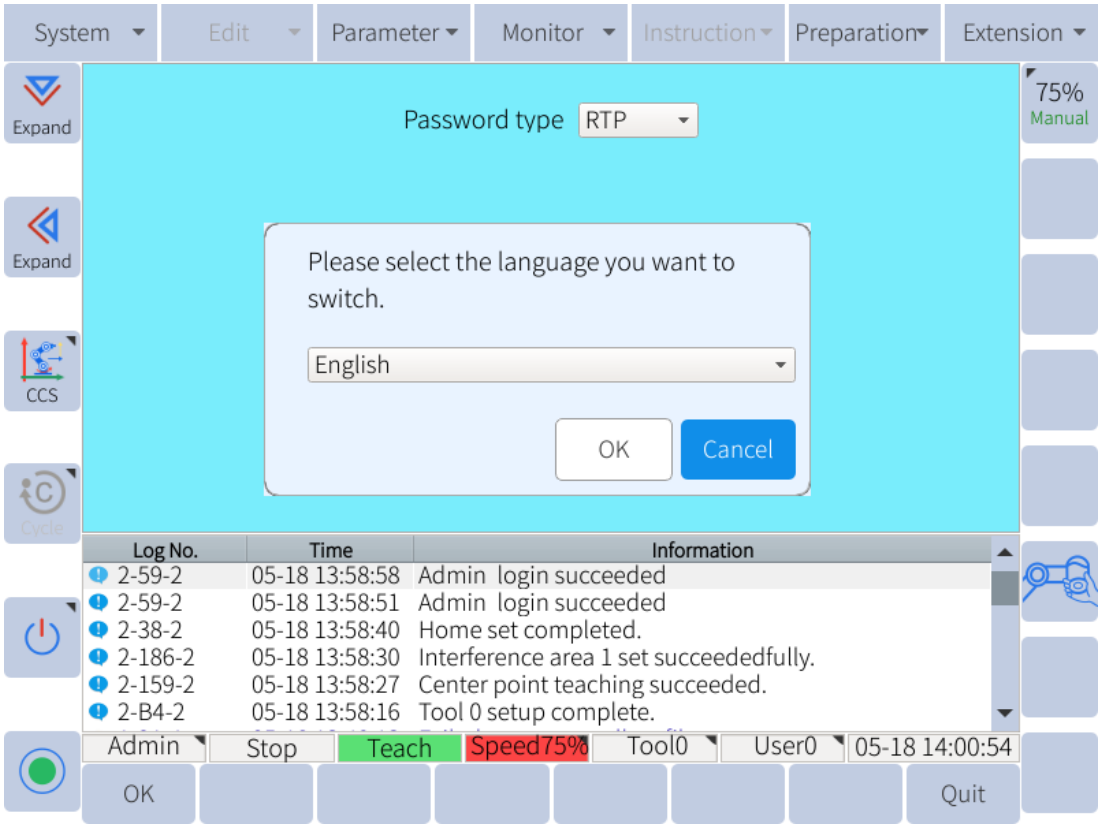


Figure 12-2 : The language configuration page

NOTICE

This version supports users to import French, Italian, Spanish, German, and Thai languages. Import the translated form, and then switch the language.

12.1.3 VNC setting

In order to use the VNC server for viewing the GUI from a laptop or desktop computer, navigate to **System -> System setting -> VNC setting**. The user will see the window shown in **Figure** 12-3 .

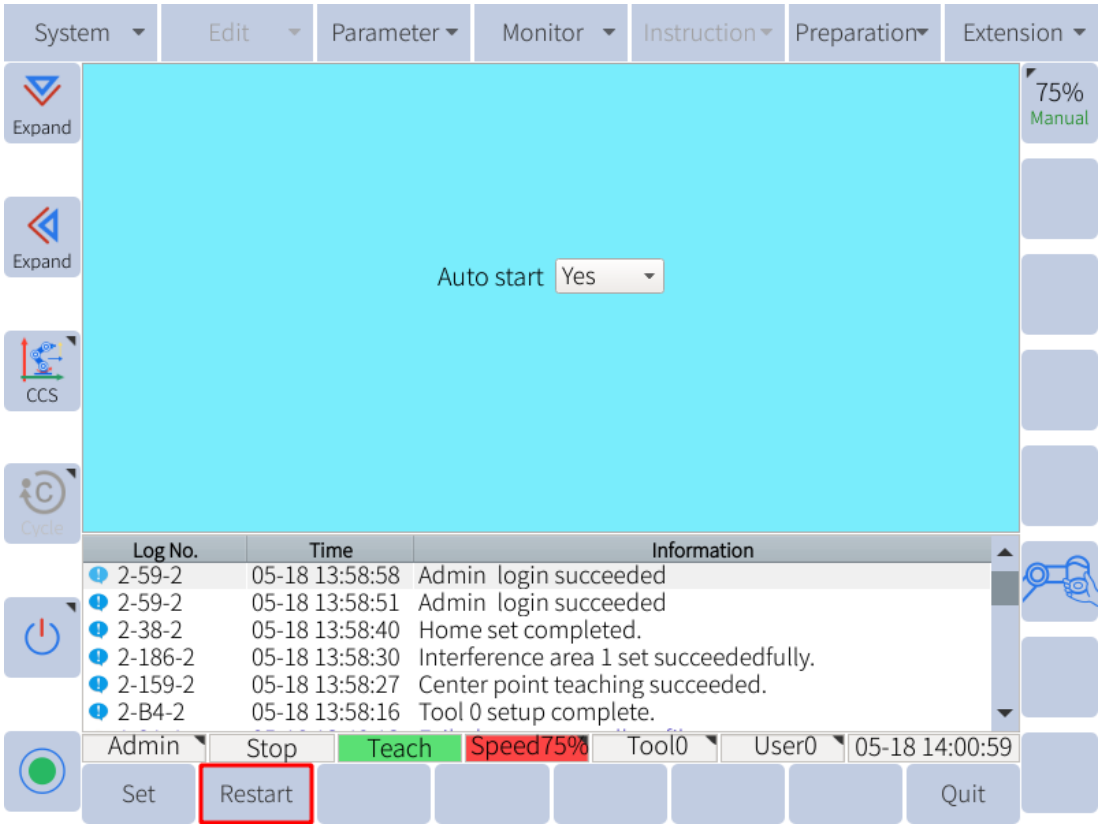


Figure 12-3 : The VNC setting page

To turn on the VNC viewer click on the “Restart” button. This will turn on the VNC server until the robot system is restarted. If the user wishes to start the VNC server automatically on system startup, they can click on the drop down menu and select YES for Autostart.

To access the VNC server and view the GUI on an external screen, the user must install a VNC viewer on their PC. Enter the IP address of the robot system in the VNC client. The user will be prompted for a password. The default VNC viewer password is 333333.

12.1.4 Password Configuration

For password configuration, please navigate to **System -> System setting -> Remote password**. The user will see the window shown in **Figure** 12-4 .

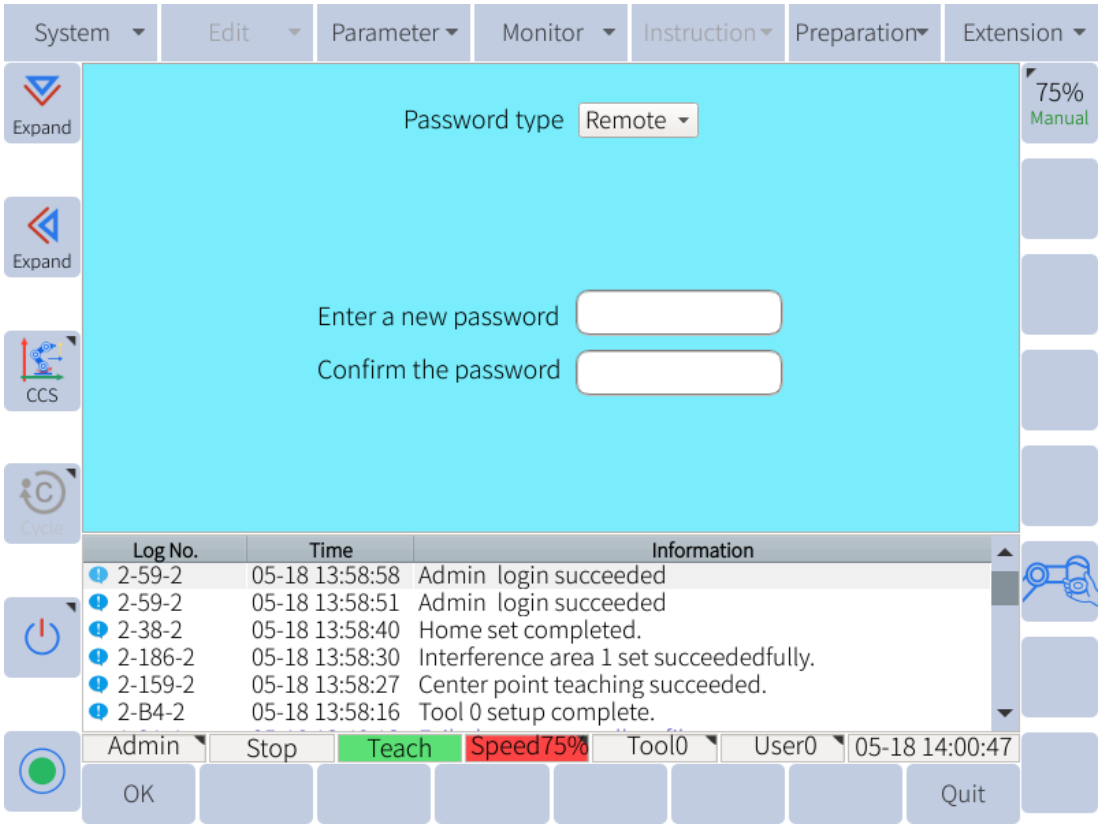


Figure 12-4 : Password configuration

The user can set a password in the remote mode, and the security parameters can be set only after obtaining the password in the remote mode. If not set, the default is ”123456”.

The user can also set the RTP username and RTP password to log in to the Web page.

12.2 Preparation

12.2.1 Robot Configuration

To set up which peripherals an operator wishes to use with the robot, navigate to **Preparation -> Process Config**. **Figure** 12-5 shows the available peripherals and settings.

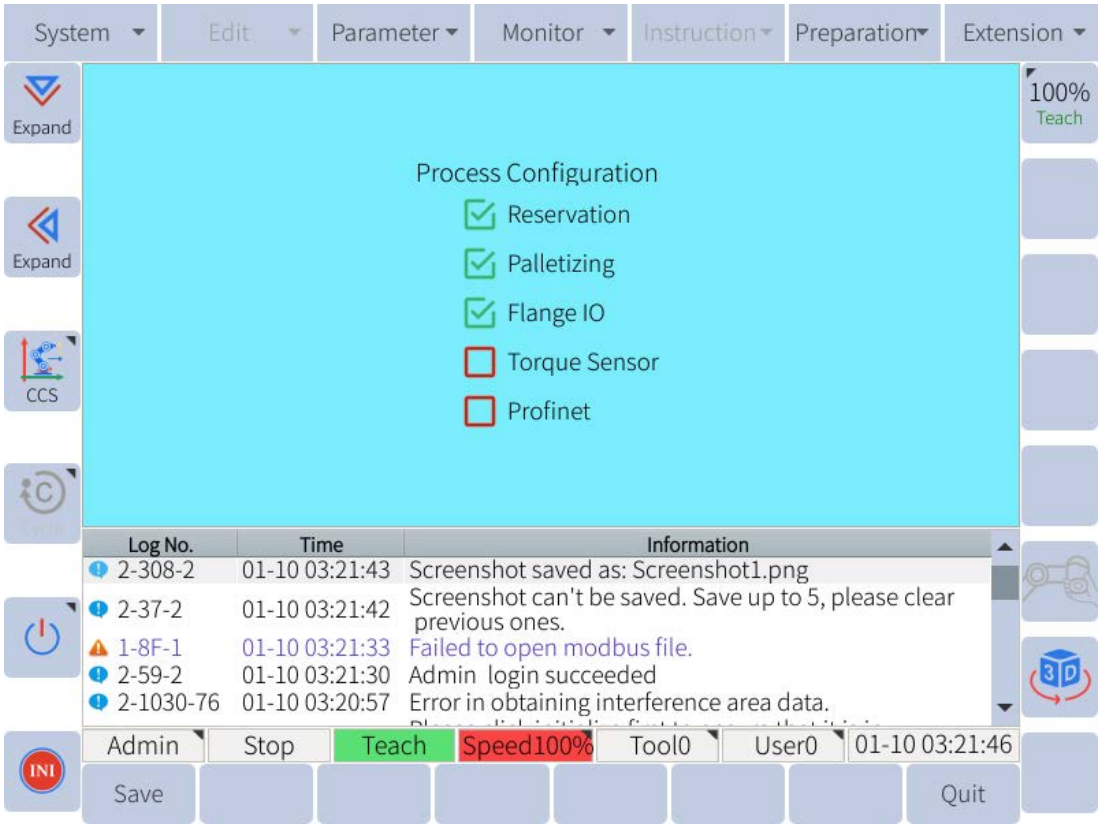


Figure 12-5 : The robot configuration page

To select or unselect a setting, click on the check box next to the setting the user wishes to configure. When finished, click “Save” in the submenu. In the popup box click “OK” to accept the action. The system will restart. If the user configured any settings, their functions will be available when the system restarts.

12.2.2 Mount config

The mount config page is used to identify the mounting pose of the robot. This information is important because it helps the robot determine the gravitational forces on the robot arm.

CAUTION

It is very important that this information is entered correctly. Gravity compensation for handguiding and other algorithms use this information. Failure to set the mount config appropriately can result in unpredictable robot motion.

Figure 12-6 shows the settings that need to be entered for the mounting pose of the robot. The mounting pose must be entered correctly. The deflection and rotation angles are the euler representation of the robot’s orientation relative to a world frame. The order of rotation for euler angles is rotation about the Z axis followed by a rotation about the Y axis, and finally a rotation about the X axis, or ZYX euler rotation.

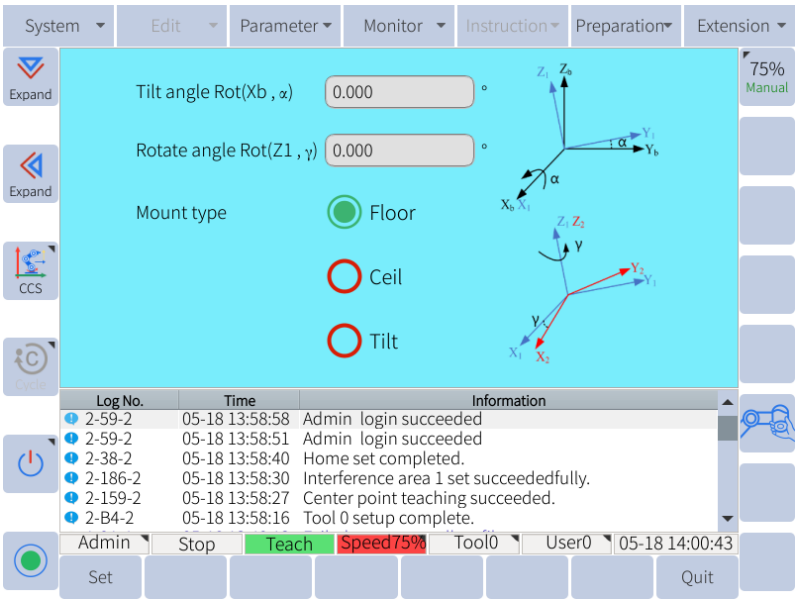


Figure 12-6 : The installation configuration page

Rotate the X-axis of the robotic base coordinate system first in accordance with the rule of the right hand. Make the XY axis plane of the robot base W1 run parallel to the mounting surface. The angle of rotation is the deflection angle Rot (Xb, α); Then rotate the Z axis of the robot base W1 in accordance with the rule of the right hand so that the new coordinate system matches the installation pose. The angle of rotation is the rotation angle Rot(Z1,γ).

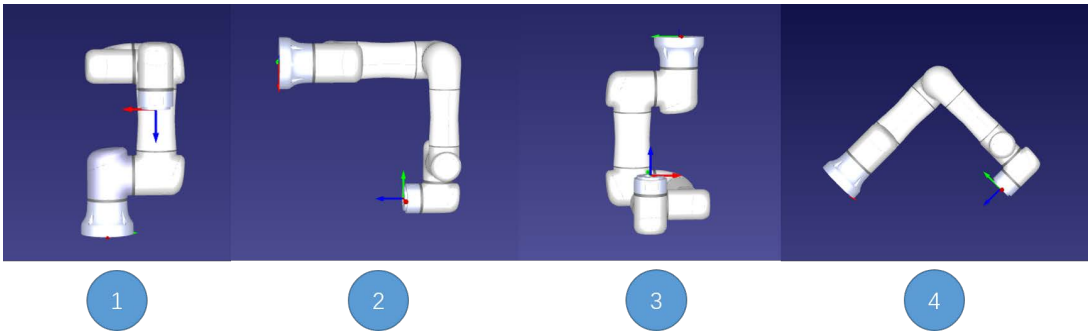


Figure 12-7 : Example of Euler's rotation theorem

Table 12-1 . Position, mounting method and angles

Position	Mounting angle	Deflection angle Rot(Xb, α)	Rotation angle Rot(Z1, γ)
Position 1	0° (ground)	0	0
Position 2	90° (wall)	-90	90
Position 3	180° (suspending)	-180	0
Position 4	45° installation	-45	90

12.2.3 Safety Limit

Certain collaborative functions of the robot can be limited for safety reasons. To configure these settings navigate to **Preparation -> Safety Config -> Safety Limit**. **Figure** 12-8 shows which of these features can be set.

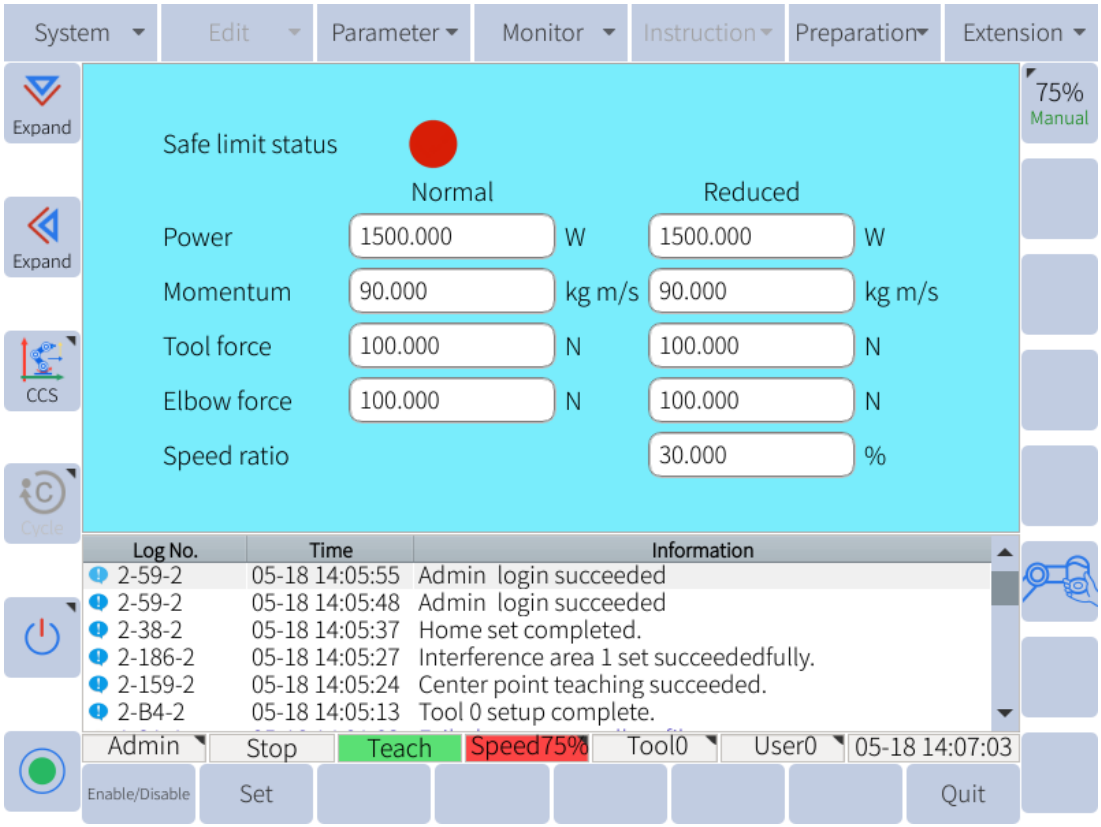


Figure 12-8 : Safety limit configuration page

The user can define normal mode and reduced mode.

After entering the reduced mode through the virtual M526 (S17) and M527 (S18), the robot runs according to the parameters of the reduced mode.

Note: Users can check whether M526 and M527 are in reduced mode on the ”Monitor > Input and output > Virtual Output” interface.

The interface parameters are explained as follows:

power: limit the power of the robot to the environment
Note: This restriction treats the payload as part of the robot and not the environment.
momentum: limit the momentum of the robot in the process of movement
tool force: limit the maximum force exerted by the robot tool in a clamping situation.
elbow force: limit the maximum force exerted by the robot’s elbow on the environment.
speed ratio: limit the speed in automatic mode.

To enable these collaborative functions and safety limits click on “Enable/Disable” in the submenu area. Once the limits have been set, click on “Set” to save the new safety limits.

12.2.4 Collision Configuration

The collision detection function of the robot can be enabled or disabled. To configure the collision detection navigate to **Preparation -> Safety config -> Collision Detection**, as shown in **Figure** 12-9 .

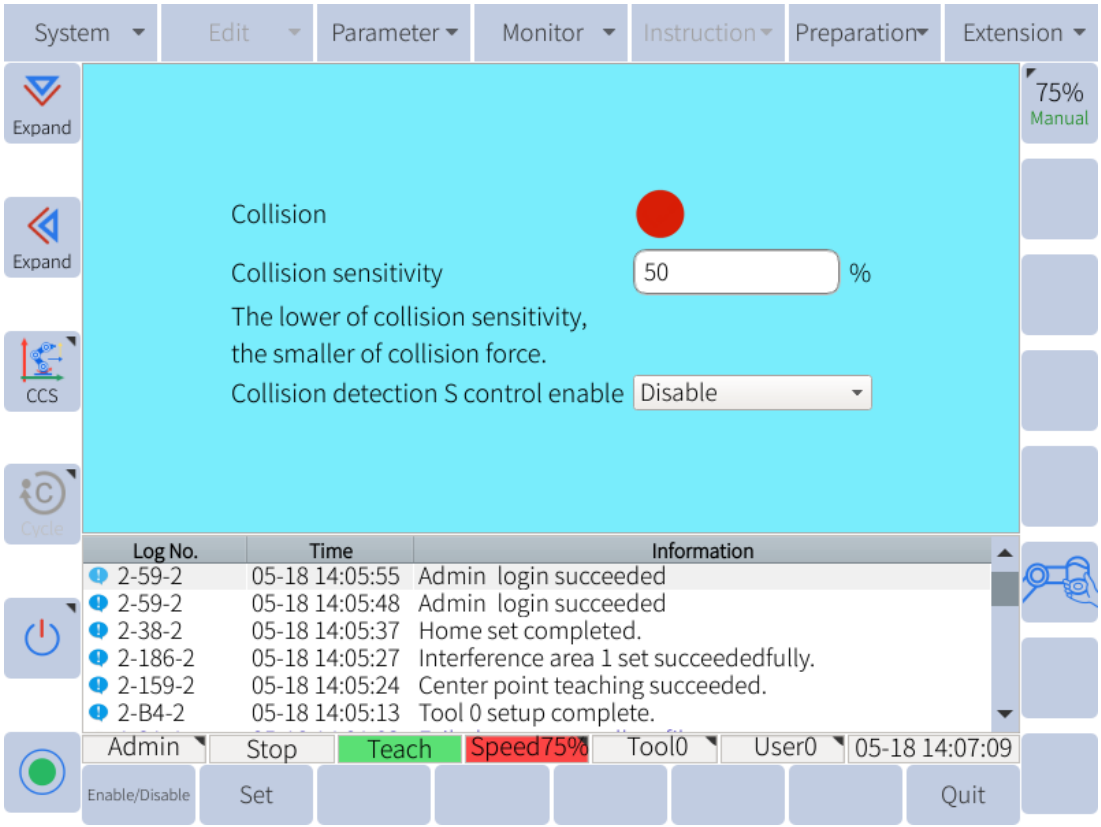


Figure 12-9 : Collision configuration page

To enable collision detection, click on “Enable/Disable” in the submenu. To set the sensitivity of the collision detection enter the sensitivity level from 0% to 100%. Click “Set” to save the new collision detection settings.

12.3 General Settings

Access to these settings are user level dependent. All settings are available to administrator level users. **Table** 12-2 shows which settings are available to each user level.

Table 12-2 . Settings accessibility by user level

User Level	Parameter
Ordinary User	1. Kinematic 2. Authority (a). User switch
Expert User	1. Kinematic 2. Controller 3. Authority (a). User switch
Super User	1. Kinematic 2. Controller 3. Soft limit 4. Authority (a). User switch (b). Password
Administrator	1. Kinematic 2. Controller 3. Soft limit 4. Joint servo 5. DH parameter 6. JOG parameter 7. Authority (a). User switch (b). Password

12.3.1 Kinematic

If users need to modify the kinematics parameters of the robot, they can go to **Parameter -> Kinematics**. The kinematics setting page is shown as **Figure** 12-10 .

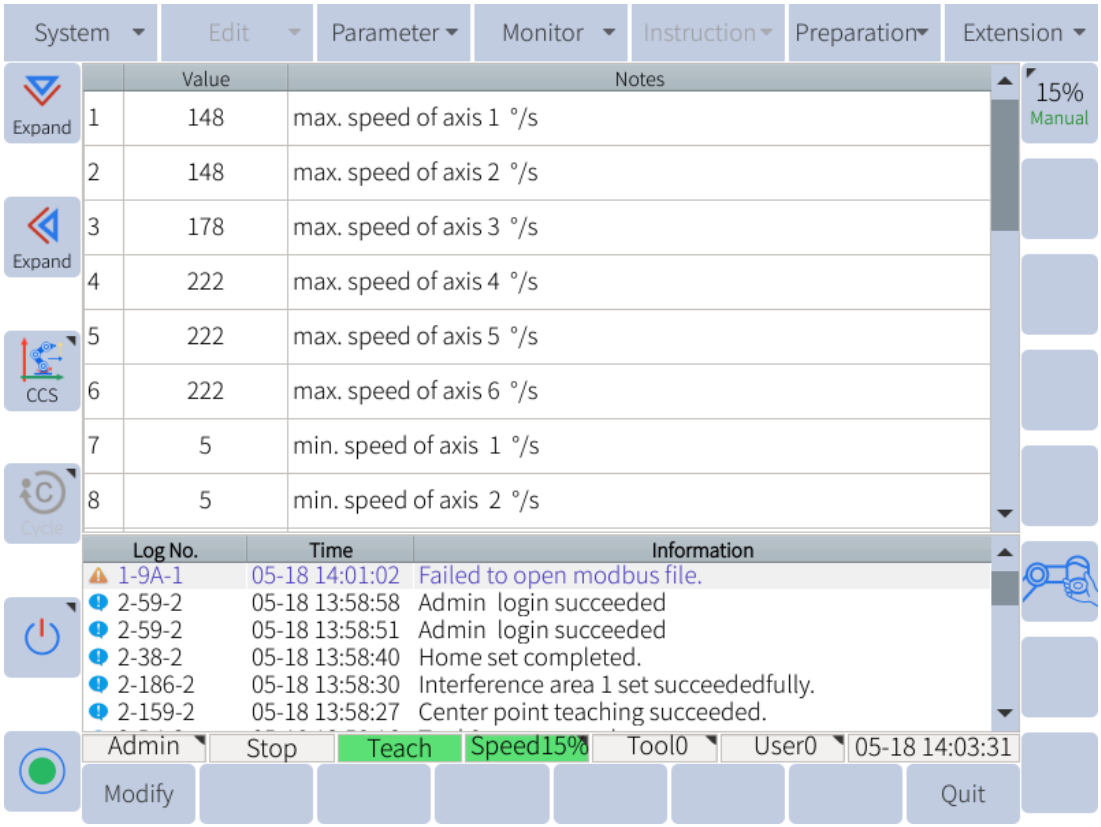


Figure 12-10 : Kinematics Setting Page

The following list shows what settings can be modified along with a description of what each setting does:

Max speed of Axis # (deg/s) - This controls the maximum rotation rate of each joint in degrees per second

Min speed of Axis # (deg/s) - This controls the minimum rotation rate of each joint in degrees per second

Max line speed (mm/s) - This controls how fast the robot TCP will move in a linear motion in millimeters per second

Min line speed (mm/s) - This controls how slowly the robot TCP will move in a linear motion in millimeters per second

Max Pose rotation angular velocity (deg/s) - this controls how fast the robot TCP will rotate about a fixed point in degrees per second

Min Pose rotation angular velocity (deg/s) - this controls how slowly the robot TCP will rotate about a fixed point in degrees per second

CAUTION

Please do not modify the settings above. If any of these settings need to be modified, please consult with ELITE ROBOT Co.,Ltd. support engineers

12.3.2 Controller settings

The system parameters are used to modify some of the teach pendant settings. To modify the system parameters navigate to **Parameter -> Controller**. **Figure** 12-11 shows the available system settings that can be modified.

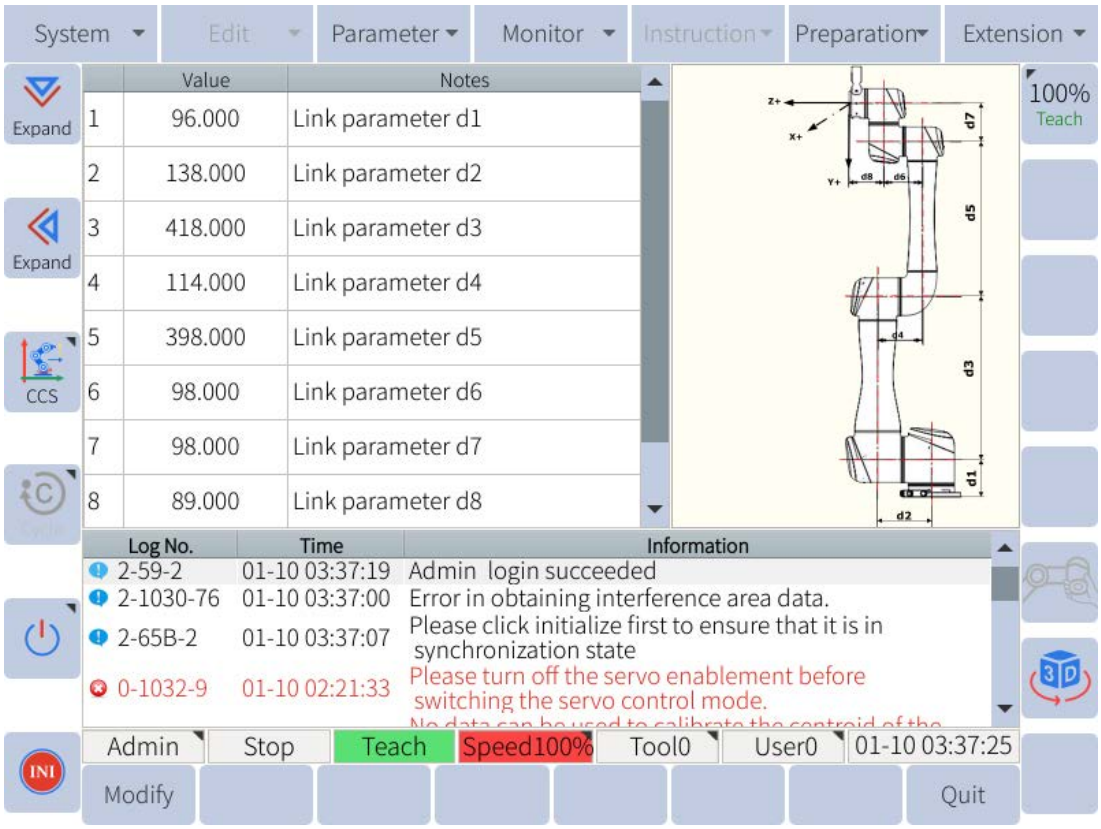


Figure 12-11 : Controller settings page

The following list contains the settings and their description:

Servo type: If you need to modify, please contact ELITE ROBOT Co.,Ltd. support engineers
Maximum motor speed: the maximum speed of the motor in the joint
Backlight brightness in normal mode- How bright the teachpendant screen is when in use (0%-100%).
Backlight brightness in power saving mode - How bright the teachpendant screen is when not in use for a specified amount of time (0%-100%).
Time to enter power saving mode- How long in seconds the teachpendant will wait before going to half brightness.
Backlight off Time - How lond in seconds the teachpendant will wait until the teachpendant becomes locked and the lock screen is displayed.
Teach pendant connection state - This controls whether the teach pendant display is used or not. If set to “disconnect” the GUI can be accessed through a VNC viewer.
Emergency stop deceleration stop time - How long the system takes to respond to an emergency stop (range from 1 to 200 ms)

12.3.3 Soft limit settings

Limits may be placed on how far each joint of the manipulator can rotate. To set these limits navigate to **Parameter -> Soft limit** (**Figure** 12-12). The maximum joint limit is +360 degrees and the minimum joint limit is -360 degrees.

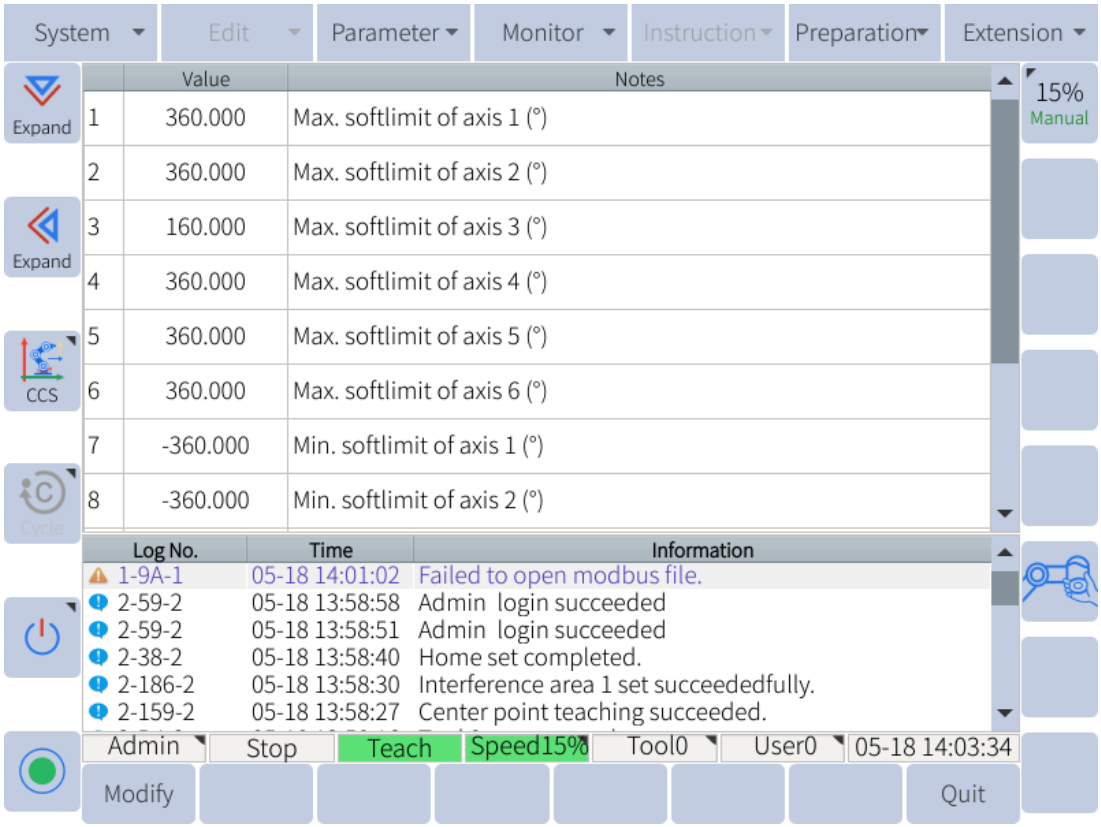


Figure 12-12 : Soft limit parameters page

12.3.4 DH Parameters

The DH parameter settings page allows the user to set the type of robot that is connected to the controller. This does not need to be modified by the user. The system comes setup so that the robot and controller are paired correctly. There is also a window showing the DH parameters of the robot. Num-bers are not given. To determine the correct dimension of each DH parameter refer to Subsection 3.1.2.

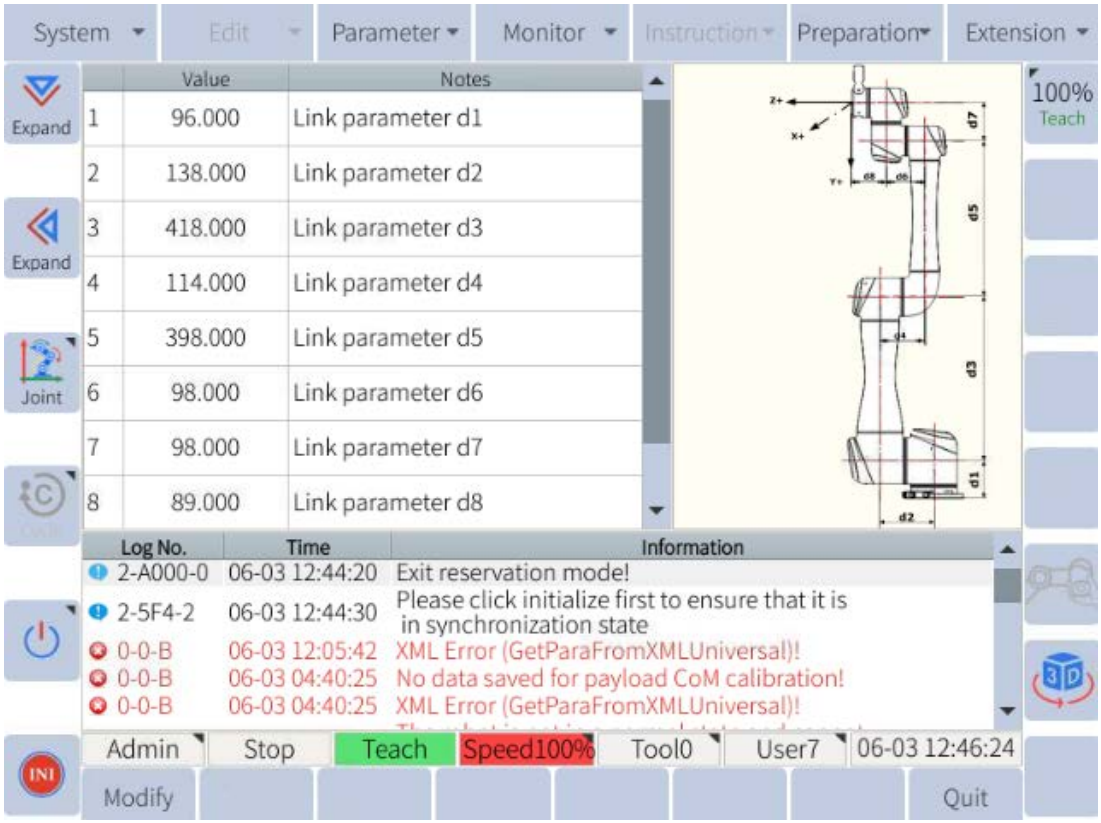


Figure 12-13 : DH parameter settings page

12.3.5 JOG Parameters

JOG parameters includes JOG parameters of the manipulator. These settings are not open for users to modify. For questions about these settings, or if the user needs to modify these settings, please consult with ELITE Robot technical support.

12.3.6 Joint servo

Servo joint are used to modify the behavior of the motor control inside the joints of the manipulator. These settings are not open for users to modify. For questions about these settings, or if the user needs to modify some settings, please consult with ELITE Robot technical support.

12.3.7 Authority

The Authority settings deal with user levels and user accessability. With these settings, users can switch to a different user level or modify user level passwords.

12.3.7.1 User switch

Figure 12-14 shows the authority settings page. Here users can select the desired user level. The user levels and what settings are available to them are discussed in Subsection 6.5.1.

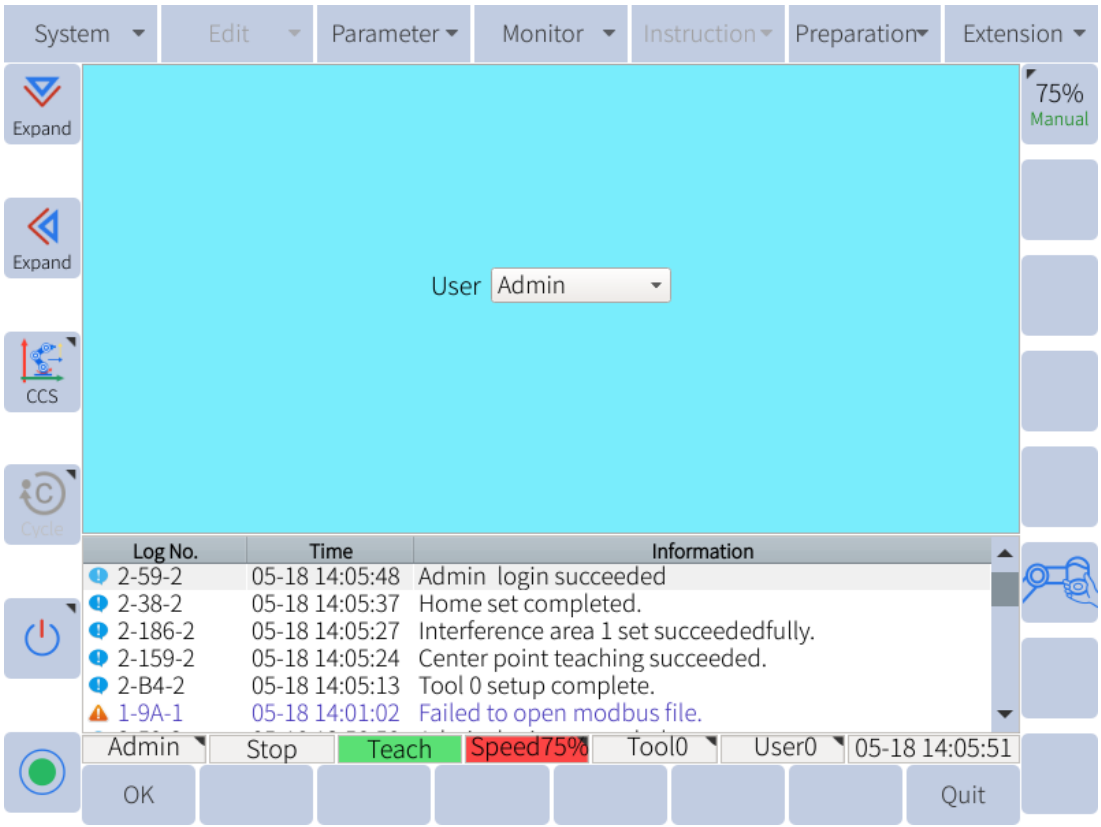


Figure 12-14 : Authority page for switching user levels

To modify the user level navigate to **Parameter -> Authority -> User switch**. Click on the drop down menu and select the desired user level. Click “OK” in the submenu to accept the change.

12.3.7.2 Modify Passwords

Figure 12-15 shows the page for modifying the administrator password. If the user wishes to modify the administrator password, they must have the administrator user level active. To modify the super user password they must have the super user level active, and so on.

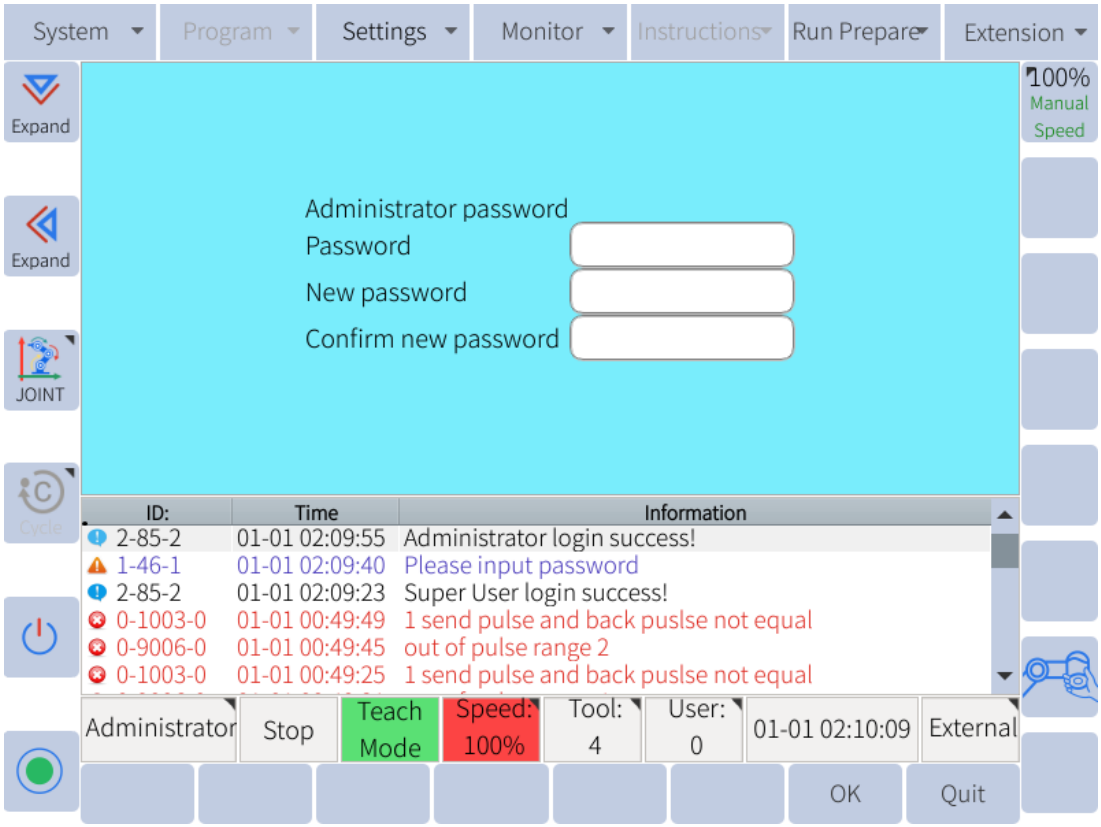


Figure 12-15 : Password page

To modify the password of the currently selected user level, navigate to **Parameter -> Authority -> Password**. Enter the current password. Enter the new password and confirm the new password. Click "OK" in the submenu to save the changes.

CAUTION

Make sure to save the new passwords in a secure location. If the user forgets the password they will not be able to log into that user level.

Chapter 13 Updates, Maintenance, Repair, and Disposal

13.1 Quality Assurance

ELITE ROBOT Co.,Ltd. should provide the necessary spare parts to replace or repair relevant parts if the new equipment and its components are defective resulting from manufacturing and/or poor materials.

ELITE ROBOT Co.,Ltd. shall possess the ownership of the equipment or components replaced or returned to ELITE ROBOT Co.,Ltd.

If the product is no longer under warranty, ELITE ROBOT Co.,Ltd. shall reserve the right of charging the customer for replacement or repair.

In case of defects of equipment that is out of warranty, ELITE ROBOT Co.,Ltd. shall not be responsible for any damage or loss caused therefrom, such as loss of production or damage due to other production equipment.

13.2 Disclaimer

If the equipment defect is caused by improper disposal or falling to comply with the relevant information stated in the user manual, the “Product Quality Assurance” will be invalid.

The warranty shall not cover the failure caused by the following circumstances:

1. Installation, wiring and connection to other control equipment are not in line with the industrial standards or not implemented in accordance with the requirements of the user manual.
2. When the EC66 is used outside the specification or standards shown in this user manual.
3. This product is used for other purposes.
4. The storage mode and operating environment are outside the specified scope (such as pollution, salt damage and dewing) of the user manual.
5. The product is damaged as a result of improper transportation.
6. Damage due to accident or impact.
7. When non-original parts and accessories are installed.
8. Damage as a result of modification, debugging or repair of the original parts by the third party outside ELITE ROBOT Co.,Ltd. or other integrators specified by ELITE ROBOT Co.,Ltd.
9. Natural disasters, such as fire, earthquake, tsunamis, lightning strikes, wind and flood.
10. Failure outside the above mentioned circumstances and not caused by ELITE ROBOT Co.,Ltd.

The following circumstances will not be covered by warranty:

1. The date of production or the start date of the warranty cannot be identified.
2. Alteration of the software or internal data.
3. The failure cannot be reproduced, or ELITE ROBOT Co.,Ltd. cannot identify the failure.
4. This product is used near or around radioactive equipment, biological test equipment, or in environments deemed hazardous by ELITE ROBOT Co.,Ltd.

In accordance with the product quality assurance agreement, ELITE ROBOT Co.,Ltd. shall be responsible for making the commitment of quality guarantee for the defects or deficiencies occurring in the products and parts sold to the dealers.

As for any other explicit or implied warranties or liabilities including, but not limited to, any implied warranty for marketability or specific use, ELITE ROBOT Co.,Ltd. shall not bear the related liability to guarantee.

In addition, ELITE ROBOT Co.,Ltd. shall not be responsible for the related liabilities in allusion to any form of indirect damage or consequence generated by the related product.

13.3 System Update

13.3.1 Image update

The user can update the computer image and the specific operations are as follows:

1. Prepare a USB flash drive and copy the image to the root directory of the USB flash drive
2. Insert the USB drive into the USB port of the control cabinet
3. Select **System -> Local from USB -> imageupdate**.
4. In the pop-up dialog box, select the desired image file and click “OK”. The system will restart automatically

NOTICE

The reimaging process may take a while. Do not power off the robot until the process is complete.

13.3.2 Software Update

System upgrade can be performed when the software needs to be updated or system failures occur. The existing user data should be backed up before the system upgrade. Note that the mechanical home position is not included for user data backup. Thus, take a photo or screenshot of the mechanical home

position page before the system upgrade.

The detailed upgrade procedure is as follows:

1. Prepare a USB flash disk and copy the system upgrade file “firmware.bin” to its root directory.
2. Insert the USB flash disk into the USB port of the controller or the collaborative robot cabinet.
3. Go to **System -> Save to USB -> User Data Backup** to back up the user data.
4. Go to **System -> System Upgrade** then press “OK” button and wait several minutes. The system will check the firmware and be upgraded automatically. It will restart the system after successful upgrade, as shown in **Figure** 13-1 .

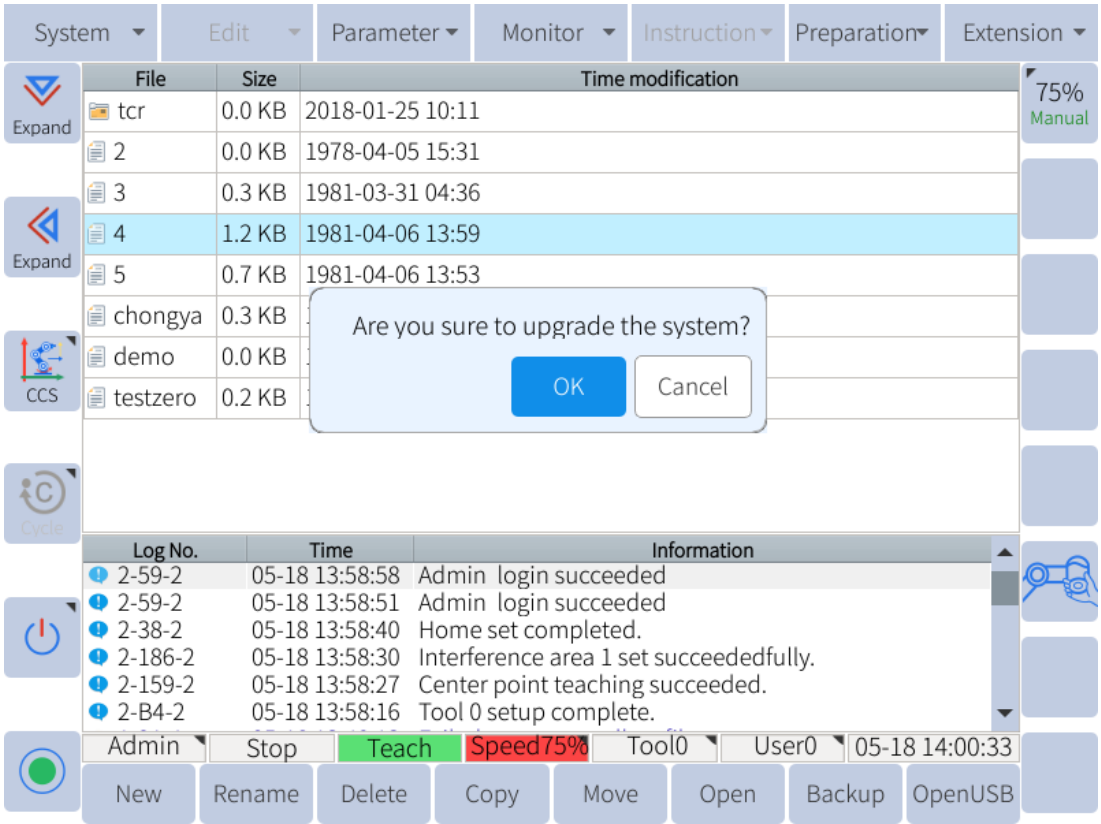


Figure 13-1 : System Upgrade

DANGER

After the software is upgraded and restarted, please reconfirm whether the zero position of the robot is normal.

13.3.3 Firmware Update

The firmware upgrade is peculiar to the collaborative robot and the detailed upgrade procedures are as follows:

1. In the root directory of the USB flash disk, create a new folder named “rbctrl” and copy the firmware upgrade file into it.
2. Insert the USB flash disk into the USB port of the collaborative robot cabinet, and a USB device icon will be displayed in the coordinate area of the programming pendant screen.
3. Go to “System > System Upgrade”, and a dialog box with the message “Confirm System Upgrade” will pop up.
4. After pressing “OK” button, the system will give the message “Please select the content that needs to be upgraded”. Then select “Upgrade Firmware”, as shown in **Figure** 13-2 .

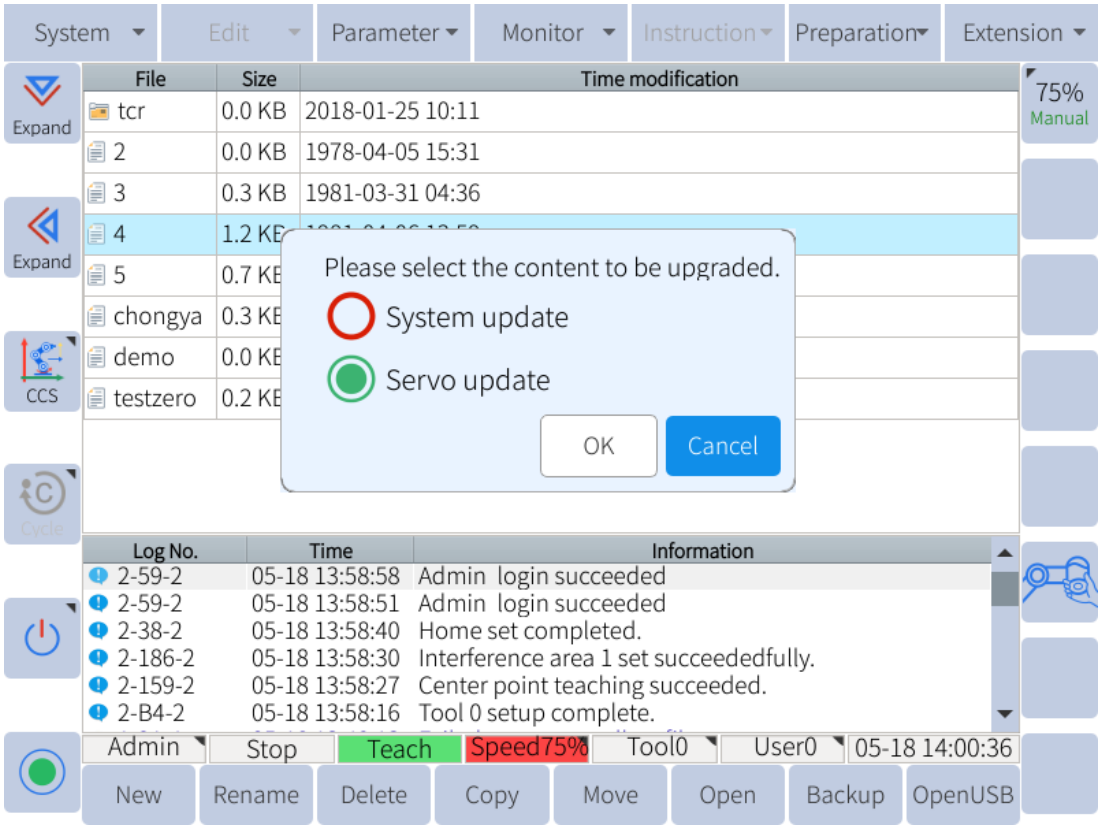


Figure 13-2 : Selecting the content that needs to be upgraded

5. Choose “Single joint upgrade” or “Whole upgrade”.
   Single joint upgrade:
   For the robot EC66, select:
   Axis 1, Axis 2: ”j25_xxxxxxxx.bin” file.
   Axis 3: ”j20_xxxxxxxx.bin” file.
   Axis 4, Axis 5 and Axis 6: ”j14_xxxxxxxx.bin” file.
   Press “Setting” button every time the upgrade file is selected for an axis until the upgrade for all axes are finished.
   Whole upgrade:
   After selecting the file with the suffix .esu, click “Settings” and wait for the upgrade to complete.
6. Power off and restart after completing the upgrade.

13.3.4 PLC Update

After the system software is updated, the system PLC is also automatically upgraded, but only supports the A23 board.

For the A22 board, before the software upgrade, you need to navigate to **System -> Save to USB -> PLC** for backup. After the upgrade is completed, navigate to **System -> Load from USB -> PLC Update** to import PLC.

To update the PLC version, acquire the plc.dat file from the ELITE Robot website or forum. Navigate to **System -> Load from USB -> PLC**.

Select “System PLC” from the list and click on “OK”.

CAUTION

The PLC upgrade must be performed after the software upgrade.

13.4 Maintenance

The maintenance and repair work must be implemented in strictly accordance with all safety instructions in this manual.

The maintenance, calibration and repair work must be operated in accordance with the latest service manual which can be found at: www.elibot.cn.

After changing the control system, the robot joints or the tool, the robot and the tool zero should be re-calibrated on the spot, and the calibration operation and the result judgment method are introduced in the specification of check for zero. In addition, the parameter settings should be checked. If the parameters are backed up, the backup parameters may be imported; if the parameters are not backed up, the parameters should be set again. If the robot joints or the tool needs to be replaced, the dynamics of the robot needs to be reentry.

Maintenance must be performed by an authorized system integrator, distributor, or ELITE ROBOT Co.,Ltd. When the parts are returned to ELITE ROBOT Co.,Ltd., disassembly and packaging should be performed in accordance with the instructions listed in the service manual.

The safety level stipulated by the maintenance and repair work must be ensured, the effective national or regional working safety rules must be followed, and all safety functions run normally must be tested.

In order to avoid damage to the robot arm or controller the following safety procedure and cautions must be followed:

Safety procedure:

1. Remove the main power cable from the back of the controller to ensure that the robot is completely powered off. Take necessary precautions to prevent other persons from re-energizing the system during the repair period. When it is powered off, double check the system to ensure that it has been completely powered down.
2. Please check the earth connection before re-starting the system.
3. Please comply with the electrostatic discharge (ESD) regulations when disassembling the robot arm or the controller.
4. Avoid disassembling the power supply system of the controller. The high voltage can be remained inside the power supply system for several hours when the controller is switched off.
5. Prevent water or dust from entering into the robot arm or the controller.

Cautions:

1. Replace faulty parts with the identical part number or the corresponding parts approved by ELITE ROBOT Co.,Ltd.
2. Reactivate all safety measures immediately upon completion of the work.
3. Record all maintenance operations in written form and save these records in the relevant technical documents for the whole robot system.
4. The controller cannot be repaired by end-users. If maintenance or repair services are needed, please contact your distributor or ELITE ROBOT Co.,Ltd.

13.5 Disposal

The EC66 robot must be disposed of in accordance with the local and national laws, regulations, and national standards.

13.6 Error Codes

13.6.1 Program alarm

Alarm Number	Description	Alarm Number	Description
0-1000-0	Failed to open Modbus library!	0-1000-7	Failed to call the interface for obtaining the permission time!
0-1000-1	Modbus slave startup failed!	0-1000-8	Failed to call the interface for obtaining the permission time!
0-1000-2	The reservation function is not enabled, please enable it first!	0-1000-9	Failed to call the interface for obtaining the permission time!
0-1000-3	The reserved program %s has not been set	0-1000-10	Failed to backup nvram data
0-1000-4	Flange button is disabled!	0-1000-11	Failed to backup nvram data
0-1000-5	The main program has not been set!	0-1000-12	Failed to restore SPI FLASH data!
0-1000-6	Failed to obtain permission time!	0-1000-13	Failed to backup SPI FLASH data!

Alarm Number	Description	Alarm Number	Description
0-1000-14	Failed to backup SPI FLASH data!	0-1020-0	The type setting of the collaborative robot does not match the Robot body!
0-1000-15	Failed to load NVRAM backup data	0-1020-1	Unknown robot subtype
0-1000-A	Failed to call the interface for obtaining the permission time!	0-1020-2	Unknown robot subtype
0-1000-B	Invalid User ID!	0-1020-3	Theta out of range[-180,0]
0-1000-C	System encryption failed!	0-1020-4	Failed to get Lua script configuration data.
0-1000-D	Invalid license	0-1020-5	Failed to set Lua script configuration document.
0-1000-E	Invalid license	0-1020-6	Failed to set Lua script configuration.
0-1000-F	Failed to get serial number	0-1020-7	Unknown robot subtype

Alarm Number	Description	Alarm Number	Description
0-1020-8	Unable to get nodeSN.xml content, unable to identify the matching between robot body and controller.	0-1030-1	Shengjin formula related errors
0-1020-9	Unable to save the matching file of the robot body and the controller	0-1030-2	Shengjin formula related errors 0
0-1020-A	Unable to get nodeSN.xml content, unable to identify the matching between robot body and controller.	0-1030-3	Shengjin formula related errors 2
0-1020-B	Incorrectly setting of swing welding type	0-1030-4	Shengjin formula related errors 3
0-1020-C	Failed to detect the welding function. Please open it in the process configuration.	0-1030-5	Shengjin formula related errors
0-1030-0	Matrix inversion failed	0-1030-6	Error: Divide by zero

Alarm Number	Description	Alarm Number	Description
0-1030-7	Shengjin formula related errors 6	2-1030-16	Dynamic model verification failed, unable to set load parameters!
0-1030-8	Shengjin formula related errors 7	0-1030-17	Failed to get reservation configuration.
0-1030-9	Error with speed calculation result of 0	0-1030-18	Failed to set reservation configuration.
0-1030-10	Incorrect tool settings	0-1030-19	The reservation program is set incorrectly!
0-1030-11	Incorrectly setting tool data.	0-1030-20	Invalid speed parameter
0-1030-12	Current robot type does not support this function!	0-1030-21	Invalid PL parameter
0-1030-14	Calculation tool failed %s	0-1030-22	Invalid CR parameter
2-1030-15	Tool calibration error: Average error: %s mm, Maximum error: %s mm, Minimum error: %s mm	0-1030-23	Invalid ACC parameter

Alarm Number	Description	Alarm Number	Description
0-1030-24	Invalid DEC parameter	2-1030-33	The robot is not in PLAY mode.
2-1030-25	Robot mode or status error	1-1030-34	Please clear the collision alarm first!
2-1030-26	Track recording has not started	2-1030-35	Robot is in the safeguard stop
2-1030-27	The number of track recording points exceeds the limit	2-1030-36	Robot is in the safeguard stop
2-1030-28	Track record memory application failed!	2-1030-37	The robot is in an external pause state.
0-1030-29	Failed to save the drag track record JBI file. Currently it is not in Drag-teach state.	2-1030-38	Safety door triggered.
0-1030-30	Check data error	2-1030-39	Pause
0-1030-31	Trial time expired!	0-1030-40	EtherCAT servo disconnected
2-1030-32	The servo is not enabled. Please turn on the servo first.	0-1030-41	Ethercat master status error

Alarm Number	Description	Alarm Number	Description
0-1030-42	Ethercat DC synchronization failed	2-1030-51	main file set up for %s
0-1030-43	%s axis alarm	2-1030-52	%s file is not a JBI program and cannot be set as the main program
0-1030-44	%s axis unknown alarm!	0-1030-53	Firmware of %s joint does not match
0-1030-45	Emergency stop alarm X0	0-1030-54	Axis %s starts to update the firmware!
0-1030-46	Emergency stop alarm M0	0-1030-55	Failed to update firmware for axis %s
0-1030-47	External emergency stop alarm	0-1030-56	Axis %s update firmware completed!
0-1030-48	Collision warning	0-1030-57	The current servo version does not support the entire package upgrade, please upgrade axis by axis.
0-1030-49	Arc breaking alarm	0-1030-58	No matching firmware found!
2-1030-50	Clear main program settings	0-1030-59	%s axis starts to write dynamics information.

Alarm Number	Description	Alarm Number	Description
0-1030-60	Unable to call setFCParas interface	0-1030-66	Unable to open function ui_zeroload_calibration
0-1030-61	Unable to call the fc_force_control interface	0-1030-67	Unable to open function ui_payload_calibration_payload
0-1030-62	Unable to call zeroFT interface	0-1030-68	Unable to open function ui_payload_calibration_zeroload
0-1030-63	Unable to call addPayloadCalibrationData interface	0-1030-69	Unable to open function load_fc_para_from_shared_mem
0-1030-64	Unable to call addZeroLoadReading interface	0-1030-70	Unable to open function ui_record_calibration_point
0-1030-65	Unable to open function isInForceControl	0-1030-71	Unable to open function ui_compute_payload_CoM

Alarm Number	Description	Alarm Number	Description
0-1030-72	Unable to open function ui_move_to_recorded_point	0-1030-79	The type of robot does not match the number of axes and can only run in joint coordinates.
0-1030-73	Unable to open function ui_change_FT_sensor_data_source	0-1030-80	%s axis has not been set
0-1030-74	Failed to set the back-end data source, torque sensor is not enabled.	0-1030-81	%s axis is not used, please reconfigure it.
0-1030-75	The data source of the torque sensor is set successfully	0-1030-82	The servo is not enabled. Please turn on the servo first.
0-1030-76	Error in obtaining interference area data.	0-1030-83	Robot is not in teach mode or remote mode!
0-1030-77	Failed to save interference zone.	1-1030-84	Please clear the collision alarm first!
0-1030-78	Failed to set interference zone.	0-1030-85	Unable to operate, abnormal manual operation

Alarm Number	Description	Alarm Number	Description
0-1030-86	Axis %s exceeds the limit at the target position.	0-1030-93	Three waypoints coincide!
0-1030-87	Unable to operate, abnormal manual operation	0-1030-94	The %s and %s waypoints coincide, cannot run MOVC/MOVEC!
0-1030-88	Please clear the collision alarm first!	0-1030-95	Unable to operate, abnormal manual operation
0-1030-89	Unable to operate, abnormal manual operation	2-1030-96	run_forward command failed to parse circular motion transition point
1-1030-90	Please clear the collision alarm first!	2-1030-97	run_forward command failed to parse circular motion transition point
0-1030-91	Unable to operate, abnormal manual operation	2-1030-98	run_forward command failed to parse tool coordinate data
0-1030-92	Unable to run the MOVC/MOVEC instruction, please check the teaching waypoint!	2-1030-99	run_forward command failed to parse user coordinate data

Alarm Number	Description	Alarm Number	Description
0-1030-A	Since the dynamics is disabled, the external force/torque cannot be estimated.	0-1030-1C	Joint soft limit alarm
0-1030-B	Since the dynamics is disabled, the external force/torque cannot be estimated.	0-1030-1D	The servo is not enabled. Please turn on the servo first.
0-1030-C	Error getting data for tool %s	0-1030-1E	Invalid motion instruction type
0-1030-D	Incorrect tool settings	0-1030-1F	Invalid speed parameter type
0-1030-E	incorrectly setting tool data.	0-1030-2A	Failed to save the track record JBI file, the file name is too long
0-1030-F	Error getting data for tool %s	2-1030-2B	The track record JBI file already exists!
2-1030-1A	Exit reservation mode!	0-1030-2C	Failed to open the file.
0-1030-1B	The robot is in suspended state	2-1030-2D	The track record JBI file is saved successfully!

Alarm Number	Description	Alarm Number	Description
2-1030-2E	Non motion commands are not executed in single step mode.	0-1030-4A	Welding machine alarm
0-1030-2F	The robot has already reached the end of the Program!	0-1030-4B	The %s axis servo is in bootloader state
0-1030-3A	Servo is writing parameters, please wait	0-1030-4C	The end IO is in the bootloader state
2-1030-3B	Clear collision alarm status!	0-1030-4D	%s axis alarm
0-1030-3C	%s axis servo alarm	0-1030-4E	Emergency stop timeout, protection stop timeout alarm
0-1030-3D	%s Stack communication alarm	0-1030-4F	The last shutdown position of joint %s is different from the current position.
0-1030-3E	Ethercat servo connection failed	0-1030-5A	%s axis write dynamic information completed!
0-1030-3F	The number of Ethercat servos does not match	0-1030-5B	%s axis starts to write dynamics information.

Alarm Number	Description	Alarm Number	Description
0-1030-5C	%s axis write dynamic information completed!	0-1030-6d	Unable to open function write_fc_para_to_xml
0-1030-5D	Unable to open force control library %s	0-1030-6e	Unable to open function ui_inertia_calibration_zeroload
0-1030-5E	Unable to call the startForceMode interface!	0-1030-6f	Unable to open function ui_inertia_calibration_payload
0-1030-5F	Unable to call the endForceMode interface	0-1030-7a	Invalid PL or CR transfer in JBI line %s
0-1030-6a	Unable to open function write_fc_para_to_shared_mem	0-1030-7b	Invalid PL or CR transfer in JBI line %s
0-1030-6b	Unable to open function print_fc_para_struct	0-1030-7c	The robot is in suspended state
0-1030-6c	Unable to open function force_mode_feature_init	2-1030-7d	The robot has reached the target point.

Alarm Number	Description	Alarm Number	Description
2-1030-7e	The robot reaches the target pose, but the configuration is inconsistent.	0-1030-8f	run_forward command motion target point %s axis over soft limit
2-1030-7f	Please enable the six-dimensional mouse function first, and then operate in the sensor coordinate system!	2-1030-9a	run_forward command failed to parse reference joint data
0-1030-8a	Configuration is inconsistent with expectation	2-1030-9b	run_forward command unknown motion type
0-1030-8b	Unable to operate, abnormal manual operation	2-1030-9c	run_forward command failed to parse motion target point
0-1030-8c	Please clear the collision alarm first!	2-1030-9d	run_forward command failed to parse motion target point
0-1030-8d	Axis %s exceeds the soft limit	2-1030-9e	%s is moving by joint in joint coordinate
2-1030-8e	Invalid parameter in motion instruction	2-1030-9f	%s is moving by line in base coordinate

Alarm Number	Description	Alarm Number	Description
2-1030-a0	%s is moving by line in tool coordinate	0-1030-a9	JOB file %s format error %s
2-1030-a1	%s is moving by line in user coordinate	0-1030-aa	Error in interval range of job file %s
2-1030-a2	%s is moving by joint in cylindrical coordinate	0-1030-ab	Memory request failed!
2-1030-a3	move_under_coord command unknown coordinate type	0-1030-ac	Failed to open JOB file %s
2-1030-a4	Axis %s exceeds the soft limit	0-1030-ad	Memory request failed!
2s-1030-a5	Axis %s exceeds the soft limit	0-1030-ae	JOB file %s format error
0-1030-a6	The servo is not enabled. Please turn on the servo first.	0-1030-af	JOB file %s format error
0-1030-a7	The robot is not in TEACH mode.	0-1030-b0	The timestamp in the trajectory motion instruction is not incremented
0-1030-a8	JOB file %s format error	0-1030-b1	JOB file %s format error

Alarm Number	Description	Alarm Number	Description
0-1030-b2	The number of timestamps in the trajectory motion instruction does not match the number of points	0-1030-b8	Parameter setting failed, parameter range%s-%s
2-1030-b3	Successfully uninstalled JOB file %s	0-1030-b9	Parameter setting failed, parameter range%s-%s
0-1030-b4	Failed to open JOB file %s	0-1030-ba	Parameter setting failed, parameter range%s-%s
0-1030-b5	The first waypoint is unreachable. Please check the first waypoint of MOVML	0-1030-bb	Parameter setting failed, parameter range%s-%s
0-1030-b6	IO range is [0-51]	0-1030-bc	The current parameter format is different from the last shutdown. Use the backup parameter.
0-1030-b7	The first waypoint is unreachable. Please check the first waypoint of MOVML	0-1030-bd	No parameter file, import default parameters.

Alarm Number	Description	Alarm Number	Description
0-1030-be	The robot type is not supported. Please select the robot type correctly!	0-1030-c4	Unable to open function velocity jacobian function
0-1030-bf	The robot type is not supported. Please select the robot type correctly!	0-1030-c5	Calibration requires 20 waypoints, %s have been taught.
0-1030-c0	Unable to open function velocity jacobian function	0-1030-c6	Current robot type does not support this function!
0-1030-c1	Unable to open the forward and inverse solution library, please try to restart.	0-1030-c7	Axis %s division ratio is wrong, please reset it.
0-1030-c2	The robot type is not supported. Please select the robot type correctly!	0-1030-c8	%s Axis exceeds the upper limit of soft limit
0-1030-b3	The robot type is not supported. Please select the robot type correctly!	0-1030-c9	%s axis exceeds the lower limit of soft limit

Alarm Number	Description	Alarm Number	Description
0-1030-ca	Joint %s speed exceeds limit [%s]:%s °/s	0-1030-d4	V%s data format error
0-1030-cb	%s axis motor overspeed	0-1030-d5	V variable index out of range!
1-1030-cc	Enter reduction mode	0-1030-d6	%s variable initialization failed.
0-1030-cd	Enter normal mode	0-1030-d7	Failed to save P variable!
0-1030-ce	%s variable initialization failed.	2-1030-d8	V%s variable save failed
0-1030-cf	%s variable initialization failed.	0-1030-d9	Failed to save V variable!
0-1030-d0	P variable file opening failed!	0-1030-da	V%s variable save failed
0-1030-d1	P%s data format error!	0-1030-db	P variable setting failed, %s axis exceeded the soft limit
0-1030-d2	P variable index out of bounds!	0-1030-dd	Axis No. %s: Alarm No. = %s , Time tag = %s
0-1030-d3	Open V variable file failed!	0-1030-de	Failed to obtain user coordinate system data!

Alarm Number	Description	Alarm Number	Description
0-1030-df	Failed to save user coordinate system data!	2-1030-e7	Inverse kinematics solution of %s axis failed
0-1030-e0	[%s:%s]Failed to create user coordinate system!	2-1030-e9	Failed to set the network.
0-1030-e1	Number of waypoints: %s, user coordinate system definition requires 3 waypoints	2-1030-ea	The network is set successfully.
0-1030-e2	Parameter setting failed, parameter range%s-%s	0-1030-eb	The target pose is singular.
0-1030-e4	Inverse kinematics solution of %s axis failed	1-1031-0	Dynamic model verification failed, unable to enable dynamic function
0-1030-e5	Inverse kinematics solution of %s axis failed	0-1031-1	At rest, the feedback position of the %s axis is greatly different from the actual position. Please check and restart the encoder.
2-1030-e6	Inverse kinematics solution of %s axis failed	1-1031-3	The robot status has been reset

Alarm Number	Description	Alarm Number	Description
0-1031-4	Servo device error!	0-1031-10	The track has been recorded for %s minutes, and up to %s minutes can be recorded.
0-1031-5	IO device error!	0-1031-11	The track record exceeds the maximum time, the exceeding track will no longer be recorded!
0-1031-6	Force sensor device error!	2-1031-12	Trajectory record failed!
0-1031-7	Joint soft limit alarm	2-1031-13	Trajectory record failed!
0-1031-8	Failed to get the force information through SDK/LUA, transmission of the force data has not yet started	2-1031-14	Failed to open the file %s
0-1031-9	At rest, the feedback position is greatly different from the actual position. Please check and restart the encoder.	0-1031-15	Drag enable is not turned on!

Alarm Number	Description	Alarm Number	Description
1-1031-16	Speed exceeds threshold, failed to start recording	0-1031-d	The parameters of receiving and sending pulses after one revolution of %s-axis motor are not set
1-1031-17	Speed exceeds threshold, failed to end recording	0-1031-e	The parameters of receiving and sending pulses after one revolution of %s-axis motor are not set
0-1031-a	%s axis target position does not match the feedback position	2-1031-f	Memory request failed!
0-1031-b	The robot body does not match the controller!	2-1032-0	It is currently in an abnormal state, and the dynamic model cannot be verified again
2-1031-c	Failed to set servo enable	2-1032-1	It is currently in drag or running state, and the dynamic model cannot be verified again

Alarm Number	Description	Alarm Number	Description
1-1032-2	Axis% s is in shielding state, unable to recheck the dynamic model	0-1032-9	Please turn off the servo enablement before switching the servo control mode.
2-1032-3	The dynamics model is verified successfully	2-1032-10	Failed to obtain kinetic parameters!
2-1032-4	The dynamics model verification failed. Please check if the setup type and payload-parameter settings are correct.	0-1032-11	Failed to open %s
0-1032-5	The robot is not in a normal state and cannot start dragging and teaching.	0-1032-12	Cannot call dynamics_init interface!
0-1032-6	Joint soft limit alarm	0-1032-13	Cannot call dynamics_exit interface!
0-1032-7	Unable to enable drag teaching in PLAY mode!	0-1032-14	Cannot call dynamics_send_position interface!
0-1032-8	Servo off timeout!	0-1032-15	Cannot call dynamics_stop_position interface!

Alarm Number	Description	Alarm Number	Description
0-1032-16	Cannot call dynamics_process_fb_data interface!	0-1032-1c	It is impossible to open the drag function in the force control mode.
0-1032-17	Cannot call dynamics_exec_payload_idt_motion interface!	0-1033-0	Axis %s exceeds the limit at the target position.
0-1032-18	Cannot call dynamics_idt_payload_params interface!	0-1033-1	The point positions of MOVC/MOVEC parameters coincide and cannot be run.
0-1032-19	Cannot call dynamics_reset_control_mode interface!	0-1033-2	Inversion failed. The target point is singular or unreachable
0-1032-1a	Cannot call dynamics_set_drag_status interface!	1-1033-3	The robot status has been reset
0-1032-1b	Unable to call dynamics_check_dyn_model interface!	0-1100-0	The target pose is singular.

Alarm Number	Description	Alarm Number	Description
2-1300-1	Device file %s is occupied.	0-1800-15	Servo alarm: %s,The software of joint %s is over-current, the joint is stuck or the load is too large
0-1800-a	Servo alarm: %s,Joint %s hardware is over-current, the joint is stuck or the instantaneous load is too large	0-1800-16	Servo alarm: %s,Joint %s is over-current during startup. Please check whether the joint is stuck or the brake fails
0-1800-14	Servo alarm: %s, Joint %s current zero offset is abnormal, please restart or contact after-sales service	0-1800-17	Servo alarm: %s,Joint %s current impact, instantaneous high current detected

Alarm Number	Description	Alarm Number	Description
0-1800-1e	Servo alarm: %s,The actual deviation of joint %s from the target position is too large, the load is too large, or the joint is stuck	0-1800-28	Servo alarm: %s,Joint %s emergency stop alarm
0-1800-1f	Servo alarm: %s, The deviation between the actual position of joint %s and the target position is too large. Please check whether the joint is stuck or the brake is faulty	0-1800-29	Servo alarm: %s,Joint is writing parameters
0-1800-20	Servo alarm: %s,Joint %s special emergency stop alarm triggered	0-1800-2b	Servo alarm: %s, Joint is restarting

Alarm Number	Description	Alarm Number	Description
0-1800-32	Servo alarm: %s,The communication of joint %s is abnormal and the bus verification fails. Please check the robot and connecting line or check the interference source	0-1800-36	Servo alarm: %s,The communication of joint %s is abnormal and the communication frame is incomplete. Please check the robot and connecting line or check the interference source
0-1800-33	Servo alarm: %s,The communication of joint %s is abnormal and the bus is not synchronized. Please check the robot and connecting line or check the interference source	0-1800-3c	Servo alarm: %s,Joint %s Joint encoder data of is abnormal. Please try restarting or contact after-sales service
0-1800-34	Servo alarm: %s,The communication of joint %s is abnormal and the master station data is not received. Please check the robot and connecting line or check the interference source	0-1800-3d	Servo alarm: %s,Joint %s The data difference between joint and motor encoder is too large. Please try restarting or contact after-sales service

Alarm Number	Description	Alarm Number	Description
0-1800-3e	Servo alarm: %s,Joint %s joint and motor encoder are not calibrated, joint encoder data is abnormal, not calibrated	0-1800-47	Servo alarm: %s,Joint %s No motor encoder index signal detected, motor encoder contaminated
0-1800-3f	Servo alarm: %s,Joint %s The data deviation between joint and motor encoder is too large, encoder failure	0-1800-48	Servo alarm: %s,Joint %s Abnormal motor encoder data, phase to phase verification failed, motor encoder polluted
0-1800-46	Servo alarm: %s,Joint %s motor encoder calibration failed, no index signal detected	0-1800-49	Servo alarm: %s,Joint %s The electrical angle deviation is too large, the motor encoder data and calibration data verification failed, and the motor encoder polluted

Alarm Number	Description	Alarm Number	Description
0-1800-4a	Servo alarm: %s,Joint %s joint and motor encoder are not calibrated, motor encoder data is abnormal, not calibrated	0-1800-4e	Servo alarm: %s,The electrical angle of joint %s is abnormal, the encoder data is out of range, and the motor encoder is polluted
0-1800-4b	Servo alarm: %s,The electrical angle deviation of joint %s is too large, the verification of motor encoder data and calibration data fails, and the motor encoder is polluted	0-1800-4f	Servo alarm: %s,The electrical angle of joint %s is abnormal, the encoder data is out of range, and the motor encoder is polluted
0-1800-4c	Servo alarm: %s,The electrical angle deviation of joint %s is too large, the verification of motor encoder data and hall data fails, and the motor encoder is polluted	0-1800-50	Servo alarm: %s,Hall sensor of joint %s is abnormal. Please try restarting or contact after-sales service

Alarm Number	Description	Alarm Number	Description
0-1800-51	Servo alarm: %s,During calibration, the hall sensor accuracy of joint %s is poor. Please try restarting or contact after-sales service	0-1800-5b	Servo alarm: %s,The holding brake of joint %s is abnormal, and the forward and reverse rotation of motor fails. Please check whether the joint is stuck
0-1800-52	Servo alarm: %s,Hall sensor of joint %s is abnormal. Please try restarting or contact after-sales service	0-1800-5c	Servo alarm: %s,The holding brake of joint %s is abnormal, and the motor reversal fails. Please check whether the joint is stuck
0-1800-5a	Servo alarm: %s, The holding brake of joint %s is abnormal and the forward rotation of motor fails. Please check whether the joint is stuck	0-1800-5e	Servo alarm: %s,The braking distance of joint %s exceeds limit. Brake fault or overload.

Alarm Number	Description	Alarm Number	Description
0-1800-64	Servo alarm: %s,Joint %s is overloaded, acceleration or load is too large	0-1800-82	Servo alarm: %s,The joint %s is overheated. Please check the ambient temperature or joint heat dissipation
0-1800-6e	Servo alarm: %s,Joint %s exceeds the maximum motor speed	0-1800-c8	Servo alarm: %s,Abnormal multi circle data in joint %s flash
0-1800-78	Servo alarm: %s,Joint %s bus voltage is overvoltage, please check whether the brake plate is connected or working normally	0-1800-c9	Servo alarm: %s,Joint %s is not ready, initialization is not complete
0-1800-79	Servo alarm: %s,Joint %s bus is under voltage, please check the bus voltage or the state of each joint	0-2001-1	[%s:%s]Index of variables or parameters %s are out of range.

Alarm Number	Description	Alarm Number	Description
0-2001-2	[%s:%s]Index of variables or parameters %s are out of range.	0-2001-8	Indexes of variables or parameters are out of range.
0-2001-3	[%s:%s]Index of variables or parameters %s are out of range.	0-2001-9	[%s:%s]Parameters of a waypoint variable type are not accepted.
0-2001-4	[%s:%s]Index of variables or parameters %s are out of range.	0-2001-10	[%s:%s]Unsupported IO type %s
0-2001-5	[%s:%s]Index of variables or parameters %s are out of range.	0-2001-11	[%s:%s]IO decoding error!
0-2001-6	Illegal variable value	0-2001-12	[%s:%s]Index of variables or parameters %s are out of range.
0-2001-7	Indexes of variables or parameters are out of range.	0-2001-13	[%s:%s]Error type

Alarm Number	Description	Alarm Number	Description
0-2001-14	[%s:%s]DIN/MIN instruction decoding error	0-2001-20	[%s:%s]Incorrect MCWAIT instruction collision sensitivity parameter!
0-2001-15	[%s:%s]DIN/MIN instruction parameter [%s] is incorrect!	0-2001-21	[%s:%s]TIMER instruction decoding error
0-2001-16	[%s:%s]Incorrect DOUT/MOUT instruction parameters	0-2001-22	[%s:%s]Unknown condition %s
0-2001-17	[%s:%s]DOUT/MOUT %s decoding error	0-2001-23	[%s:%s]Repeat condition, forget | or &
0-2001-18	[%s:%s]AXISDISABLE Command format error %s	0-2001-24	[%s:%s]PULSE instruction decoding error
0-2001-19	[%s:%s]AXISDISABLE command contain redundant parameters %s	0-2001-25	[%s:%s]PULSE %s instruction decoding error

Alarm Number	Description	Alarm Number	Description
0-2001-26	[%s:%s]AOUT instruction decoding error	0-2001-34	[%s:%s]ELSEIF instruction decoding error!
0-2001-27	[%s:%s]AOUT decoding error parameter %s	0-2001-35	[%s:%s]ELSEIF instruction decoding error!
0-2001-28	[%s:%s]AOUT instruction decoding error	0-2001-36	[%s:%s]ELSE instruction decoding error!
0-2001-29	[%s:%s]AOUT %s instruction decoding error	0-2001-37	[%s:%s]ELSE instruction decoding error!
0-2001-30	[%s:%s]AIN decoding error	0-2001-38	[%s:%s]ENDIF instruction decoding error!
0-2001-31	[%s:%s]AIN decoding error	0-2001-39	[%s:%s]ENDIF instruction decoding error!
0-2001-32	[%s:%s]AIN decoding error parameter %s	0-2001-40	[%s:%s]ENDWHILE instruction decoding error!
0-2001-33	[%s:%s]AIN decoding error parameter %s	0-2001-41	[%s:%s]ENDWHILE instruction decoding error!

Alarm Number	Description	Alarm Number	Description
0-2001-42	[%s:%s]CONTINUE instruction decoding error!	0-2001-49	[%s:%s]Empty LABEL
0-2001-43	[%s:%s]BREAK instruction decoding error!	0-2001-50	[%s:%s]The %s Label has been defined in the %s line of the %s file.
0-2001-44	[%s:%s]%s is empty label	0-2001-51	[%s:%s]TIMER instruction must set the T parameter
0-2001-45	[%s:%s]%s label memory out of bounds	0-2001-52	[%s:%s]TIMER instruction decoding error
0-2001-46	[%s:%s]Execution file %s memory overflow	0-2001-53	[%s:%s]Incorrect SAVEVARP Instruction parameter %s
0-2001-47	[%s:%s]Unknown format %s, the correct format is %s	0-2001-54	[%s:%s]%s [%s] instruction decoding error
0-2001-48	[%s:%s]LABEL must start with *	0-2001-55	[%s:%s]NOP [%s] instruction decoding error

Alarm Number	Description	Alarm Number	Description
0-2001-56	[%s:%s]CLEAR instruction decoding error	0-2001-62	[%s:%s]Unsupported parameters type
0-2001-57	[%s:%s]CLEAR length parameter must be a constant or ALL!	0-2001-63	[%s:%s]Invalid variable, %s
0-2001-58	[%s:%s]CLEAR instruction parameter type is incorrect!	0-2001-64	[%s:%s]%s tool number must be set
0-2001-59	[%s:%s]CLEAR [%s] instruction decoding error	0-2001-65	[%s:%s]%s user number must be set
0-2001-60	[%s:%s]data2 [%s] decoding error	0-2001-66	[%s:%s]%s parsing unknown error %s
0-2001-61	[%s:%s]%s [%s] instruction decoding error	0-2001-67	[%s:%s]Instruction of getting the linear interpolation pose, parsing the output parameters failed

Alarm Number	Description	Alarm Number	Description
0-2001-68	[%s:%s]Instruction of getting the linear interpolation pose, parsing the proportional parameters failed	0-2001-73	[%s:%s]SETTOOLFRAME instruction must set the tool number
0-2001-69	[%s:%s]Instruction of getting the linear interpolation pose, the proportional parameters are too long	0-2001-74	[%s:%s]Incorrect SETTOOLFRAME instruction parameter %s
0-2001-70	[%s:%s] Instruction of getting the linear interpolation pose, parsing the data 1 failed	0-2001-75	[%s:%s]SETTOOLFRAME instruction unknown error, %s
0-2001-71	[%s:%s]Instruction of getting the linear interpolation pose, parsing the data 2 failed	0-2001-76	[%s:%s]data1 [%s] decoding error
0-2001-72	[%s:%s]Instruction of getting the linear interpolation pose, parse unknown parameters	0-2001-77	[%s:%s]data2 [%s] decoding error

Alarm Number	Description	Alarm Number	Description
0-2001-78	[%s:%s]Unsupported parameters type	0-2001-85	[%s:%s]Incorrect SETV instruction parameter %s
0-2001-79	[%s:%s]%s [%s] instruction decoding error	0-2001-86	[%s:%s]SETPOSE parsing ConstV error
0-2001-80	[%s:%s]SETZEROPOS instruction decode AXIS error	0-2001-87	[%s:%s]Constv Rx, Ry, RZ parameters are out of range
0-2001-81	[%s:%s]Decoding error, unable to recognize SETP variable %s	0-2001-88	[%s:%s]SETPOSE parsing ConstV error
0-2001-82	[%s:%s]SETJOINT parsing ConstP error	0-2001-89	[%s:%s]%s AC parameter decoding error.
0-2001-83	[%s:%s]ConstP parameter range must be -360 to 360	0-2001-90	[%s:%s]%s AV parameter decoding error.
0-2001-84	[%s:%s]SETJOINT parsing ConstP error	0-2001-91	[%s:%s]%s [%s] instruction decoding error

Alarm Number	Description	Alarm Number	Description
0-2001-92	[%s:%s]%s AC parameter decoding error.	0-2001-98	[%s:%s]Palletizing instruction parameter [%s] is incorrect!
0-2001-93	[%s:%s]%s AV parameter decoding error.	0-2001-99	[%s:%s]Fish scale welding parameter decoding error%s
0-2001-94	[%s:%s]The %s dist parameter is incorrect!	0-2001-100	[%s:%s]Fish scale welding parameter is out of range %s
0-2001-95	[%s:%s]%s [%s] instruction decoding error	0-2001-101	[%s:%s]Fish scale welding parameter is out of range %s
0-2001-96	[%s:%s]Palletizing command is not enabled	0-2001-102	[%s:%s]Fish scale welding failed to identify parameter [%s]
0-2001-97	[%s:%s]PALLET instruction decoding error.	0-2001-103	[%s:%s]%s WEV parameter decoding error

Alarm Number	Description	Alarm Number	Description
0-2001-104	[%s:%s]Weaving instruction parameter [%s] is incorrect!	0-2001-111	[%s:%s]Unknown coordinate system error
0-2001-105	[%s:%s]%s Serial number should be in the range of [0-9]	0-2001-112	[%s:%s]Coordinate system parameter error!
0-2001-106	[%s:%s]%s value is ON or OFF	0-2001-113	[%s:%s]MFRAME parsing error
0-2001-107	[%s:%s]HSEN Instruction Parameter T Decoding Error	0-2001-114	[%s:%s]MFRAME parameter is incorrect!
0-2001-108	[%s:%s]SFTON decoding error	0-2001-115	[%s:%s]MFRAME parameter %s is incorrect!
0-2001-109	[%s:%s]CCOOD instruction decoding error	0-2001-116	[%s:%s]MOV/MOVE parameter PL repeated
0-2001-110	[%s:%s]Coordinate system parameter error!	0-2001-117	[%s:%s]PL error in MOV/MOVE instruction decoding

Alarm Number	Description	Alarm Number	Description
0-2001-118	[%s:%s]PL level can only be an integer from 0 to 7	0-2001-124	[%s:%s]MOV/MOVE command failed to parse the actual acceleration A variable
0-2001-119	[%s:%s]MOV/MOVE parameter CR repeated	0-2001-125	[%s:%s]MOV/MOVE parameter ACC repeated
0-2001-120	[%s:%s]MOV/MOVE instruction decoding CR error	0-2001-126	[%s:%s]ACC error in MOV/MOVE instruction parameters
0-2001-121	[%s:%s]MOV/MOVE parameter CR data is too long	0-2001-127	[%s:%s]MOV/MOVE parameter DEC repeated
0-2001-122	[%s:%s]MOV/MOVE parameter CR out of range	0-2001-128	[%s:%s]MOV/MOVE command failed to parse the actual deceleration D variable
0-2001-123	[%s:%s]MOV/MOVE parameter ACC repeated	0-2001-129	[%s:%s]MOV/MOVE parameter DEC repeated

Alarm Number	Description	Alarm Number	Description
0-2001-130	[%s:%s]DEC error in MOV/MOVE instruction parameters	0-2001-135	[%s:%s]UNTIL error in MOV/MOVE instruction decoding
0-2001-131	[%s:%s]COOP error in MOV/MOVE instruction parameters	0-2001-136	[%s:%s]MOV/MOVE parameter REF repeated
0-2001-132	[%s:%s]In MOV/MOVE instruction, T parameter must be set for TIMER	0-2001-137	[%s:%s]MOV/MOVE parameter REF error
0-2001-133	[%s:%s]Movement instruction judges the output parameters through the condition judgement statements, parsing failed	0-2001-138	[%s:%s]MOV/MOVE instruction reference joint %s axis exceeds soft limit
0-2001-134	[%s:%s]Movement instruction judges the output parameters through the condition judgement statements, parsing failed	0-2001-139	[%s:%s]MOV/MOVE parameter REF error

Alarm Number	Description	Alarm Number	Description
0-2001-140	[%s:%s]MOV/MOVE parameter REF error	0-2001-146	[%s:%s]MOVC/MOVEC parameter P/V error
0-2001-141	[%s:%s]MOV/MOVE parameter position repeated	0-2001-147	[%s:%s]MOV/MOVEC command parses more than 2 waypoints
0-2001-142	[%s:%s]MOV/MOVE parameter ConstP error	0-2001-148	[%s:%s]MOV/MOVE parameter ConstP error
0-2001-143	[%s:%s]ConstP parameter range must be -360 to 360	0-2001-149	[%s:%s]MOV/MOVE parameter position repeated
0-2001-144	[%s:%s]ConstP joint %s exceeds soft limit	0-2001-150	[%s:%s]MOV/MOVE parameter CONSTV error
0-2001-145	[%s:%s]MOV/MOVEC command parses more than 2 waypoints	0-2001-151	[%s:%s]Constv Rx, Ry, RZ parameters are out of range

Alarm Number	Description	Alarm Number	Description
0-2001-152	[%s:%s]Constv pose data is all zero	0-2001-158	[%s:%s]Fixed tool coordinate system parsing failed
0-2001-153	[%s:%s]MOV/MOVEC command parses more than 2 waypoints	0-2001-159	[%s:%s]Workpiece coordinate system parsing failed
0-2001-154	[%s:%s]MOVC/MOVEC parameter P/V error	0-2001-160	[%s:%s]Pose data in the workpiece coordinate system is out of range
0-2001-155	[%s:%s]MOV/MOVEC command parses more than 2 waypoints	0-2001-161	[%s:%s]Workpiece coordinate system parsing failed
0-2001-156	[%s:%s]MOV/MOVE parameter CONSTV error	0-2001-162	[%s:%s]Workpiece coordinate system parsing failed
0-2001-157	[%s:%s]MOV/MOVE parameter flange repeated	0-2001-163	[%s:%s]MOV/MOVE parameter position repeated

Alarm Number	Description	Alarm Number	Description
0-2001-164	[%s:%s]MOVC/MOVEC parameter P/V error	0-2001-174	[%s:%s]Lua process has not been opened.
0-2001-165	[%s:%s]Movement instruction, errors of the waypoint occur when parsing the variables	0-2001-175	[%s:%s]The STOPLUA instruction must set the INDEX additional item
0-2001-166	[%s:%s]Unknown [%s] parameter error in MOV/MOVE instruction	0-2001-176	[%s:%s]Error in STOPLUA instruction parsing INDEX additional items
0-2001-171	[%s:%s]Lua process has not been opened.	0-2001-177	[%s:%s]Lua process has not been opened.
0-2001-172	[%s:%s]The STARTLUA instruction must set the INDEX additional item	0-2001-178	[%s:%s]The RESTARTLUA instruction must set the INDEX additional item
0-2001-173	[%s:%s]STARTLUA instruction parsing INDEX additional item error	0-2001-179	[%s:%s]RESTARTLUA instruction parsing INDEX additional item error

Alarm Number	Description	Alarm Number	Description
0-2001-180	[%s:%s]Lua process has not been opened.	0-2001-186	[%s:%s]Incorrect SETPAYLOAD instruction M parameter
0-2001-181	[%s:%s]GETLUASTATE instruction parsing B additional item error	0-2001-187	[%s:%s]SETPAYLOAD instruction must set parameter X
0-2001-182	[%s:%s]The GETLUASTATE instruction must set the INDEX additional item	0-2001-188	[%s:%s]Incorrect SETPAYLOAD instruction X parameter
0-2001-183	[%s:%s]GETLUASTATE instruction parsing INDEX additional item error	0-2001-189	[%s:%s]SETPAYLOAD instruction must set parameter Y
0-2001-184	[%s:%s]The SETPAYLOAD instruction must set the tool number parameter!	0-2001-190	[%s:%s]Incorrect SETPAYLOAD instruction Y parameter
0-2001-185	[%s:%s]The SETPAYLOAD instruction must set the Payload parameter	0-2001-191	[%s:%s]SETPAYLOAD instruction must set parameter Z

Alarm Number	Description	Alarm Number	Description
0-2001-192	[%s:%s]Incorrect SETPAYLOAD instruction Z parameter	0-2001-198	[%s:%s]The SETUSERFRAME instruction must set the parameter num!
0-2001-193	[%s:%s]Invalid JOB, %s	0-2001-199	[%s:%s]Invalid SETUSERFRAME instruction parameter %s
0-2001-194	[%s:%s]Invalid variable, %s	0-2001-200	[%s:%s]SETUSERFRAME instruction unknown error, %s
0-2001-195	[%s:%s]Invalid parameter %s in GETUSERFRAME instruction	0-2001-201	[%s:%s]Invalid parameter %s in GETTOOLFRAME instruction
0-2001-196	[%s:%s]The GETUSERFRAME instruction must set the parameter num	0-2001-202	[%s:%s]The GETTOOLFRAME instruction must set the parameter num
0-2001-197	[%s:%s]Invalid parameter %s in GETUSERFRAME instruction	0-2001-203	[%s:%s]Invalid parameter %s in GETTOOLFRAME instruction

Alarm Number	Description	Alarm Number	Description
0-2001-204	[%s:%s]GETTCPFORCE parameter %s error	0-2001-210	[%s:%s]GETTCPFORCE unknown parameter
0-2001-205	[%s:%s]GETTCPFORCE parameter ConstV error	0-2001-211	[%s:%s]Invalid SPEED instruction parameter %s
0-2001-206	[%s:%s]Constv Rx, Ry, RZ parameters are out of range	0-2001-212	[%s:%s]Invalid SPEED instruction parameter %s
0-2001-207	[%s:%s]GETTCPFORCE parameter ConstV error	0-2001-213	[%s:%s]MOV/MOVE parameter V repeated
0-2001-208	[%s:%s]GETTCPFORCE must set the TOOL number	0-2001-214	[%s:%s]Parameter V is incorrect in MOV/MOVE instruction
0-2001-209	[%s:%s]GETTCPFORCE must set the user coordinate number	0-2001-215	[%s:%s]MOV/MOVE parameter V repeated

Alarm Number	Description	Alarm Number	Description
0-2001-216	[%s:%s]Parameter VJ is incorrect in MOV/MOVE instruction	0-2001-222	[%s:%s]MOV/MOVE parameter V repeated
0-2001-217	[%s:%s]MOV/MOVE is missing the required position parameters	0-2001-223	[%s:%s]Parameter V is incorrect in MOV/MOVE instruction
0-2001-218	[%s:%s]MOV/MOVE parameter V missed	0-2001-224	[%s:%s]MOV/MOVE parameter Tool repeated
0-2001-219	[%s:%s]MOV/MOVE parameter V repeated	0-2001-225	[%s:%s]MOV/MOVE instruction must set the tool number
0-2001-220	[%s:%s]MOV/MOVE parameter V repeated	0-2001-226	[%s:%s]MOV/MOVE instruction must set the user coordinate number
0-2001-221	[%s:%s]MOV/MOVE parameter V repeated	0-2001-227	[%s:%s]MOV/MOVE is missing the required position parameters

Alarm Number	Description	Alarm Number	Description
0-2001-228	[%s:%s]MOV/MOVE parameter V missed	0-2001-234	[%s:%s]%s DRAGV parameter is incorrect!
0-2001-229	[%s:%s]The fixed tool cannot be the center of the flange plate.	0-2001-235	[%s:%s]MOV/MOVE parameter CR out of range
0-2001-230	[%s:%s]MOVC/MOVEC waypoints less than two	0-2001-236	[%s:%s]%s decoding error
0-2001-231	[%s:%s]MOV/MOVEC command parses more than 2 waypoints	0-2001-237	[%s:%s]Parameter AV is incorrect in MOV/MOVE instruction
0-2001-232	[%s:%s]The JOB parameter file %s in the command MOVEFILE does not exist, or error exists!	0-2001-238	[%s:%s]Parameter V is incorrect in MOV/MOVE instruction
0-2001-233	[%s:%s]%s VJ parameter is incorrect!	0-2001-239	[%s:%s]Parameter V is incorrect in MOV/MOVE instruction

Alarm Number	Description	Alarm Number	Description
0-2001-240	[%s:%s]Parameter V is incorrect in MOV/MOVE instruction	0-2001-246	[%s:%s]1st parameter is incorrect in DIST instruction
0-2001-241	[%s:%s]Parameter TF is incorrect in TOOL instruction	0-2001-247	[%s:%s]2nd parameter is incorrect in DIST instruction
0-2001-242	[%s:%s]Unknown parameters in TOOL instruction	0-2001-248	[%s:%s]3rd parameter is incorrect in DIST instruction
0-2001-243	[%s:%s]Incorrect TF parameter in SETTOOLNUMBER instruction.	0-2001-249	[%s:%s]Parameter [%s] has grammatical error in DIST instruction
0-2001-244	[%s:%s]Unsupported parameters type	0-2001-250	[%s:%s]Incorrect TTINIT instruction parameter %s
0-2001-245	[%s:%s]SETTOOLNUMBER %s instruction decoding error.	0-2001-251	[%s:%s]Incorrect TTINIT instruction parameter %s

Alarm Number	Description	Alarm Number	Description
0-2001-252	[%s:%s]Incorrect TTINIT instruction parameter %s	0-2001-258	[%s:%s]Invalid subscript parameter of ADDPAYLOAD instruction
0-2001-253	[%s:%s]Incorrect TTINIT instruction parameter %s	0-2001-259	[%s:%s]Unknown parameter error %s of ADDPAYLOAD instruction
0-2001-254	[%s:%s]Incorrect TTINIT instruction parameter %s	0-2001-260	[%s:%s]Failed to start the force control mode, the data source of the force control is unknown
0-2001-256	[%s:%s]Invalid subscript parameter of ADDZEROLOAD instruction	0-2001-261	[%s:%s]Failed to start the force control mode, the back-end mode cannot be selected when the torque sensor is not switched on.
0-2001-257	[%s:%s]Unknown parameter error %s of ADDZEROLOAD instruction	0-2001-262	[%s:%s]Unable to parse the set force control mode parameters

Alarm Number	Description	Alarm Number	Description
0-2001-263	[%s:%s]Set invalid first parameter for force control command	0-2001-267	[%s:%s]Set force control mode parameters-max. speed limit parameter-invalid
0-2001-264	[%s:%s]Set force control mode parameters-force and torque parameters-invalid	0-2001-268	[%s:%s]Set force control mode parameters-control mode parameter-invalid
0-2001-265	[%s:%s]Set force control mode parameters-force control switch parameter-invalid	0-2001-269	[%s:%s]No Label %s@%s found!
0-2001-266	[%s:%s]Set force control mode parameters-force control coordinate frame parameter-invalid	0-2001-270	Loading file :%s repeatedly.

Alarm Number	Description	Alarm Number	Description
0-2001-271	CALL has too many subroutine calls %s	1-2001-278	Failed to load file %s
0-2001-272	Open file failed %s %s %s	0-2001-279	WHILE or IF instruction is used incorrectly
0-2001-273	Too many MOV/MOVE instructions (number:%s),insufficient memory!	0-2001-280	WHILE or IF instruction is used incorrectly
0-2001-274	Incorrect file format,2 or more NOP exists	0-2001-281	[%s:%s]Subscripts index type of the IO variable are illegal
0-2001-275	Incorrect file format. It contains 2 END.	0-2001-282	[%s:%s]Failed to clear all sensor values to zeros, wrong data source
0-2001-276	Unknown instruction, filename %s: %s line	0-2001-283	[%s:%s] The parameter V in the MOVEJ instruction is duplicated
0-2001-277	Incorrect file format, NOP should be on the first line, END on the last line.	0-2001-284	[%s:%s] The parameter VJ in the MOVEJ instruction is wrong

Alarm Number	Description	Alarm Number	Description
0-2001-285	[%s:%s] The parameter V in the MOVEJ instruction is missing	0-2001-289	[%s:%s] The parameter V in the MOVE instruction is missing
0-2001-286	[%s:%s] The parameter V in the MOVE instruction is wrong	1-2001-290	[%s:%s] In the MOV/MOVE instruction, the parameter FIXTOOL coexists with the parameter WOBJ.
0-2001-287	[%s:%s] The parameter tool in the MOVE instruction is duplicated	0-2001-291	[%s:%s] The parameter TRIGGER in the MOV/MOVE instruction is duplicated or it coexists with the parameter UNTIL.
0-2001-288	[%s:%s] Please set the tool number first before executing the MOVE instruction	0-2001-292	[%s:%s] The conditions of the parameter TRIGGER in the MOV/MOVE instruction is wrong.

Alarm Number	Description	Alarm Number	Description
0-2001-293	[%s:%s] The parameter TRIGGER %s in the MOV/MOVE instruction is wrong.	0-2001-297	[%s:%s] The parameter UNTIL in the MOV/MOVE instruction is duplicated or it coexists with the parameter TRIGGER.
0-2001-294	[%s:%s] The parameter TRIGGER %s in the MOV/MOVE instruction is too long.	0-2002-1	[%s:%s]Missing macro definition,%s
0-2001-295	[%s:%s] The IO value of the parameter TRIGGER in the MOV/MOVE instruction is set incorrectly.	0-2002-2	[%s:%s]Missing macro definition,%s
0-2001-296	[%s:%s] The IO type of the parameter TRIGGER in the MOV/MOVE instruction is set incorrectly.	0-2002-3	[%s:%s]Unknown coordinate %s

Alarm Number	Description	Alarm Number	Description
0-2002-4	[%s:%s]P variable index out of bounds	0-2002-16	[%s:%s]Variable value to be set is out of range
0-2002-5	[%s:%s]P variable index out of bounds	0-2002-17	[%s:%s]Variable value to be set is out of range
0-2002-6	[%s:%s]%s axis soft limit alarm	0-2002-18	[%s:%s]P variable is not opened.
0-2002-7	[%s:%s]Unknown coordinate %s	0-2002-19	[%s:%s]Failed to obtain data
0-2002-8	[%s:%s]Point singularity	0-2002-20	[%s:%s]P variable is not opened.
0-2002-9	[%s:%s]%s axis soft limit alarm	0-2002-21	[%s:%s]V variable is not opened
0-2002-10	[%s:%s]P variable index out of bounds	0-2002-22	[%s:%s]Failed to set data
0-2002-11	[%s:%s]%s axis soft limit alarm	0-2002-23	[%s:%s]V variable is not opened
0-2002-12	[%s:%s]P variable index out of bounds	0-2002-24	[%s:%s]Failed to obtain data
0-2002-13	[%s:%s]Failed to get the end external force	0-2002-25	[%s:%s]V variable is not opened
0-2002-14	[%s:%s]Variable value to be set is out of range	0-2002-26	[%s:%s]Failed to set data
0-2002-15	[%s:%s]Variable value to be set is out of range	0-2002-27	[%s:%s]V variable is not opened

Alarm Number	Description	Alarm Number	Description
0-2002-28	[%s:%s]Failed to obtain data	0-2002-34	[%s:%s]End force or joint torque index out of range
0-2002-29	[%s:%s]V variable is not opened	0-2002-35	[%s:%s]Parameter out of range!
0-2002-30	[%s:%s]Failed to set data	0-2002-36	[%s:%s]Only external axis can be prohibited, robot axis cannot be prohibited
0-2002-31	[%s:%s]Failed to obtain data	0-2002-37	[%s:%s]The delay value of the TIMER instruction cannot be less than 0 seconds.
0-2002-32	[%s:%s]Failed to set data	0-2002-38	[%s:%s]The delay value of the TIMER instruction cannot be less than 0 seconds.
0-2002-33	[%s:%s]The parameter %s exceeds the maximum value %s	0-2002-39	[%s:%s]CALL instruction is nested more than 10 layers and cannot be executed.

Alarm Number	Description	Alarm Number	Description
0-2002-40	[%s:%s]The call of CALL cannot be found in the RET instruction	0-2002-47	[%s:%s]The address of variable in the CLEAR instruction parameter is incorrect
0-2002-41	[%s:%d]%s	0-2002-48	[%s:%s]Tool index [%s] is out of range
0-2002-42	[%s:%s]AOUT instruction parameter out of range	0-2002-49	[%s:%s]Tool %s has not been set
0-2002-43	[%s:%s]AOUT instruction parameter out of range	0-2002-50	[%s:%s]User coordinate system index [%s] is out of range!
0-2002-44	[%s:%s]The delay value of the TIMER instruction cannot be less than 0 seconds.	0-2002-51	[%s:%s]User coordinate system %s has not been set
0-2002-45	[%s:%s]Choose fish scale spot welding time T or walk S1	0-2002-52	Divide by zero error in DIV instruction

Alarm Number	Description	Alarm Number	Description
0-2002-53	Divide by zero error in MOD instruction	2-2002-62	[%s:%s]In single step mode, the motion command PL or Cr parameter is ignored, PL = 0 or Cr = 0
2-2002-54	[%s:%s]Tool index [%s] is out of range	0-2002-64	[%s:%s]Arc failure, error code %s
0-2002-55	Location data is illegal	0-2002-65	[%s:%s]Palletizing command is not enabled
2-2002-56	The current point coincides with the target point	0-2002-66	[%s:%s]Incorrect palletizing parameters
2-2002-57	[%s:%s]In single step mode, the motion command PL or Cr parameter is ignored, PL = 0 or Cr = 0	0-2002-67	[%s:%s]Weaving process number has not been set
0-2002-59	The tool index is invalid	0-2002-68	[%s:%s]Weaving process number must be [0-7]
0-2002-60	Invalid user coordinate system	0-2002-69	[%s:%s]Waiting for the gripper feedback signal timeout!

Alarm Number	Description	Alarm Number	Description
0-2002-70	[%s:%s]Unknown coordinate %s	0-2002-76	[%s:%s]RESTARTLUA instruction INDEX additional item range error
0-2002-71	[%s:%s]Incorrect load parameter range!	0-2002-77	[%s:%s]RESTARTLUA instruction execution error
0-2002-72	[%s:%s]STARTLUA instruction INDEX additional item range error	0-2002-78	[%s:%s]GETLUASTATE instruction INDEX additional item range error
0-2002-73	[%s:%s]STARTLUA instruction execution error	0-2002-79	[%s:%s]Tool index [%s] is out of range
0-2002-74	[%s:%s]STOPLUA instruction INDEX additional item range error	0-2002-80	[%s:%s]Tool %s has not been set
0-2002-75	[%s:%s]STOPLUA instruction execution error	0-2002-81	[%s:%s]User coordinate system index [%s] is out of range

Alarm Number	Description	Alarm Number	Description
0-2002-82	[%s:%s]User coordinate system %s has not been set	0-2002-87	[%s:%s]Unable to run the MOVC/MOVEC instruction, please check the teaching waypoint!
0-2002-83	[%s:%s]Tool index [%s] is out of range	0-2002-88	[%s:%s]Three waypoints coincide!
0-2002-84	[%s:%s]User coordinate system index [%s] is out of range	0-2002-89	[%s:%s]The %s and %s waypoints coincide, cannot run MOVC/MOVEC!
0-2002-85	[%s:%s]Get the linear interpolation pose, the proportional parameters to be set are out of range	0-2002-90	[%s:%s]In single step mode, the motion command PL or Cr parameter is ignored, PL = 0 or Cr = 0
0-2002-86	[%s:%s]Failed to create user coordinate system!	0-2002-92	[%s:%s]There are less than three road points in MOVC/MOVEC!

Alarm Number	Description	Alarm Number	Description
0-2002-93	[%s:%s]The arc instruction FPT can only be set to the third point	0-2002-99	[%s:%s]No matching MOVFW found
2-2002-94	[%s:%s]In single step mode, the motion command PL or Cr parameter is ignored, PL = 0 or Cr = 0	0-2002-100	[%s:%s]No matching MOVFW found
0-2002-96	Swing welding function is not enabled	0-2002-101	[%s:%s]Cannot run MOVFW
0-2002-97	[%s:%s]No matching MOVFW found	0-2002-102	[%s:%s]Two points coincide, unable to spot welding
0-2002-98	[%s:%s]No matching MOVFW found	0-2002-103	[%s:%s]Incorrect TTINIT instruction parameter range %s

Alarm Number	Description	Alarm Number	Description
2-2002-104	[%s:%s]TTTARGETJOINT failed, the queue is full!	0-2002-110	[%s:%s]The force control mask parameter is out of range
0-2002-105	[%s:%s]Force control %s parameter %s is not an integer	0-2002-111	[%s:%s]The force control target parameter is out of range
0-2002-106	[%s:%s]Failed to start the force control mode, no force control end command	0-2002-112	[%s:%s]The force control torque parameter is out of range
0-2002-107	[%s:%s]Force control mode parameter setting is out of range.	0-2002-113	[%s:%s]The force control linear speed is out of range
0-2002-108	[%s:%s]Force control coordinate system parameters x, y, z parameters are out of range	0-2002-114	[%s:%s]The force control angular speed is out of range
0-2002-109	[%s:%s]Force control coordinate system parameters rx, ry, rz parameters are out of range	0-2002-115	[%s:%s]Inverse kinematics solution of %s axis failed when executing the move instructions

Alarm Number	Description	Alarm Number	Description
0-2002-116	[%s:%s]Inverse kinematics solution of %s axis failed when executing the mov instructions	0-2002-120	[%s:%s]In single step mode, the motion command PL or Cr parameter is ignored, PL = 0 or Cr = 0
0-2002-117	[%s:%s]Inverse kinematics solution of %s axis failed when executing the TTTARGETJOINT instructions	0-2002-121	The tool index is invalid
0-2002-118	[%s:%s]Inverse kinematics solution of %s axis failed when executing the POSETOJOINT instructions	0-2002-122	[%s:%s] The MOVJ instruction does not allow that the IO is triggered by the distance condition.
0-2002-119	[%s:%s] Failed to clear the data of the force sensor. The sensor is not in force control mode	0-2002-123	[%s:%s] The MOVEJ instruction does not allow that the IO is triggered by the distance condition.

Alarm Number	Description	Alarm Number	Description
0-4000-0	Point singularity	0-4000-6	During the zero calibration of 20 points, waypoints coincidence error, point %s and point %s coincide
0-4000-1	Invalid user coordinate system	0-4000-7	During the zero calibration of 20 points,calculation error, the point is unreasonable
0-4000-2	User coordinate system %s is not set!	0-4000-8	The calculation result exceeds 5mm, it is recommended not to use this data.
0-4000-3	The tool index is invalid	0-4000-9	%s mm
0-4000-4	Tool number %s is not set, please set first!	0-4000-a	The points are coincident
0-4000-5	During the zero calibration of 20 points, the dynamic memory request failed	0-4000-b	Matrix inversion failed

Alarm Number	Description	Alarm Number	Description
0-4000-c	The points are coincident	2-6000-8	Script %s, parameter %s, range from %s to %s
0-4000-d	Matrix inversion failed	2-6000-9	Script %s, parameter %s, range from %s to %s
2-6000-0	General messages	2-6000-10	Instruction of getting the linear interpolation pose, parsing data failed
2-6000-1	Lua script load completed!	2-6000-11	Failed for the script to call the function
2-6000-2	Lua script error: %s: %s	2-6000-12	Lua script parameters do not match
2-6000-3	Lua script error: %s: %s	2-6000-13	Lua scripts print: %s
2-6000-4	Script %s parameter %s error	2-6000-14	No Lua script file is loaded
2-6000-5	Lua script parameter range: 0～%s	2-6000-15	Lua script file %s does not exist
2-6000-6	Lua script parameter range is from %s to %s	0-7000-0	Memory request failed!
2-6000-7	Lua script parameters range from %s to %s or from %s to %s	0-7000-1	Incorrectly calculating node vector

Alarm Number	Description	Alarm Number	Description
0-7000-2	Incorrectly calculating node vector	0-7000-10	Incorrect user coordinate system index
0-7000-3	Memory request failed!	0-7000-11	The robotic arm is in a singular zone or unreachable zone
0-7000-4	Fail to open the JOB file.	0-7000-12	The type of robot does not match the number of axes and can only run in joint coordinates.
0-7000-5	Fail to open the JOB file.	0-7000-13	The type of robot does not match the number of axes and can only run in joint coordinates.
0-7000-6	Fail to open the JOB file.	0-7000-14	Unrecognized curve
0-7000-7	MOVEML trajectory planning calculation failed	0-7000-15	The robotic arm is in a singular zone or unreachable zone
0-7000-8	Memory request failed!	0-7000-21	The target pose is singular
0-7000-9	Memory request failed!	0-7000-22	The target pose is singular

Alarm Number	Description	Alarm Number	Description
0-7000-23	The target pose is singular	0-7000-c	Encoder calibration failed, please try again or manually move each axis to complete calibration
0-7000-24	The target pose is singular	0-7000-d	%s axis exceeds the lower limit of soft limit
0-7000-26	The target pose is singular	0-7000-f	%s Axis exceeds the upper limit of soft limit
0-7000-27	The target pose is singular	0-9000-0	Point singularity
0-7000-a	Memory request failed!	0-9000-1	Point singularity
0-7000-b	The pseudo inverse solution of singular value decomposition failed during encoder calibration. Please change the position and try again	0-9000-2	The palletizing process number is entered incorrectly.

Alarm Number	Description	Alarm Number	Description
0-9000-3	The user coordinate number is entered incorrectly!	0-9000-12	File %s already exists.
0-9000-4	The layout number is entered incorrectly!	0-9000-13	Failed to open %s
0-9000-5	The layer number is entered incorrectly!	0-9000-14	Failed to create file %s
0-9000-6	The layer layout mode is entered incorrectly!	2-9000-15	File %s is successfully created.
0-9000-7	The layer height mode is entered incorrectly!	0-9000-16	Palletizing parameter input error.
0-9000-8	Process %s layout %s layout mode error!	0-9000-17	The layout mode is entered incorrectly!
0-9000-9	Process %s layout %s Status are invalid!	0-9000-18	The palletizing point number is entered incorrectly!
0-9000-10	Process %s reference point does not exist!	0-9000-19	The preparation point number is entered incorrectly.
0-9000-11	Process %s transition point does not exist!	0-9000-20	Leaving point number is entered incorrectly!

Alarm Number	Description	Alarm Number	Description
0-9000-21	The palletizing process number is entered incorrectly!	0-9000-29	The palletizing process number is entered incorrectly.
0-9000-22	The user coordinate number is entered incorrectly!	0-9000-30	The layer height is entered incorrectly.
0-9000-23	The layout number is entered incorrectly!	0-9000-31	Transition point height exceeds limit!
0-9000-24	The layer number is entered incorrectly!	0-9000-32	The layer layout mode is entered incorrectly!
0-9000-25	The layer layout mode is entered incorrectly!	0-9000-33	Layout %s has been used.
0-9000-26	The layer height mode is entered incorrectly!	0-9000-34	The layout type is entered incorrectly!
0-9000-27	The palletizing process number is entered incorrectly!	0-9000-35	The number of pallets is entered incorrectly!
2-9000-28	Note the entered layout value and set the maximum layout to %s	0-9000-36	The palletizing point number is entered incorrectly!

Alarm Number	Description	Alarm Number	Description
0-9000-37	The parameter input of the palletizing point is incorrect!	0-9000-43	The parameter of the preparation point is entered incorrectly!
0-9000-38	The preparation point number is entered incorrectly.	0-9000-44	The leave point parameter is entered incorrectly!
0-9000-39	The parameter of the preparation point is entered incorrectly!	0-9000-45	The palletizing point parameter is invalid, please set the parameter first!
0-9000-40	Leaving point number is entered incorrectly!	0-9000-46	Wrong number of columns. The column value should be greater than 1.
0-9000-41	The leave point parameter is entered incorrectly!	0-9000-47	The palletizing point parameter is invalid, please set the parameter first!
0-9000-42	The parameter input of the palletizing point is incorrect!	0-9000-48	Wrong number of rows. The row value should be greater than 1.

Alarm Number	Description	Alarm Number	Description
0-9000-49	The number of rows, columns or pallets is entered incorrectly	0-D000-1	Matrix inversion failed
0-9000-50	Failed to check the validity of palletizing process parameters!	0-D000-2	The target pose is singular
0-9000-51	Palletizing parameter input error.	0-D000-3	The target pose is singular
0-9000-52	The palletizing process number is entered incorrectly!	0-D000-4	The target pose is singular
0-9000-53	Palletizing process parameters are invalid!	0-1-1	Product dimension error: range is %d-%d
0-9000-54	The current pallet number exceeds the limit!	0-1-2	Height of approaching waypoint is less than height of product
0-D000-0	Matrix inversion failed	0-1-3	Height of leaving waypoint is less than height of product

Alarm Number	Description	Alarm Number	Description
0-1-5	Soft limit is illegal, out of range	0-2-9	Open file failed
0-2-1	Open file failed: %s	0-2-12	USB monitoring service creation failed: %s
0-2-2	Incorrect file format: %s	0-2-13	USB monitoring service binding failed, %s
0-2-3	Incorrect file type: %s	0-2-A	Error occurs when writing file, %s
0-2-4	Palletizing file doesn't contain stack info field: %s	0-2-D	Can't connect to mcserver.
0-2-6	Writing file failed: %s	0-2-E	Open mcserver log file failed: %s

13.6.2 Servo drive alarm

Alarm Number	Description	Possible Reasons	Suggested Solutions
		The load and acceleration parameters are incorrectly set	Check whether the load and acceleration parameters are set correctly
10	Joint %s hardware is over-current, the joint is stuck or the instantaneous load is too large	The load is too large and exceeds the load characteristic curve	Check whether the load is too large and exceeds the load characteristic curve of the user manual
		Mechanical stuck phenomenon caused by impact, joint brake not opened, etc.	Clear the alarm, power off and restart, check whether each joint can operate normally
		Joint driver hardware damage	If the alarm continues to appear, please contact the official after-sales department
20	Joint %s current zero offset is abnormal, please restart or contact after-sales service	The zero drift detected by the joint driver is too large	Clear the alarm, power off and restart, check whether the alarm appears again, if it persists and cannot be eliminated, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
		The load and acceleration parameters are incorrectly set	Check whether the load and acceleration parameters are set correctly
21	The software of joint %s is over-current, the joint is stuck or the load is too large	The load is too large, exceeding the load characteristic curve	Check whether the load is too large and exceeds the user manual load characteristic curve
		Mechanical stuck phenomenon caused by impact, joint brake not opened, etc.	Clear the alarm, power off and restart, check whether each joint can operate normally
		Joint driver hardware damage	If this alarm continues to appear, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
22	Joint %s is over-current during startup. Please check whether the joint is stuck or the brake fails	Servo brake is not opened	Clear the alarm, restart after power off, use the reverse drive function, push the robot to a lower gravity position to open the brake, and then use the normal brake opening function; If this alarm phenomenon persists, please contact the official after-sales department
		The load and acceleration parameters are incorrectly set	Check whether the load and acceleration parameters are set correctly
23	Joint %s current impact, instantaneous high current detected	The load is too large and exceeds the load characteristic curve	Check whether the load is too large and exceeds the load characteristic curve of the user manual
		The mechanical jam phenomenon caused by the impact, the joint brake is not opened, etc.	Clear the alarm, break Power cycle, check each joint for normal operation

Alarm Number	Description	Possible Reasons	Suggested Solutions
23	Joint %s current impact, instantaneous high current detected	The hardware of the joint driver is damaged	If this alarm phenomenon persists, please contact the official after-sales department
		The load and acceleration parameters are incorrectly set	Check whether the load and acceleration parameters are set correctly
30	The actual deviation of joint %s from the target position is too large, the load is too large, or the joint is stuck	The load is too large and exceeds the load characteristic curve	Check whether the load is too large and exceeds the load characteristic curve of the user manual
		Mechanical stuck phenomenon caused by impact, joint brake not opened, etc.	Clear the alarm, power off and restart, check whether each joint can operate normally
		The hardware of the joint driver is damaged	If this alarm phenomenon persists, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
31	The deviation between the actual position of joint %s and the target position is too large. Please check whether the joint is stuck or the brake is faulty	The servo brake is not opened	Clear the alarm, power off and restart, use the reverse drive function, push the robot to a lower gravity position to open the brake, and then use the normal Open the brake function; if the alarm phenomenon persists, please contact the official after-sales department
32	Joint %s special emergency stop alarm triggered	The driver (non-standard hardware version) receives the emergency stop input signal (special IO) from the driver board	Check the hardware emergency stop signal of the joint
40	Joint %s emergency stop alarm	The emergency stop button of the teach pendant is photographed	Check whether the emergency stop button of the teach pendant is photographed. If the emergency stop button is photographed, turn the emergency stop button to perform reset and synchronization operations.

Alarm Number	Description	Possible Reasons	Suggested Solutions
40	Joint %s emergency stop alarm	External interference causes emergency stop false alarm (the burned FPGA version is wrong)	If the alarm cannot be eliminated continuously, please contact the official after-sales department.
41	Joint %s is writing parameters	Error is caused by carrying out “restore default parameters” or “permanently save parameters”	If it is confirmed that the driver is being restored or a flash is being written, please ignore the error.
41	Joint %s is writing parameters	Flash is abnormal	If this alarm phenomenon persists, please contact the official after-sales department
43	Joint %s is restarting	The driver is going to the process of “firmware upgrading”	If it is confirmed that the firmware is upgrading, please ignore the error. After the upgrading is finished, please remove the error. If the error persists, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
50	The communication of joint %s is abnormal and the bus verification fails. Please check the robot and connecting line or check the interference source	Communication verification failed	Clear the alarm, power off and restart, check whether the alarm appears again, if it persists and cannot be eliminated, please contact the official after-sales department; or check whether it is in a strong electromagnetic environment
51	The communication of joint %s is abnormal and the bus is not synchronized. Please check the robot and connecting line or check the interference source	The communication is synchronizing or the synchronization fails	Click the 'reset' button to clear the alarm; or the alarm persists and cannot be eliminated, please contact the official after-sales department
52	The communication of joint %s is abnormal and the master station data is not received. Please check the robot and connecting line or check the interference source	Frame from master station is not received	Usually occurs after the controller and servo software are upgraded, the alarm will be eliminated after power off and restart, if it cannot be eliminated, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
54	The communication of joint %s is abnormal and the communication frame is incomplete. Please check the robot and connecting line or check the interference source	The master frame is received, not executed	Usually occurs after the controller and servo software are upgraded, the alarm will be eliminated after power off and restart, if it cannot be eliminated, please contact the official after-sales department
60	Joint %s Joint encoder data of is abnormal. Please try restarting or contact after-sales service	The joint encoder cable is connected incorrectly, the cable is loose, and the cable is disturbed, which causes the joint encoder value to be incorrect or the joint encoder related hardware is interfered, resulting in incorrect joint encoder value	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
61	Joint %s The data difference between joint and motor encoder is too large. Please try restarting or contact after-sales service	The joint encoder cable is connected incorrectly, the cable is loose, and the cable is interfered, causing the joint encoder value to be incorrect or the joint encoder related hardware is interfered, resulting in an incorrect joint encoder value correct	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department
62	Joint %s joint and motor encoder are not calibrated, joint encoder data is abnormal, not calibrated	The encoder is not calibrated	
63	Joint %s The data deviation between joint and motor encoder is too large, encoder failure	The joint encoder is damaged	

Alarm Number	Description	Possible Reasons	Suggested Solutions
70	Joint %s motor encoder data lost	The A and B pulse of the motor encoder may be contaminated	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department
		Motor encoder index pulse may be contaminated	
71	Joint %s No motor encoder index signal detected, motor encoder contaminated	Motor encoder pulse may be contaminated	
72	Joint %s Abnormal motor encoder data, phase to phase verification failed, motor encoder polluted	Motor encoder pulse may be polluted	
73	Joint %s The electrical angle deviation is too large, the motor encoder data and calibration data verification failed, and the motor encoder polluted	The motor encoder pulse may be polluted	

Alarm Number	Description	Possible Reasons	Suggested Solutions
74	Joint% s joint and motor encoder are not calibrated, motor encoder data is abnormal, not calibrated	The motor encoder is not calibrated or the calibration fails	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department
75	The electrical angle deviation of joint% s is too large, the verification of motor encoder data and calibration data fails, and the motor encoder is polluted	The motor encoder pulse may be polluted	
76	The electrical angle deviation of joint% s is too large, the verification of motor encoder data and hall data fails, and the motor encoder is polluted	The motor encoder pulse may be polluted	
78	The electrical angle of joint% s is abnormal, the encoder data is out of range, and the motor encoder is polluted	The motor encoder pulse may be polluted	

Alarm Number	Description	Possible Reasons	Suggested Solutions
79	The electrical angle of joint% s is abnormal, the encoder data is out of range, and the motor encoder is polluted	The motor encoder pulse may be polluted	
80	Hall sensor of joint% s is abnormal. Please try restarting or contact after-sales service	Hall sensor wiring error, looseness, cable damage, etc. cause inaccurate return value of hall sensor or related hardware damage of hall sensor, resulting in inaccurate return value of hall sensor	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department
81	During calibration, the hall sensor accuracy of joint %s is poor. Please try restarting or contact after-sales service	Hall sensor is not calibrated or calibrated abnormally	

Alarm Number	Description	Possible Reasons	Suggested Solutions
82	Hall sensor of joint% s is abnormal. Please try restarting or contact after-sales service	hall sensor is loose	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department
		hall sensor is calibrated abnormally	
90	The holding brake of joint% s is abnormal and the forward rotation of motor fails. Please check whether the joint is stuck	The brake is abnormal	
91	The holding brake of joint% s is abnormal, and the forward and reverse rotation of motor fails. Please check whether the joint is stuck	Abnormal when opening the brake	

Alarm Number	Description	Possible Reasons	Suggested Solutions
92	The holding brake of joint% s is abnormal, and the motor reversal fails. Please check whether the joint is stuck	Abnormality when opening the brake	Clear the alarm, power off and restart, check whether the alarm appears again, If it persists and cannot be eliminated, please contact the official after-sales department
94	The holding brake of joint% s is abnormal, the holding brake distance is too large, the holding brake fails or the load is too heavy	The sliding distance is too large after closing the brake	
		The load and acceleration parameters are incorrectly set	Check whether the load and acceleration parameters are set correctly
100	Joint% s is overloaded, acceleration or load is too large	The load is too large and exceeds the load characteristic curve	Check whether the load is too large and exceeds the load characteristic curve of the user manual
		Mechanical stuck phenomenon due to impact, joint brake not opened, etc.	Clear the alarm, power off and restart, check whether each joint is functioning properly

Alarm Number	Description	Possible Reasons	Suggested Solutions
100	Joint% s is overloaded, acceleration or load is too large	Joint driver hardware damage	If this alarm phenomenon persists, please contact the official after-sales department
110	Joint% s exceeds the maximum motor speed	The use speed exceeds the maximum allowable value	Set the controller speed parameters correctly, and try again after power off and restart
120	Joint% s bus voltage is overvoltage, please check whether the brake plate is connected or working normally	The brake plate of the control box may be abnormal	Clear the alarm, power off and restart, check whether the alarm appears again, if it persists and cannot be eliminated, please contact the official after-sales department
121	Joint% s bus is under voltage, please check the bus voltage or the state of each joint	The power of the control box is not enough due to hardware damage	Clear the alarm, power off and restart, check whether the alarm appears again, if it persists and cannot be eliminated, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
130	The joint% s is overheated. Please check the ambient temperature or joint heat dissipation	The load used is too large, exceeding the load characteristic curve	Check the size of the end load, and configure the load correctly according to the model
		The working environment temperature used is too high	Check the working environment temperature and use the robot according to the requirements specified in the user manual; Questions, please contact the official after-sales department
200	Abnormal multi circle data in joint% sflash	The driver saves the relevant information about the joint	If it is confirmed that the calibration or writing parameters is in progress, please ignore the error. After the actions are complete for a few seconds, please remove the error. If the error persists, please contact the official after-sales department

Alarm Number	Description	Possible Reasons	Suggested Solutions
201	Joint% s is not ready, initialization is not complete	The drive has not been initialized	Usually appears after the power is turned on, which is a normal alarm content; or click the ‘reset’ button to clear the alarm.

Chapter 14 Appendix

14.1 A IO Instructions for Use

The typical IO usage instructions are shown in the following table:

IO name	Function	Valid status	Remarks
X0	Emergency stop	low level effective	It will be triggered so long as any of
X1	Emergency stop	low level effective	them (X0/X1) is valid
X2	Safeguard stop	low level effective	It will be triggered so long as any of
X3	Safeguard stop	low level effective	them (X2/X3) is valid
X4	Digital input 4	high level effective	Digital input 4
X5	Digital input 5	high level effective	Digital input 5
X6	Digital input 6	high level effective	Digital input 6
X7	Digital input 7	high level effective	Digital input 7
X8	Digital input 8	high level effective	Digital input 8
X9	Digital input 9	high level effective	Digital input 9
X10	Digital input 10	high level effective	Digital input 10
X11	Digital input 11	high level effective	Digital input 11
X12	Digital input 12	high level effective	Digital input 12
X13	Digital input 13	high level effective	Digital input 13
X14	Digital input 14	high level effective	Digital input 14
X15	Digital input 15	high level effective	Digital input 15

IO name	Function	Valid status	Remarks
X16	Digital input 16	high level effective	Digital input 16
X17	Digital input 17	high level effective	Digital input 17
X18	Digital input 18	high level effective	Digital input 18
X19	Digital input 19	high level effective	Digital input 19
X50	Flange drag/mark/disable (blue)	high level effective	Pressed back to 1
X51	Flange drag/mark/disable (green)	high level effective	
Y0	Digital output 0	high level effective	Digital output 0
Y1	Digital output 1	high level effective	Digital output 1
Y2	Digital output 2	high level effective	Digital output 2
Y3	Digital output 3	high level effective	Digital output 3
Y4	Digital output 4	high level effective	Digital output 4
Y5	Digital output 5	high level effective	Digital output 5
Y6	Digital output 6	high level effective	Digital output 6
Y7	Digital output 7	high level effective	Digital output 7
Y8	Digital output 8	high level effective	Digital output 8
Y9	Digital output 9	high level effective	Digital output 9
Y10	Digital output 10	high level effective	Digital output 10

IO name	Function	Valid status	Remarks
Y11	Digital output 11	high level effective	Digital output 11
Y12	Digital output 12	high level effective	Digital output 12
Y13	Digital output 13	high level effective	Digital output 13
Y14	Digital output 14	high level effective	Digital output 14
Y15	Digital output 15	high level effective	Digital output 15
Y50	Blue button	high level effective	The light is always on (the Flange IO
Y51	Green button	high level effective	is selected)
M0	Emergency stop	low level effective	Set it to 0 when any of them (X0/X1) is valid
M1	External emergency stop	low level effective	The external emergency stop is triggered when setting the value to 0
M3	External start	high level effective	The JBI program is executed when setting the value to 1
M4	External pause	high level effective	The JBI program is paused when setting the value to 1
M5	External servo enable	high level effective	The servo is enabled when setting the value to 1
M6	Clearing the alarm externally	high level effective	The system alarm is cleared when setting the value to 1
M7	External pause	high level effective	The pause function is triggered when setting the value to 1

IO name	Function	Valid status	Remarks
M8	Reservation 1	high level effective	The scheduled program 1 will be executed when setting the value to 1
M9	Reservation 2	high level effective	The scheduled program 2 will be executed when setting the value to 1
M10	Reservation 3	high level effective	The scheduled program 3 will be executed when setting the value to 1
M11	Reservation 4	high level effective	The scheduled program 4 will be executed when setting the value to 1
M12	Reservation 5	high level effective	The scheduled program 5 will be executed when setting the value to 1
M13	Reservation 6	high level effective	The scheduled program 6 will be executed when setting the value to 1
M14	Reservation 7	high level effective	The scheduled program 7 will be executed when setting the value to 1
M15	Reservation 8	high level effective	The scheduled program 8 will be executed when setting the value to 1
M24	External stop	high level effective	The robot stops when setting the value to 1
M26	inconsistent emergency stop	high level effective	Set it to 1 when the statuses of the X0 and X1 port are inconsistent within 400ms

IO name	Function	Valid status	Remarks
M27	inconsistent safeguard stop	high level effective	Set it to 2 when the statuses of the X2 and X3 port are inconsistent within 400ms
M36	External synchronization	high level effective	The hold time is at least 20ms
M38	Servo-enabling state	high level effective	1: enable the servo, 0: disable the servo
M40	Switch off the servo from the outside	high level effective	Set it to 1 when switching off the servo enable
M41	Encoder calibration	high level effective	Set it to 1 when calibrating the encoder
M42	System reset	high level effective	Set it to 1 when resetting the system
M43	Backdrive	high level effective	Set it to 1 when entering into the backdrive mode
M44	Collision detection enable/disable	high level effective	1: enable the collision detection, 0: disable the collision detection
M45	Clear the booking queue	high level effective	Set it to 1 when clearing the booking queue

IO name	Function	Valid status	Remarks
M48	Automatic reset after the safeguard stop	high level effective	The robot resumes to run after the object leaves due to safeguard stop instead of other means (e.g. through the teach pendant)
M49	Safeguard stop status	high level effective	Set it to 1 to enter the safeguard stop status, the value will be set to 0 after the program is resumed
M50	External pause status	high level effective	Set it to 1 when the pause is triggered externally
M51	Pause status of the teach pendant	high level effective	Set it to 1 when the pause is triggered by the teach pendant, hold time is at least 20ms
M80	Back to the first line of the main program	high level effective	Back to the first line of the main program when setting the value to 1
M400	Servo-enabling state	high level effective	1: enable the servo, 0: disable the servo
M401	The robot is at the origin	high level effective	Set to 1 when the robot is at the program home, set to 0 when the robot is not at the program home

IO name	Function	Valid status	Remarks
M406	Reservation enable status	high level effective	Set it to 1 after selecting "Reservation", set to 0 when not selecting this option
M408	Reservation 1 - Status of the scheduled program 1	high level effective	Scheduled program 1 running status bit
M409	Reservation 2 - Status of the scheduled program 2	high level effective	Scheduled program 2 running status bit
M410	Reservation 3 - Status of the scheduled program 3	high level effective	Scheduled program 3 running status bit
M411	Reservation 4 - Status of the scheduled program 4	high level effective	Scheduled program 4 running status bit
M412	Reservation 5 - Status of the scheduled program 5	high level effective	Scheduled program 5 running status bit

IO name	Function	Valid status	Remarks
M413	Reservation 6 - Status of the scheduled program 6	high level effective	Scheduled program 6 running status bit
M414	Reservation 7 - Status of the scheduled program 7	high level effective	Scheduled program 7 running status bit
M415	Reservation 8 - Status of the scheduled program 8	high level effective	Scheduled program 8 running status bit
M416	Teach mode status	high level effective	Set it to 1 when the robot is in the TEACH mode
M417	Play mode status	high level effective	Set it to 1 when the robot is in the PLAY mode
M418	Remote mode status	high level effective	Set it to 1 when the robot is in the REMOTE mode
M419	Run button	high level effective	After pressing the start button at the lower right corner of the teach pendant, set it to 1

IO name	Function	Valid status	Remarks
M420	Pause button	high level effective	After pressing the pause button at the lower right corner of the teach pendant, set it to 1
M421	Servo button	high level effective	After pressing the servo button at the lower right corner of the teach pendant, set it to 1
M422	Clear the alarm button	high level effective	After pressing the clear the alarm button at the lower right corner of the teach pendant, set it to 1
M424	Stop status	high level effective	The detection hold time is at least 20ms
M425	Pause status	high level effective	The detection hold time is at least 20ms
M427	Program running status	high level effective	The detection hold time is at least 20ms
M428	Warning status	high level effective	The detection hold time is at least 20ms
M440	Interference zone 1	high level effective	Interference area signal 1 status bit
M441	Interference zone 2	high level effective	Interference area signal 2 status bit
M442	Interference zone 3	high level effective	Interference area signal 3 status bit

IO name	Function	Valid status	Remarks
M443	Interference zone 4	high level effective	Interference area signal 4 status bit
M444	Interference zone 5	high level effective	Interference area signal 5 status bit
M445	Interference zone 6	high level effective	Interference area signal 6 status bit
M446	Interference zone 7	high level effective	Interference area signal 7 status bit
M447	Interference zone 8	high level effective	Interference area signal 8 status bit
M448	Interference zone 9	high level effective	Interference area signal 9 status bit
M449	Interference zone 10	high level effective	Interference area signal 10 status bit
M450	Interference zone 11	high level effective	Interference area signal 11 status bit
M451	Interference zone 12	high level effective	Interference area signal 12 status bit
M452	Interference zone 13	high level effective	Interference area signal 13 status bit
M453	Interference zone 14	high level effective	Interference area signal 14 status bit
M454	Interference zone 15	high level effective	Interference area signal 15 status bit
M455	Interference zone 16	high level effective	Interference area signal 16 status bit
M464	Move the cursor to the first line of the main program	high level effective	Set it to 1 when moving the cursor to the first line of the main program, set it to 0 when leaving the first line of the main program, the detection hold time is at least 20ms
M465	Sync status	high level effective	It must take more than 20ms to detect

IO name	Function	Valid status	Remarks
M466	Collision alarm status	high level effective	Set it to 1 when triggering the collision alarm, set it to 0 after removing the collision alarm
M467	External button status	high level effective	The drag and remark functions are enabled when setting the value to 1
M468	Program single-step execution mode	high level effective	Set it to 1 when it is in the single-step mode, it must take more than 20ms to detect
M469	Program single-cycle execution mode	high level effective	Set it to 1 when it is in the single-cycle mode, it must take more than 20ms to detect
M470	Program continuous loop mode	high level effective	Set it to 1 when it is in the continuous loop mode, it must take more than 20ms to detect
M472	Precise mode status	high level effective	0: Imprecise, 1: Precise, the detection hold time is at least 20ms
M473	Initialization mode status	high level effective	0: Uninitialized, 1: Initialized, the detection hold time is at least 20ms

IO name	Function	Valid status	Remarks
M474	Backdrive status	high level effective	Set it to 1 when entering the backdrive mode, the detection hold time is at least 20ms
M475	Collision detection on/off status	high level effective	1: On, 0: Off
M476	Normal state	high level effective	1 indicates that the robot is ready to switch on the servo, 0 indicates that the robot is not ready to switch on the servo
M525	Automatic reset after the safeguard stop	high level effective	After the safeguard stop, set to 1 if it allows the program to automatically resume operation. Otherwise, set to 0
M526	Reduced mode	low level effective	Both of M526 and M527 are valid
M527	Reduced mode	low level effective	and can enter the reduced mode

14.2 B Glossaries

Stop Category 0: The robot motion is stopped immediately when the power supply of the robot is turned off. It is an uncontrolled stop, where the robot may deviate from the programmed path as each joint may brake as fast as possible. This protective stop may be used when a safety-related limit is exceeded, or when a fault occurs in the safety-related assessment part of the control system. For more information, please refer to EN ISO 13850:2015 or EN IEC 60204-1:2018.

Stop Category 1: The robot motion is stopped with power available for the robot to achieve the stop, and the power supply is turned off when the stop is achieved. It is a controlled stop, where the robot will comply with the programmed path. The power is turned off after one second or once the robot stands still. For more information, please refer to EN ISO 13850:2015 or EN IEC 60204-1:2018.

Stop Category 2: It is defined as a controlled stop with power available to the robot. The robot stops all motions within one second. Through the operation of the safety-related assessment control system, the robot may stay at the stop position. For more information, please refer to EN IEC 60204-1:2018.

Diagnostic coverage (DC): It is used to measure effectiveness of the diagnosis which is implemented to achieve the assessed performance level. For more information, please refer to EN ISO 13849-1:2015.

Integrator: The integrator is an organization designing the final installation of the robot. The integrator is responsible for implementing the final risk assessment, and must make sure that the final installation complies with local laws and regulations.

Mean time to dangerous failure (MTTFd): The MTTFd is defined as a value acquired by calculation and detection which are implemented to achieve the assessed performance level. For more information, please refer to EN ISO 13849-1:2015.

Risk assessment: The risk assessment is the whole process of identifying all risks and reducing these risks to an appropriate level. The risk assessment should be recorded and archived. please refer to ISO 12100 for details.

Performance level (PL): The PL is a discrete level which is used to specify the ability of each safety-related part in the control system to implement the safety function under foreseeable conditions. PLd is a second highest reliability classification, meaning that the safety function is extremely reliable. For more information, please refer to EN ISO 13849-1:2015.

14.3 C Certification and Detection

Through verification and evaluation of the quality management system and the sample type test of the enterprise by the third party certification organization, the productEC63 of the company is confirmed to be in line with the specific requirements and have the ability of producing the qualified products continuously and steadily, with the written confirmation. The description is as follows:

The EC63 has passed detection and certification of multiple well-known international third party organizations, and has acquired the EU CE certification and Korean KC certification. The product safety has achieved the international leading level.

The EC63 has passed the robot performance test of National Robot Testing and Assessment Center (Headquarters) of China; and the performance indexes have exceeded most of the domestic brands and achieved the standard of the traditional industrial robot, and have been gradually narrowing a gap with the top international brands.

The EC63 robot has passed the EU CE certification, and the product is in line with all relevant requirements of the EU CE directive:

Low-voltage Directive (LVD) 2006/95/EC

Machinery Directive (MD) 2006/42/EC

Electro Magnetic Compatibility Directive (EMC) 2004/108/EC

EN ISO 10218:2011

EN ISO 12100:2012

EN 60204-1: 2006+A1: 2009

The EC63 robot has been certified and tested by the official authority of Korea, has passed Korean KC certification, and is in line with all relevant requirements of the certification standards of Korea.

The EC63 robot has been certified and tested by National Robot Testing and Assessment Center (Headquarters) of China, has passed the CR certification and is in line with all relevant requirements of the CR certification standards regarding the collaborative robot. The test standards are as follows:

GB 5226.1-2008GB 11291.1-2011

GB/T 15706-2012

GB/T 17799.2-2003GB 17799.4-2012

The EC63 robot is subjected to the robot performance test implemented by National Robot Testing and Assessment Center (Headquarters) of China, and the test basis and standards are as follows:

GB/T 12642-2013 Industrial robots – Performance criteria and related test methods.

14.4 D Spare Parts List

For the spare parts list, please refer to: T202001007-Parts list of collaborative robots.

14.5 E Reference Standards

The robot is designed by using the following standards for reference, as shown in **Table** 14-3 .

Table 14-3 . Reference standards

Standard	Definition
2006/42/EC:2006	Machinery Directive: Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)
2004/108/EC:2004	EMC Directive: Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC
EN ISO 13850:2015	Safety of machinery: Emergency stop - Principles for design
EN ISO 13849-1:2015	Safety of machinery: Safety-related parts of control systems - Part 1: General principles of design
EN ISO 13849-2:2012	Safety of machinery: Safety-related parts of control systems - Part 2: Validation
EN ISO 12100:2012	Safety of machinery: General principles of design, risk assessment and risk reduction
EN ISO 10218:2011	Industrial robots: Safety Note: Content equivalent to ANSI/RIA R.15.06-2012, Part 1
ISO/TS 15066:2016	Safety requirements for collaborative industrial robot Robots and robotic devices —Collaborative robots

14.6 F Technical Specifications

Robot type	EC66
Weight	17.5kg
Maximum payload	6kg
Reach	914mm
Joint range	+/-360°
Joint speed	J1-J2:144°/s J3:180°/s J4-J6:224°/s
TCP speed	2.8m/s
Repeated positioning accuracy	+/-0.03mm
Controller IO	16 x DI, 16 x DO, 2 x AI, 4 x AO
Tool IO	2 x DI, 2 x DO, 1 x 24V 1 x AI, 1 x AO, 1 x RS485
IO power supply	The controller is 24V 2A, and the tool end is 24V 2A
Communication with controller	Ethernet TCP/IP, UDP, ModbusTCP. RS485/RS232, Modbus-RTU. Profinet, EthernetIP, CCLink.
Tool Communication	RS485
Protection class	IP54
Typical power consumption	250W/1600W
Temperature	0-50°C
Power supply	90-264VAC 50-60Hz 19-72VDC
controller weight	15kg
Anticipated service life	35000 hours

ELITE ROBOTS
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