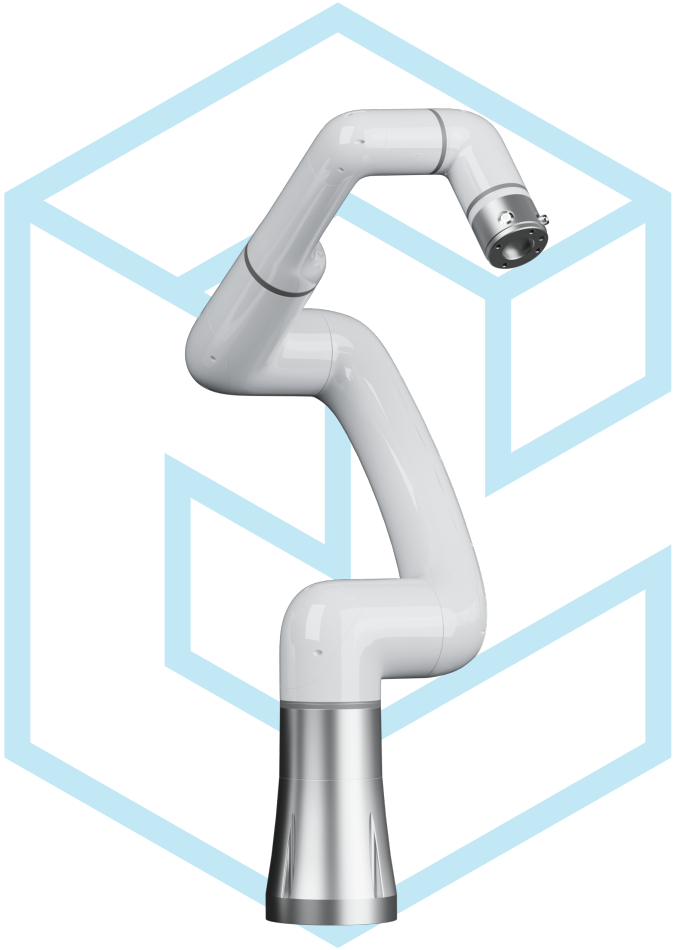
ELITE ROBOTS
艾利特机器人

ELITE ROBOTS LS Series User Guide



LS65 User Manual

Elite Intelligent Robot Co., Ltd.

2026-11-16

Version: Ver3.0.0

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

Elite Intelligent 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	V3.0.0
Servo version	V1.03.28
Terminal IO version	V2.01.38
Mechanical version	V1.1
Hardware version	V1.0
Service manual	V3.0.0

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Chapter 1 Robot General Guidelines

This chapter describes the general principles and requirements for operating the LS65 robot or robot system.

1.1 Safety

Integrators and users must carefully read this manual, especially all safety warnings, and strictly follow the instructions provided.

Due to the complexity of robot systems and the associated operational risks, personnel must fully understand the potential hazards and comply with all requirements specified in this manual.

Integrators and users must have adequate safety awareness and comply with applicable industrial robot safety standards, regulations, and laws.

This product has not been designed or certified in accordance with functional safety standards. Any functional descriptions in this document do not constitute a functional safety claim or a commitment to safety certification.

1.1.1 Responsibilities and Compliance

The LS65 robot can be used in combination with other equipment. Therefore, this manual does not cover the complete design, installation, and operation of a system that includes additional equipment, nor does it address the potential impact on surrounding equipment.

The safety of the robot installation depends on how the robot is integrated. The integrator must perform a risk assessment for the system design and installation in accordance with applicable national laws, regulations, and safety standards.

Risk assessment is a mandatory task for the integrator. It must be carried out based on the specific application scenario and in accordance with applicable laws, regulations, and industry safety standards in the country or region of use.

The integrator of the ELITE robot is responsible for, but not limited to, the following:

- Perform a comprehensive risk assessment of the complete robot system;
- Ensure correct design and installation of the robot and associated equipment;

- Provide training to users and operators;
- Establish complete operating procedures for the system;
- Implement appropriate safety measures;
- Eliminate hazards or reduce risks to an acceptable level during final installation;
- Communicate residual risks to the end user;
- Affix the integrator's identification and contact information to the robot;
- Maintain relevant technical documentation.

For applicable standards and legal guidelines, please visit the website: www.eliterobots.com.

1.1.2 Limitation of Liability

All safety information in this manual does not constitute a guarantee by Elite Intelligent Robot Co., Ltd. Even when all safety instructions are followed, personal injury or equipment damage may still occur.

Elite Intelligent Robot Co., Ltd. reserves the right to improve products without prior notice.

While every effort has been made to ensure the accuracy and reliability of this manual, the company assumes no responsibility for errors or omissions.

1.1.3 Warning Symbols

The following warning symbols indicate different hazard levels used in this manual and must be observed.

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.

REMINDER



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.

1.1.4 Safety Precautions

This section describes measures to protect personnel and prevent damage to the equipment. Users must read this manual thoroughly and be familiar with all safety precautions. Although every effort has been made to cover relevant safety situations, it is not possible to describe all potential hazards or prohibited operations due to the wide range of possible applications.

1.1.4.1 Instructions for Use

Before initial startup of the robot or robot system, the following basic information must be understood and followed. Additional safety information is provided in other sections of this manual. Safety measures must always be evaluated based on the specific application.

REMINDER



1. The robot and all electrical equipment must be installed in accordance with the requirements specified in this manual.
2. Before initial use and commissioning, the robot and its safeguarding system must be tested and inspected.
3. Before initial startup, verify that the system and equipment are complete, undamaged, and safe to operate. Ensure compliance with applicable national or regional safety regulations. All safety functions must be tested.
4. All safety parameters and user programs must be verified as correct, and all safety functions must operate properly. Safety checks must be performed by qualified personnel. The robot may only be started after successful completion of a comprehensive safety verification.

REMINDER



1. The robot must be installed and commissioned by professionals according to the mounting standards.
2. Once the robot is installed, a comprehensive risk assessment must be performed and documented.
3. Safety parameters may only be configured or modified by authorized personnel. Measures such as password protection should be implemented to prevent unauthorized changes. After any modification, the relevant safety functions must be verified by qualified personnel.
4. In the event of an emergency or abnormal operation, press the emergency stop button to stop the robot.
5. The LS65 joints are equipped with brakes to maintain position when power is off. Do not frequently switch the power supply on and off. A minimum interval of 10 seconds between power cycles is recommended.
6. The LS65 features collision detection. When the external force applied on the robot arm exceeds the preconfigured normal force range, the robot will automatically stop to prevent personnel injury and equipment damage. This function is intended for human-robot collaboration and is only effective when used within the specified operating conditions and with ELITE collaborative robot controllers. If other controllers are used, this function may not

be available, and the user assumes all associated risks.

WARNING



1. The robot and the controller generate heat during running. Do not touch the robot while it is operating or immediately after it has stopped.
2. Allow at least one hour for the robot to cool down after power-off.
3. Do not place fingers near heated areas of the controller.

REMINDER



1. Ensure that the robot arm and end effector are correctly and securely installed.
2. Ensure sufficient space for safe robot movement.
3. Do not use a damaged robot.
4. Do not connect safety devices to standard I/O. Use safety I/O only.
5. Ensure correct configuration (e.g. mounting angle, payload in TCP, TCP offset, and safety configuration). Ensure user data is properly saved and applied.
6. Tools and surrounding objects must not have sharp edges or pinch points.
7. Ensure all personnel remain outside the robot's reachable workspace.
8. Be aware of robot motion when operating the teach pendant.
9. Integration with other machinery may introduce additional hazards. Differences in safety or emergency stop performance must be evaluated and appropriate measures implemented.
10. Read and understand the manuals for the robot and all associated equipment.
11. Do not modify the robot. Unauthorized modifications may result in unpredictable hazards. Any authorized modification must follow the latest Service Manual. Elite Intelligent Robot Co., Ltd. assumes no liability for unauthorized modifications.
12. Before transportation, verify insulation and protective measures.
13. Follow handling and transportation requirements to avoid impact or damage.

REMINDER



1. When operating the robot with machinery that may cause damage, verify the robot functions and programs independently.
2. Do not expose the robot to strong or permanent magnetic fields, as this may cause damage.
3. Elite Intelligent Robot Co., Ltd. shall not be liable for damage or injury resulting from program errors or improper operation.

1.1.4.2 Personnel Safety

When operating the robot, personnel safety must always be ensured. Appropriate measures shall be taken to protect operators.

Precautions are as follows:

1. Personnel operating the robot must complete training provided by Elite Intelligent Robot Co., Ltd. Users must ensure that operators are fully trained in safe and standardized operating procedures and are qualified to operate the robot. For training details, please contact our company at service@elibot.com.
2. When operating the robot, do not wear loose clothes or jewelry (such as necklaces, bracelets, rings, earrings, etc.) . Long hair must be tied back.
3. During operation, even if the robot appears to have stopped, it may be waiting for a start signal and could move at any time. The robot must always be regarded as being in motion unless it is confirmed to be safely stopped.
4. Mark the robot workspace on the floor so that operators are aware of the full range of motion, including any attached holding tools (manipulator, tools, etc.).
5. Implement appropriate safety measures around the robot work area (e.g., safety fences, barriers, or protective screens) to protect operators and nearby personnel. Where necessary, install locking devices to restrict access to the robot power supply to authorized personnel only.
6. When using the control panel or teach pendant, do not wear gloves, as this may lead to operating errors.
7. In emergency situations, such as when a person is trapped or surrounded by the robot, the robot can be manually moved by applying force (400N) to the robot body to release the person. Manual movement of the robot without power is for emergency use only and may cause damage to the joints.

1.1.5 Intended Use

The ELITE LS series collaborative robots are intended for general industrial and light commercial applications, such as operating or handling tools and equipment, and processing or transferring parts and products.

The ELITE LS series collaborative robots support collaborative applications. Under appropriate risk assessment and safety considerations, human-robot collaboration can be implemented.

Integrators or users shall evaluate potential contact risks between personnel, the robot, end effectors, and the working environment based on the specific application scenario, and take necessary measures to ensure that such risks are maintained within an acceptable range.

The robot system (including the controller and robot arm) shall not be used for applications beyond its intended use. Prohibited uses include, but are not limited to, the following:

- Use in flammable, explosive, or otherwise hazardous environments;
- Use in devices intended to transport or carry humans or animals;
- Devices such as medical equipment for human life;
- Use in applications with significant social or public impact;
- Use in environments subject to strong vibration, such as vehicles or ships;
- Use as climbing or lifting equipment.

1.1.6 Risk Assessment

The risk assessment shall consider all potential contact between the operator and the robot during normal use and foreseeable misuse. The operator's neck, face, and head shall not be positioned in areas where contact with the robot may occur.

Before operating the robot without peripheral safety safeguarding devices, a risk assessment shall be conducted based on the specific application to determine whether the identified hazards may result in unacceptable risks. Potential hazards include, but are not limited to:

- Use of sharp end effectors or tool connectors;
- Handling of toxic or other hazardous substances;
- Risk of operator fingers being trapped by the robot base or joints;
- Risk of collision with the robot;
- Risk of the robot or end-of-arm tooling not being properly secured;
- Risk of impact between the robot payload and rigid surfaces.

The integrator shall identify and assess such hazards and associated risk levels through risk assessment, and determine and implement appropriate measures to reduce risks to an acceptable level. Note that additional significant hazards may exist depending on the specific application.

By combining the inherent safety design features of ELITE collaborative robots with the risk assessment and mitigation measures implemented by integrators and end users, the risks associated with LS65 collaborative operation can be minimized.

This document provides information on residual risks that may exist during the installation and use of the robot. If the integrator determines that risks in a specific application may be unacceptable, appropriate risk reduction measures shall be implemented before the robot is put into operation.

If the robot is installed in a non-collaborative application (e.g., when using hazardous tools), the risk assessment may require the integration of additional safety devices (e.g., enabling devices) to ensure the safety of personnel and equipment.

1.1.7 Emergency Handling

1.1.7.1 Emergency Stop Device

Pressing the emergency stop button will immediately stop all robot motion. An emergency stop shall not be used as a risk reduction measure, but may serve as a secondary protective measure. If multiply emergency stop buttons are required, a risk assessment shall be conducted based on the specified application.

The LS65 is equipped with an emergency stop button on the teach pendant. In case of an abnormal condition or emergency, press the emergency stop button immediately to stop the system.

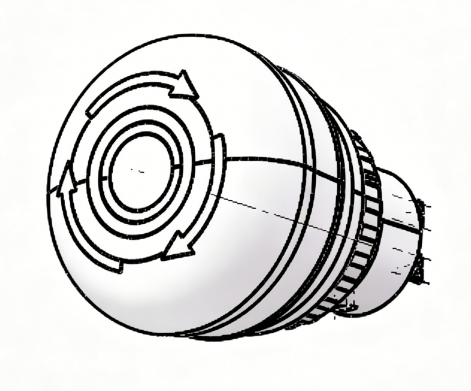


Figure 1-1: Emergency stop button

The controller is equipped with a port for connecting to external emergency stop

and protective stop devices, which may be used as required by the application.

REMINDER



If tools or equipment connected to the end effector pose a potential hazard, they must be integrated into the system's emergency stop circuit. Failure to comply with this warning may result in serious property damage, severe personal injury, or death.

1.1.7.2 Recovery from Emergency

All emergency stop devices are equipped with a latching mechanism. The emergency stop condition can only be cleared by releasing this mechanism. The emergency stop button can be released by rotating it.

After recovery from the emergency stop condition, the robot shall be powered on again, the brake released, and the system returned to normal mode. The previously running program may resume.

Note that recovery from the emergency stop condition shall only be performed after all hazards have been eliminated.

1.1.7.3 Emergency Forced Movement of Joints

In rare cases, it may be necessary to move one or more robot joints manually in an emergency, such as when power is unavailable or intentionally not applied. The robot joints may be forced to move by the following method:

Forced backdriving: Push or pull the robot arm with sufficient force (at least 400N) to move the joints.

Backdrive function: This function can be used to release the robot from a stuck condition. In backdrive mode, the robot can be manually guided. When sufficient force is applied, the servo system will automatically release the brake, allowing the robot to be moved.

Trigger condition: When the robot is in standby mode, press the hand-guiding button to enter backdrive mode.

REMINDER



Manual forced movement of the robot is intended for emergency use only and may damage the joints.

1.2 Safety-Related Control Functions and Interfaces

LS65 robot provides a variety of safety-related control functions and electrical interfaces (including safety I/O, digital and analog signals) for connection and control of external devices or protective equipment.

These functions are intended to support operation, control and application development and do not constitute a functional safety system. When using this product, a risk assessment shall be carried out based on the specific application, and appropriate external protective measures shall be implemented to ensure overall system safety.

Refer to Section 2.2 for I/O connection methods. Refer to Section 3.3 and Section 3.5 for the configuration of functions, inputs and outputs.

REMINDER



1. The use and configuration of these interfaces shall be based on the risk assessment of the specific application (see Subsection 1.1.6).
2. If a fault or violation is detected in the safety system (e.g., interruption of the emergency stop circuit or a safety limit violation), a Stop Category 0 will be initiated.
3. The stopping time shall be considered as part of the application risk assessment.

DANGER



1. Use of configuration parameters that differ from those determined by the risk assessment may result in personal injury or equipment damage.
2. Ensure that tools and grippers are properly secured to prevent hazards in the event of a power interruption.
3. Ensure that all electrical parameters (e.g., voltage) of external devices are correctly configured. If a device rated for 12V is incorrectly set to 24V, equipment damage may occur.

1.2.1 Stop Category

Based on the definitions in IEC 60204-1, this product supports the following stop categories (for description of control behavior only and not representing functional safety classifications):

Table 1-1. Stop Category

Stop Category	Definition
Stop Category 0	Uncontrolled stop achieved by immediately removing power from the actuators.
Stop Category 1	Controlled stop in which the actuators actively brake; power is removed after the stop is completed. The stop is not guaranteed to follow the intended trajectory.
Stop Category 2	Controlled stop in which the actuators actively brake and the stop is ensured along the intended trajectory; power is retained after the stop.

1.2.2 Mode Overview

1.2.2.1 Operation Modes

Operation modes define how robot motion is executed, as shown in **Table** 1-2.

Table 1-2. Operation Modes

Operation Mode	Description
Manual Mode	The operator controls robot motion using the teach pendant.
Automatic Mode	The robot automatically executes configured Python programs.

In Manual Mode, the operator can jog or hand-guide the robot, monitor I/O signals, and create, edit, and run programs. Menu path: [Elite] icon → [Settings] → [Password] → [Mode].

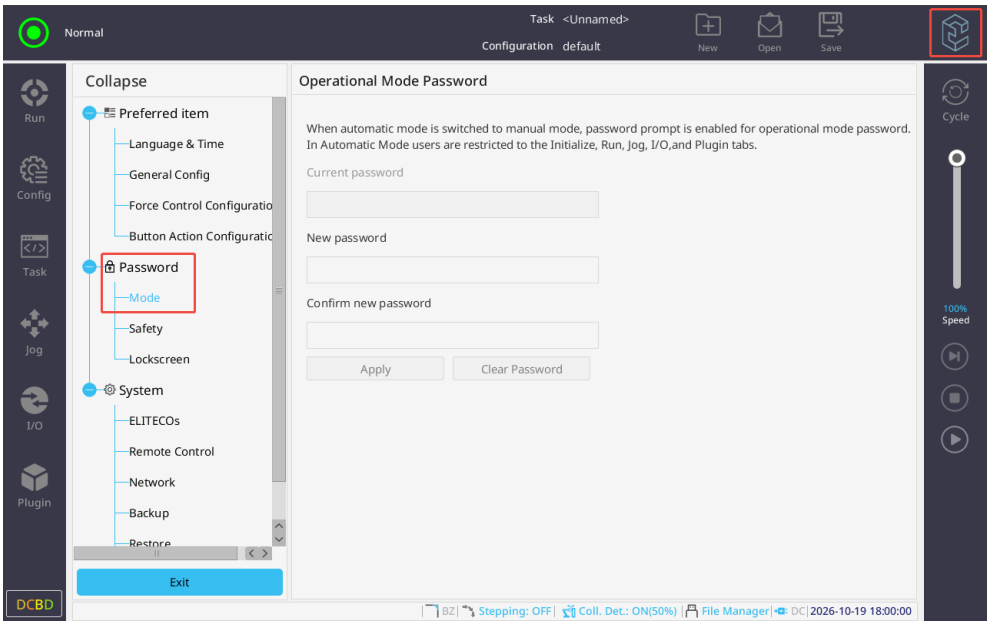


Figure 1-2: Set the Password for Operation Modes

Set the operation mode password on this screen, then the system automatically switches to Manual Mode.

In Automatic Mode, only program execution, signal monitoring, and I/O-related operations are allowed; program creation and editing are not supported. Tap the Manual Mode icon on the right side of the teach pendant to switch to the automatic mode.

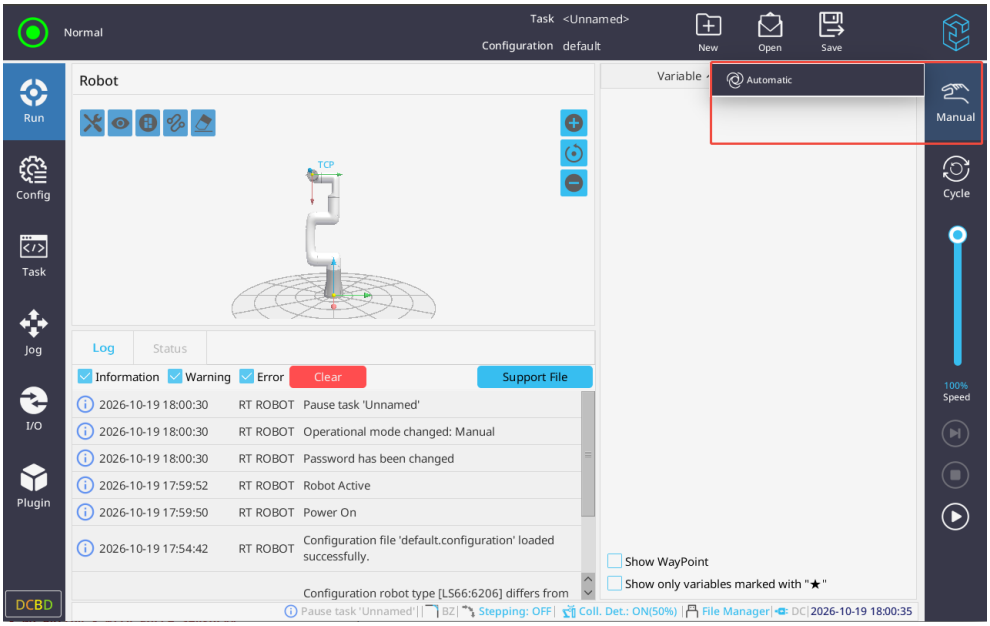


Figure 1-3: Switch to Automatic Mode

NOTICE

1. Tasks and configuration files can only be created and opened in Manual Mode.
2. If a mode password has been set, password verification is required when switching back to Manual Mode from Automatic Mode.

1.2.2.2 Control Modes

To prevent multiple control sources from controlling the robot simultaneously, the system provides Local Control Mode and Remote Control Mode to restrict the sources of robot control commands. After enabling the [Remote Control] function, the user can select the appropriate control mode as needed.

Table 1-3. Control Modes

Control Mode	Description
Local Control Mode	The robot can be controlled only via the teach pendant. In this mode, the operation mode can be changed.
Remote Control Mode	The robot can be controlled only through external interfaces (port 30001, dashboard commands, I/O signals, etc.). In this mode, the operation mode cannot be changed.

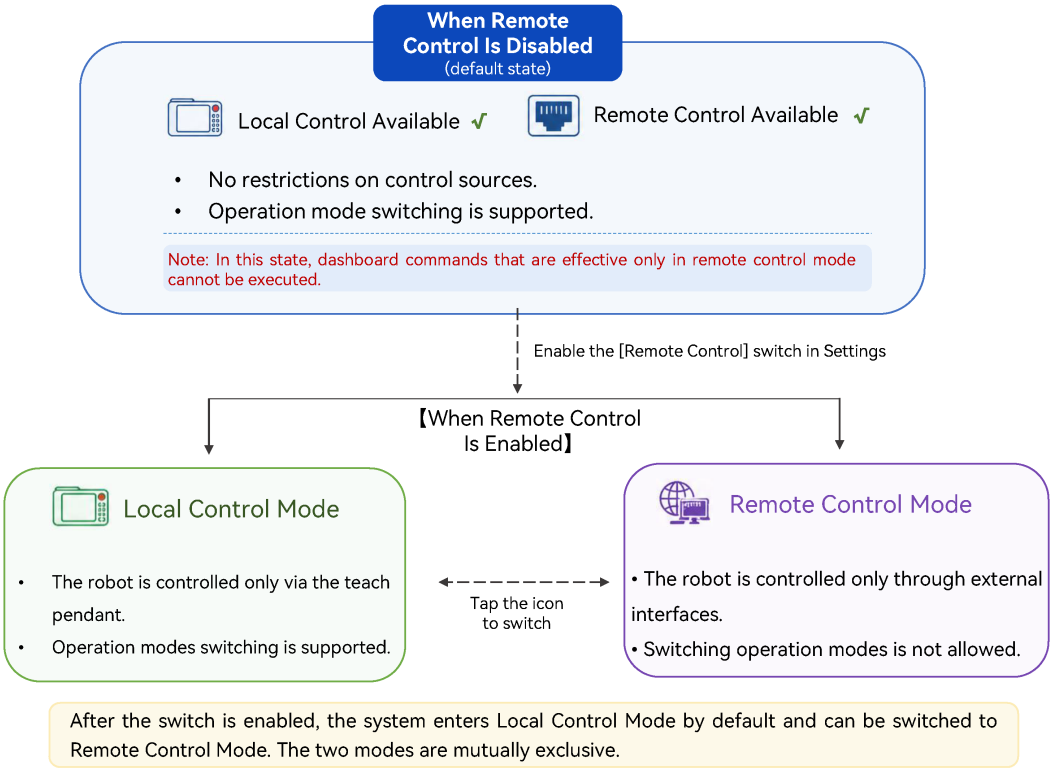


Figure 1-4: Control Modes Overview

When Remote Control Is Disabled:

When the system is in its default state, the [Remote Control] function is disabled and the operation mode password is not set. In this state, operators can control the robot via the teach pendant or through supported external interfaces.

NOTICE

> Some dashboard commands on port 29999 that are effective only in remote mode cannot be executed in this state.

When Remote Control Is Enabled:

To enable remote control, select the [Elite] icon → [Settings] → [System] → [Remote Control], then turn on the [Enable] switch.

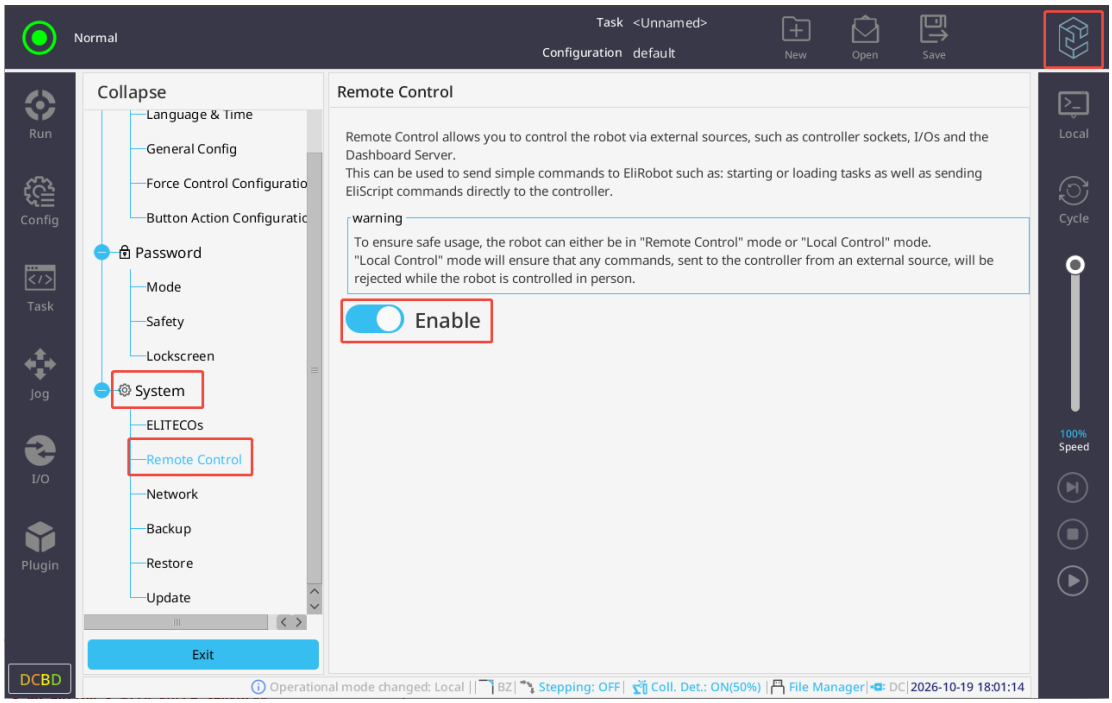


Figure 1-5: Enable Remote Control

Once enabled, the system switches to Local Control Mode by default. Select Local Control Mode or Remote Control Mode as needed to restrict the sources of control commands.

1.2.2.3 Safety Modes

Safety modes define safety parameters and function restrictions for different operating states, as shown in **Table** 1-4.

Table 1-4. Safety Modes

Safety Mode	Description
Normal Mode	Safety parameter configuration when the robot is operating normally
Reduced Mode	Safety parameter restrictions when the robot enters a reduced zone or is being moved via a three-position enabling device during hand guiding

1.3 Transporting

When the robot is hoisted, appropriate measures shall be taken to locate the moving parts, so as not to cause accidental movement and harm in the process of hoisting and transportation. During packaging and transportation, the packaging shall be carried out according to the packaging standard, and the required marks shall be marked on the outside of the packaging box.

During transportation, it is necessary to ensure that the robot is stable and fixed in a proper position.

The controller shall be lifted with a handle.

When the robot is moved to the mounting position from the packaging material, hold the robot until all the screws of the robot base are fastened.

After fixing, power on the robot, and adjust the robot posture to the appropriate position by using the robot drag teach function.

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

REMINDER



1. When lifting the robot, please make sure to keep back or shoulder away from overloaded.
2. All regional and national guidelines should be followed. Elite Intelligent Robot 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 mounting in-

structions.

1.4 Quick Start

1.4.1 Robot System Introduction

The LS65 robot system is mainly composed of robot arm (hereinafter referred to as: arm), robot ERB1C600MET-Mini controller (hereinafter referred to as: controller) and robot teach pendant ERP500 (hereinafter referred to as: teach pendant).

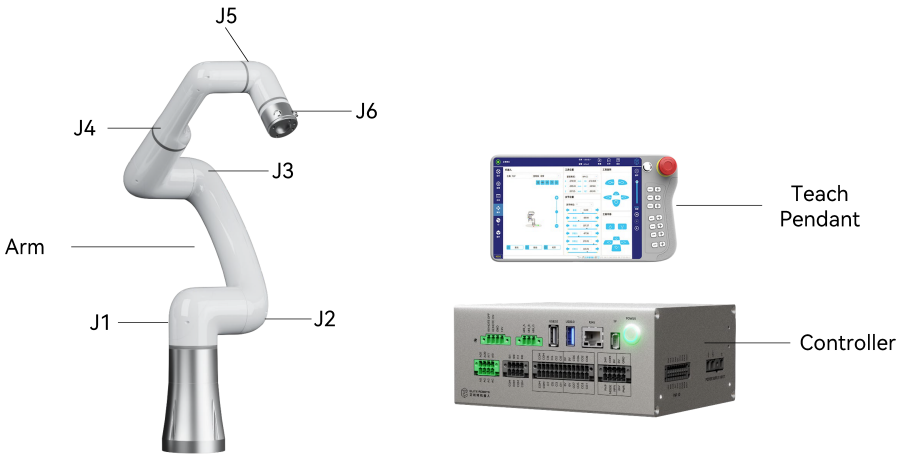


Figure 1-6: LS65 System

As the main part of the robot system, the arm is composed of link and joints. Users can use teach pendant to coordinate the actions of these joints.

- Base: perform arm rotary motion;
- Shoulder and elbow: perform extensive work;
- Wrist 1 and wrist 2: perform finer work;
- Wrist 3: Perform the rotation action of the end tool.

The controller serves as the control system of the whole robot system, i.e. to control the robot movement position, velocity, acceleration, attitude and the equipment connected with the input and output terminals.

Teach pendant is the display and can also be used to operate the robot. The teach pendant mainly includes: a 10.1-inch LCD touch screen, a power switch, an emergency stop button, a drag switch, six pairs of axis motion control keys, one pair of speed adjustment keys, and a connector socket of the teach pendant. LCD touch screen not only show the details of robot motion to the user, including position and attitude parame-

ters, but also facilitate the user's operation. All operations can be completed by directly clicking on the screen.

The design of the teach pendant shell has both aesthetics and ergonomics. Behind it is a nylon rope and two hanging rings. The former is used to hold the teach pendant, and the latter can be used to hang the teach pendant on the controller.

The LS65 robot can be started quickly by referring to the following process:

1. Open the box and take out the robot arm, controller, teach pendant and related cables;
2. Install the robot arm;
3. Install the robot controller and teach pendant;
4. Connect cables;
5. Power on the robot;
6. Write programs to operate robots.

1.4.2 Robot System Installation

1.4.2.1 Robot Arm Installation

The installation steps of the robot arm are as follows:

- Unpack and take out the robot arm and controller;
- Install the robot arm on the base.

When installing on the base, use 4 * M6 screws with grade 8.8 strength and 4 6.6mm mounting holes at the bottom. It is recommended to tighten these screws with a torque of 8Nm. If the robot arm mounting position needs to be very accurate, drilling two Ø5 pin holes and fix them with pins can help guiding. **Figure** 1-7 shows the drilling position and screw installation position for arm installation. Install the robot on a firm, vibration free surface that is sufficient to withstand at least 10 times the maximum overturning moment of the base joint and at least 5 times the weight of the robot arm. See Subsection 2.1.2.1 for the installation dimensions of robot base.

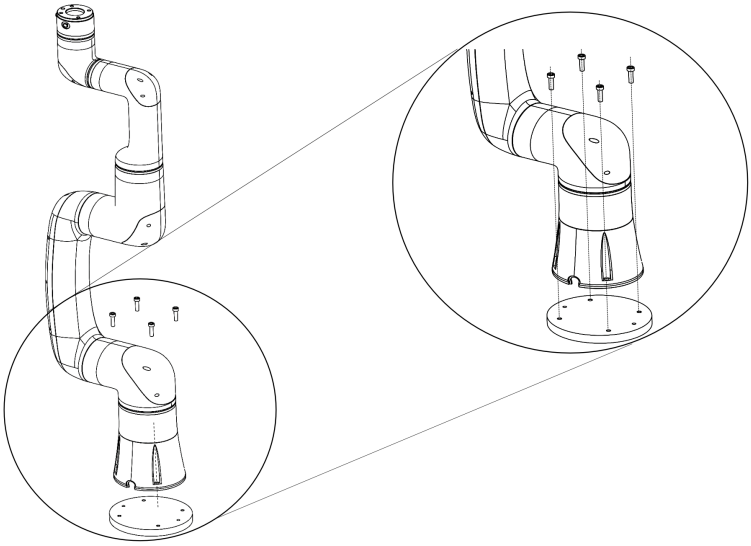


Figure 1-7: Arm installation

1.4.2.2 Robot Controller and Teach Pendant Installation

The controller may be wall-mounted or floor-mounted and the teach pendant may be wall-mounted. After installing the robot arm and controller, the teach pendant can be used.

REMINDER



The controller shall be placed vertically or horizontally on the ground. 50mm gap shall be reserved on each side of the controller to ensure smooth air circulation.

DANGER



1. Keep the controller, teach pendant, and cables away from liquids. Moisture may cause fatal hazards.
2. Install the teach pendant (IP54) and controller (IP20) in environments suitable for their respective IP ratings. Pay close attention to the environment with conductive dust.

1.4.3 Cable Connection

The front, left and right sides of the controller have one port respectively, for connecting the teach pendant, the robot arm, and an external DC power supply. Before use, insert the corresponding cables into these ports.

1.4.3.1 Robot arm and Controller Connection

Please connect the robot arm to the controller according to the following steps:

1. Connect the robot cable connector to the interconnecting cable, ensuring the connector is securely locked.
2. Connect the two leads of the intermediate cable to the corresponding ports on the left side of the controller:
   - Communication Connector: Insert into the Robot Communication port;
   - Power Connector: Insert into the Robot Power Supply port.

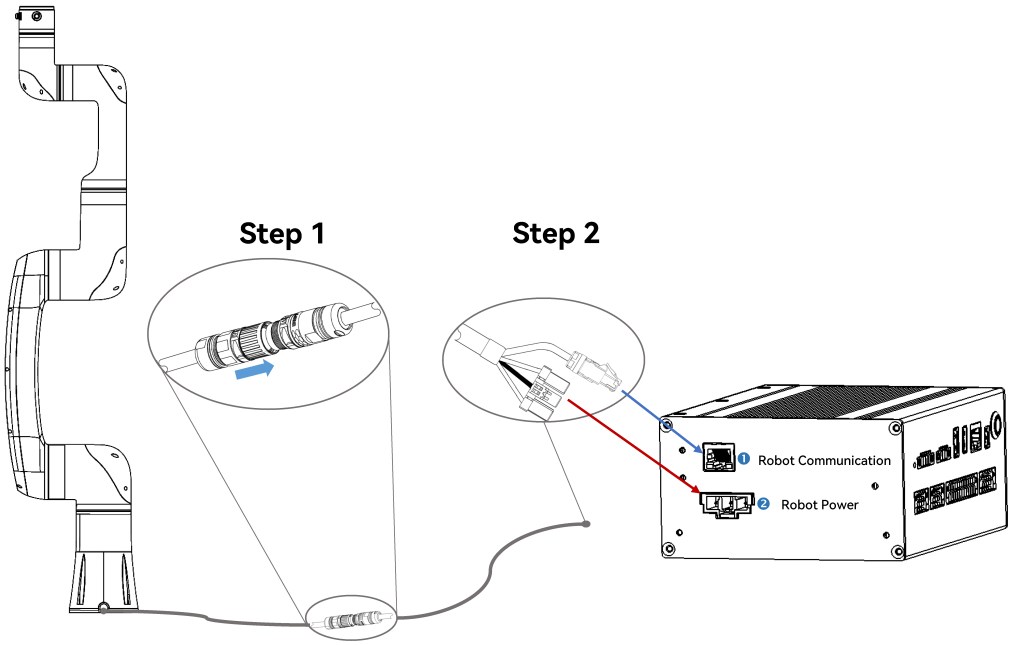


Figure 1-8: Robot Arm Connection

1.4.3.2 Controller and Teach Pendant Connection

Insert the teach pendant cable connector into the TP port on the front of the controller.

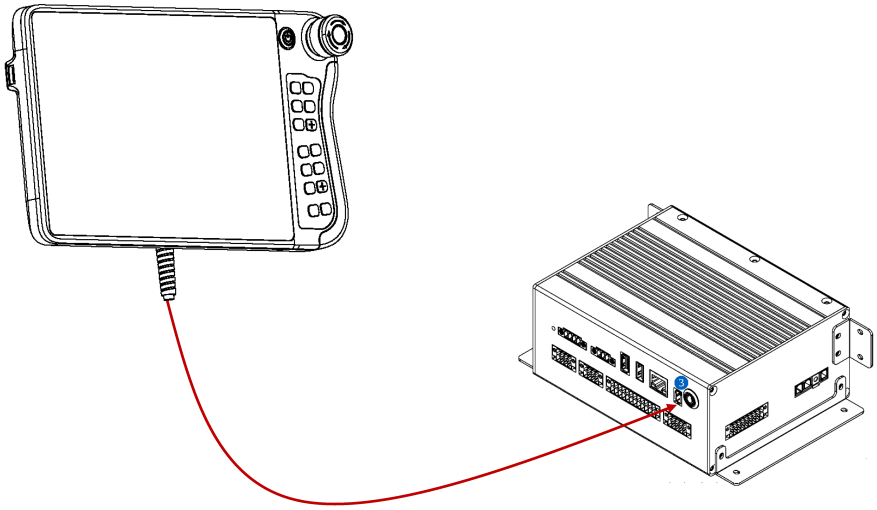


Figure 1-9: Teach Pendant Connection

1.4.3.3 External DC Power Connection

The right side of the controller is equipped with a controller power input interface. Insert the output connector from the power adapter into the Power Input port on the right of the controller. Then Connect the power cord to the adapter's AC input, and the other end into a power outlet.

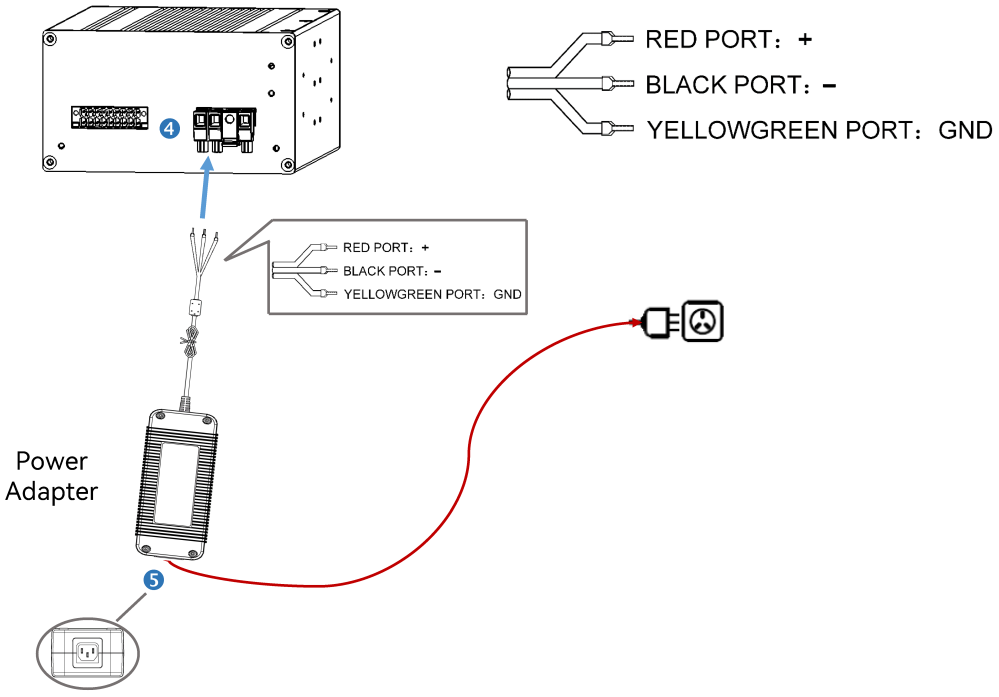


Figure 1-10: External DC Power Connection

DANGER



1. Ensure that the robot is grounded in the correct way (electrical grounding). The grounding connector shall have at least the rated current of the highest current in the system.
2. Ensure that all cables are correctly connected before the controller is powered on. Use the original power cord correctly.

WARNING



1. Do not disconnect the robot cable when the robot arm is powered on.
2. Do not extend, modify, or alter the original cable without authorization.

1.4.4 Power on The Robot

1.4.4.1 Preparation before Powering on

The preparation of the LS65 robot before powering on is as follows:

- Check whether the robot is well connected with the controller;
- Check whether the connection between the teach pendant and the controller is intact;
- Check whether the power cable of the controller is well connected;
- The emergency stop switch of the teach pendant is in the pop-up state;
- Ensure that the robot will not touch the surrounding personnel or equipment.

1.4.4.2 Power on/off Robot Arm

Click the robot status icon at the top left of the screen to enter the [Robot Status] interface.

Tap [Power On] and the robot is in the ready state. Then tap [Brakes Release] again, brakes released and the robot can be operated.

REMINDER



When the holding brakes are released, the robot arm is powered on, accompanied by sound and slight movement.

1.4.5 First Task

After completing the preparations according to Subsection 1.4.4, power on the controller. Click  in the upper left corner of the status and menu bar on the teach pendant. Click [Power On] under [Robot Status], then [Brake Release]. After Robot in "Normal" mode is checked, click [Exit] at the bottom left to exit the current page. Payload settings need to be configurated based on the actual robot status under [Config] tab. If the arm is not mounted on the floor horizontally, mounting settings need to be configurated as well under [Config] tab.

Click  on the right of the status and menu bar, choose [Settings] > [Password] > [Safety], and set a safety password to unlock safety configuration parameters.

Note: The "Current password" does not need to be entered only when the safety password is set for the first time.

The user can use the operation tab (see Section 3.8) to move the robot arm to the desired position, or press and hold the free drive button on the back of the teach pendant to drag the robot arm to the teach position.

The following is a simple task that allows the robot arm to move between two waypoints.

1. Click [New] in the upper right corner of the screen and select [Task].
2. Select [Task] > [Basic] > [Waypoint] and add the waypoint to the task tree. At the same time, the default MoveJ is also added to the task tree.
3. Select the created waypoint and click [Set Waypoint] in the [Instruction] interface on the left.
4. Set waypoints. For details, please refer to Section 3.8. The user can also press and hold the free drive button and drag the robot arm to the desired position.
5. If the robot arm is in place, press the [Accept] key, and the new waypoint will be displayed as waypoint_1.
6. Follow steps 2 to 5 to create waypoints_2.
7. Stand in a safe position, the arm moves to the starting point, click  to run the current task in the control bar, and the robot moves at the waypoint_1 and

waypoints_2.

NOTICE



1. Do not let the robot collide with itself or other objects, which will cause damage to the robot.
2. This is a quick start guide for LS65 robot with basic introduction. Please do not increase the speed or acceleration above the default value. Risk assessment should always be carried out before operating the robot.

Chapter 2 Robot Hardware

This chapter describes the hardware components of the LS65 robot system, including the mechanical structure and electrical interfaces.

2.1 Mechanical Structure

This section describes the basic precautions when installing the LS65 robot and its system components.

2.1.1 Mechanical Parameters

2.1.1.1 Robot Mechanical Dimensions

The mechanical dimensions of the LS65 robot are shown in **Figure** 2-1.

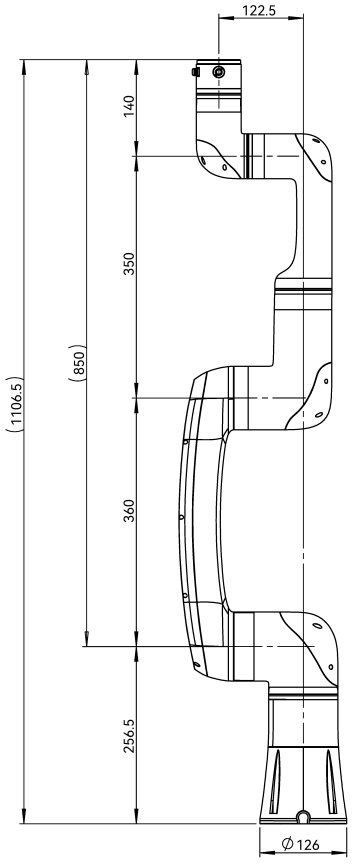


Figure 2-1: Mechanical dimensions of the LS65 robot (unit: mm)

2.1.1.2 Robot Workspace

The workspace of the LS65 robot is shown in **Figure** 2-2. When the robot moves, the Tool Center Point (TCP) can move within the maximum reachable range. The TCP should remain within the recommended working range whenever possible.

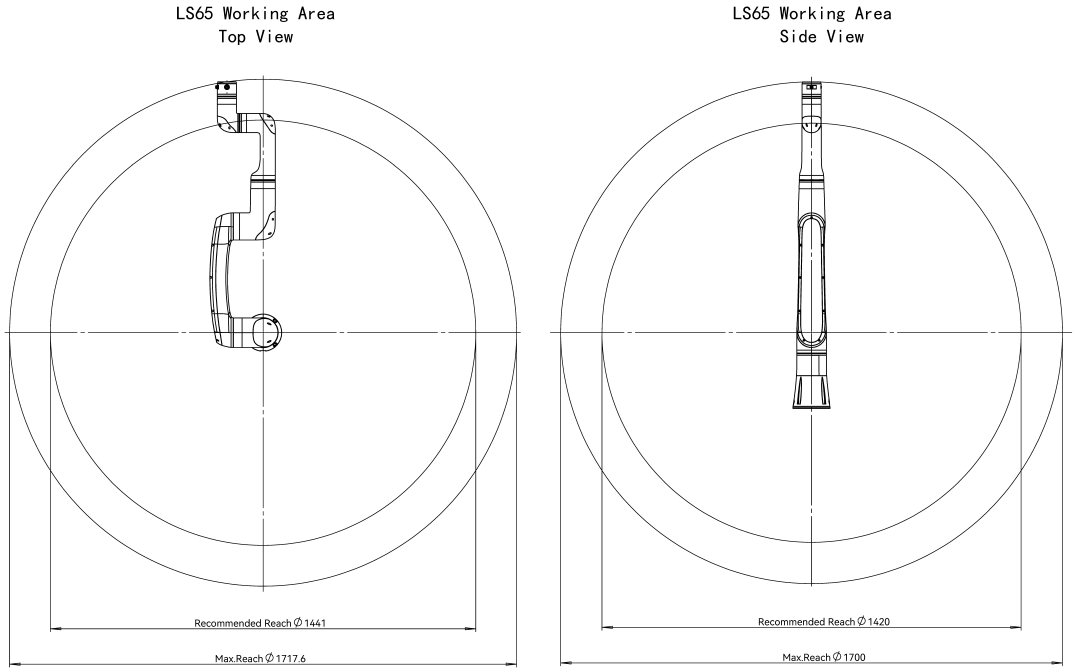


Figure 2-2: Workspace of the LS65 robot (unit: mm)

2.1.1.3 DH Parameters

Denavit–Hartenberg (DH) parameters are a standard method for representing the forward kinematics of a robot. They define the position of the TCP in the base coordinate system based on the robot joint angles.

The DH parameters of the LS65 robot are listed in **Table** 2-1.

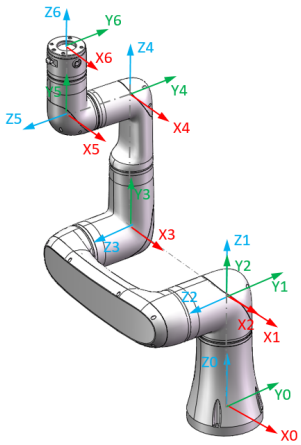


Figure 2-3: Robot DH diagram

The DH parameters of the LS65 robot are listed in **Table** 2-1.

Table 2-1. LS65 DH parameters

Joint	theta[rad]	a[m]	d[m]	alpha[rad]
Joint 1	0	0	0.2565	0
Joint 2	0	0	0	π/2
Joint 3	0	-0.360	0	0
Joint 4	0	0	0.350	-π/2
Joint 5	0	0	0.1225	π/2
Joint 6	0	0	0.140	-π/2

2.1.2 Mounting

When designing, installing, or maintaining the LS65 robot, the following warnings and precautions must be observed.

WARNING



1. Keep all equipment dry. If water enters the product, cut off the power supply and contact the supplier.
2. Use the original cable of the robot only. Do not use the robot in those applications where the cable is subject to repeated bending. If longer cables or

flexible cables are needed, please contact the supplier.

3. The negative connector is the GND connection and is bonded to the robot and controller enclosure. GND is used for power supply and signal transmission only. For protective grounding (PE), please use the dedicated power supply socket of the controller to provide reliable grounding for the controller.
4. Exercise caution when installing interface cables to the robot I/O interfaces. The metal plate on the side of the cabinet is designed for routing interface cables and installing connectors. Remove this metal plate before drilling. Before reinstalling the metal plate, remove all burrs from the drilled holes. Remember to use the correct size gland.

2.1.2.1 Robot Arm Mounting

Use 4 grade 8.8 M6 screws to mount the robot arm with the 4 mounting holes on the base. It is recommended to tighten all screws to a torque of 8Nm. Use the provided Ø5 locating holes with dowel pins for precise positioning. It is also possible to purchase an accurate base counterpart to install the robot. **Figure** 2-4 shows the mounting dimensions of LS65 robot base.

Install the robot on a rigid, vibration-free surface capable of withstanding at least 10 times the maximum overturning moment of the base joint and 5 times the robot weight. For installations on a linear axis or movable platform, limit the acceleration of the movable mounting base to avoid triggering safety stops.

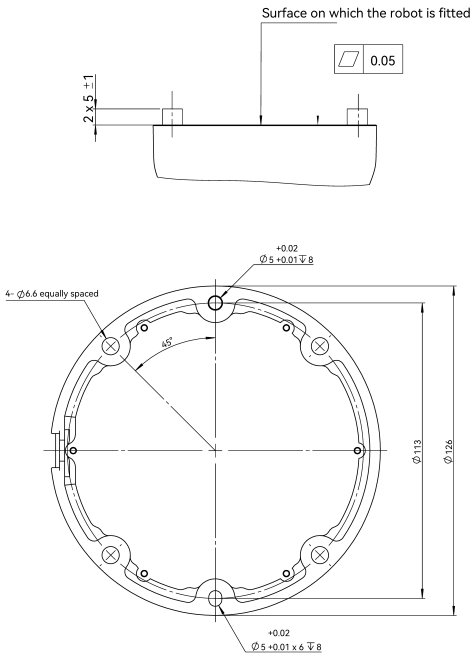


Figure 2-4: Mounting dimension drawing of LS65 robot's base (unit: mm)

2.1.2.2 End Effector Mounting

The robot flange is equipped with 4 M6 threaded holes for mounting the end effector. Tighten screws to 8 Nm (grade 8.8). Use the Ø6 locating hole with the dowel pin for precise alignment.

Figure 2-5 shows the mounting dimension drawing of the LS65 robot tool flange. It is recommended to use radial slotted holes or pins to avoid excessive restraint while maintaining accurate position. The screw engagement depth must not exceed 8 mm.

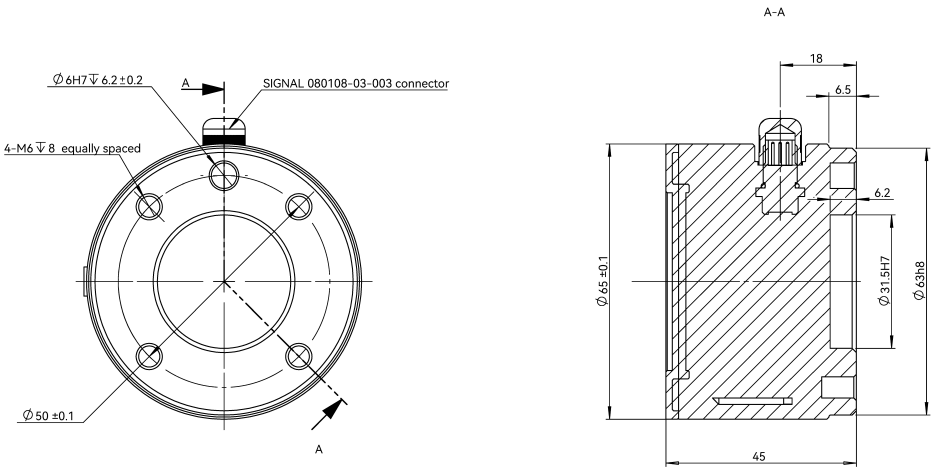


Figure 2-5: Mounting dimension drawing of LS65 robot's tool flange (unit: mm)

The LS65 robot end flange is equipped with a blue button. Its functions can be set

via the [Button Action Configuration] interface, for instance, to configure free drive or clear protective stop.

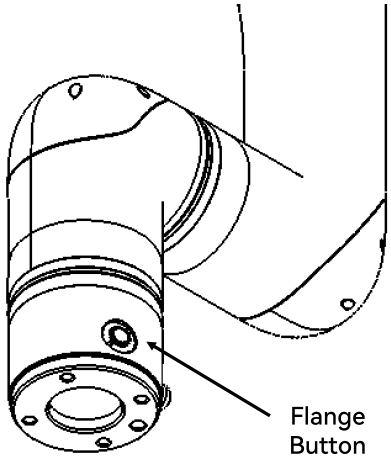


Figure 2-6: Robot End Flange Button

After the robot arm is powered on, the button remains continuously lit by default.

Button actions are executed according to the settings in the [Button Action Configuration] interface (see Button Action Configuration Section). Supported action types include:

- Press-and-hold action: Can be configured for Free Drive or no action. When configured for Free Drive, holding the button enters Free Drive mode, allowing you to drag the robot to the target position; releasing the button exits this mode.
- Double-click action: Can be configured to toggle Free Drive, release the protective stop, or perform no action.

NOTICE

- If the robot triggers an alarm during dragging, it enters a protective stop state. A button action configured as ”Unlock Protective Stop” can be used to clear this state.
- If the robot is idle, triggering Free Drive will switch it into Backdrive mode.

DANGER



1. Ensure the end effector is securely mounted.
2. Ensure the tool structure prevents parts from falling.
3. Screws exceeding 8 mm engagement depth may permanently damage the flange.

The maximum payload is shown in **Figure** 2-7. The allowable payload depends on the distance between the payload center of gravity and the flange center.

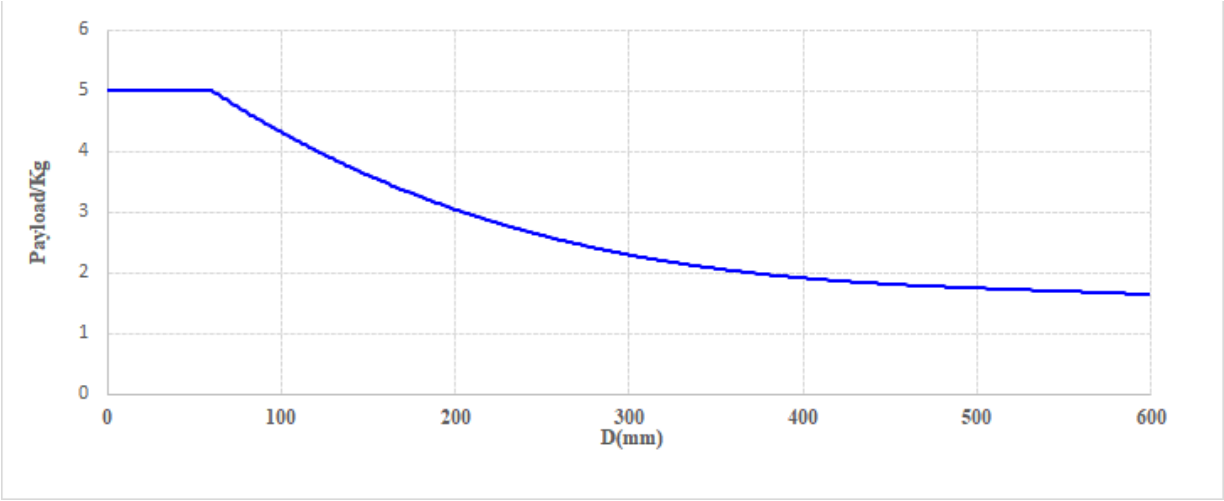


Figure 2-7: Payload diagram

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.

REMINDER



1. Do not exceed the maximum payload under any circumstances.
2. Exceeding payload limits may result in premature damage.

2.1.2.3 Controller and Teach Pendent Installation

The controller may be wall-mounted or floor-mounted. Maintain at least 50 mm clearance on all sides for ventilation.

The teach pendant may be wall-mounted. Ensure cables do not create tripping hazards.

Optional mounting brackets are purchasable.

DANGER



1. Keep the controller, teach pendant, and cables away from liquids. Moisture may cause fatal hazards.
2. Install the teach pendant (IP54) and controller (IP20) in environments suitable for their respective IP ratings.

2.2 Electrical Interface

2.2.1 Introduction

This section describes the electrical interfaces of the Elite LS series collaborative robots. These interfaces are mainly located on the robot controller, teach pendant, and robot arm. All electrical interfaces and application examples of selected interfaces are described in detail below.

2.2.2 Electrical Warnings and Precautions

Follow the warnings and precautions below when designing, installing, and maintaining the robot.

DANGER



1. Do not connect safety signals to non-safety I/O that does not meet the required safety level. Failure to comply with this warning may result in serious injury or death due to failure of the safety stop function. Be sure to separate safety interface signals from normal I/O signals.
2. All safety signals are redundant and consist of two separate channels. Keep the two channels separate to ensure that safety is maintained in the event of a single failure.
3. Some I/O interfaces inside the controller can be configured as normal I/O or safety I/O. Refer to Subsection 2.2.3.3.

WARNING



1. Ensure that the robot is properly grounded through a reliable electrical connection to ground. The grounding conductor shall be rated to carry at least the maximum system current.
2. Use the original cable of the robot only. Do not use the robot in those applications where the cable is subject to repeated bending. If longer cables or flexible cables are needed, please contact the supplier.
3. The negative connector is the grounding "GND" connector, which is connected to the protective covers of the robot and the controller. All GND connectors mentioned in this manual are only applicable to power supply and signal transmission. For protective grounding (PE), please use the dedicated power supply socket of the controller to provide reliable grounding for the controller.

REMINDER



1. The robot has passed electromagnetic compatibility (EMC) tests according to IEC standards. Interference signals exceeding the levels specified in IEC standards will cause abnormal behavior of the robot. Extremely high signal levels or prolonged exposure will cause permanent damage to the robot. EMC problems usually occur during welding and are indicated by error messages in the log. Elite Intelligent Robot Co., Ltd. (ELITE) shall not be responsible for any loss caused by EMC issues.

2. The length of I/O cable used to connect the controller with other mechanical and plant equipment shall not exceed 10 m, unless verified by a cable extension test.

NOTICE

All voltages and currents are DC unless specified.

2.2.2.1 Power Supply Specifications

The power supply shall meet the following requirements:

1. Ground connection;
2. External DC power.

Table 2-2. Electrical specifications of the mains connection

Parameter	Min.	Typ.	Max.	Unit
Input voltage (DC)	45	-	55	VDC

DANGER

1. Ensure the robot is properly grounded (electrical connection to ground). The grounding conductor must support the maximum rated input current of the system.
2. Before powering on the controller, verify that all cables (including the intermediate cable) are connected correctly and securely. Use the original power adapter, along with the designated connection cables.

2.2.3 Electrical Interface of Controller

Both front and sides of the controller are equipped with interfaces of different functional types.

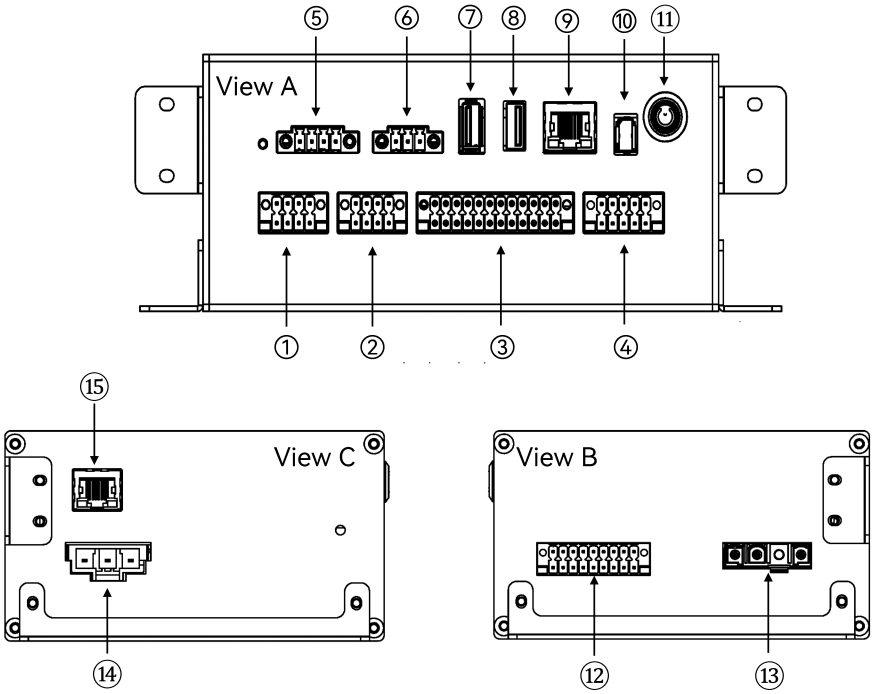


Figure 2-8: Controller Interfaces

Table 2-3. Introduction to interfaces

No.	Description
①	Analog I/O Interfaces
②	Emergency Stop and Protective Stop Interfaces
③	Configurable I/O Interfaces
④	NPN/PNP Configuration+I/O Power Supply Interfaces
⑤	Remote Control Interfaces
⑥	RS485 Communication Interfaces
⑦	USB2.0
⑧	USB3.0
⑨	Ethernet Port
⑩	Teach Pendant Interface
⑪	Power Button
⑫	Digital I/O Interfaces
⑬	Controller Power Supply Interface

No.	Description
⑭	Robot Power Supply Interface
⑮	Robot Communication Interface

2.2.3.1 Power Supply Interface and Button

1. Controller Power Supply Control Button

A power supply control (POWER) button (see **Figure** 2-8) is located on the front panel.

To power the controller on:

1. Connect the controller to the power adapter.
2. Then press the POWER button.

Press the button again to power it off.

2. Robot Communication & Power Supply Output Interfaces

The Robot Communication interface is used to establish communication for the robot body, while the robot power supply output interface is used to connect to it and provide power supply for it.

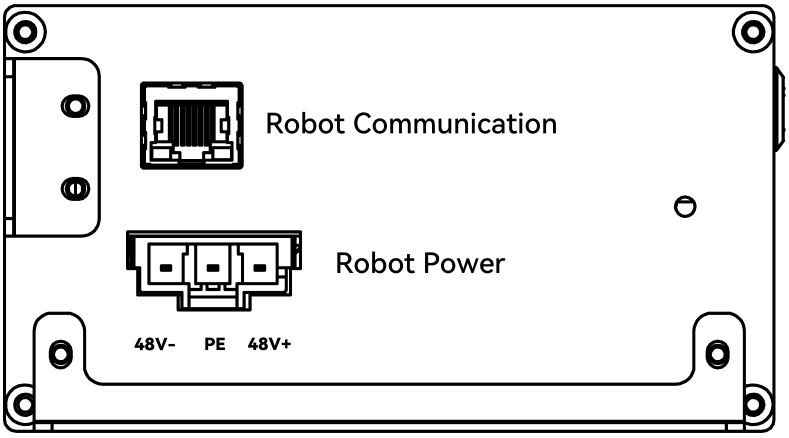


Figure 2-9: Robot Communication & Power Supply Output Interfaces

REMINDER

1. Do not disconnect the robot cable while the robot is powered on.
2. Do not extend or modify the original cable without authorization.

3. Power Supply for Controller

The pin definitions of the controller power input interface (see **Figure** 2-10) are shown in **Table** 2-4.

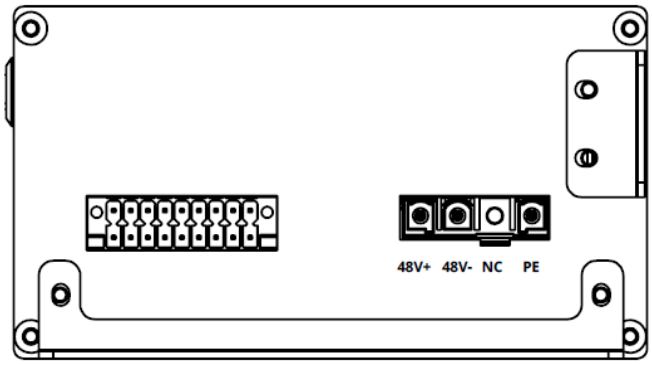


Figure 2-10: Controller Power Supply Interface

Table 2-4. Definition of Controller Power Supply Interface

No.	Signal	Description	Remark
1	PE	Protective earth terminal	The power supply shall meet the brake voltage requirements.
2	48V+	Positive pole of DC power supply	
3	48V-	Negative pole of DC power supply	

The power supply specifications for the LS series are rated voltage DC 48 V and maximum power requirement of 288 W (with overload capability required). The compatible power supply model is GQ360-4800600-E1.

2.2.3.2 I/O Interfaces of Controller

The controller is equipped with such I/O interfaces as safety I/O, I/O power, Configurable I/O, digital I/O, analog I/O and remote on/off.

Table 2-5. Controller's I/O Interfaces

Name	Terminal	Function
Safety I/O	COM	Common input terminal (low/high level)
	EI0	Access to external emergency stop switch 0
	COM	Common input terminal (low/high level)
	EI1	Access to external emergency stop switch 1
	COM	Common input terminal (low/high level)
	SI0	Access to peripheral safeguard device 0
	COM	Common input terminal (low/high level)
	SI1	Access to peripheral safeguard device 1
Configurable Input	COM	Common input terminal (low/high level)
	CI0	Configurable safety input 0
	CI1	Configurable safety input 1
	CI2	Configurable safety input 2
	CI3	Configurable safety input 3
	CI4	Configurable safety input 4
	CI5	Configurable safety input 5
	CI6	Configurable safety input 6
	CI7	Configurable safety input 7
Digital Input	24V	24V output
	DI0	Digital input 0, MOSFET, active high
	DI1	Digital input 1, MOSFET, active high
	DI2	Digital input 2, MOSFET, active high
	DI3	Digital input 3, MOSFET, active high
	DI4	Digital input 4, MOSFET, active high
	DI5	Digital input 5, MOSFET, active high

Name	Terminal	Function
	DI6	Digital input 6, MOSFET, active high
	DI7	Digital input 7, MOSFET, active high
I/O Power	PWR	24VDC output, internal power supply output terminal, power supply is grounded
	GND	
	24V	24VDC input, I/O power supply input terminal, which is connected to the power supply output terminal (internal power supply) by default
	0V	
NPN/PNP (Signal Level Configuration)	0V	For input type configuration (NPN/PNP)
	NPN/PNP	
	24V	
	24V	For COM port configuration (high/low level) 0V
	COM	
	0V	
Remote ON /OFF	12V	12V auxiliary power supply "+" terminal, 12V voltage constant supply
	GND	12V auxiliary power supply "-" terminal, 12V voltage constant supply
	ON	Turn on the "48V" power supply input terminal of the controller, activation time: 100ms-2000ms
	OFF	Turn off the "48V" power supply input terminal of the controller, normally closed
Configurable Output	0V	0V voltage power supply output terminal
	CO0	Configurable safety output of 0
	CO1	Configurable safety output of 1
	CO2	Configurable safety output of 2
	CO3	Configurable safety output of 3
	CO4	Configurable safety output of 4
	CO5	Configurable safety output of 5

Name	Terminal	Function
	CO6	Configurable safety output of 6
	CO7	Configurable safety output of 7
Digital Output	0V	0V output
	DO0	Digital output 0, MOSFET, high level output
	DO1	Digital output 1, MOSFET, high level output
	DO2	Digital output 2, MOSFET, high level output
	DO3	Digital output 3, MOSFET, high level output
	DO4	Digital output 4, MOSFET, high level output
	DO5	Digital output 5, MOSFET, high level output
	DO6	Digital output 6, MOSFET, high level output
	DO7	Digital output 7, MOSFET, high level output
Analog I/O	AG	Analog power supply A_GND, the terminal has been short circuited internally
	AI0	Analog input 0, voltage 0-10V, current 4-20mA, resolution 12bit
	AI1	Analog input 1, voltage 0-10V, current 4-20mA, resolution 12bit
	AO0	Analog Output 0, voltage 0-10V, current 4-20mA, resolution 12bit
	AO1	Analog Output 1, voltage 0-10V, current 4-20mA, resolution 12bit

1. Analog I/O

The controller provides 4 groups of analog I/O interfaces for sending/receiving analog signals.

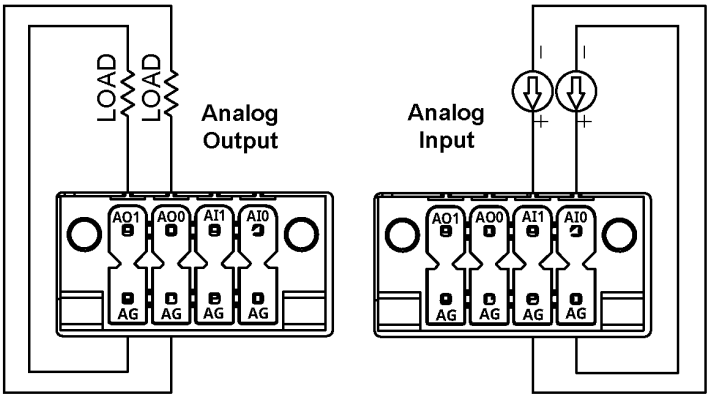


Figure 2-11: Analog I/O Wiring

Table 2-6. Analog I/O Electrical Specifications

Terminal	Parameter	Minimum Value	Typical Value	Maximum Value
Current Mode: Analog Input, AIx - AG	Electric Current	4mA	-	20mA
	Resistance	-	20kΩ	-
	Resolution	-	12bit	-
Voltage Mode: Analog Input, Aix - AG	Voltage	0	-	10V
	Resistance	-	10kΩ	-
	Resolution	-	12bit	-
Current Mode: Analog Output, AOx - AG	Electric Current	4mA	-	20mA
	Voltage	0V	-	24V
	Resolution	-	12bit	-
Voltage Mode: Analog Output, AOx - AG	Voltage	0V	-	10V
	Electric Current	4mA	-	20mA
	Resistance	-	1kΩ	-
	Resolution	-	12bit	-

2. NPN/PNP Configuration Interface

Safety input and configurable input support NPN and PNP modes; digital input, configurable output and digital output can only be configured for PNP mode.

NPN and PNP modes correspond to different signal types.

NPN mode: active low (signal is active when low).

PNP mode: active high (signal is active when high).

The auxiliary power terminal (COM) must be correctly configured for NPN/PNP configuration. To ensure that, please wire the connections according to the way illustrated in **Figure** 2-12.

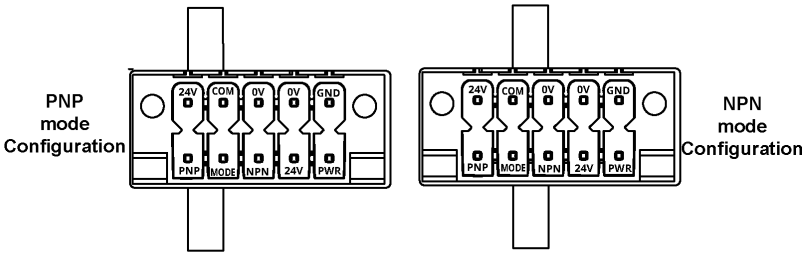


Figure 2-12: NPN/PNP Configuration

1. PNP Signal Configuration
   - Connect the PNP interface to MODE terminal;
   - Meanwhile, connect the COM terminal to 24V terminal.
2. NPN Signal Configuration
   - Connect the NPN interface to MODE terminal;
   - Meanwhile, connect the COM terminal to 0V terminal.

NOTICE

The system automatically detects if the connection of NPN/PNP to the COM terminal is correct. If the wiring is missing or mismatched, a safety system alarm will be triggered.



Figure 2-13: Safety System Warning (PNP)

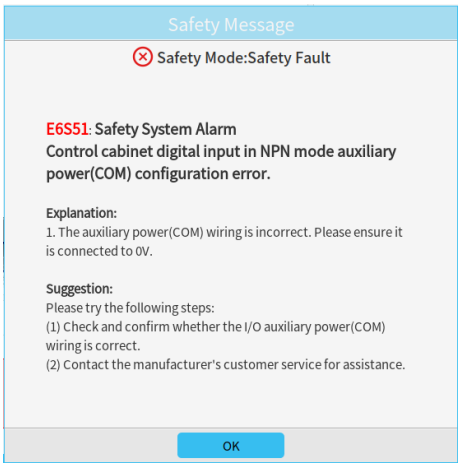


Figure 2-14: Safety System Warning (NPN)

3. Safety I/O

The controller is equipped with four groups of safety I/O interfaces to realize safety input or output. All safety interfaces are configured with redundancy, meaning each safety-related control function has two independent channels. Even if one fails, the safety-related control function remains active.

NOTICE

Before use, please check whether safety devices are installed in strict accordance with the requirements and are well grounded. When wiring, both paired safety I/O channels must be connected to ensure the proper configuration of the robot system's safety features.

The controller supports two types of safety stop inputs, that is, emergency stop (EI) and protective stop (SI). The former is dedicated to halting the operation of the equipment in emergencies, while the latter can be used for all types of safety protection devices. Their functional differences are presented in **Table** 2-7.

Table 2-7. Difference between Emergency Stop and Protective Stop

	Emergency Stop	Safeguard Stop
The robot stops moving	Yes	Yes
Task execution	Pause	Pause
Robot power supply	Open	Open
Resetting	Manual	Automatic or manual
Operating frequency	Not often used	No more than once per run cycle
Downtime category	1	2

NOTICE

1. It is recommended that the length of the I/O cable is within 3m.
2. Please supply the I/O interfaces with power in a correct connection; otherwise, safety I/O function cannot be activated. All safety I/O interfaces are powered internally by default.

Table 2-8. Technical Specifications of the Safety Inputs

Parameter	Min.	Typical Value	Max.	Unit
Voltage	-3	-	30	V
OFF region	-2	-	2	V
ON region	8	-	30	bit
Current (8-30V)	2	-	8.5	mA
Function	-	NPN	-	Type
IEC 61131-2	-	3	-	Type

a. Emergency Stop

The controller can be connected to one or more external emergency stop buttions, and their wiring is presented in **Figure** 2-15.

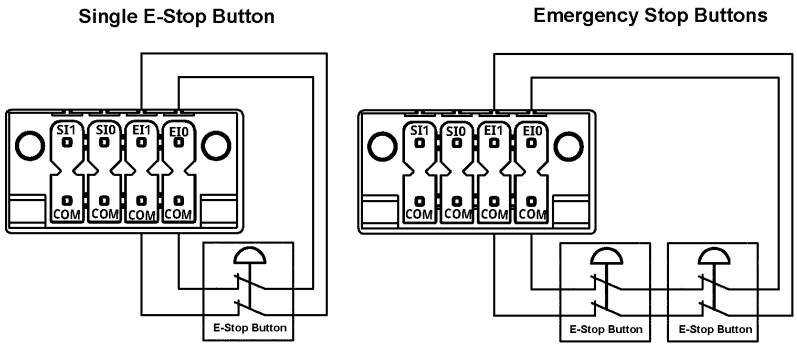


Figure 2-15: Connection for External Emergency Stop Buttons

b. Protective Stop

Protective stop is used to pause the program that is running, supporting all types of safeguard devices, and their connection is illustrated in **Figure** 2-16.

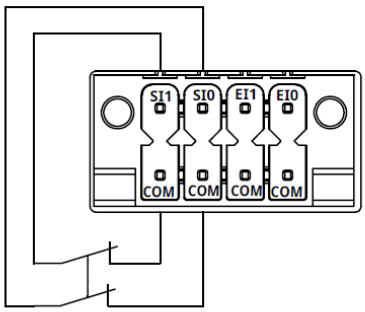


Figure 2-16: Connection of Protective Stop Device

DANGER

When the safeguard signal is restored, the robot automatically resumes its motion (if this function has been configured). Do not use this configuration if the signal can be restored inside the safety zone.

4. Configurable I/O

The controller is equipped with 8 groups of configurable NPN/PNP safety inputs and 8 groups of configurable safety outputs only supporting PNP mode. Users can define the functions of these configurable I/O through the teach pendant.

Configurable input can be set to: start task, stop task, pause task and drag mode.

Configurable output can be set to: minimum when not running, maximum when not running, maximum when running - minimum when stopping and continuous pulse when running.

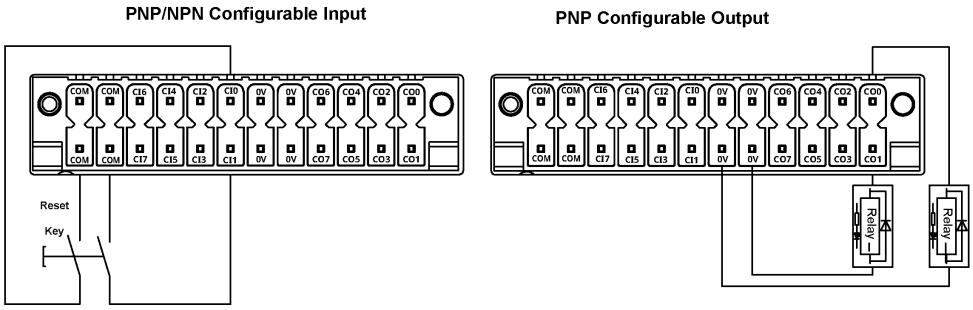


Figure 2-17: Connection of Configurable I/O Interfaces

Table 2-9. Configurable I/O Electrical Specifications

Terminal	Parameter	Minimum Value	Typical Value	Maximum Value
Configurable Output	Output voltage	-1V	24V	30V
	Load capacity	0A	-	1.4A
	Pressure drop (0.5A)	-	75mV	-
	Leakage current	0mA	-	0.1mA
	IEC 61131-2	-	TYPE 3	-
Configurable Input	Input voltage	-0.3V	24V	30V
	OFF area	-2V	-	2V
	ON area	8V	24V	30V
	Electric current	2mA	-	8.5mA
	OEC 61131-2	-	TYPE 3	-

5. Digital I/O

Digital input and output only support PNP mode and cannot be configured.

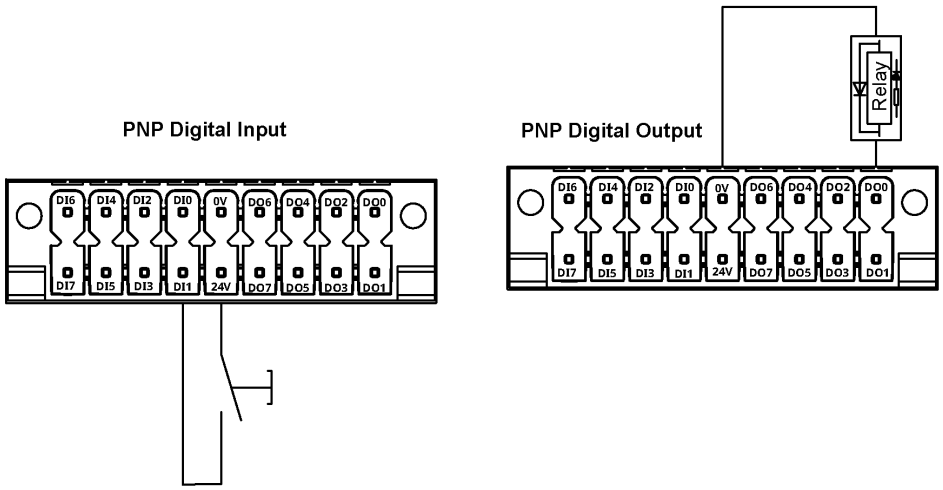


Figure 2-18: Connection of PNP type digital I/O

Table 2-10. Digital I/O Electrical Specifications

Terminal	Parameter	Minimum Value	Typical Value	Maximum Value
Digital output	Maximum Load Current of Single Output Port	-	-	1.4A
	Total Maximum Load Current of Output Port	-	-	2A
	Output Voltage	22.8V	24V	25.2V
Digital input	Input Voltage	-3V	24V	30V
	OFF Area	-2V	-	2V
	ON Area	8V	24V	30V
	Electric Current	2mA	-	8.5mA

6. I/O Power Supply Interfaces

The I/O of MINI controller can be powered by internal 24V power supply. For higher currents, an external regulated power supply can also be used to provide power through the configured power terminals.

Please refer to the connection of internal and external power supply in **Figure** 2-19.

The definition of I/O power supply interfaces is presented in **Table** 2-11.

Table 2-11. Definition of I/O Power Supply Interfaces

No.	Terminal	Description	Remark
1	24V	positive pole of all general digital I/O	24VDC input, I/O power supply input terminal, connected to the power supply output terminal (internal power supply) by default
2	0V	negative pole of all general digital I/O	
3	PWR	24V positive pole of internal power supply	24V output, internal power supply output terminal, power supply is grounded
4	GND	24V negative pole of internal power supply	

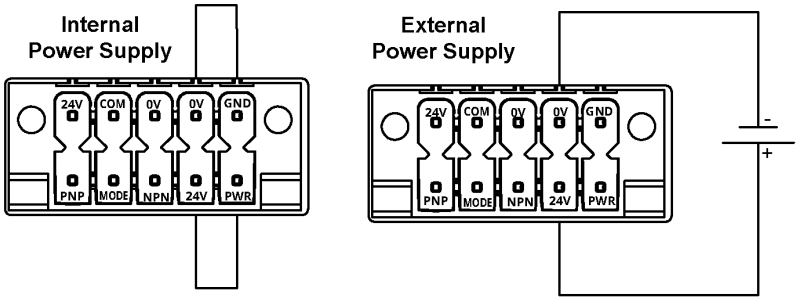


Figure 2-19: Connection of I/O Power Supply

Table 2-12. Technical Specifications of I/O Power

Terminal	Parameter	Min.	Typical Value	Max.
Built-in Power Supply	Voltage	22.8V	24V	25.2V
	Current	0A	-	2A
External Power Supply	Voltage	20V	24V	30V
	Current	0A	-	6A

7. Remote On/Off Interfaces

Remote switch enables power on and off the robot controller without teach pendant. It is usually used for the following situation:

- The teach pendant is inaccessible;
- The PLC system implements the full control;
- Multiple robots must be turned on or off simultaneously.

The remote ON / OFF terminal provides a 12V auxiliary power supply. When the main power is on and the controller is off, the 12V auxiliary power terminal of the functional terminal will remain charged.

- When the controller is off, remote ON input is used for powering on with an effective pulse time of 100-2000ms. If it does not meet the effective pulse time, it will not be possible to turn on the power.
- When the controller is on, remote OFF input is used for powering off with an effective pulse time of 100-2000ms. Likewise, if it does not meet the effective pulse time, the controller cannot be powered off.

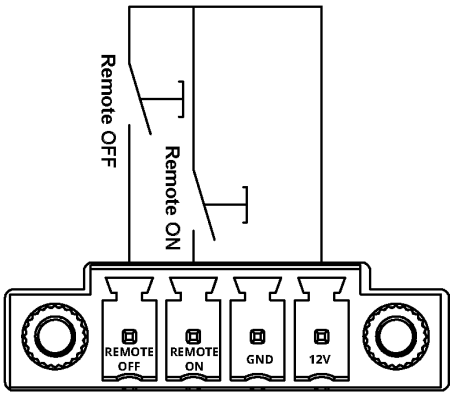


Figure 2-20: Connection of Remote ON/OFF

Table 2-13. Technical Specifications of Remote ON/OFF

Terminal	Parameter	Min.	Typical Value	Max.
12V-GND	Voltage	10V	12V	13V
	Current	-	-	500mA
ON/OFF	Passive voltage	0V	-	0.5V
	Active voltage	5V	-	12V
	Input current	-	1mA	-
	Activation time	100ms	-	2000ms

2.2.3.3 Other Interfaces of Controller

The front, left and right sides of the MINI controller are also equipped with some interfaces for USB data transportation, communication, or connection to external devices.

1. RS485 Interface

The controller features a RS485 interface, through which RS485 devices can be connected to the controller, enabling easy serial communication.

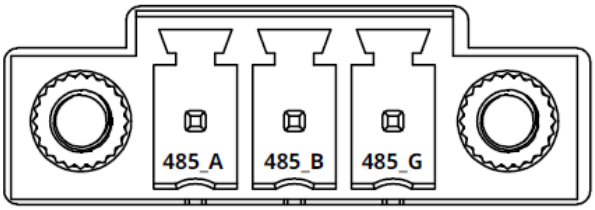


Figure 2-21: RS485 Interface

Table 2-14. Definition of RS485 Communication Interface

No.	Terminal	Description
1	485A	RS485+, positive end in differential signaling

2	485B	RS485-, negative end in differential signaling
3	485G	Ground terminal in RS-485 interface

2. USB Interfaces

The right side of the controller is equipped with one USB 2.0 and one USB 3.0 port (see **Figure** 2-8) respectively, which are used for data transfer, data backup or upgrade.

3. Ethernet interface

The front of the controller is equipped with an RJ45 Ethernet port (see **Figure** 2-8) supporting TCP/IP. Users can utilize TCP/IP-compliant host software, SDKs, scripts, or third-party applications, to achieve data interaction, command control, and bus communication with the device via this interface.

4. Teach Pendant Interface

A teach pendant interface is designed on the front of the MINI controller (see the TP interface in **Figure** 2-8). Before use, plug the teach pendant cable into this inteface to connect to the teach pendant.

2.2.4 Teach Pendant Electrical Interface

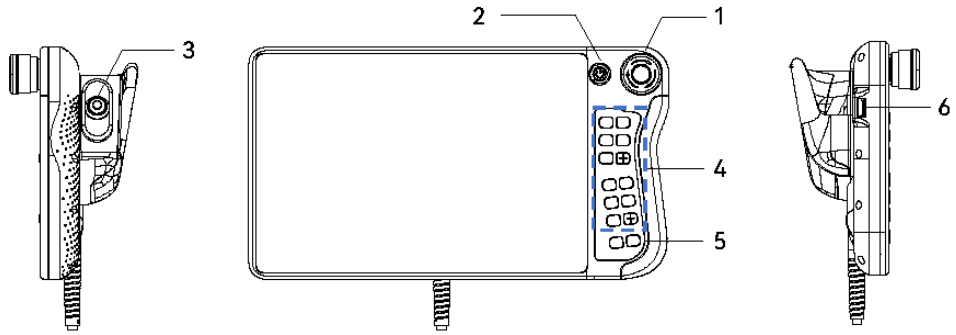


Figure 2-22: Teach Pendant Electrical Interface

Table 2-15. Digital definition of teach pendant electrical interface

No.	Interface	Description
1	Emergency Stop Button	Press in case of emergency to immediately stop all robot arm motion. This function is always active under the default safety configuration.
2	Start Button	Power on/off the teach pendant.
3	Drag Teaching Enable Button	Press and hold the button to enter and maintain drag teaching mode. Once the button is released, the robot arm exits this mode.
4	Axis Jog Keys	Control the robot arm's motion along each axis.
5	Speed Adjustment Keys	Adjust the current running speed by increasing or decreasing the percentage.
6	USB Port	For connecting USB storage devices.

The function of the axis motion control area varies with the selected mode and must be operated via the software. To operate, tap the Jog button at the bottom of the teach pendant, then select [Joint] or [Cartesian] from the pop-up [Teach Button] setting menu.

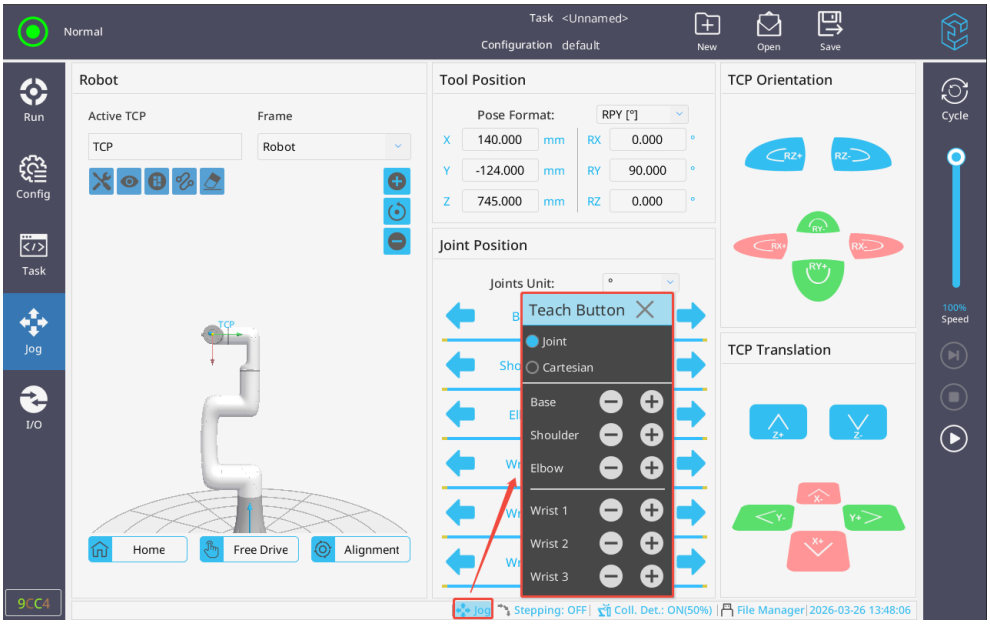


Figure 2-23: Teach Button Setting

- **Joint Motion Mode**: the six pairs of keys correspond, from top to bottom, to the positive/negative rotation of axes J1 through J6.
- **Cartesian Motion Mode**: they correspond to translation of the tool end along X, Y, and Z axes, and rotation about these axes.

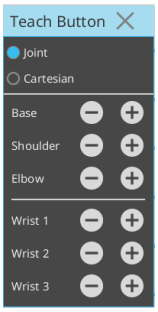


Figure 2-24: Axis Jog Keys (Joint)



Figure 2-25: Axis Jog Keys (Cartesian)

2.2.5 Robot Arm Electrical Interface

This subsection mainly introduces the electrical interface contained in the robot arm, which includes the cable of the arm and terminal I/O.

2.2.5.1 Robot Arm Base Electrical Interface

On the cable of the robot arm, there is a plug at the end. Please plug it into the robot controller. Be careful about the direction of the connector, and lock connector properly after plugging in.

REMINDER

1. Do not disconnect the robot cable while the robot is powered on.
2. Do not extend or modify the original cable without authorization.

2.2.5.2 Robot Arm Tool End I/O Interface

A cylindrical interface of the tool flange at the end of the robot is equipped with an 8-pin I/O port, which can provide power and control signals for the gripper, sensor and other devices connected to the robot terminal I/O, as shown in **Figure** 2-26.

The aviation plug of I/O interface at the robot tool end is shown in **Figure** 2-27, and the aviation plug welding wire of the user is shown in **Figure** 2-28.

The definition and function of I/O pin at the tool end are shown in **Table** 2-16.

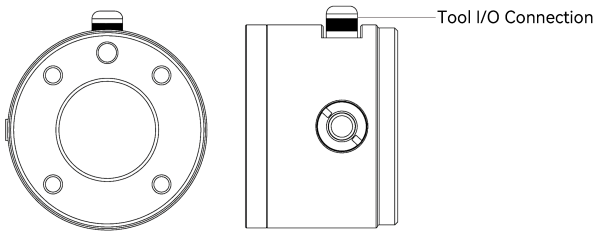


Figure 2-26: Robot terminal I/O

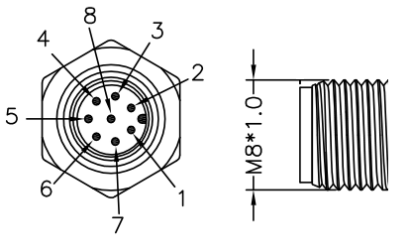


Figure 2-27: Robot terminal I/O aerial plug-in interface

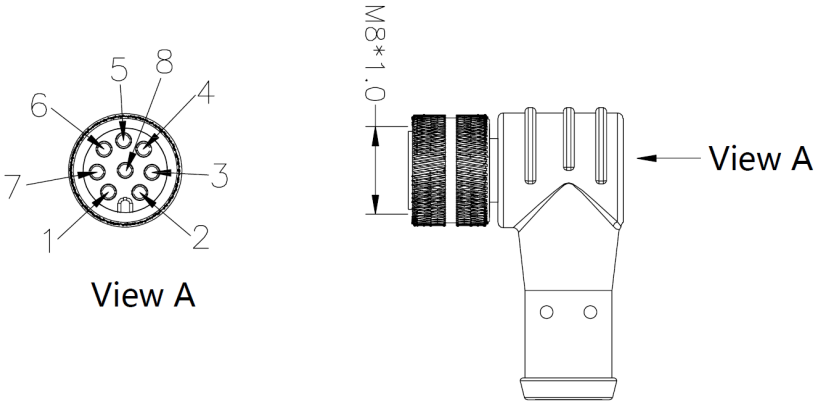


Figure 2-28: The user aviation plug welding wire

Table 2-16. Terminal I/O definition

Pin No.	Cable Color	Signal Name	Signal Description
1	Red	RS485+	RS485+
2	Black	RS485-	RS485-
3	Orange	DI1	Digital input 1
4	Yellow	DI0	Digital input 0
5	Brown	POWER	24V
6	White	DO0	Digital output 0
7	Green	DO1	Digital output 1
8	Blue	GND_OUT	Ground output

1. Tool Power Supply

Tool I/O can provide 24V power supply to external tools, which can be set in the I/O tab of the user interface of the teaching pendant.

Table 2-17. Internal power electrical specifications

Parameter	Min. Value	Typical Value	Max. Value
Supply voltage: 24V mode	22.8V	24V	25.2V
Supply current: Single pin	-	1000mA	1000mA
Supply power capacitive load	-	-	800μF

Power Mode

Configure the tool power mode as follows:

1) Wiring:

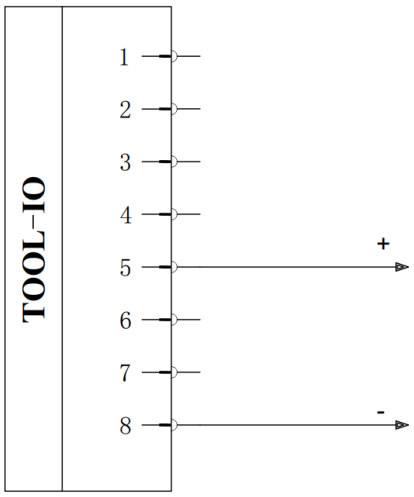


Figure 2-29: Power mode wiring

2) After completing the wiring and confirming it is correct, select [Single-pin] on the teach pendant (see Subsection 3.5.1.9).

2. Tool Digital Output

Digital output can only be configured as PNP mode, which supports 500mA current outflow. The wiring method of digital output is presented in **Figure** 2-30.

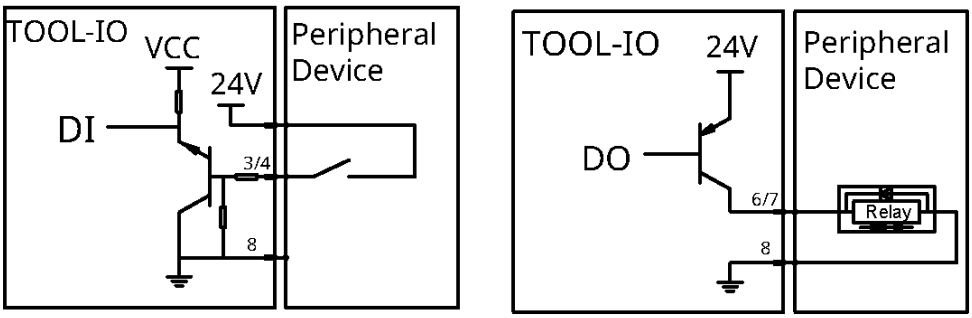
- Active state: output a high-level signal (typically +24V)
- Inactive state: switch to a high-impedance state

3. Tool Digital Input

The digital input is implemented in the form of a PNP with a weak pull-down resistor. This means that the reading of the floating input is always low. The electrical specifications are shown in **Table** 2-18, and the wiring is shown in **Figure** 2-30.

Table 2-18. Tool digital input electrical specifications

Parameter	Minimum Value	Typical Value	Maximum Value
Input voltage	-0.5V	-	26V
Logic low level	-	-	2V
Logic high level	3V	-	-
Input impedance	4.7kΩ	-	-



Tool Digital Input **Tool Digital Output**

Figure 2-30: Tool digital input & output wiring method

4. Tool Communication I/O

To use the RS485 port at the end to communicate with the actuator, it needs to be configured in the teach pendant Tool I/O interface. Under Tool Analog I/O section, choose USART Mode, and set parameters such as the baud rate based on the actual actuator parameters.

There is a delay around 2ms to 4ms between writing the data on the robot controller and sending data with RS485. The delay between receiving the data with RS485 and processing on robot controller is around 2ms to 4ms as well.

Chapter 3 Robot Software Operation

3.1 Software Overview

Elite robot provides convenient programming methods, users only need a small amount of programming knowledge to program LS series of robots. LS robot software is using python based scripting language. With the workflow graphical interface, users can build task based on modular programming tree, which greatly improve programming efficiency.

Note: The pictures of the following settings are for reference only.

Users can use the teach pendant to operate robots and perform tasks. The main functions of the teach pendant are shown in **Figure** 3-1.

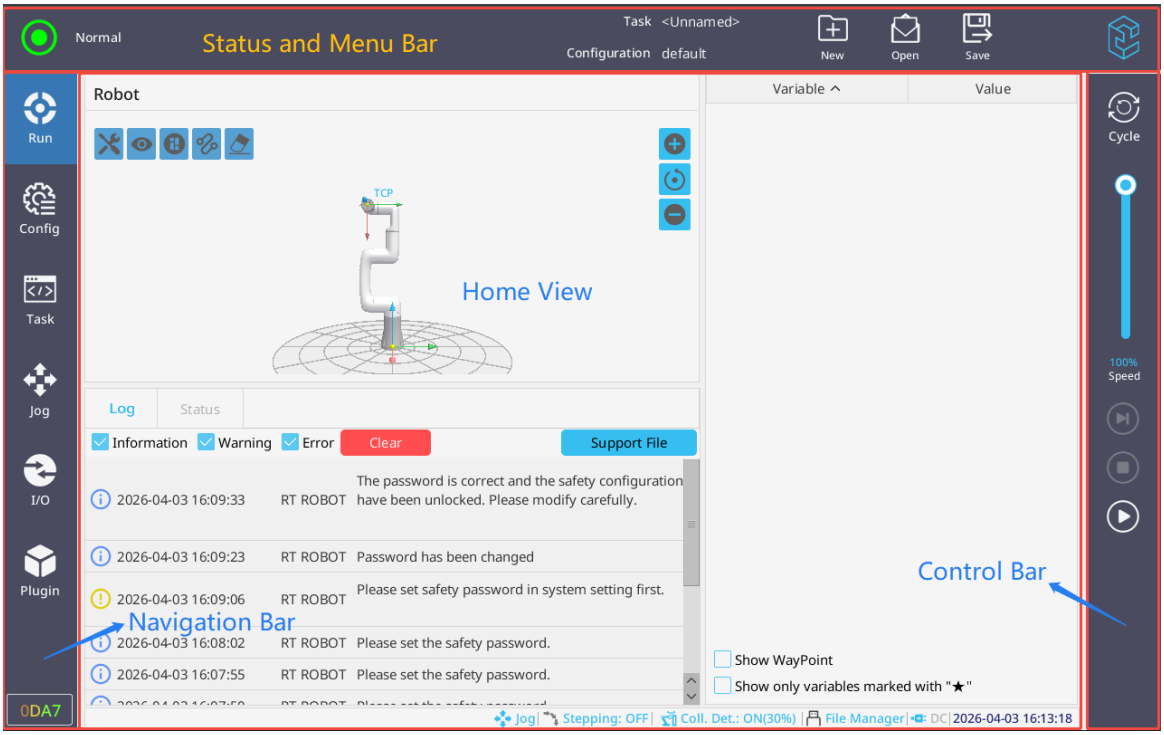


Figure 3-1: Screen division diagram

- Status and Menu Bar: users can view the current mode of the robot and manage tasks and configuration files;
- Navigation Bar: the user can choose to open the robot configuration, operation, I/O and other tabs;
- Control Bar: the user can control the operation status, speed and mode of the current task of the robot;
- Home View: the user can view the robot status and operate the robot.

The following is a brief description of each function column of the teach pendant:

1. Status and Menu Bar



Displays the current mode of the robot.



Manage task files and profiles.



System menu, view robot information, configure system parameters and shut down.

2. Navigation Bar



Configure robot parameters, including general parameters, safety parameters, bus communication functions and configuration plugins.



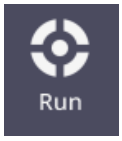
Insert task nodes into the task tree to create and manage tasks, including basic nodes, advanced nodes and task plugin nodes.



Control the robot to carry out joint motion or tool translation and rotation motion in the specified frame, and view the robot's pose.



View the real-time status of I/O and modify the status of output io.



Check the status and log of the robot and monitor the global variables in the current running task.



Using the menu bar plugin.

3. Control Bar





Manual or automatic mode. To switch to manual mode, the user needs to enter the mode password.





Single or cyclic mode, click to switch mode.



Display and adjust the running speed percentage of the robot in real time.



Start or pause the currently running task of the robot.



Step through the current task.



Stop the currently running task of the robot.

3.2 Status and Menu Bar

This section mainly describes the LS65 robot state, task and configuration manager, general operation instructions, including how to power on the robot, set up the payload, and how to create, open, and save tasks and configuration files.

3.2.1 Robot Status

The upper left corner of the status and menu bar indicates the status of the robot. Common robot states are as follows:

- Normal or reduced: the robot is in normal or reduced mode.
- Protective stop: the robot is in a protective stop state.
- Alarm: when the robot system fails.
- Starting: in the process of releasing the holding brakes.
- No controller: when eliserver service is not detected.
- Power off or power on: turn off or turn on the power of the robot.
- Idle: when the power is turned on but the holding brakes are not released.
- Running: when the robot is moving.
- Paused: when the robot task is paused.
- Free drag: press and hold the free drive button on the back of the teach pendant or click [drag] on the operation tab.
- Servo alarm: when servo communication fails.

3.2.1.1 Turn on Robot Power

The steps to turn on the power of the robot are as follows:

1. Click  in the upper left corner of the status and menu bar to enter the [Robot Status]page.
2. Click [Power On], the robot will be standby.
3. Click [Brakes Release] to enable operating the robot.
4. Click [Exit] at the bottom left to exit the current page.

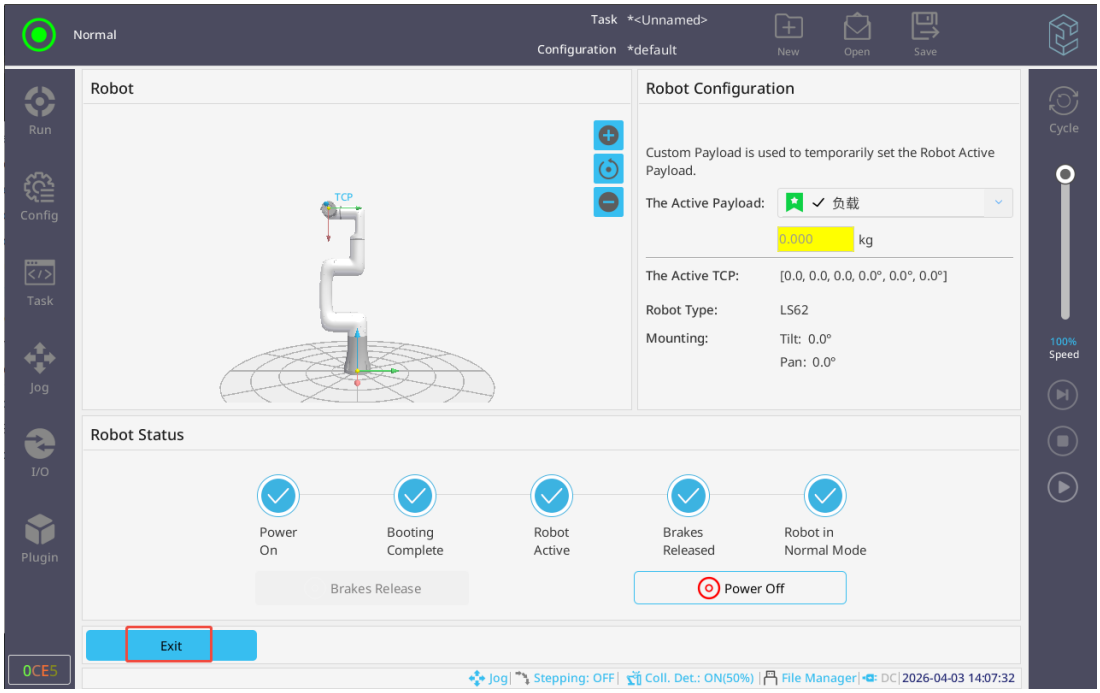


Figure 3-2: Exit the page

Users can directly view the activated TCP data on this interface.

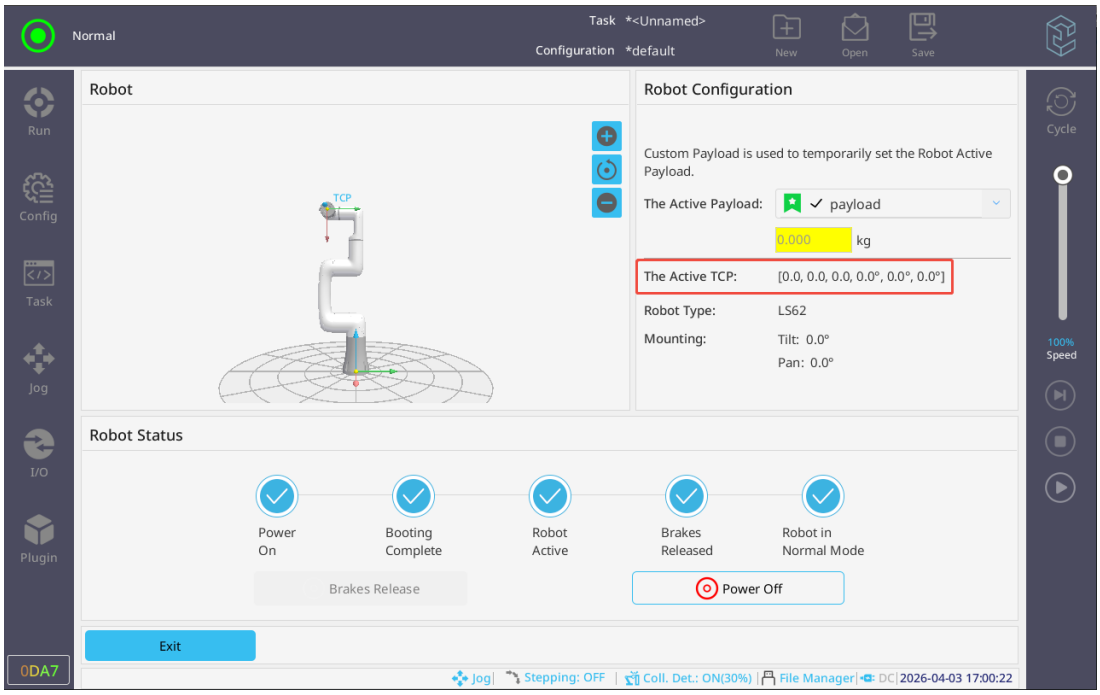


Figure 3-3: View Currently Activated TCP Data

3.2.1.2 Setting Payload

Set the payload actually used by the robot under [Robot Config].

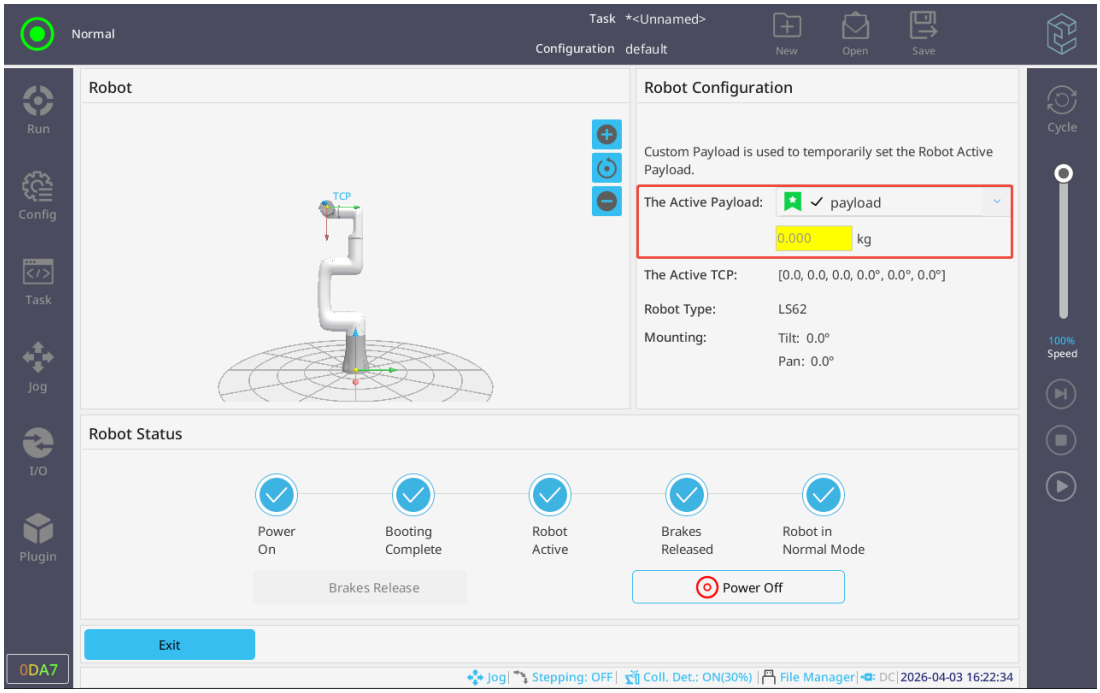


Figure 3-4: Setting payload

Note that the active payload refers to the load actually used by the robot when the task is running.

3.2.2 Task and Profile Management

There are tasks and configuration manager on the status and menu bar.

[Task] and [Config] on the left side of the manager show the name of the currently loaded task file and the name of the configuration file. If a * sign appears at the top right of the task name or configuration name, it indicates that the current task or configuration file has been modified but not saved.

The right side of the manager contains three icons: [New], [Open] and [Save].

When a new task file or configuration file is created or opened, the file name changes. When new task is created, the task uses the currently opened configuration file.

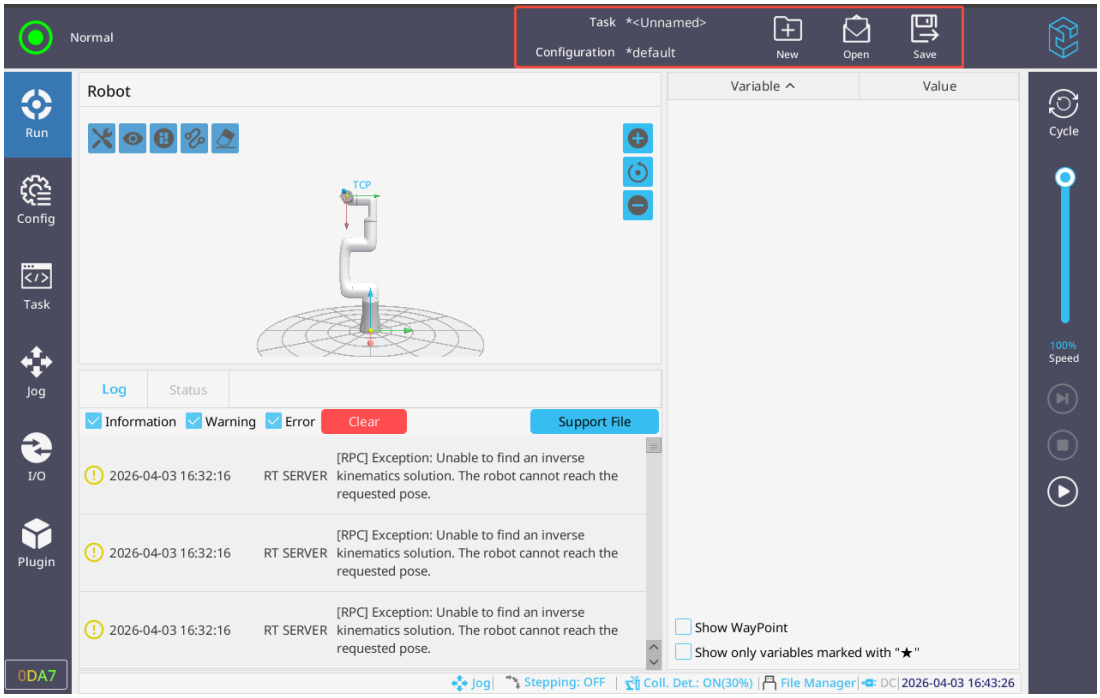


Figure 3-5: Task and configuration manager

3.2.2.1 New

Users can create new task files or configuration files.

The steps for creating a new task file are as follows:

1. In task and configuration manager, click [New], and then select [Task].

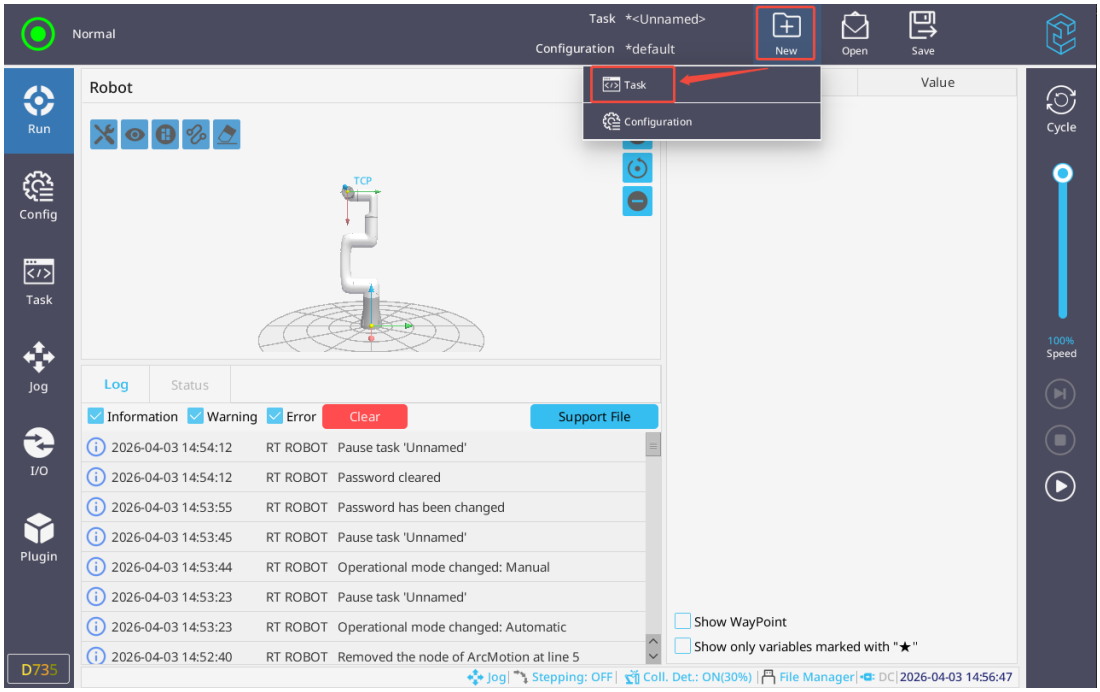


Figure 3-6: New task

2. In [Task] tab, configure new tasks as needed.
3. In task and configuration manager, click [Save].
4. Select [Save All] or [Save Task As] to save the task file.
5. In the [Task] on the left side of the manager, the name of the currently created task file will be displayed.

The steps for creating a new profile are as follows:

1. In task and configuration manager, click [New] and then select [Config].

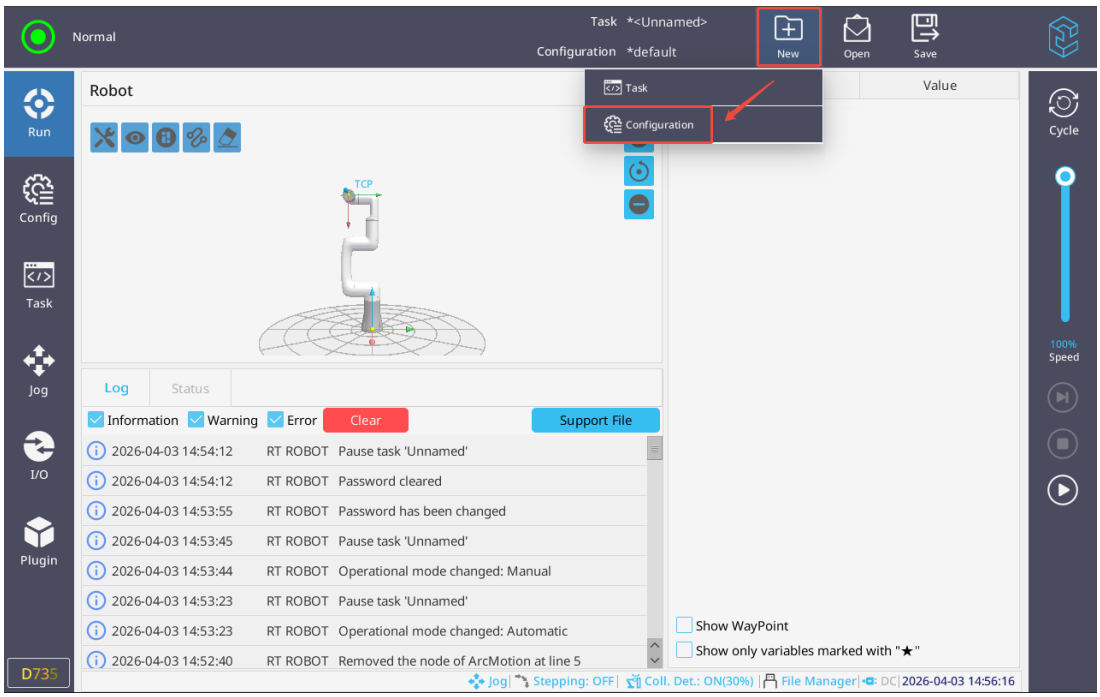


Figure 3-7: New profile

2. In [Config] tab, set a new configuration as needed.
3. In task and configuration manager, click [Save].
4. Select [Save All] or [Save Config As] to save the configuration file.
5. In [Config] on the left side of the manager, the name of the currently created configuration file will be displayed.

REMINDER

When creating a new configuration file, the new configuration file will be opened directly and a pop-up box will appear. For details, see Subsection 3.2.2.2.

3.2.2.2 Open

Tap [Open] to open the task file or configuration file.

Open the task file as follows:

1. In task and configuration manager, click [Open] and then select [Task].

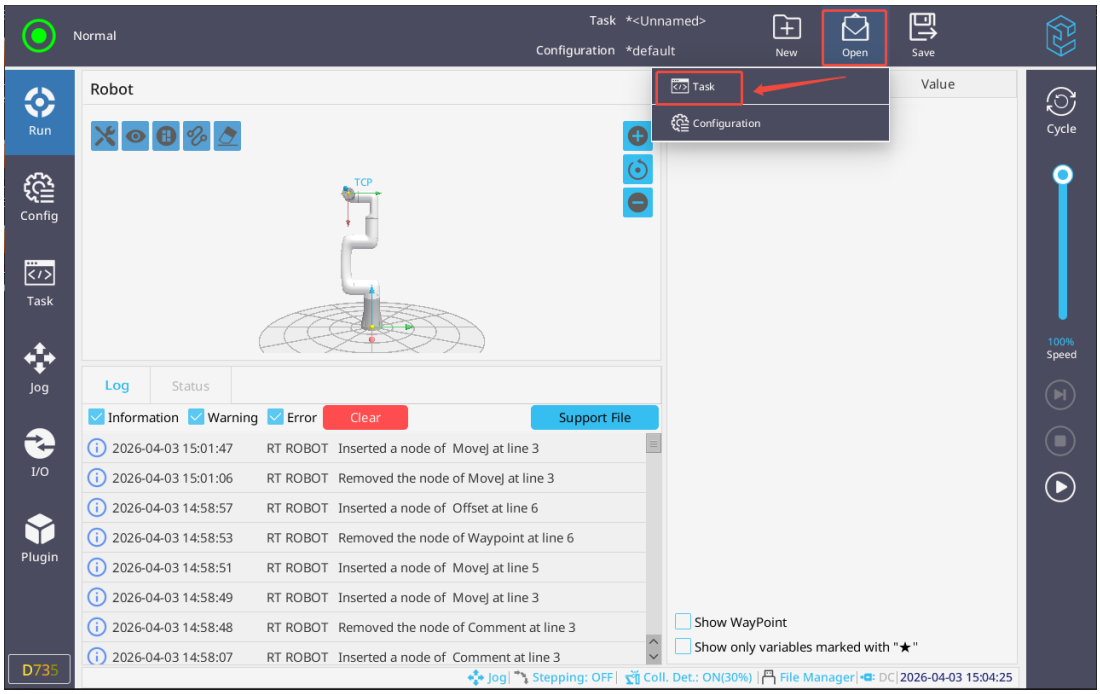


Figure 3-8: Open task

2. After selecting a task and opening it, the interface will automatically jump to the [Task] tab.
3. In the [Task] on the left side of the manager, the name of the currently opened task file will be displayed, and the configuration file used will be opened automatically.

The steps to open the configuration file are as follows:

1. In task and configuration manager, click [Open] and then select [Config].

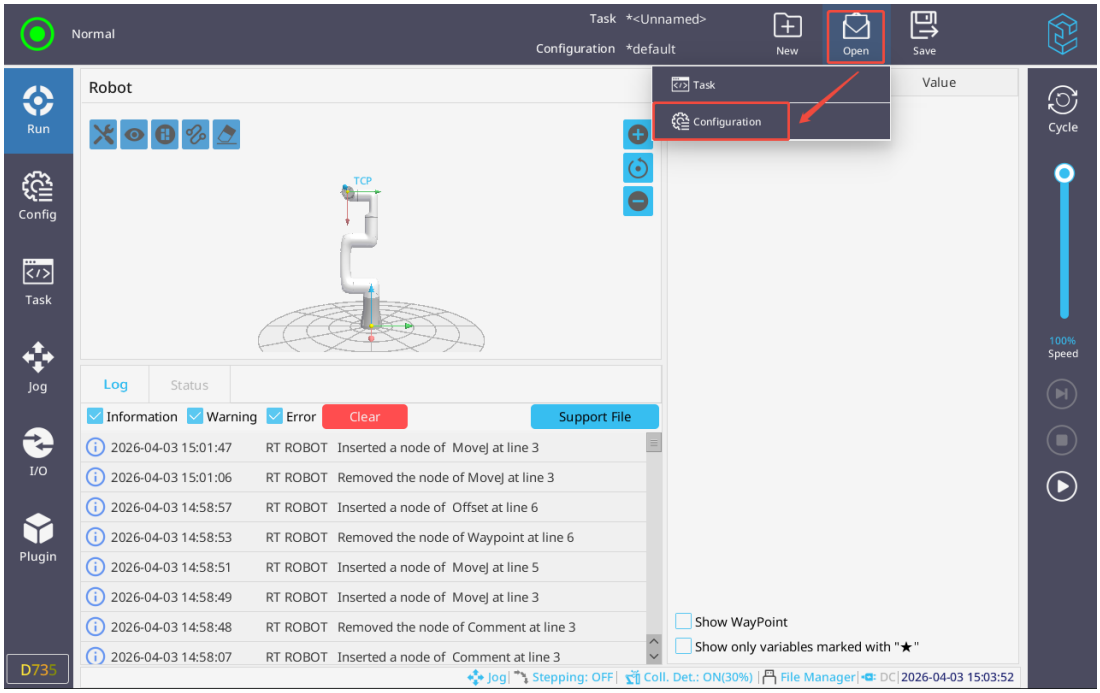


Figure 3-9: Open profile

2. Select the configuration file and open it. If the selected configuration file is inconsistent with the configuration file used by the current task, the following pop-up box will appear:
   Update task: the current task uses the configuration file to be opened.
   Not updated: do not change the configuration file used by the current task.
3. Click [Update task] or [Not updated] to jump to the configuration tab.
4. In [Config] on the left side of the manager, the name of the currently open configuration file will be displayed.

3.2.2.3 Preservation

Save the open or newly created task file and configuration file as follows:

- Save all: save the current task and configuration immediately;
  - Modify only task files: save only task files. If it is a new file, it needs the file name to be entered before saving;
  - Modify only configuration file: save only configuration file;
  - Modify both: save task file and configuration file.
- Save task as: after saving and renaming the currently open task file, open the saved task file;
- Save configuration as: after saving and renaming the currently open configuration file, open the saved configuration file.

3.2.3 System Notifications

When the system detects low disk space or a low battery, a corresponding notification icon appears in the status bar.

3.2.3.1 Disk Space Warning

When system disk space is running low or nearly full, the status bar at the bottom displays the corresponding disk space warning icon. The warning levels are as follows:

- Yellow disk icon: The used space in any disk partition has reached or exceeded 90%, indicating that disk space is running low.
- Red disk icon: The used space in any disk partition has reached or exceeded 99%, indicating that disk space is almost full.

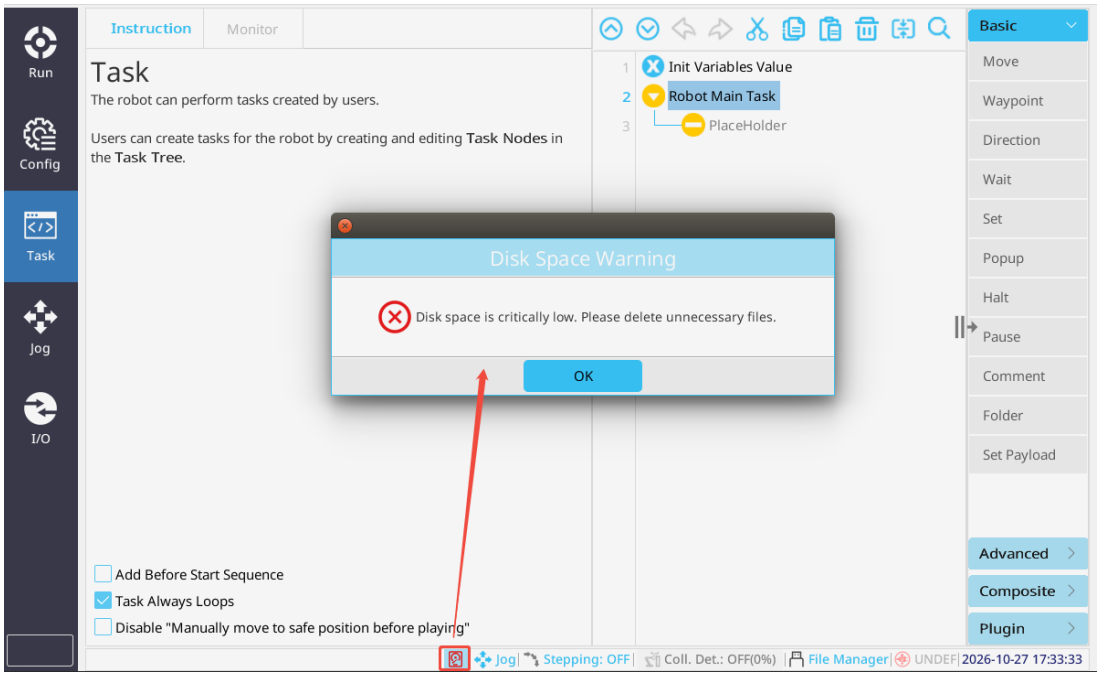


Figure 3-10: Disk Space Nearly Full

Insufficient disk space may cause issues such as failure to open or save tasks or configuration files, or incomplete support files. When a disk space warning appears, check disk space usage promptly and take appropriate measures to free up disk space.

3.2.3.2 Low Button Battery Notification

The system checks the battery status at startup. If low power is detected, a red icon appears in the status bar, and a warning notification briefly appears in the

upper-right corner of the screen.

When this prompt appears, please refer to the instructions in Section 3.3.3 of the Service Manual to replace the battery promptly.

NOTICE

If the battery is depleted, the system time may become incorrect when the controller is powered off and then back on. After replacing the battery, set the system time again on the teach pendant, then restart the system. Otherwise, this low-battery notification may still appear.

3.2.4 Menu Shortcut

The bottom status bar provides several menu shortcuts for enabling/disabling functions such as Stepping Mode and Collision Detection.

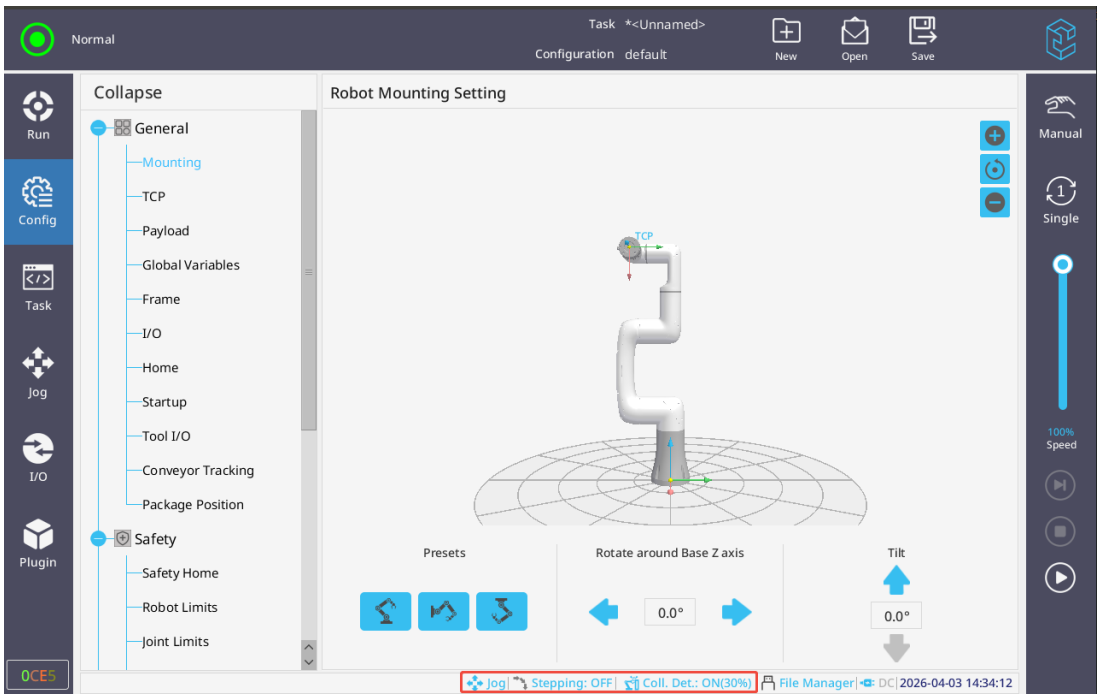


Figure 3-11: Menu Shortcuts

1. Stepping Mode

Click and toggle the [Stepping Mode] switch in the floating panel to enable/disable Stepping Mode (disabled by default). Set the stepping parameters for TCP

Translation, TCP Orientation, and Joint Move as required (default value: 0.50 mm). Note that Stepping Mode is automatically disabled when the floating panel is closed.

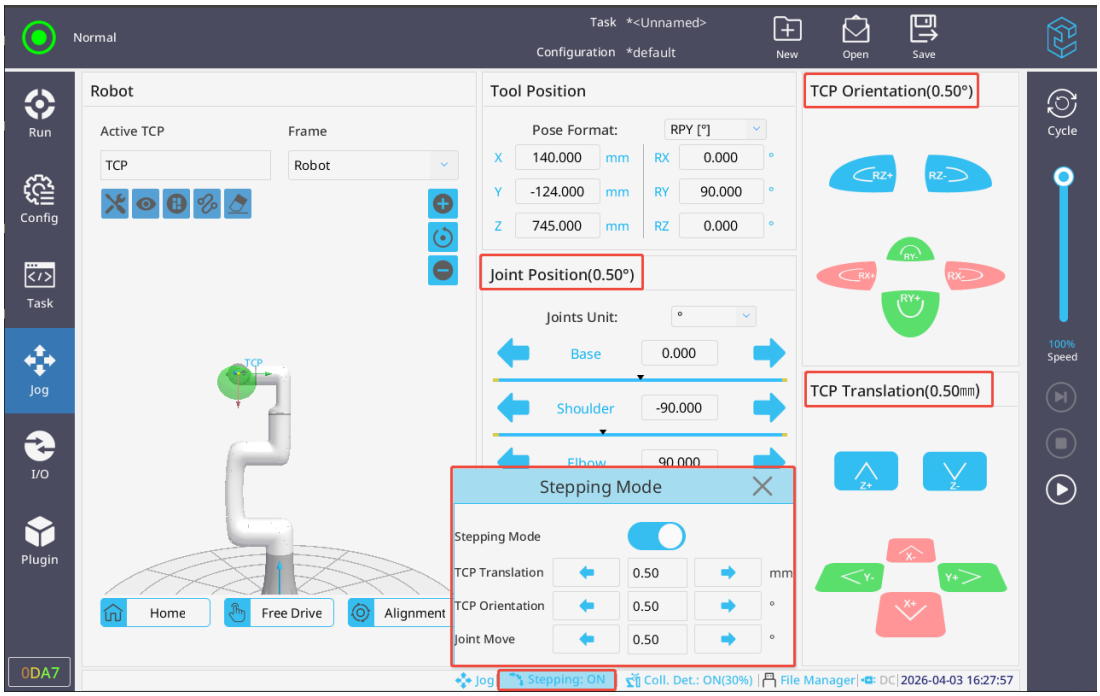


Figure 3-12: Enable Stepping Mode

2. Collision Detection

Click and toggle the [Collision Detection] button in the floating panel to enable/disable the collision detection function (enabled by default). Drag the slider on the right to select the appropriate collision sensitivity. The value is updated in real time.

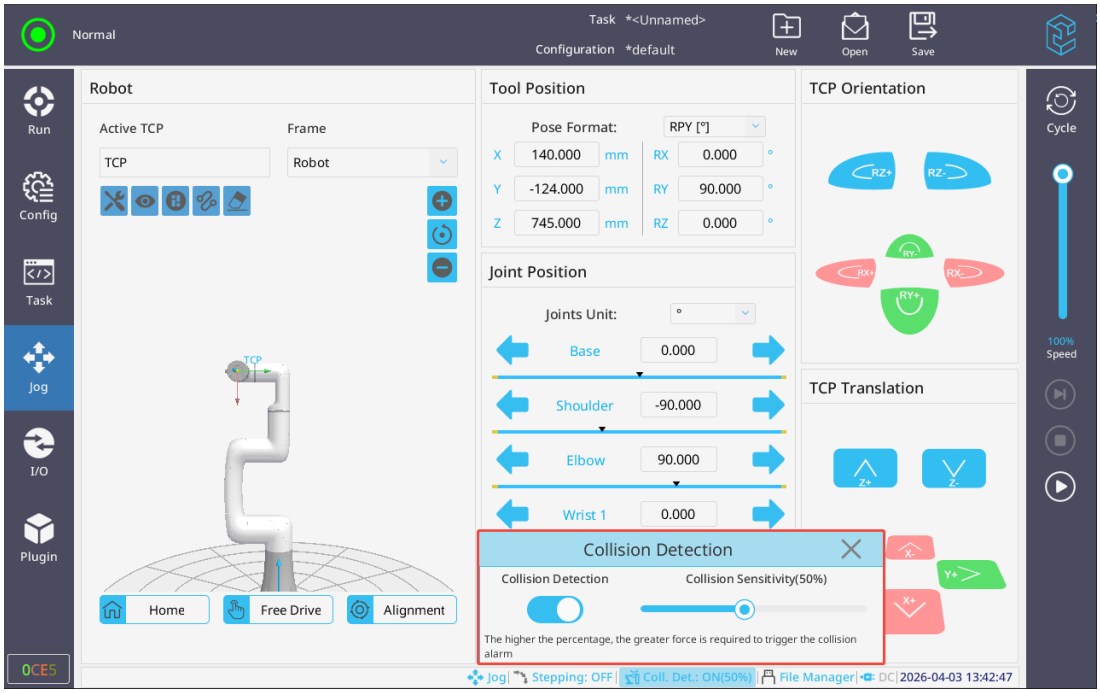


Figure 3-13: Enable Collision

3.2.5 File Manager

Insert a USB flash drive into the USB port on the teach pendant or the controller. Once inserted, the USB icon in the bottom status bar turns blue. Click the icon to open the file manager.

When searching for files, you can select the desired type from the file type drop-down menu. Supported file types include plugins, scripts, tasks, backups, configurations, variables, and compressed files.

According to your requirements, click the corresponding icons to perform the following operations:

- : Return to the previous directory.
- : Go to homepage.
- : Create a new folder.
- : Copy the selected files.
- : Paste the copied files.
  - To copy files to a specific folder, please enter the target folder before pasting.
  - To copy files from the USB drive to the local system, please switch to the local directory via the path bar after copying, and then paste the copied files.
- : Delete the selected files.
- : Rename the selected files.
- : Open the selected folder.

- Click : Sort files by name (alphabetical order). Click the icon again to reverse the order. When sorted in reverse order, folders are displayed first.
- Click : Sort files by time (last modified). Click the icon again to reverse the order. When sorted in reverse order, folders are displayed first.

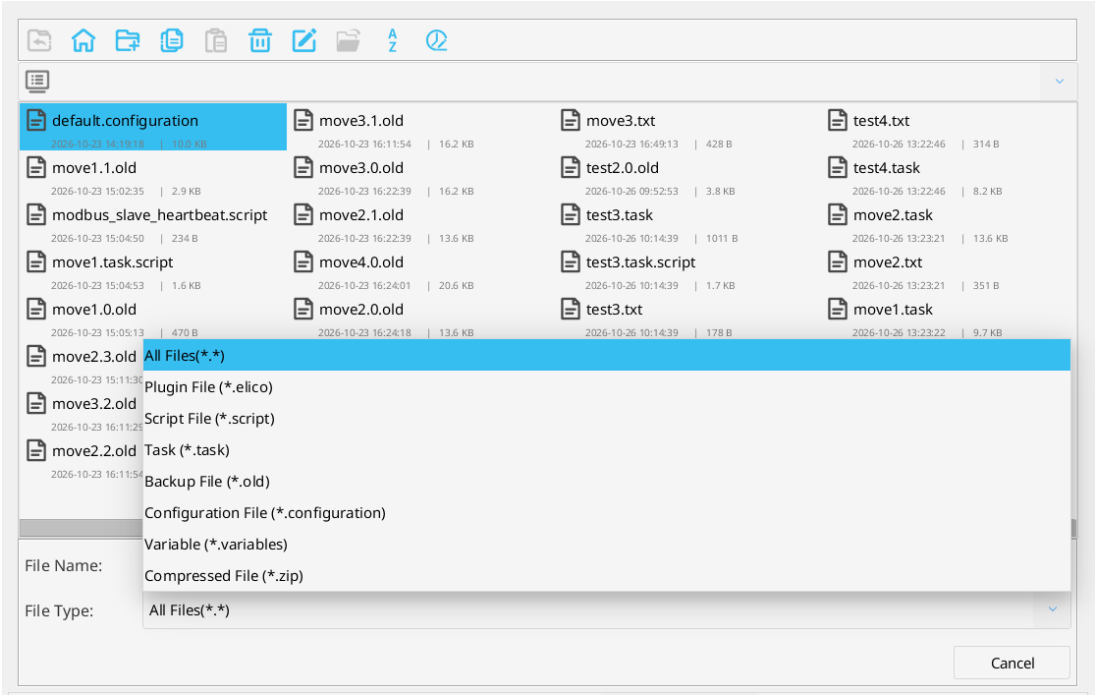


Figure 3-14: File manager

3.2.6 Text Keyboard

The text keyboard is used for text editing.



Figure 3-15: Text Keyboard

Auxiliary Toolbar

Click the button to expand or collapse the auxiliary toolbar.

The expanded auxiliary toolbar contains the following function buttons:

- **Left selection ( )/right selection ( )**
  - When no text is selected, the selection expands left or right from the cursor position.
  - When the selected text is to the left of the cursor, the selection expands left or right.
  - When the selected text is to the right of the cursor, the selection shrinks left or right.
- **Select All ( )**: Selects all text in the text field.
- **Copy ( )**: Copies the selected text to the clipboard. The system keeps a history of the most recent 30 copied items.
- **Paste ( )**:
  - Click: Pastes the most recently copied text at the cursor position, or replaces the currently selected text.
  - Long press (about 500 ms): Displays the clipboard history. Drag the list or scroll bar to browse the history, and select the desired item to paste.

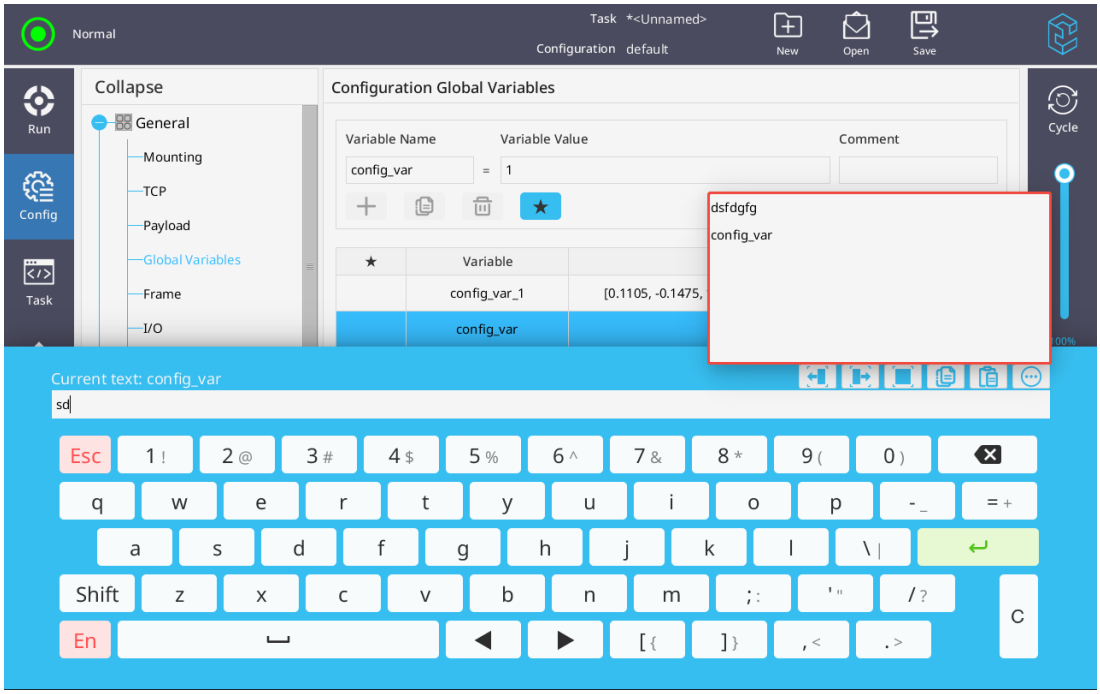


Figure 3-16: Select the Item to Paste

3.3 System Configuration

This section mainly describes the operation instructions of relevant configuration of the LS65 robot system, including querying relevant version/copyright information. Users can set language, time, password, etc. in the system menu, and perform system backup, recovery and update.

3.3.1 About

Users can query software / hardware version information, copyright information, etc.

1. Click  on the right side of the status and menu bar.
2. Click [About] to view version or legal information.
3. Click [Shut down] to return to the screen.

3.3.2 Setting

Click  on the right side of the status and menu bar, and click [Setting] to enter the [Setting] page.

3.3.2.1 Preferences

1. Language and Time

Users can set the language or current time and date as needed.

1. Click  on the right side of the status and menu bar.
2. Select [Settings] > [Preferred item] > [Language & Time].
3. View or adjust the language and time as needed.
4. Click [Apply and restart] to apply the changes.

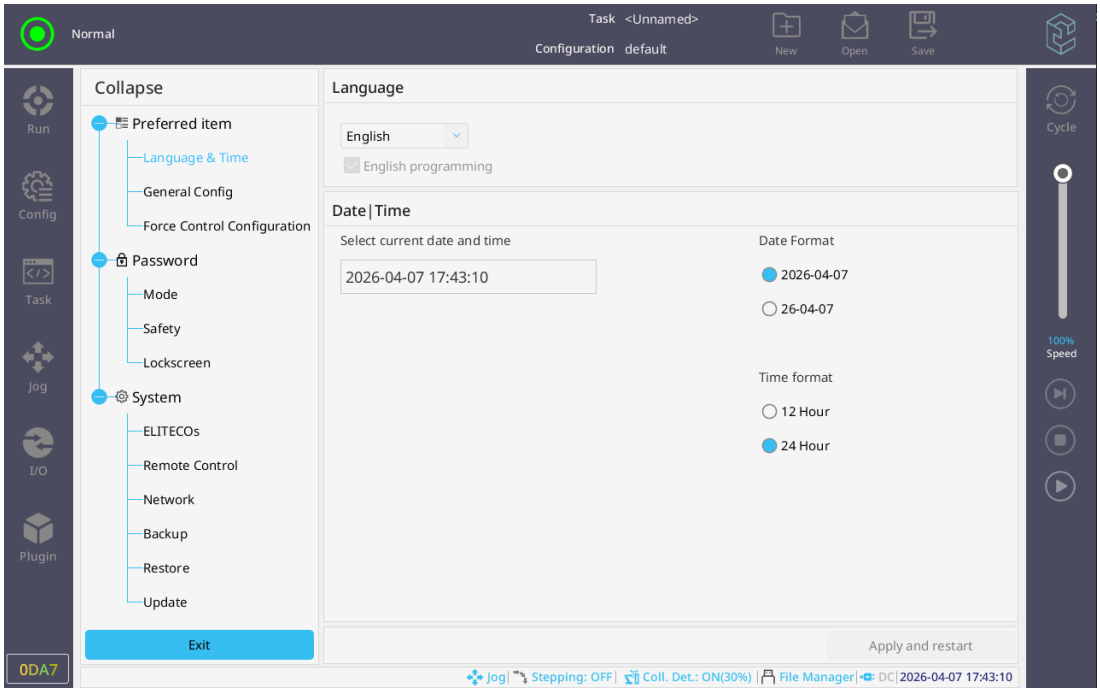


Figure 3-17: Language and Time Settings

Note:

a. If it is the first time to power on the robot, a dialog box with the message ”Language Setting” will pop up. The default is Chinese. Click the drop-down list in the right of the text to select the required language. Currently supported languages are: Chinese(Simplified), Chinese (Traditional), English, Japanese, French, German, Russian, Korean, Polish, Czech, Turkish, Spanish, Italian and Vietnamese, which are now available for all interfaces. Click [OK] and the robot will automatically restart;

b. If [English programming] is checked, the task bar and task tree on the right side of the [Task] tab will display English.

2. General Configuration

Users can perform the following five settings in this interface(see **Figure** 3-18).

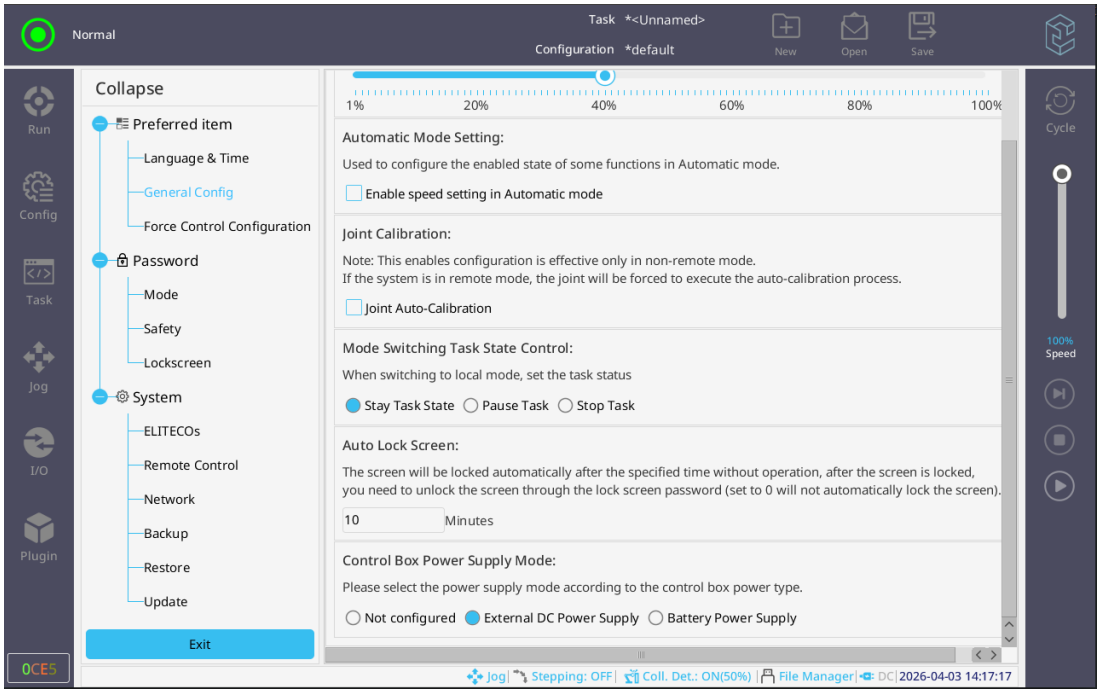


Figure 3-18: General Configuration

1. **Adjust Screen Brightness:** Slide the scale axis to adjust the screen brightness.
2. **Automatic Mode Configuration:** tap the button so that the running speed of the program can be adjusted when the system is in automatic mode.
3. **Control Mode Switching:** tap the button so that the system will pause running automatically when switching between modes.
4. **Automatic screen locking:** enter the time required for initiating automatic screen locking in the input box and then the screen will automatically lock after the specified period.

3. Button Action Configuration

The Button Action Configuration interface is used to configure the actions of various robot buttons.

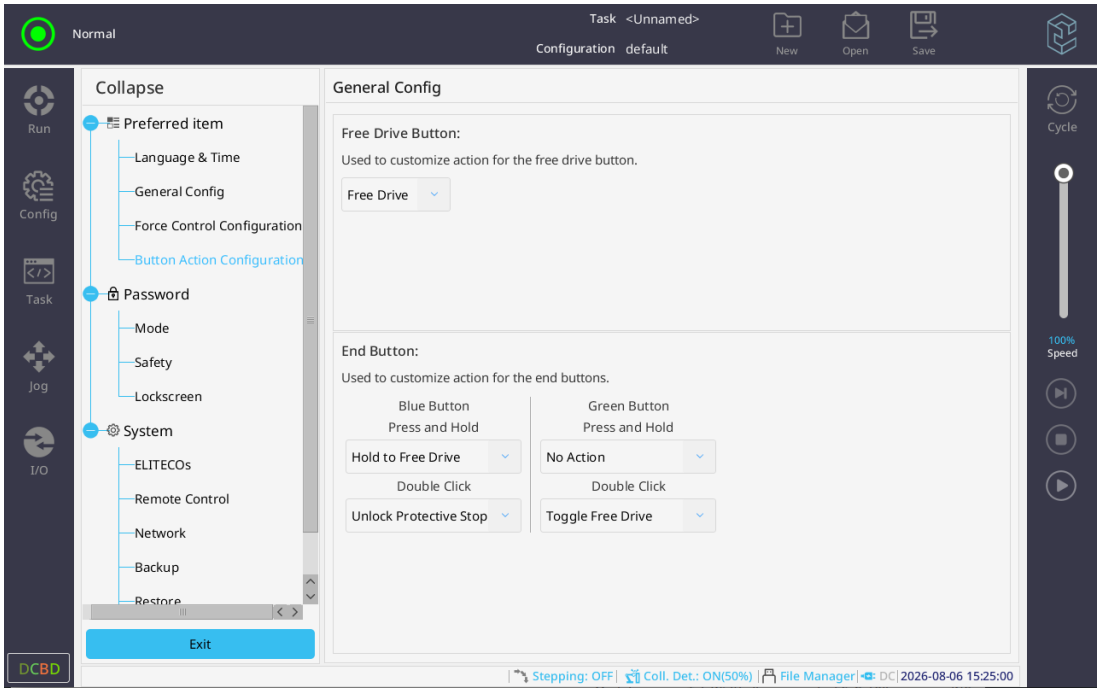


Figure 3-19: Button Action Configuration

1. Free Drive Button (i.e., the drag teaching enable button on the teach pendant): Can be configured for [Free Drive] or [No Action].
2. End Flange Buttons: The robot end flange is equipped with blue and green buttons, supporting configuration for both “press-and-hold” and “double-click” trigger modes.
   - Press and Hold: Can be configured as [No Action] or [Free Drive] (press and hold the button to enter free drive mode; release the button to exit).
   - Double Click: Can be configured as [No Action], [Toggle Free Drive], or [Unlock Protective Stop].
   - Note that the press-and-hold and double-click actions for the same button cannot both be configured for Free Drive at the same time.

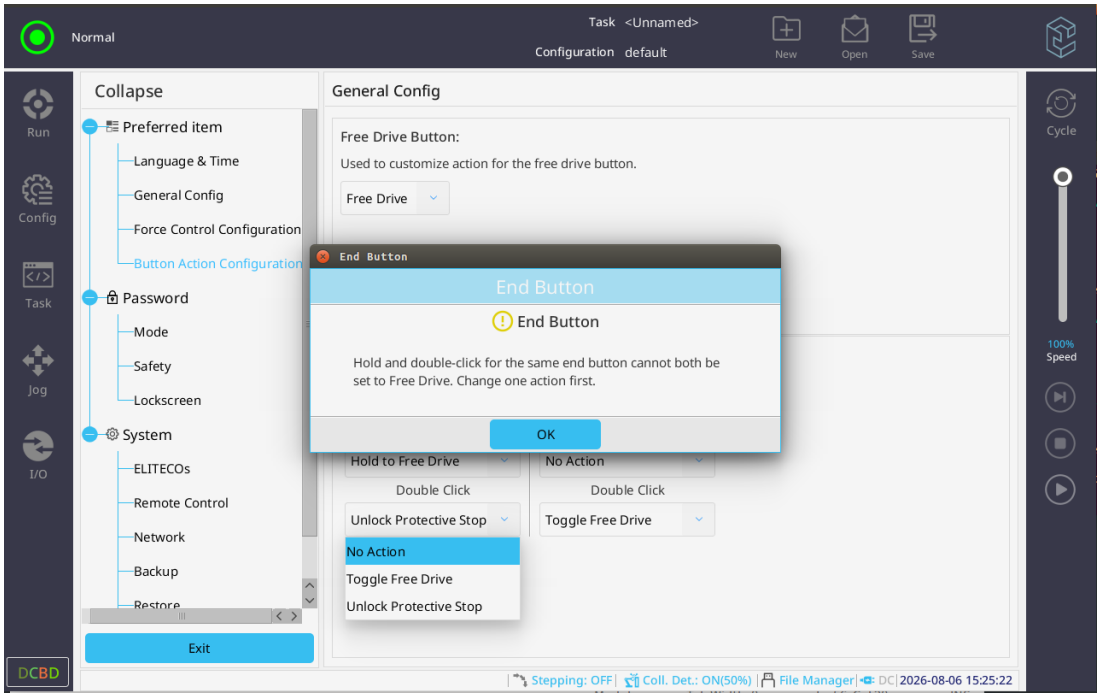


Figure 3-20: Button Action Conflict

3.3.2.2 Password

The user can set the operation mode password and safety password as required.

1. Mode

The robot can operate in manual mode or automatic mode. The user can set the mode password on the interface.

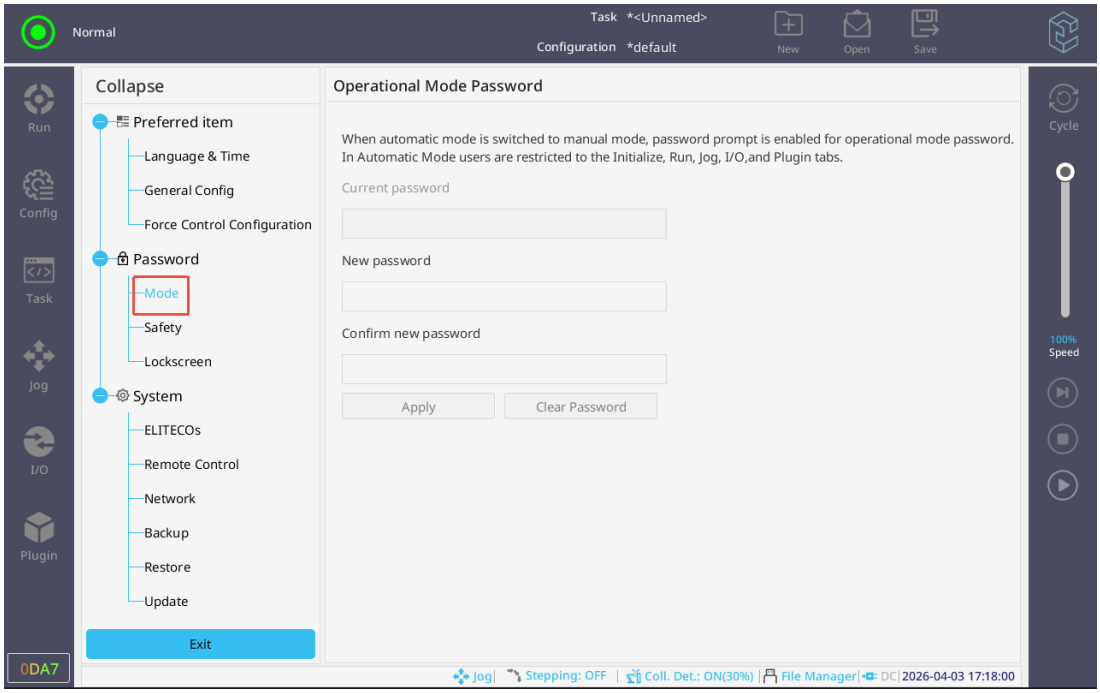


Figure 3-21: Mode password

When setting the operation mode password, the task or configuration can only be created and opened in manual mode. Whenever the user enters the manual mode, the user needs to enter the mode password set on the current page.

2. Safety

The safety password can prevent unauthorized changes to the safety parameter configuration.

DANGER

Before configuring the robot safety settings, the user must perform a risk assessment to ensure the safety of personnel and equipment around the robot. Risk assessment is the assessment of all work tasks during the whole life of the robot. The risk assessment is performed to apply the correct safety configuration settings. Risk assessment must be carried out and the following settings must be made:

1. The user must prevent unauthorized personnel from changing the security configuration, such as security password protection.
2. Understand the application scenario of the robot and its corresponding

safety function parameter configuration.

3. Configure the safety parameters of the teaching pendant before the robot body is powered on for the first time.
4. The user must ensure that all changes to the security configuration comply with the risk assessment.

(a) Set Safety Password

The user must set a password to unlock all safety configurations in [Config] > [Safety].

Note: If the safety password is not configured yet, the user will be notified to set a password.

1. Click on the right side of the status and menu bar  .
2. Select [Settings] > [Password] > [Safety] to enter the Safety page.

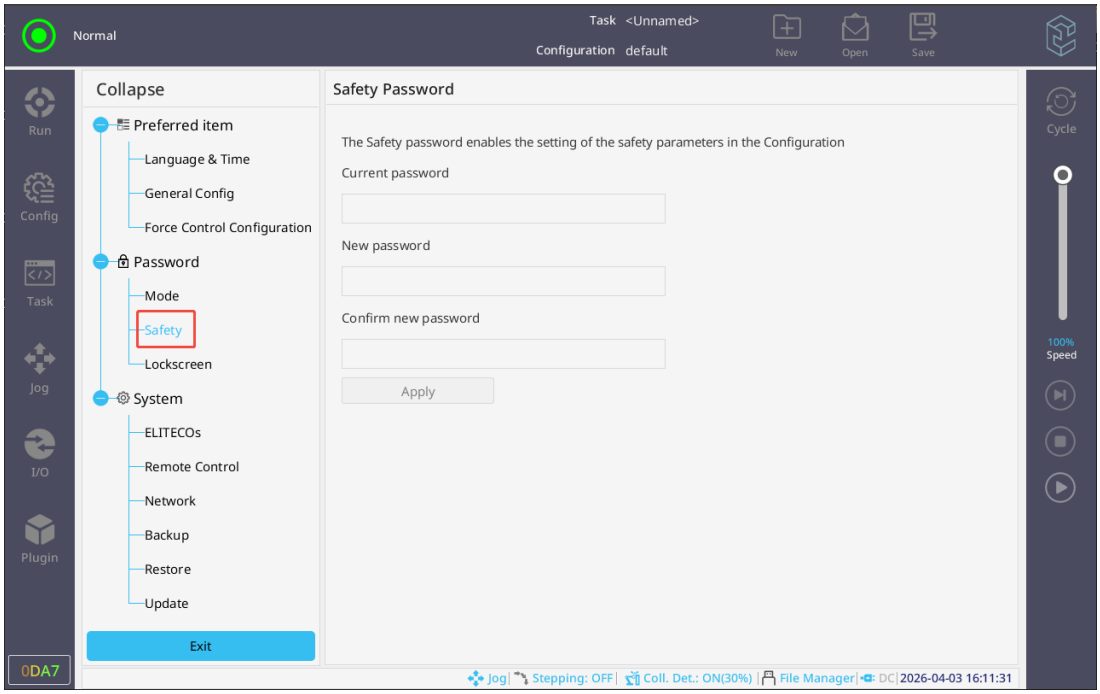


Figure 3-22: Safety password

3. Enter the current password and new password, then enter the same password as the new password in ”Confirm new password”.
   Note: The ”Current password” does not need to be entered only when the safety password is set for the first time.
4. Click [Apply] to complete the safety password configuration.

(b) Access Safety Configuration

The operation steps of accessing safety configuration are as follows:

1. In the navigation bar, click [Config] tab.

2. Click [Safety] to access the safety configuration.

REMINDER

The safety configuration is password protected. The safety configuration only can be changed after password is set.
After modifying the safety configuration, click [Apply] or [Lock] to save the modification.

3.3.2.3 System

1. ELITECOs

Users can click + to install plugins. Users can put the plugin on the USB flash drive, and then install the plugin on the USB flash drive by installing the plugin function.

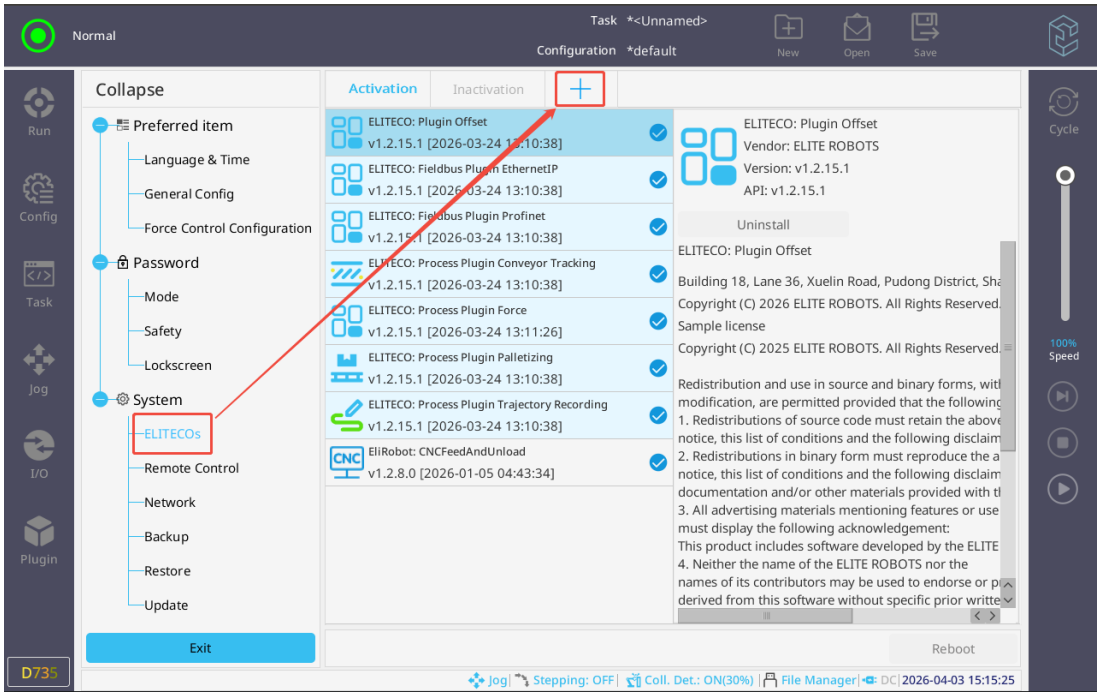


Figure 3-23: Plugins management

After the plugin is installed, click [Restart] to load the plugin; Click [Unintall] to delete selected plugin.

Note: If the plugin is not loaded or is not successfully loaded, it can be viewed on the [Inactivation] page.

2. Remote Control

When disabled, click the switch button to enable the remote mode.

Remote control allows the user to control the robot via external sources, such as controller interface and I/O.

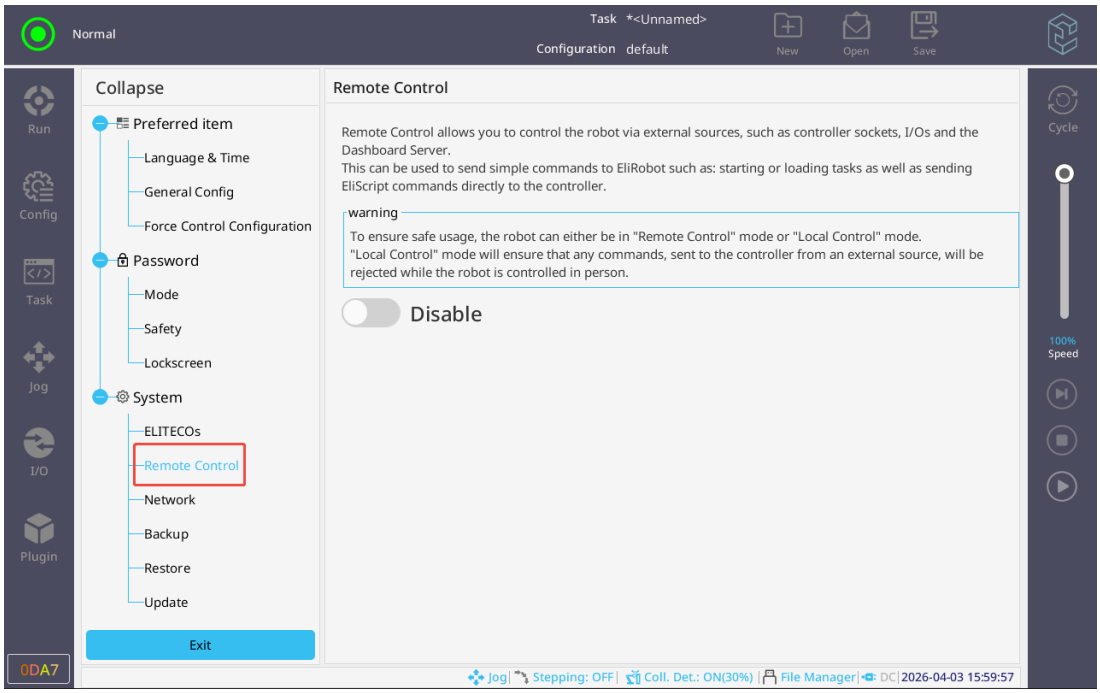


Figure 3-24: Remote control

WARNING

To ensure safety, the robot can be in ”Remote Control” mode or ”External” mode. In ”Local” mode, any command sent to the controller from an external source will be rejected.

3. Backup

Users can back up tasks and configuration files to USB flash disk to counter accidents such like unintentional files removal. The name of backup files includes the serial

number, backup time, and software version information, making it convenient for users to search.

Here are the **steps for operation**.

1. Tap  on the right side of the status and menu bar.
2. Select [Settings] > [System] > [Backup].

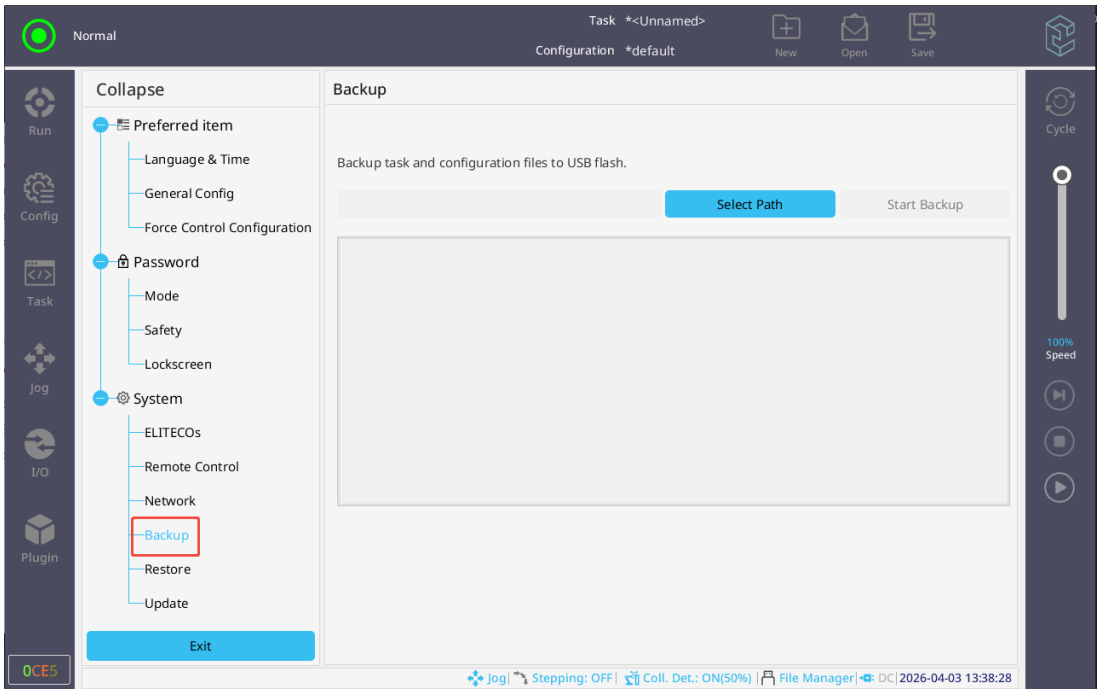


Figure 3-25: Backup

3. Tap [Select Path] and select the location where the file is stored for backup.
4. Tap [Start Backup].

4. Restore

On the Restore interface, users can select the data to be restored and import the corresponding files from a USB flash drive into the system.

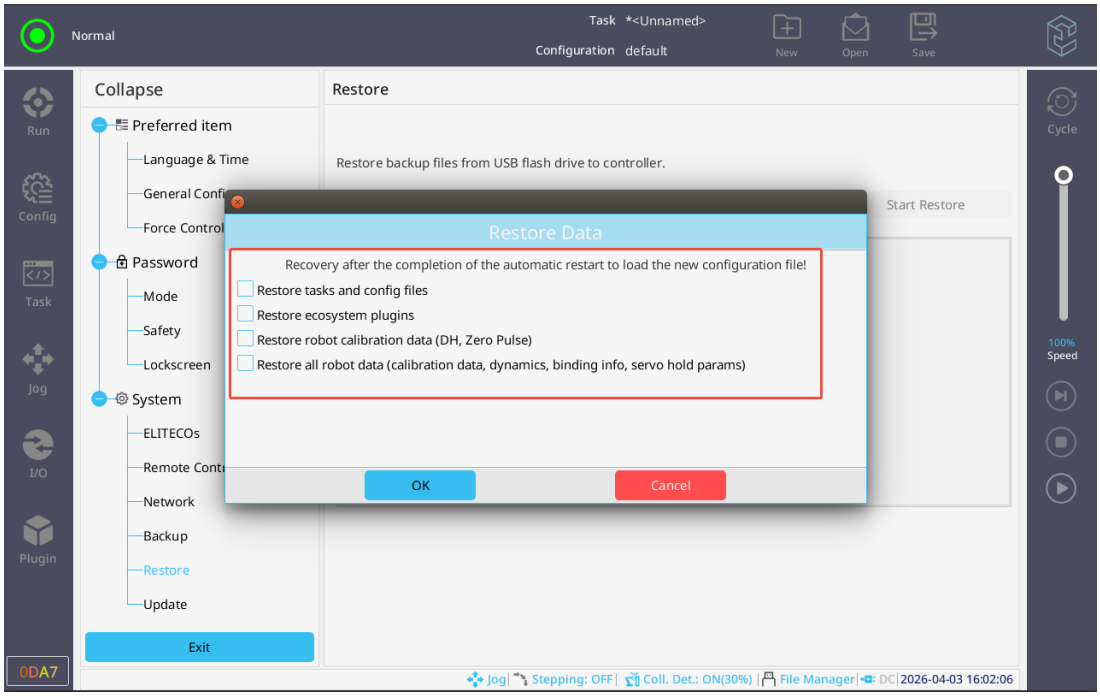


Figure 3-26: Restoring Data Options

- **Restore tasks and config files:** Restores task files and related configuration files.
- **Restore ecosystem plugins:** Restores ecosystem plugin data, including Elitecos plugins.
- **Restore robot calibration data (DH, Zero Pulse):** Restores robot DH parameters and zero pulse calibration data.
- **Restore all robot data(calibration data, dynamics, binding info, servo hold params):** Restores all robot-related data, including calibration data, dynamic parameters, binding information, and servo hold parameters.

NOTICE

1. When restoring DH parameter data, if the robot type does not match the current robot model, a prompt will appear. Please verify the information and decide whether to enable the option for forced restoration.

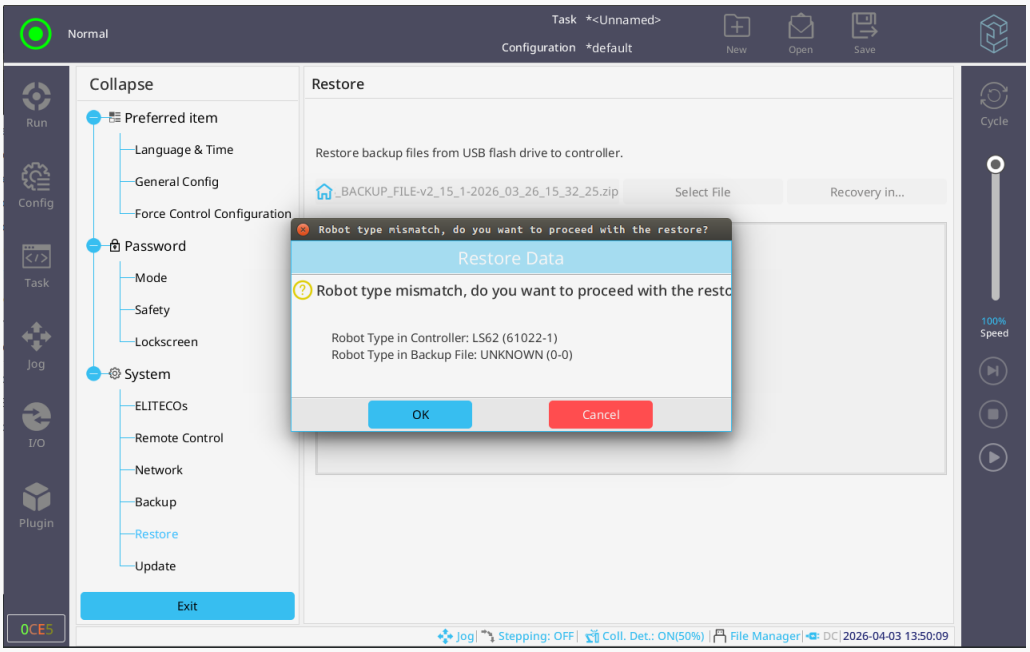


Figure 3-27: Robot Type Mismatch

2. If the safety password has not been set, restoring robot calibration data or all robot data is not allowed. Please go to [Settings] > [Password] > [Safety] to set a safety password.

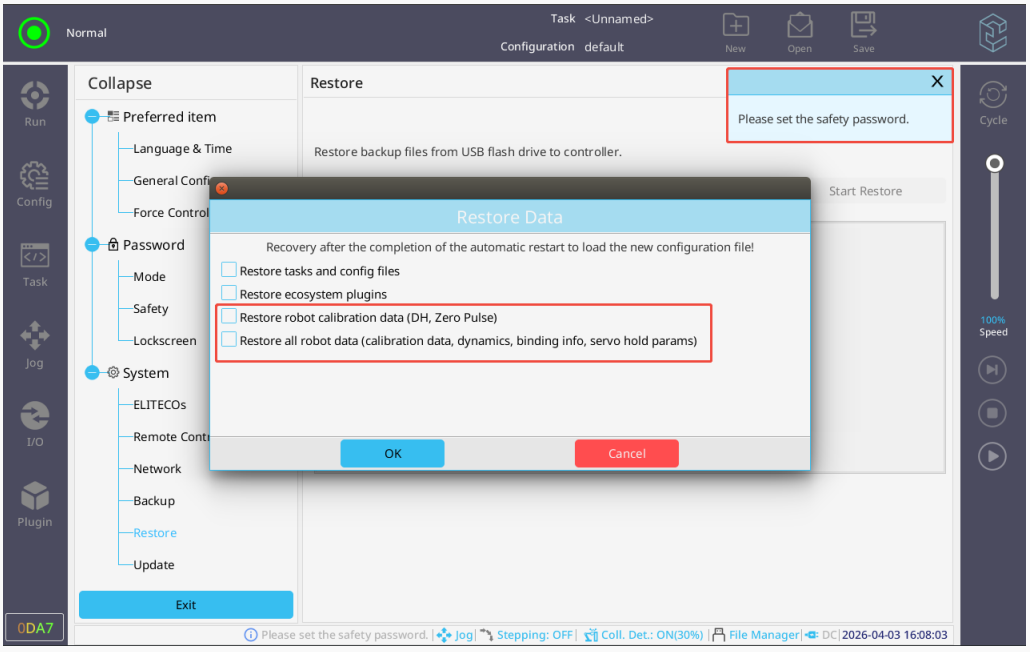


Figure 3-28: Safety Password Required

3. After the safety password is set, restoring robot calibration data or all robot data requires entering the safety password. Otherwise, the system will not perform the restoration even if [OK] is clicked.

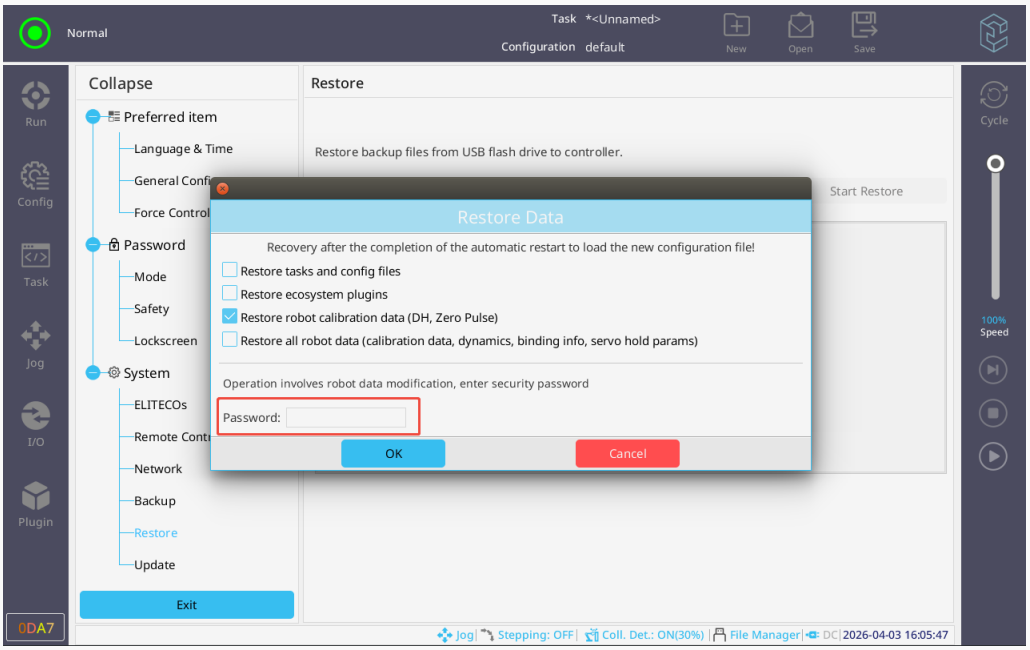


Figure 3-29: Enter Safety Password

Here are the **instructions for operation**.

1. Tap  on the right side of the status and menu bar.
2. Select [Settings] > [System] > [Restore].
3. Tap [Select file] and select the file to be imported.
4. After importing, tap [Start Restore].

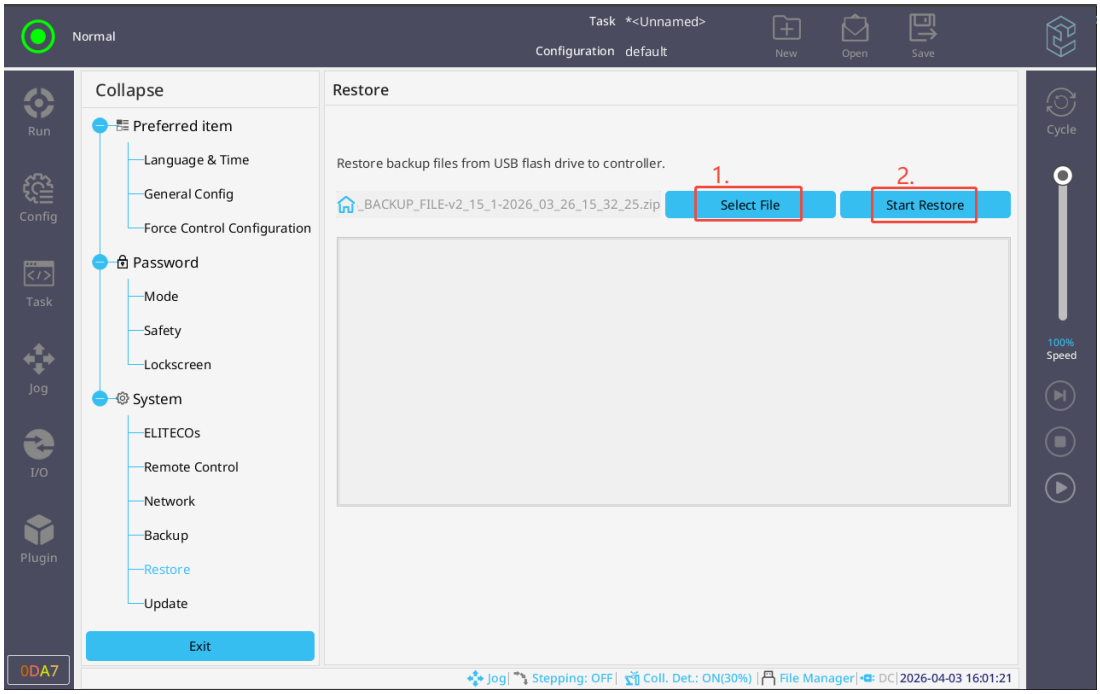


Figure 3-30: Restore

5. Select the specific data to be restored from the pop-up window (see **Figure** 3-26) and then tap [OK].

5. Update

Users can update applications, drivers or systems.

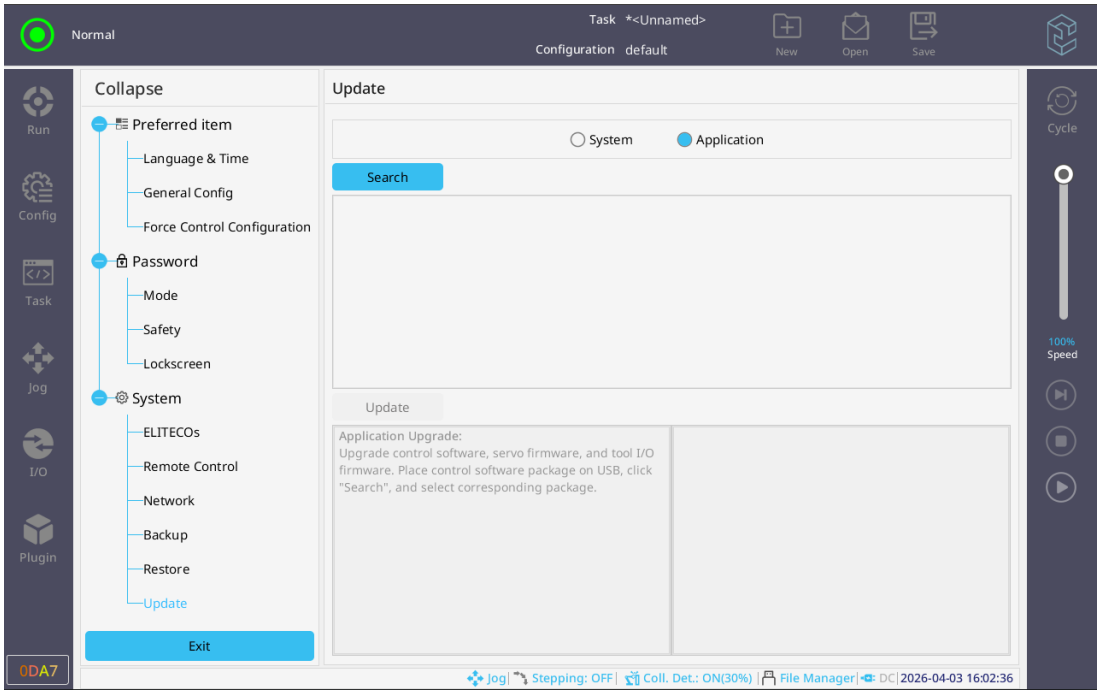


Figure 3-31: Update

1. Click  on the right side of the menu bar.
2. Select [Settings] > [System] > [Update].
3. Copy the upgrade package to a USB flash drive, and then insert the USB flash drive into the controller.
4. Update:
   - Application Update: To upgrade the **control software, servo firmware, or tool I/O firmware**, copy the control software upgrade package to a USB flash drive. Click [Search] to search for integrated upgrade packages with the .eup suffix. Click [Update] to select the modules to be upgraded. You can select modules individually or select all modules at once. Then click [Yes] to start the update.

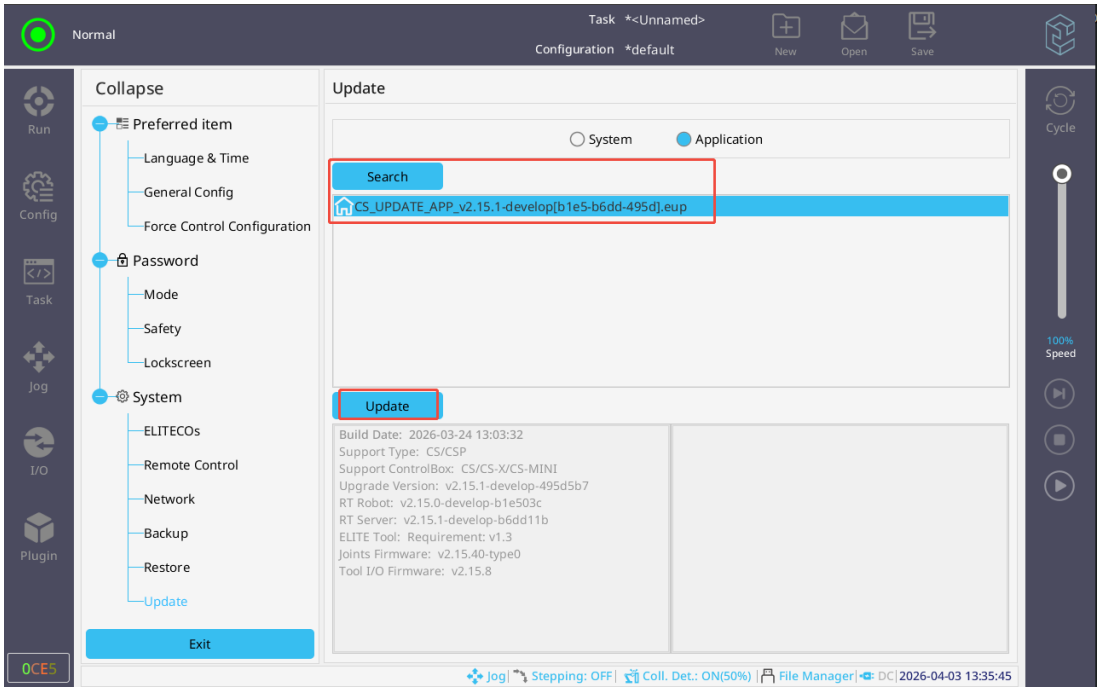


Figure 3-32: Update Application

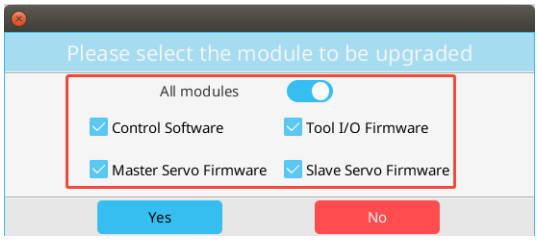


Figure 3-33: Choose the Module

- System Update: To perform a complete upgrade of the **file system and underlying hardware drivers**, copy the upgrade package (with the .eru suffix) to a USB flash drive. Under [System], click [Update] > [Confirm] to start the system upgrade. After the upgrade is completed successfully, the system automatically reboots to apply the update.

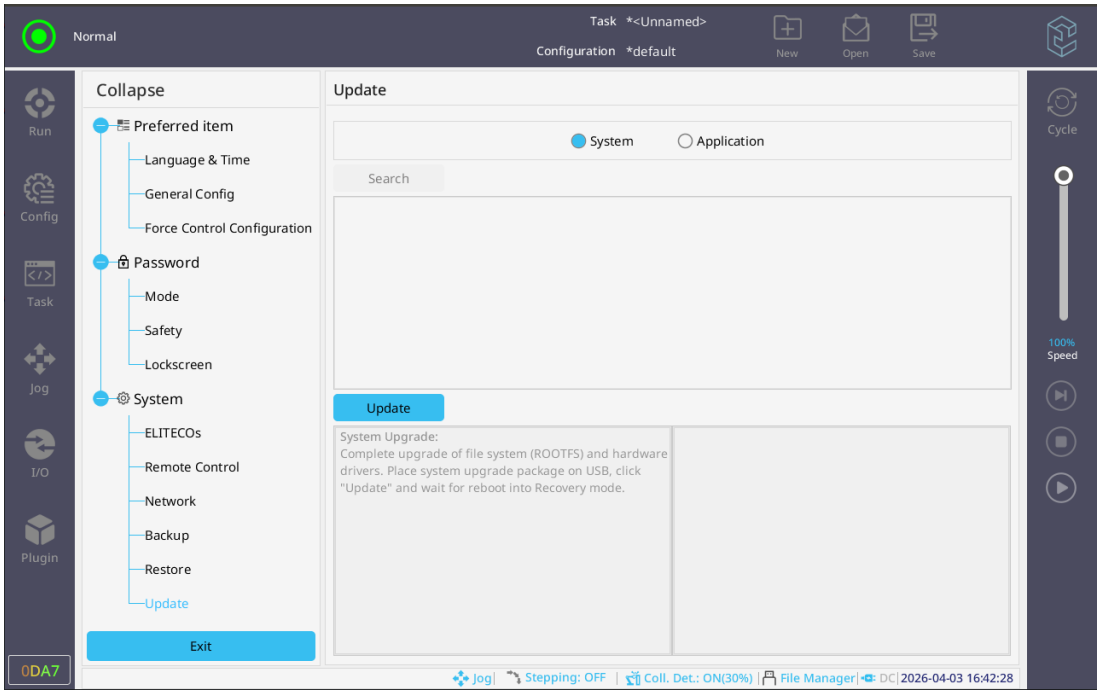


Figure 3-34: Update System

3.3.3 Shut down

Turn off the robot button to power off or restart the robot. The operation steps are as follows:

1. Click  on the right side of the status and menu bar.
2. Select [Settings] > [System] > [Shut down].
3. Click [Shut down] or [Restart] to shut down or restart the robot.

3.4 Run Tab

This section mainly describes the options in the operation of the LS65 robot, including log, robot status and variable.

Users can query logs and robot status and monitor variables, as shown in **Figure** 3-35.

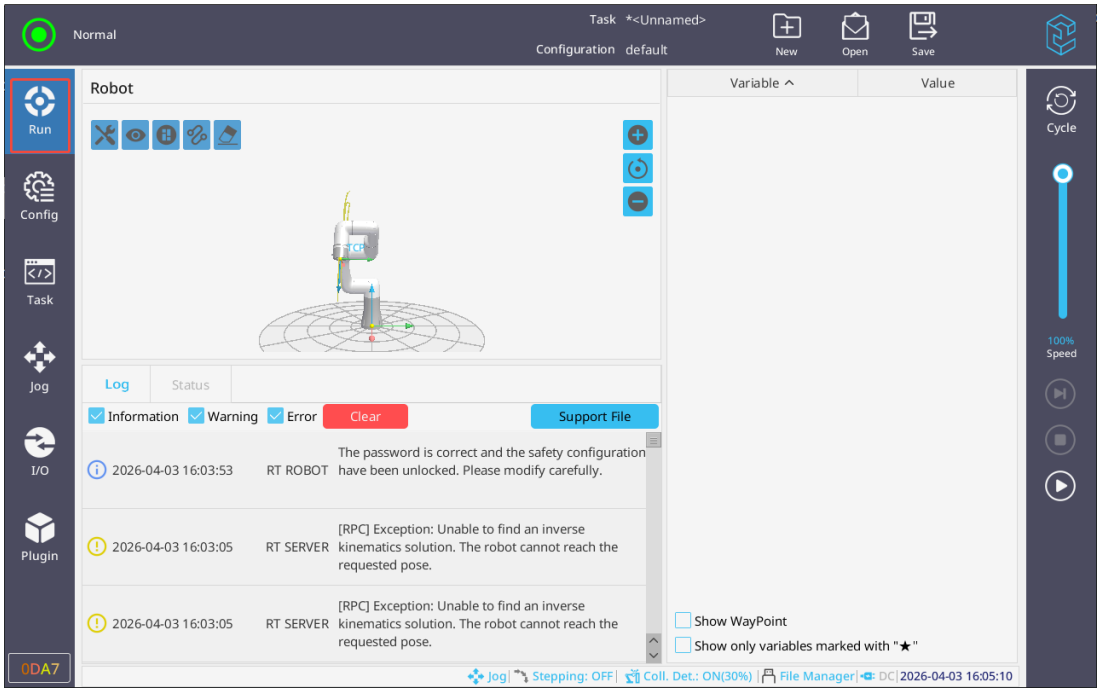


Figure 3-35: Run

3.4.1 Log

The log records the prompts, warnings and error messages generated during the operation of the robot.

Users can sift logs by checking or unchecking the check box.

The first column of the log is classified according to the severity of the log record. The second column shows the arrival time of the message. The last column shows the specific information of the log.

Tap [Clear] to clear the current log list.

3.4.2 Status

The user can view the robot status in the status interface, including running time, joint temperature, joint current and other parameters.

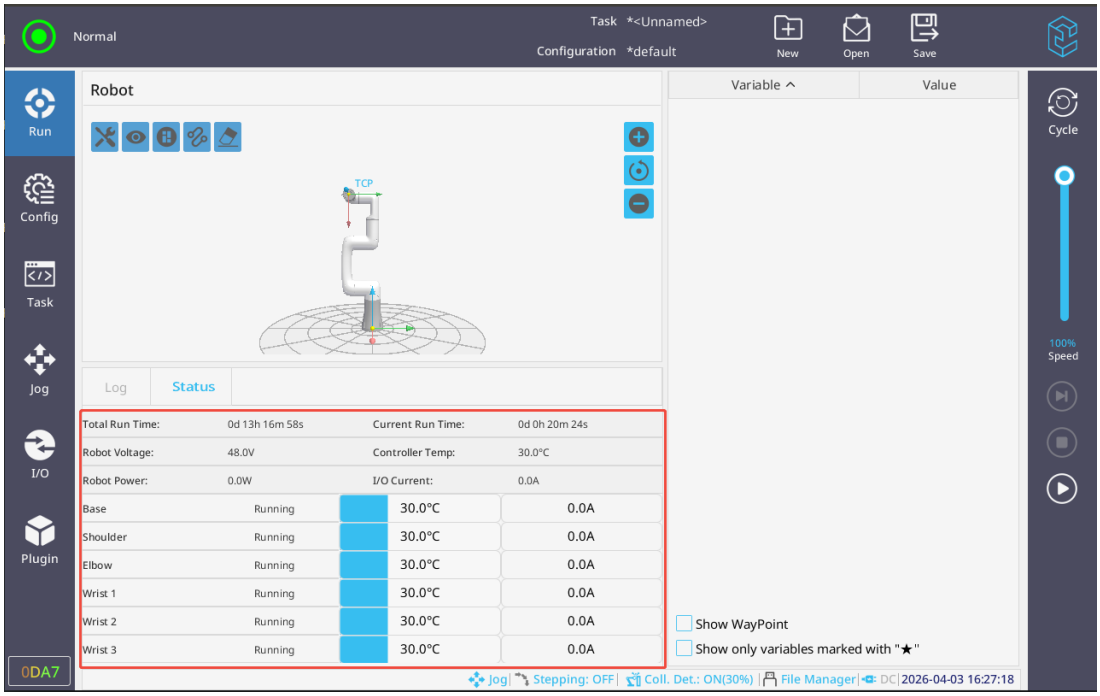


Figure 3-36: Status

3.4.3 Variable

The user can monitor variables on the current page. See Subsection 3.6.3 for details.

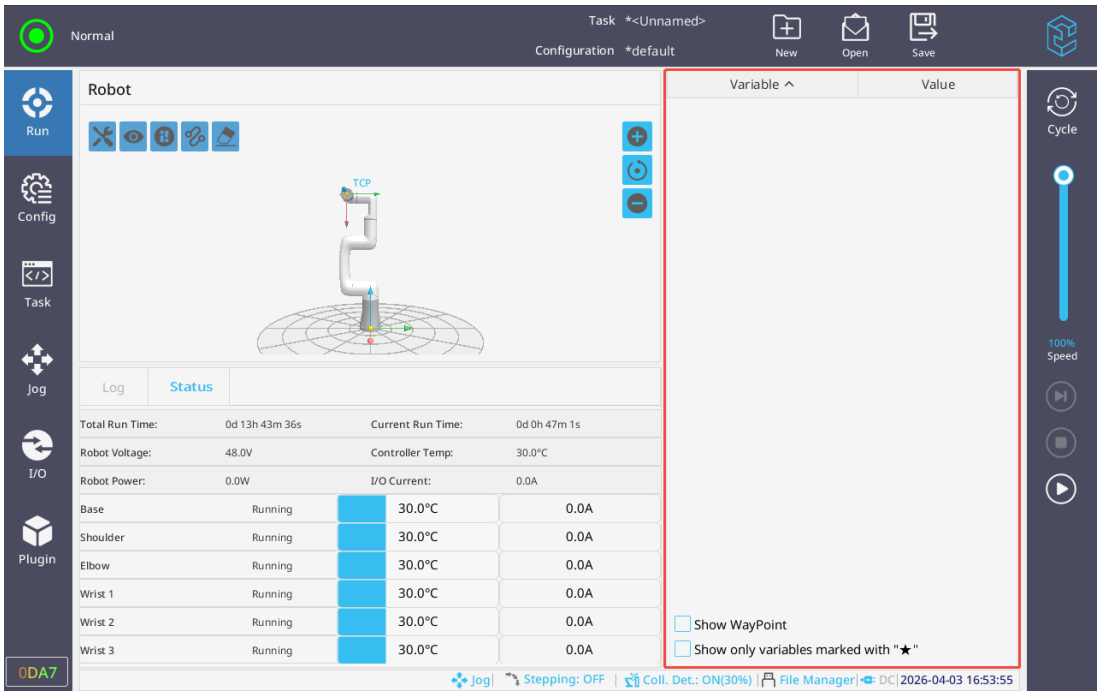


Figure 3-37: Variable

3.5 Configuration Tab

This section describes the options and operation instructions in the configuration of the LS65 robot, including general, safety, communication, plugin and other options. Users can carry out robot arm mounting, TCP, payload, frame, force control and other operations in general. The configuration of security parameters includes robot limit, joint limit, safety planes, safety I/O and three position. Users can use Modbus client I/O signal and plugin configuration.

3.5.1 General

3.5.1.1 Mounting

The mounting of the specified robot arm has two purposes:

1. Correctly display the manipulator on the screen.
2. Inform the controller of the gravity direction.

WARNING



If the mounting posture of the robot arm is not set correctly, it will lead to unexpected movement when the robot arm is in free dragging mode.

If the robot arm is mounted on a smooth surface or floor, no changes need to be made to this screen. However, if the robot arm is mounted on a ceiling, wall, or at a certain Angle, the mounting posture must be correctly set.

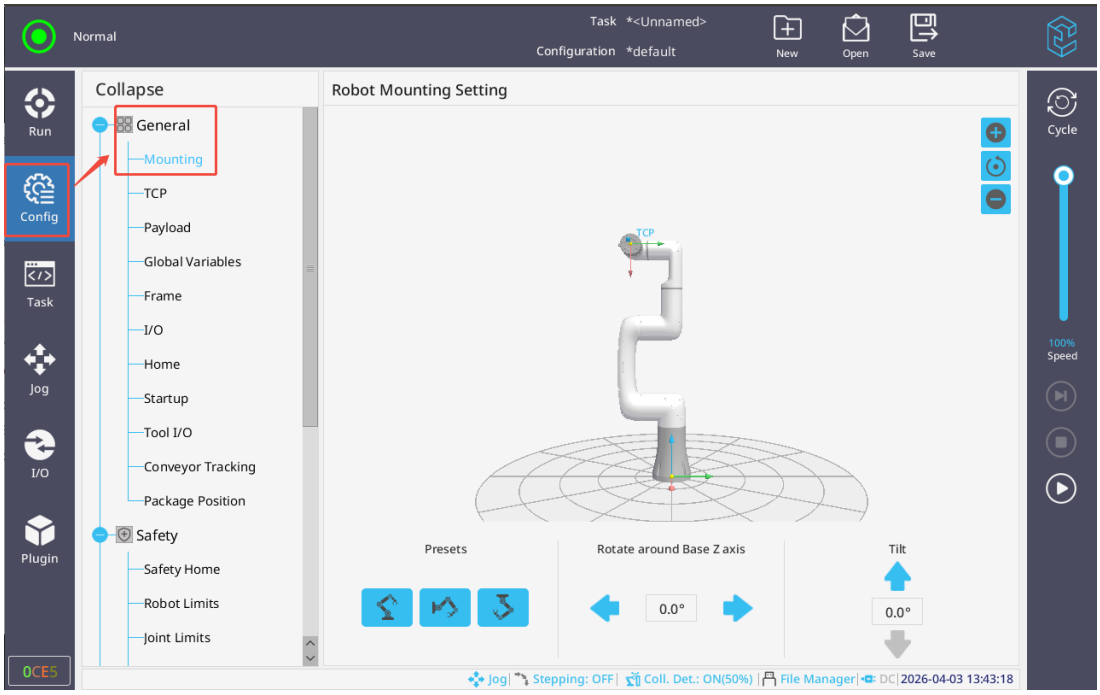


Figure 3-38: Mounting

The three [Presets] buttons represent three mounting methods: floor, wall, ceiling mounting. [Rotate around Base Z axis] is used to rotate the mounting angle of the robot arm, which should be consistent with the actual mounting angle as far as possible. The [Tilt] button sets the plane angle.

3.5.1.2 TCP

In order to ensure that the robot can correctly perform the operations of moveL, moveJ, moveP and other motion types, the accurate size information of the tool must be recorded, and the position of the tool center point (TCP) must be defined.

After modifying the TCP, the robot will move to the Cartesian attitude saved in the waypoint with the new TCP.

1. Position

The X, Y, and Z coordinates specify the TCP location. When all values (including direction) are zero, TCP coincides with the center point of the tool output flange.

2. Default Direction

The default tool orientation of LS65 robot's end flange is the negative direction of Y-axis, as is indicated by the arrow in **Figure** 3-39, perpendicular to the flange mounting surface. The locating pin hole is located along the negative direction of the Y-axis.

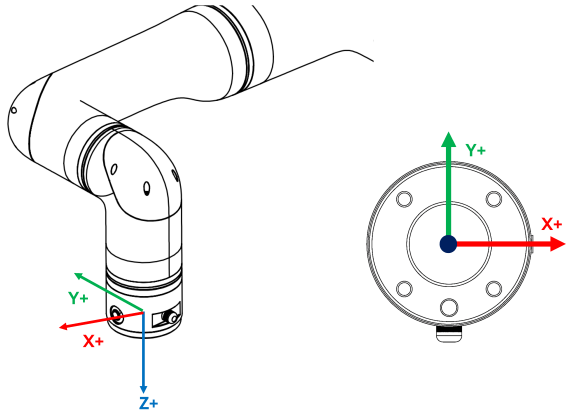


Figure 3-39: The Default Orientation of the Tool Coordinate

3. Pose

The RX, RY, and RZ frames specify the TCP direction. Pose Format can be chosen between degrees or radians from the drop-down menu.

4. Other

- Copy: click , copy a TCP;
- Add: click to create a new TCP;
- Rename: select the TCP to rename and click ;
- Delete: select the TCP to delete and click ;
  Note: The last TCP cannot be deleted.
- : is the currently activated TCP.

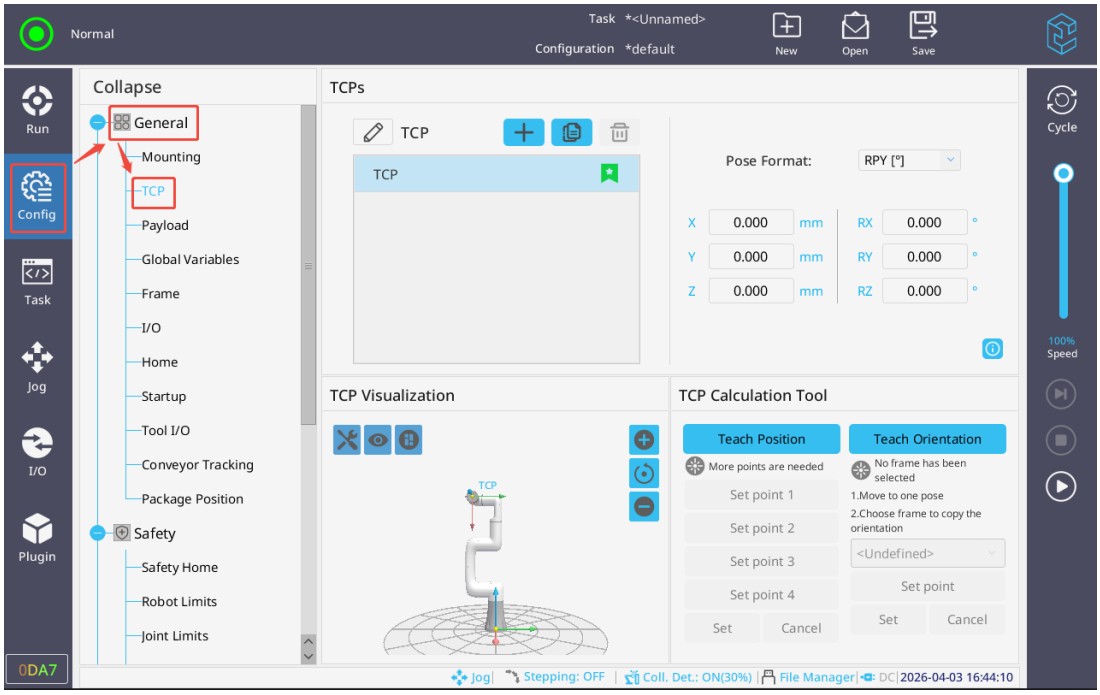


Figure 3-40: Other functions

5. Teach Position

TCP position coordinates can be calculated automatically through the following steps:

1. Click [Teach Position] > [Set point 1].

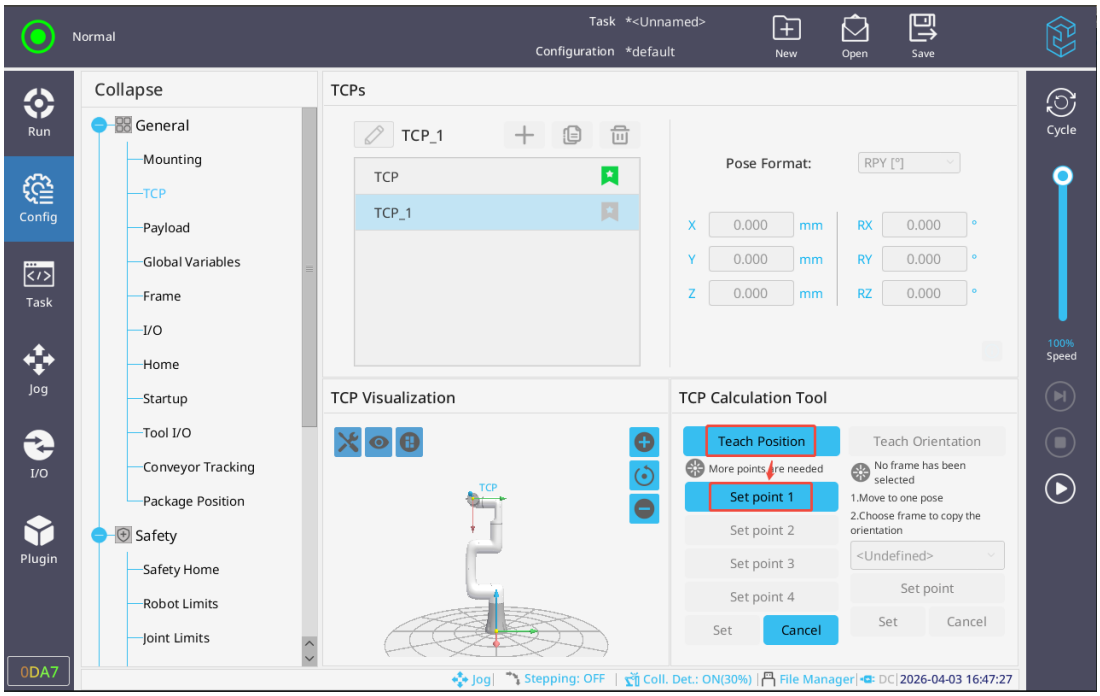


Figure 3-41: Set point 1

2. Set a fixed point in the robot workspace. Use the position arrow on the right side of the screen to move TCP from at least three different angles.
3. Click [Set] in the lower left corner of the page.
4. Click [Set point 2], [Set point 3] and [Set point 4] to set the point.
5. Click [Set] to apply the verified coordinates to the appropriate TCP.
   The attitude of the four points from point 1 to point 4 should be as different as possible to ensure the correct calculation results. If the difference between them is small, the status LED above the button will turn red.

Even though three locations are usually enough to determine TCP, the fourth location is still needed to further verify that the calculation result is correct.

6. Teach Pose

TCP direction can be calculated automatically through the following steps:

1. Click [Teach Pose].

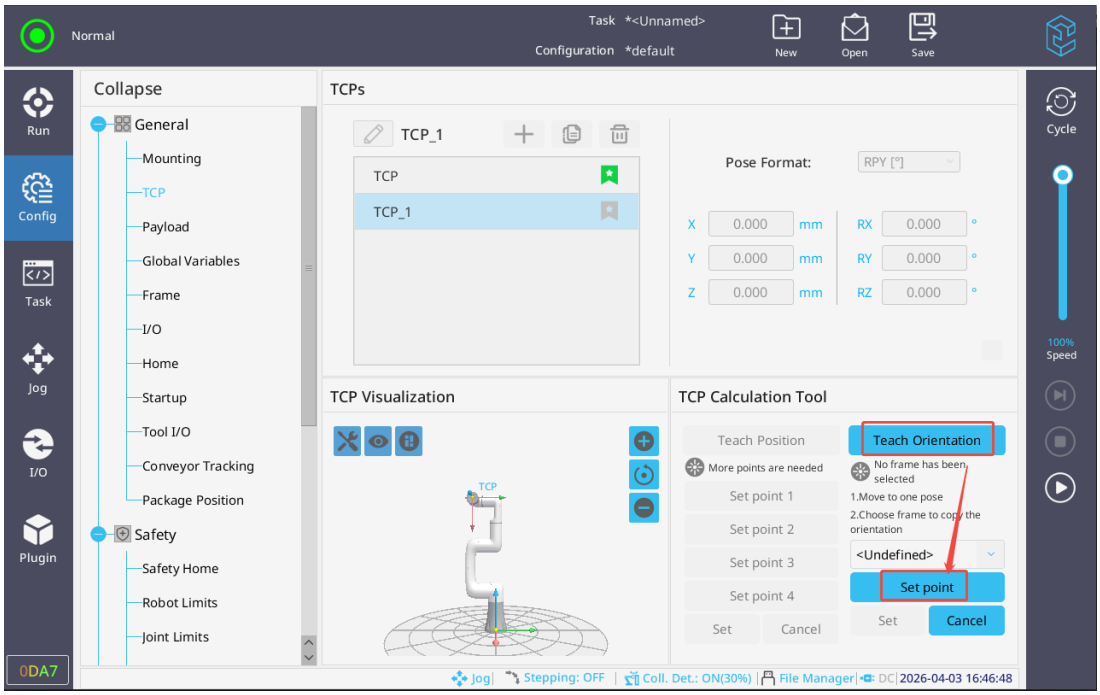


Figure 3-42: Teach Pose

2. Select a frame from the drop-down list.
3. Click [Set point] to ensure that the direction of the tool and the corresponding TCP coincide with the selected frame.
4. Verify the calculated TCP direction, click [Set] and apply it to the selected TCP.

7. TCP calibration

The TCP calibration method employed by the LS65 robot involves teaching of several control points in various poses, the system will automatically calculate tool dimensions based on these data. Here are the steps for setting the tool coordinate system.

1. Tap [Teach Position] > [Set Point1] to sequentially teach the pose for P1 to P4. These four points constitute a set of base pose data, and their poses must be as different as possible, presenting various orientations, to enhance computational accuracy;
2. Users can choose the default base or a newly taught one as the coordinate system. If choosing the base, adjust the tool pose to a new point P5. Ensure that of the tool's end aligns with the orientation of the coordinate system and that X and Y directions of to meet the specified requirements. Tap [Set Point] > [Set] and the system will calculate the data for the desired pose based on the coordinate system and then apply the data to the TCP in **Figure** 3-44;

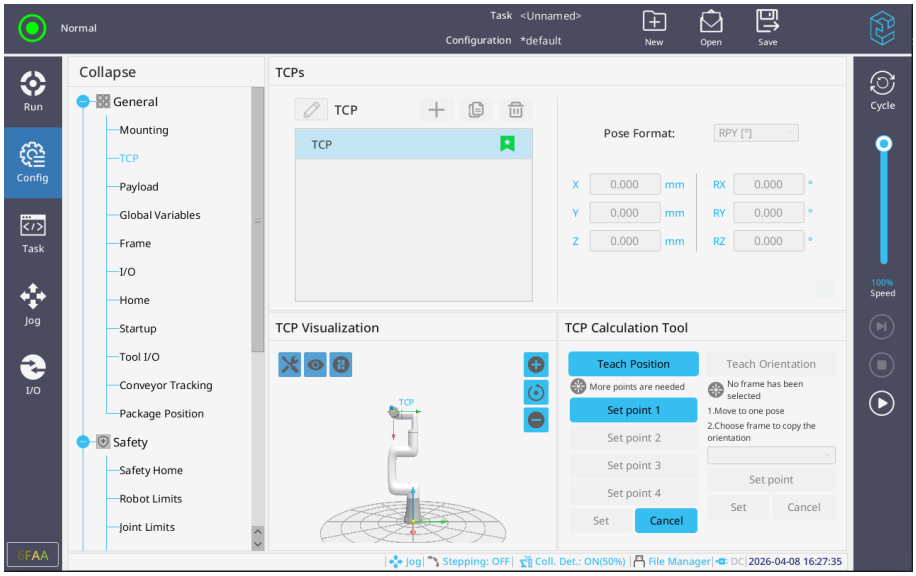


Figure 3-43: Set TCP

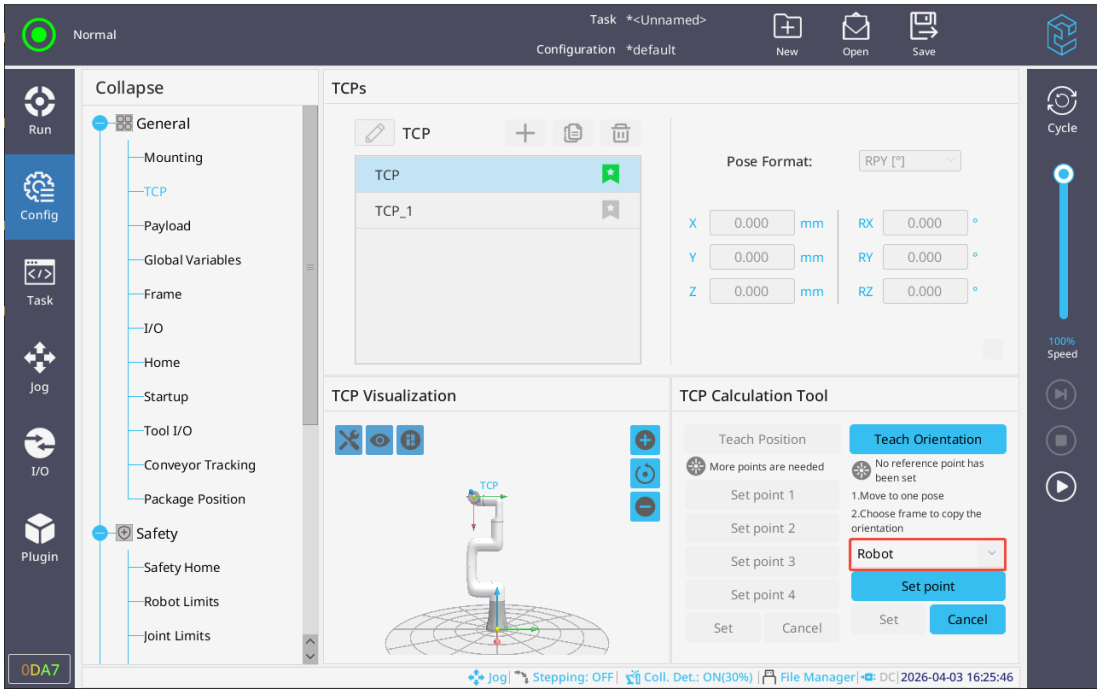


Figure 3-44: When Selecting Base

3. If the direction of the coordinate system is unknown, users can first teach its direction based on the robot's with the three-point method. Here are the instructions.
   - Using the calibration gun as a reference, P6 is used to specify the horizontal direction of tool movement; P7 specifies the Z direction of the tool coordinate system building on P6.
   - Ensure that the vertical part of the tool end remain in a straight line with the calibration gun so that the robotic arm moves in a straight line along the Z direction of the tool coordinate system.
   - After teaching the tool coordinate system, select it and samely adjust the tool pose to a new point direction, tap [Set Point] > [Set], then the TCP data of the current tool pose can be accessed.
   - It should be noted that the control points of P1-P5 for this case must be always in contact with the tip of the calibration gun.

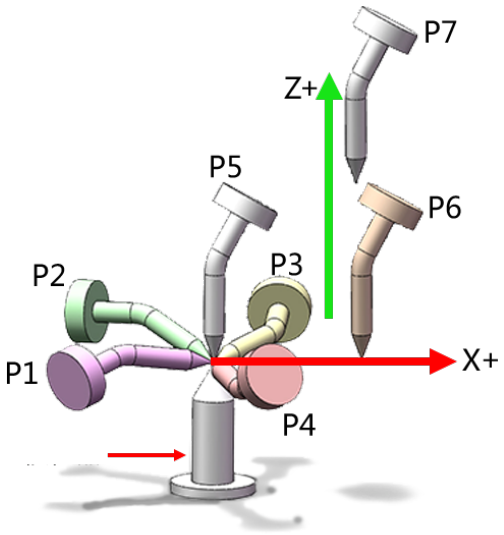


Figure 3-45: When Teaching the Coordinate System with Three-point Method

3.5.1.3 Payload

The user can specify the weight of the payload and define the center of gravity, and can add, rename, delete, copy and other operations on the payload.

1. Add Payload

The operation steps are as follows:

- Click + to create a new payload.
- Set the [Mass] (0-5kg) and [Center of Gravity(CoG)] (-60-60mm) of the payload.
- When setting the CoG, its parameters of the X/Y/Z axes must be aligned with those of the tool flange axes. Click ! , refer to the directions of the tool flange axes.

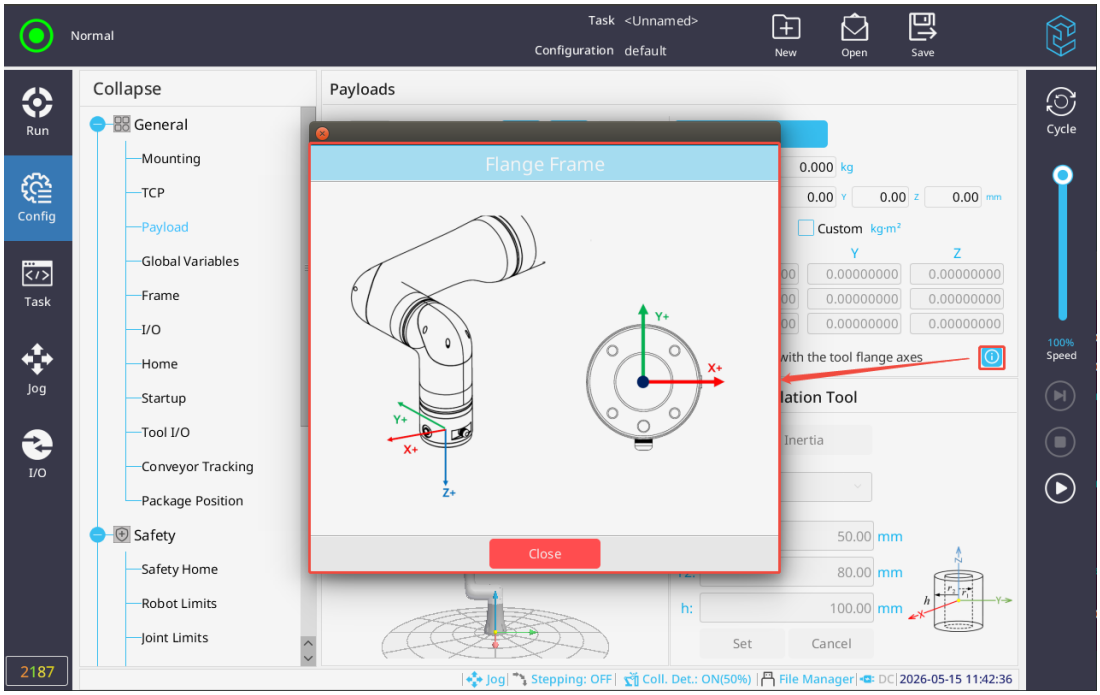


Figure 3-46: Directions of the Tool Flange Axes

- To customize the inertia matrix, check [Custom] to teach the inertia in [Payload Calculation Tool]. If its setting does not satisfy the standard, its X, Y, Z input boxes will become yellow as a warning message, and there is also a prompt dialog box named ”Please verify that the Inertia Matrix is correct”. Note that the payload cannot be set at this time.

2. Other Operations

- Copy: click , copy a payload;
- Rename: select the payload to rename and click ;
- Delete: select the payload to delete and click ;
  Note: The last payload cannot be deleted.
- : the payload that takes effect in the task when the task is running;
- Immediate setting: click [Set Now], a black check mark will appear, indicating that the payload is activated immediately.

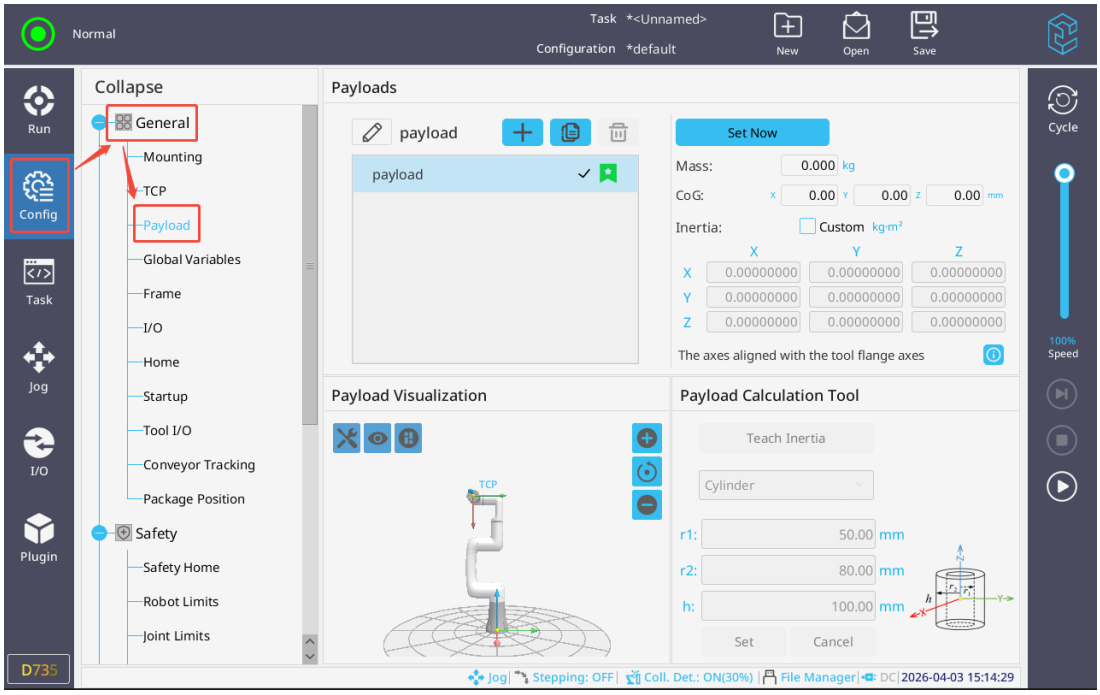


Figure 3-47: Set Payload now

3.5.1.4 Global Variable

Users can create global variables in [Config] > [General] > [Global Variables], which can be used in tasks.

NOTICE

The global variable is used in the task, and the value of the variable changes when the task runs, and the value in the [Config] will also be updated.

The value of the global variable will be saved to the system in real time. In other words, even if the task stops running, or the robot arm and controller are powered off and restarted, the data of global variables will remain unchanged.

The user can perform the following operations on the interface.

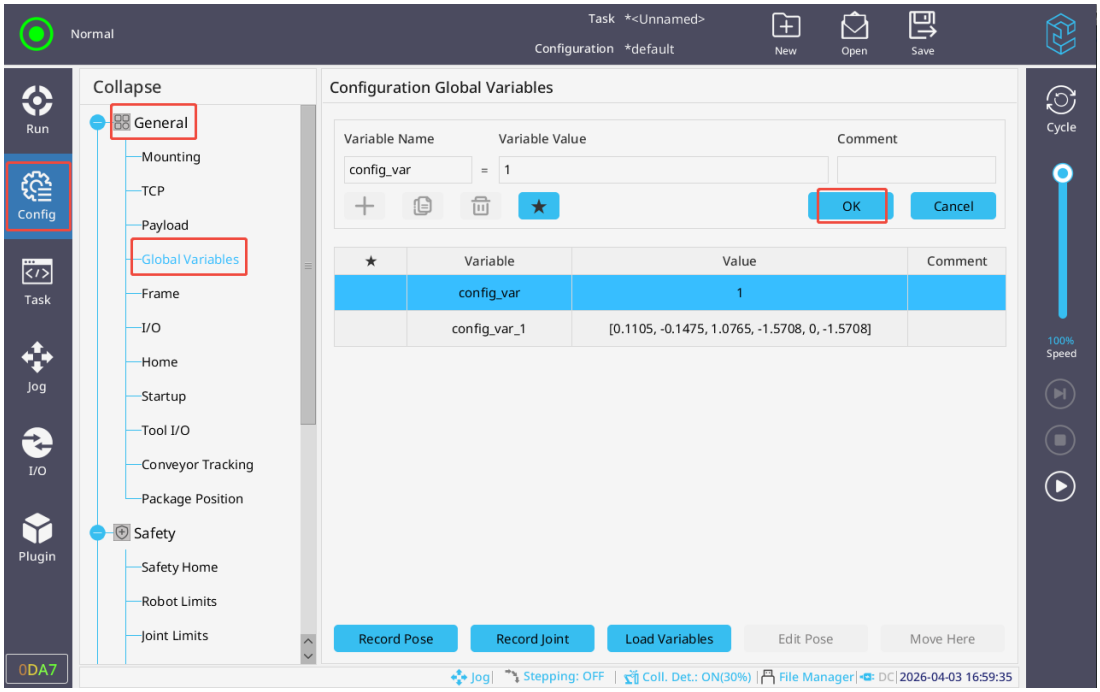


Figure 3-48: Global variables

New variable: click + and set the variable name and value in the corresponding input box respectively. The variable type supports int, float, boolean, string and vector with length of 6. After setting, click [OK] to complete the variable creation.

Collect Variable: Select the variable to be collected and click ★ to collect it. Click the icon again to cancel the collection.

Copy variable: select the variable to be copied and click .

Delete variable: select the variable to be deleted, and click > OK in the tip window.

Record pose/joint: to record the data for current pose/joint (rounded to 5 decimal places).

Modify variable value: click the variable to be modified and the button [OK] becomes [Edit]. Then modify it in the related textbox or use pose/joint data to overwrite the value by clicking [Record Pose/Record Joint]. At last, click [OK] to complete variable modification.

Global variables can be sorted by name, value, or comment. Click the corresponding column (such as “Comment”). When an up or down arrow appears, it indicates that the list is sorted by that column. Click again to switch between ascending and descending order.

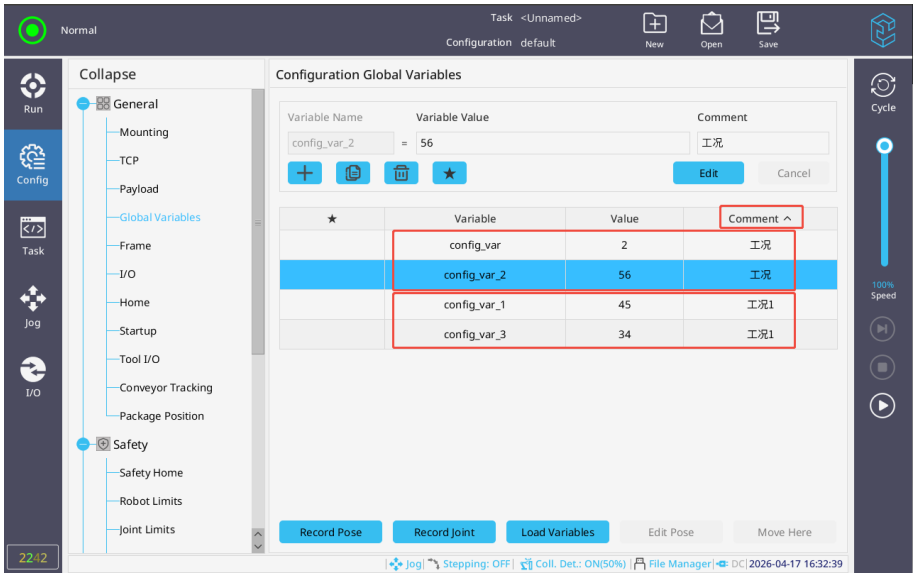


Figure 3-49: Sorting by Comment

Load Variables

You can batch create or update system variables by importing a variable file, improving configuration efficiency.

1) Supported file formats

- The supported import file type is .variables.
- The file should be in XML format.
- The file must comply with the system variable format requirements. Otherwise, the variables cannot be imported.

NOTICE

If the imported file format is incorrect, the import will fail and the corresponding error information will be recorded in the system log.

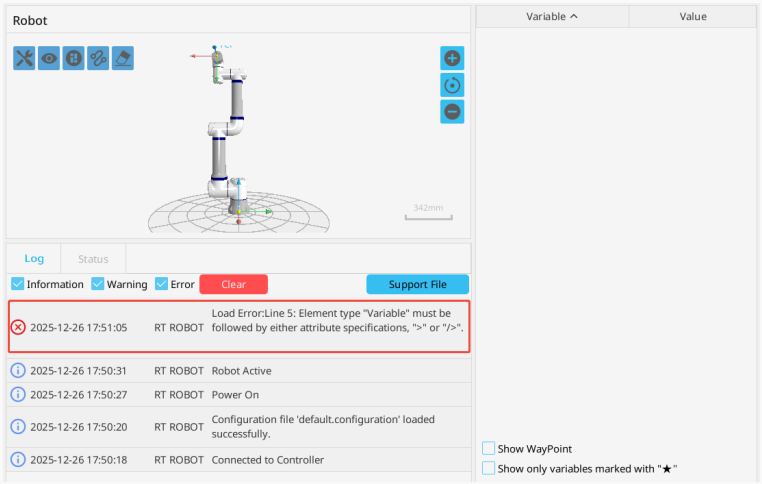


Figure 3-50: Import Failed

2) How to import

- Click the [Load Variables] button.
- Select the file to be imported in the file selector.

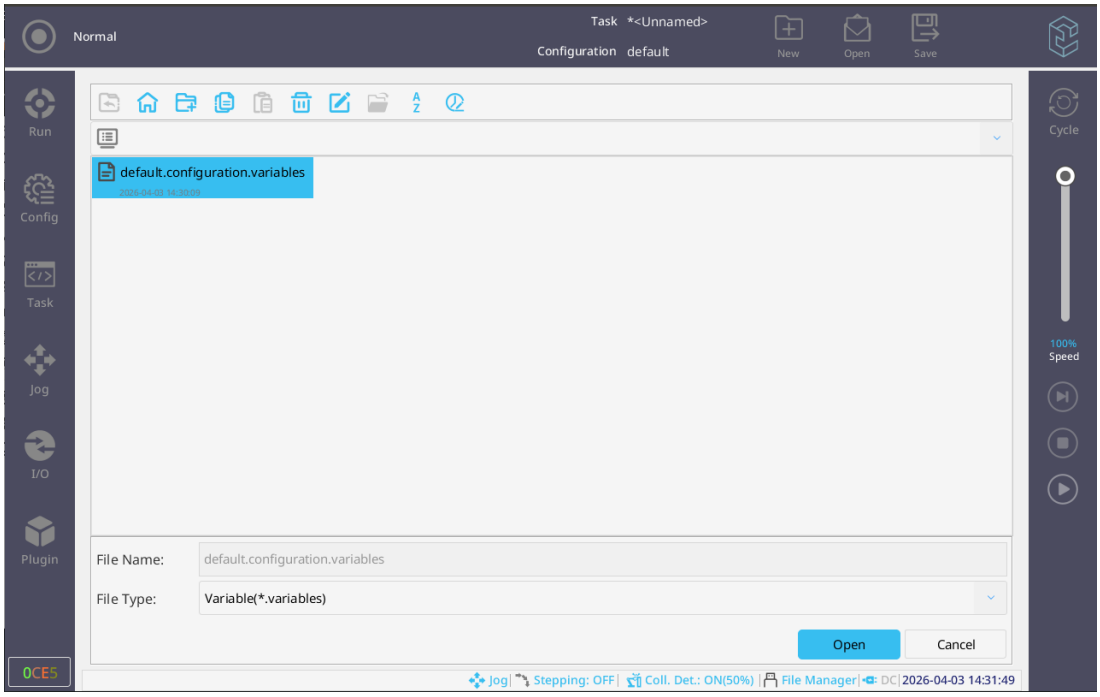


Figure 3-51: Import Variable File

- After the file is parsed, the [Variable Selection] page is displayed.
- Select the variables to be imported and click [Continue]. If you click [Cancel], this operation will be canceled and the system configuration will remain unchanged.
- After confirming the selected variables, click [Confirm] to complete the import.

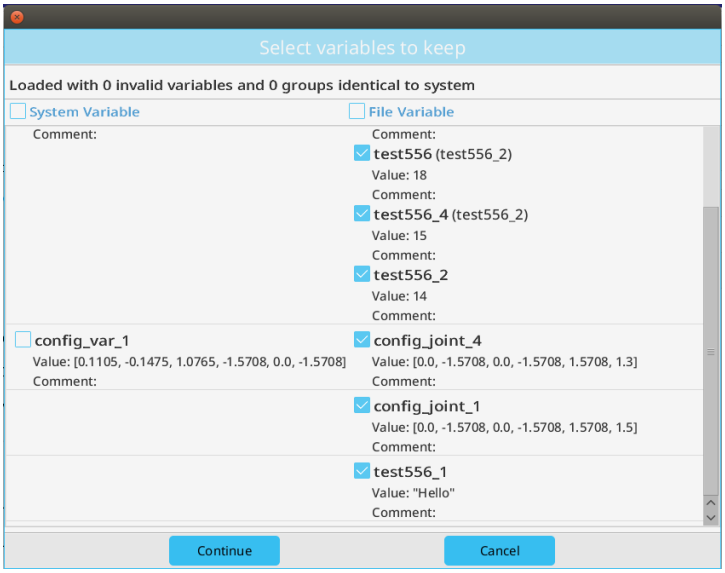


Figure 3-52: Select the variables to import

- After a successful import, the system configuration is updated and a configuration modification flag (*) is displayed.

3) Variable Selection Interface

System Variables (left): Variables that already exist in the system

File Variables (right): Variables read from the imported file

Based on their status, variables are categorized as follows:

- Variables with the same name but different values
- Variables with different names
- Variables with the same name and the same value.

If a category contains no variables, it will not be displayed.

NOTICE

If the file is formatted correctly, but some of the variables have illegal values, those variables will be marked in red with a strikethrough. Variables marked as invalid cannot be selected for import.

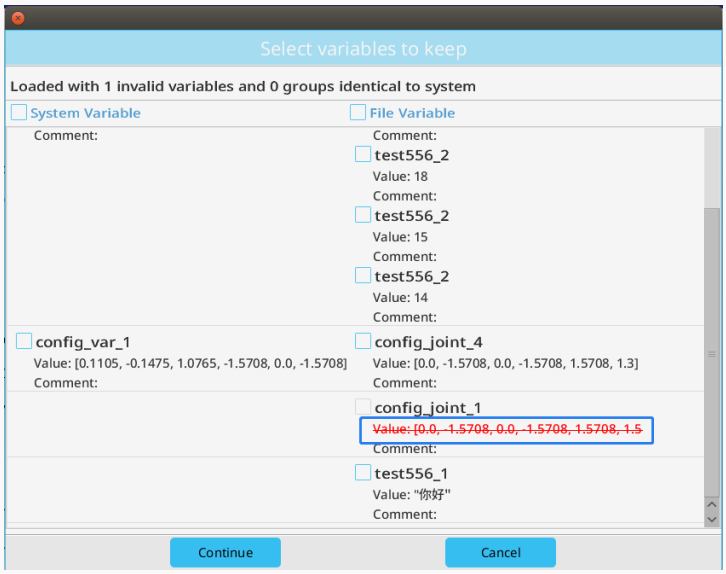


Figure 3-53: Invalid Variables

4) Variable Naming Rules

The following rules are applied during import to handle variable name conflicts.

a. System variables

- System variable names take precedence.
- Existing system variable names remain unchanged, even if they conflict with file variable names.

b. File variables

- File variables retain their original names whenever possible.
- If no name conflict exists, the original name is used. If a conflict occurs, the system automatically adjusts the names of some file variables to avoid duplication.

Recording Mode

- If no variable is chosen, tap [Record Pose/Record Joint] and a new variable will be created to record the robot's current position.
- If certain variable is chosen, tap [Record Pose/Record Joint] and choose to create a new variable or update the currently selected variable to record the robot's current position.

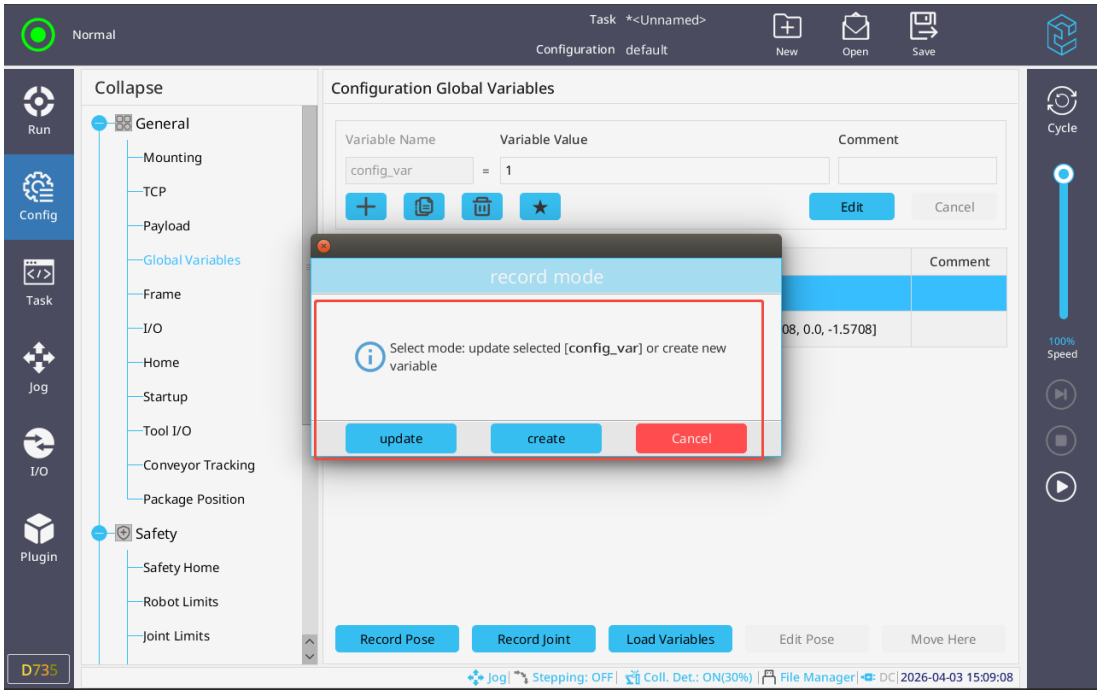


Figure 3-54: Choose to whether override the data

- Update: to overwrite the currently selected variable with the current pose/joint values. This function can be used to update any variable.
- New: to create a new variable and record the current pose/joint.
- Cancel: to abort the new variable creation operation.

Edit pose: select the variable to be edited and click [Edit Pose] to choose the target pose data type (Cartesian Pose or Joint Angle Pose) after the operation can be performed in the [Edit Pose] page.

Move here: select the variable to be used for moving and click [Move Here] to choose the target pose data type (Linear Motion or Joint Motion) after the operation can be performed in the [Move] Interface.

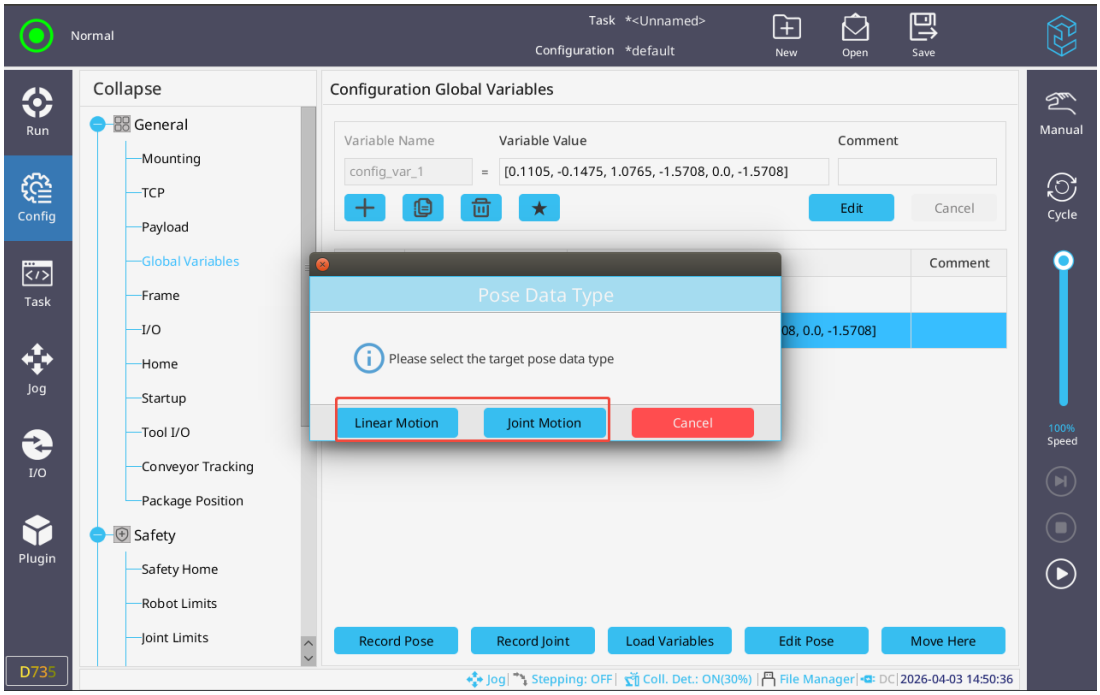


Figure 3-55: Select Target Pose Data Type

3.5.1.5 Frame

A coordinate system can be configured either by manually entering values or by teaching three points with the robot.

1. Adding a Coordinate System

Please follow these steps to add a coordinate system:

1. Select [Config] > [General] > [Frame], then click + to add a coordinate system.

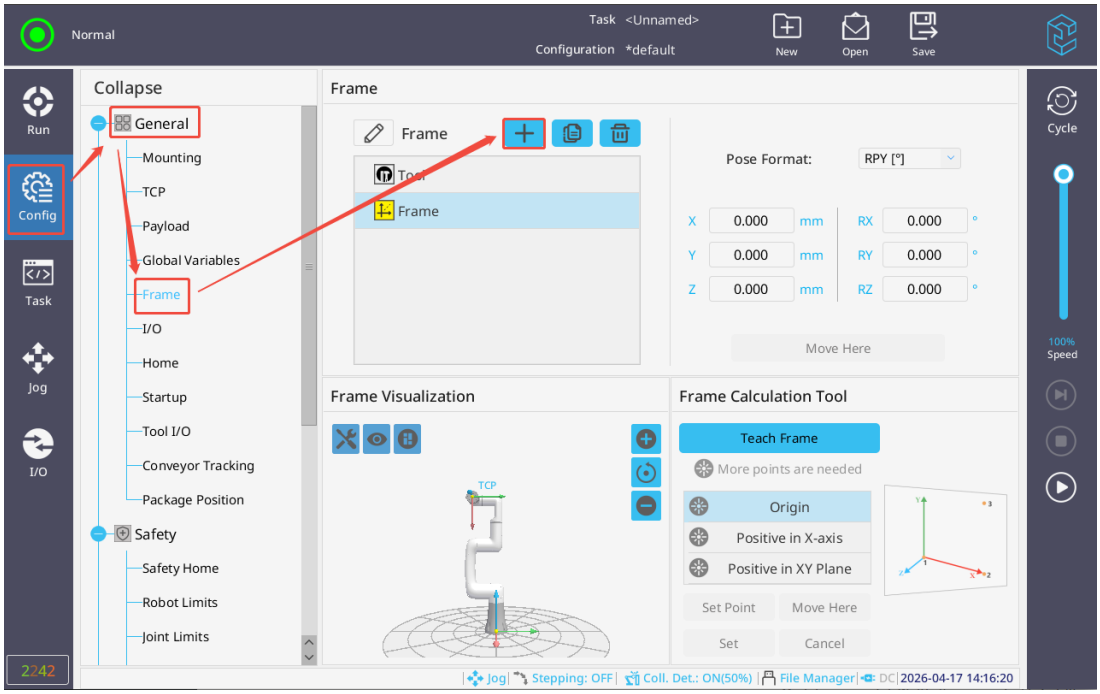


Figure 3-56: Add a Coordinate System

2. **Method 1: Manually Enter Values**
   (a). Set the position and orientation of the new coordinate system in the right panel.
   (b). Click the [Move Here] button at the bottom; then the robot will move to the specified position and orientation.
3. **Method 2: Three-Point Teaching**
   (a). In the [Frame Calculation Tool] area, click [Teach Frame] to begin teaching.
   (b). Click [Origin] > [Set Point]; after jogging the robot to the desired origin position, click [✓].

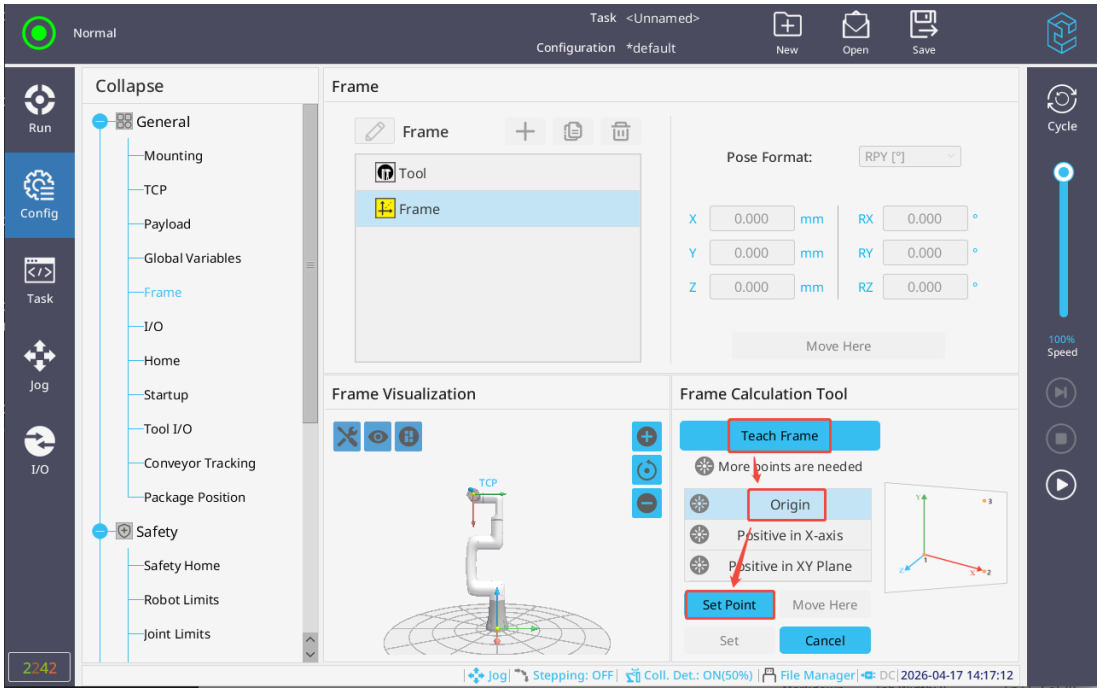


Figure 3-57: Teach Origin

(c). Click [Positive in X-axis] and [Positive in XY Plane] to set these two points respectively.

(d). After all points are set, click [Set]. The system will automatically calculate the coordinate system pose and apply it to the selected coordinate system.

(e). When teaching waypoints, you can click [Move Here] to move the robot to the taught point and verify if the waypoint is valid. If any of the three waypoints are set incorrectly, click [Change Point] to re-teach the waypoint.

NOTICE

1. The tool coordinate system cannot be modified, and the [Move Here] button is disabled.
2. If the currently set pose exceeds the robot's workspace or no valid inverse kinematics solution is found, the [Move Here] button will change to "Frame Pose Unreachable" and become inactive.

2. Other

- Copy: Click , copy tool or custom frame;
- Rename: Select frame, click to rename;

- Delete: select the coordinate to be deleted, click ;
- Modify: Click [Modify] to re-teach points or update the defined frame value directly;
- Reset: Roll back to original data before modification.

3.5.1.6 I/O

The user can configure all I/O signals, including name, configuration I/O tab control and operation when triggered.

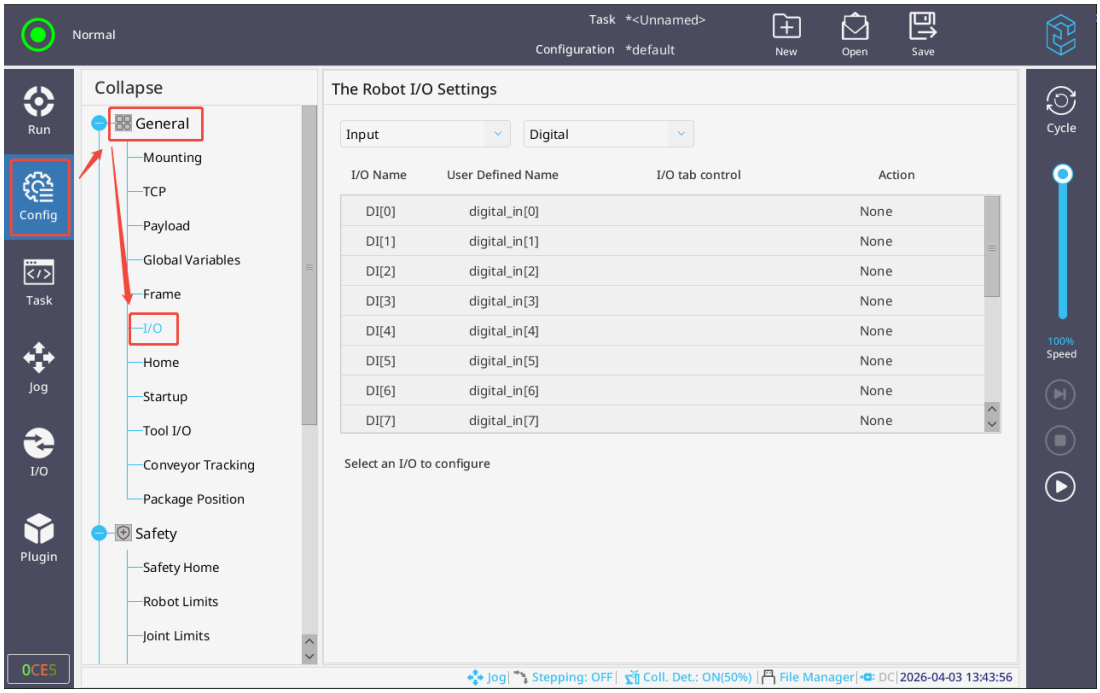


Figure 3-58: I/O set

Caution: Tool analog input will be unavailable when Tool Communication Interface(TCI) start.

Types of I/O signal are shown as below:

- Digital, configurable and tool;
- Analog;
- Modbus;
- General register (boolean, integer and float).

1. Configure I/O Signal Type

The user can select [Input] or [Output] signals, and select the I/ signal type to find the signal that needs modification.

Besides, Input signals and General Registers do not support configurations about I/O tab control.

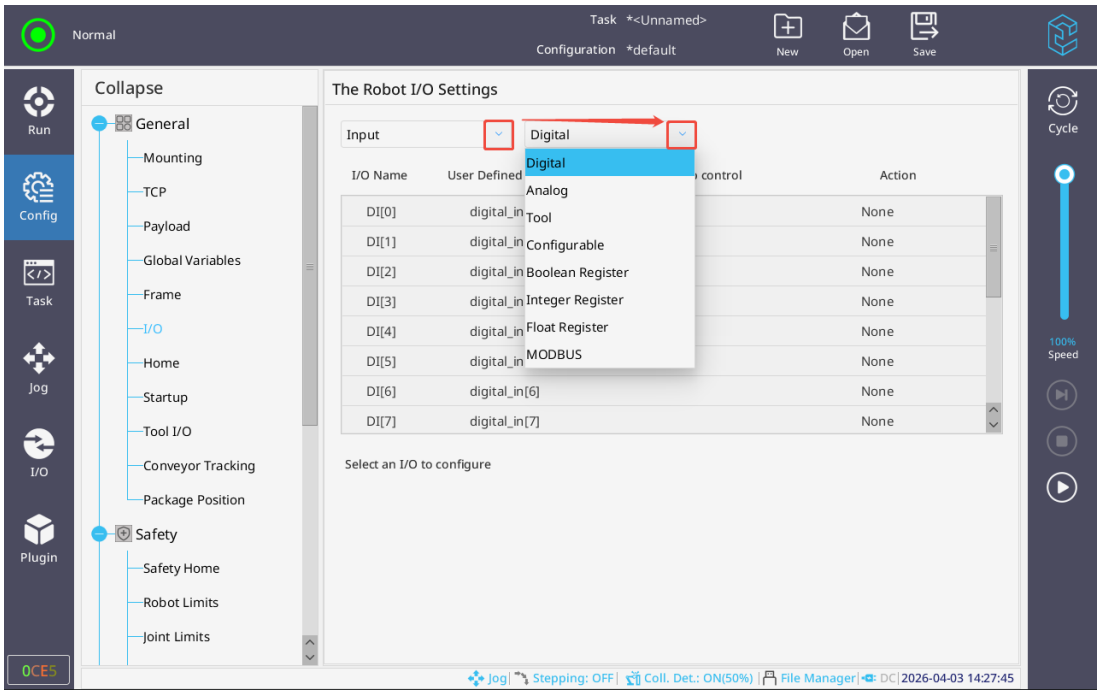


Figure 3-59: I/O signal type

2. Configure I/O Type as Digital, Configurable or Tool Input Signal

The user can modify the name of the input I/O and set the operation of the robot when the signal is high.

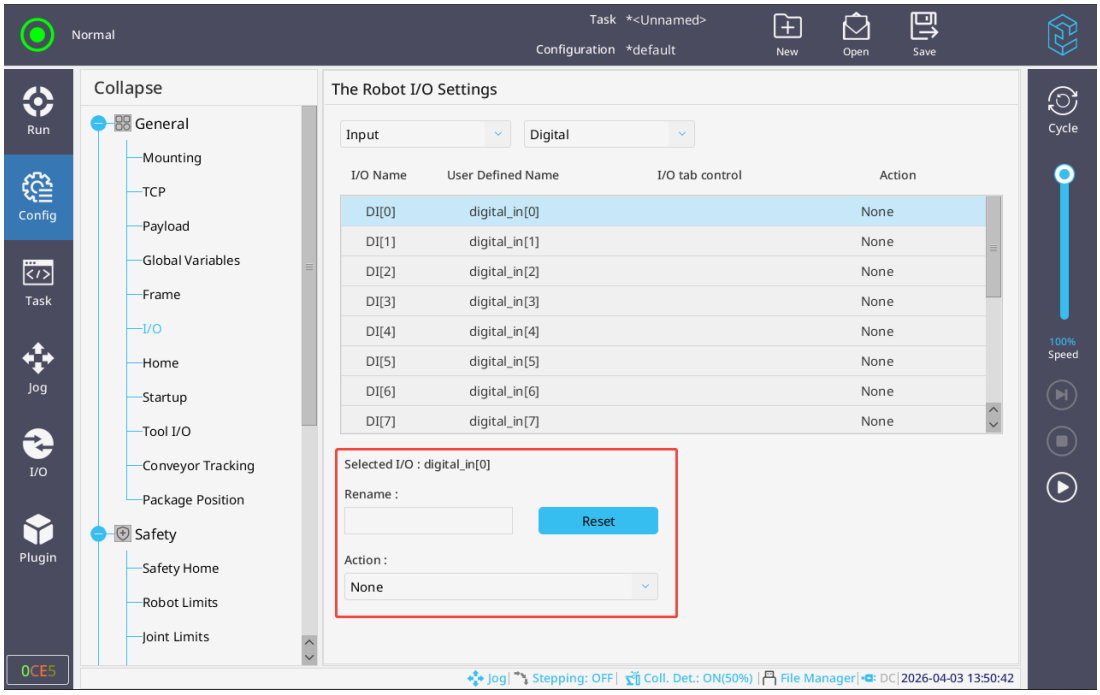


Figure 3-60: Digital input signal

The robot operation including:

- None: the robot has no operation;
- Run task: run current task upon a valid signal goes high;
- Stop task: stop currently running task upon a valid signal goes high;
- Pause task: pause currently running task upon a valid signal goes high;
- Free Drive: drive the robot upon a valid signal goes high.

Note: Modified name applies in task, it's recommended to relate the names to I/O signals.

3. Configure I/O Type as Digital, Configurable or Tool Output Signal

The user can modify the name of the I/O, status of I/O and I/O Tab Control when task is running.

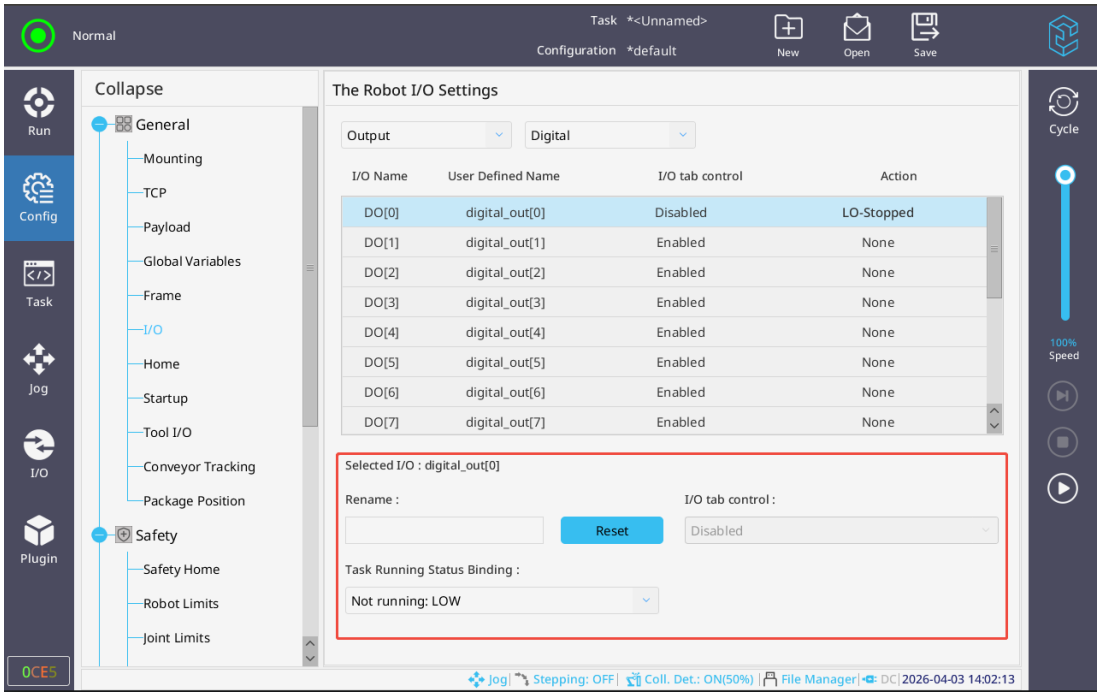


Figure 3-61: Digital output signal

[I/O Tab Control] is divided into:

- Enable: under the I/O tab, the status of the current output signal can be modified.
- Disable: under the I/O tab, the status of the current output signal cannot be modified.
- Manual mode only: the current output signal can be controlled only in manual mode.

The operation of the robot including:

- Low when not running: when the task is not running, the output signal is low.
- High when not running: when the task is not running, the output signal is high.
- High when running-low when stopped: when the task is running, the output signal is high; when the task is not running, the output signal is low.
- Periodic pulse when running: the time length of high and low can be configurable.

4. Configure I/O Type as Analog Output Signal

Compare to digital, configurable and tool output signals, Analog Output signals have different robot operation options.

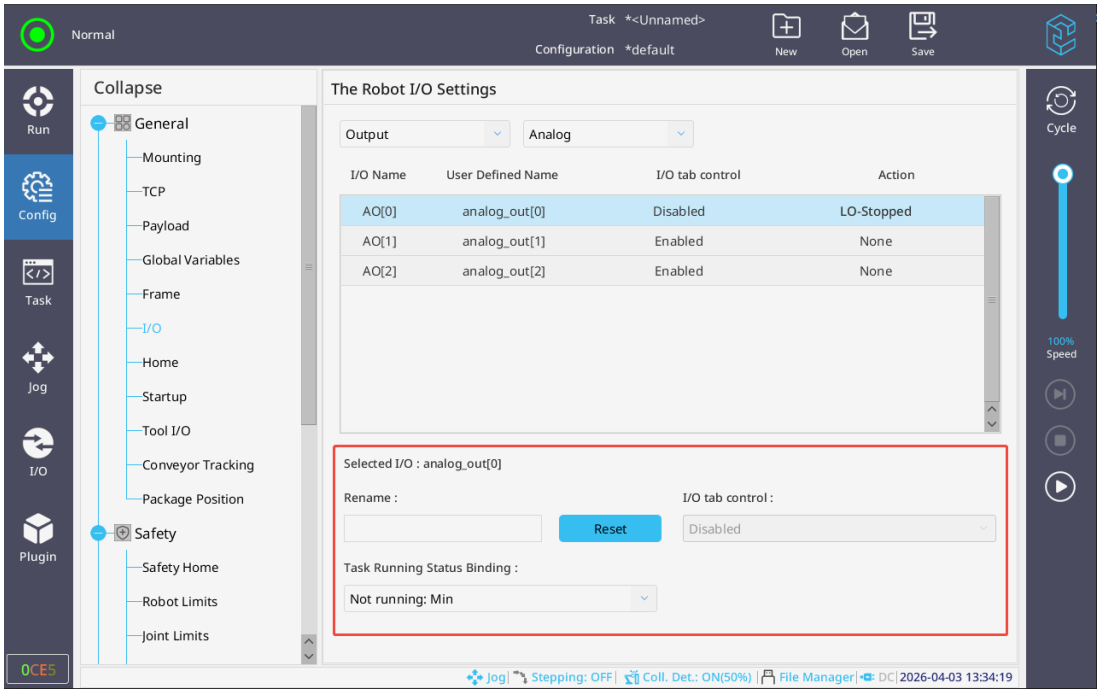


Figure 3-62: Analog output signal

Robot operation including:

- Min when not running: when the task is not running and in current mode, it is 4mA; In voltage mode, the value is 0V;
- Max when not running: when the task is not running and in current mode, it is 20mA; In voltage mode, the value is 10V;
- Max when running-min when stopped: the task is at high when running and low when stopping.

3.5.1.7 Home

The home is a reference point related to the robot operation. Theoretically, the home position can be set to any point inside the operation range of the robot, the home position must be at a point that never cause the robot to interfere with the fixture and workpiece, so the normal operation of the robot is not affected. The default joint coordinate for home position of CS robot is (0, -90, 0, -90, 90, 0). The home configuration is shown as **Figure** 3-63.

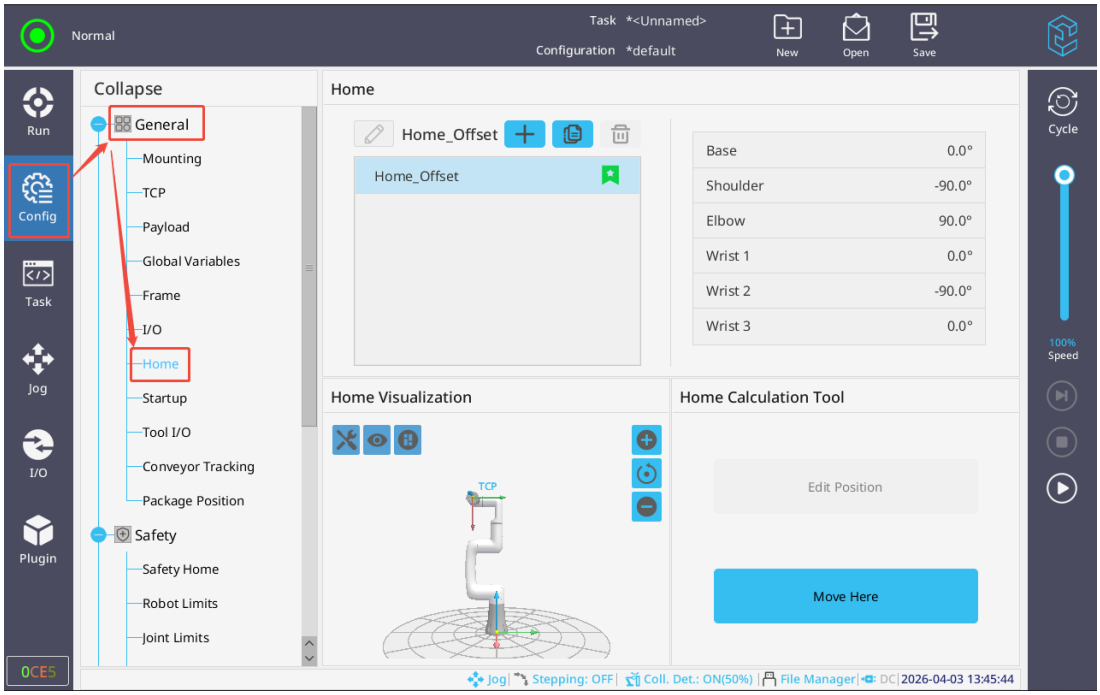


Figure 3-63: Home set

The operation steps of adding the home are as follows:

1. Click [Config] > [General] > [Home].
2. Click + .
3. To configure the points, please refer to Section 3.8 for details.
4. Click [Accept] at the bottom left to add the home.

NOTICE

Changing [Home_Offset] is not available.

3.5.1.8 Startup

Startup refers to the setting of automatic add-on, including starting the default task and automatically initializing the robot arm when starting.

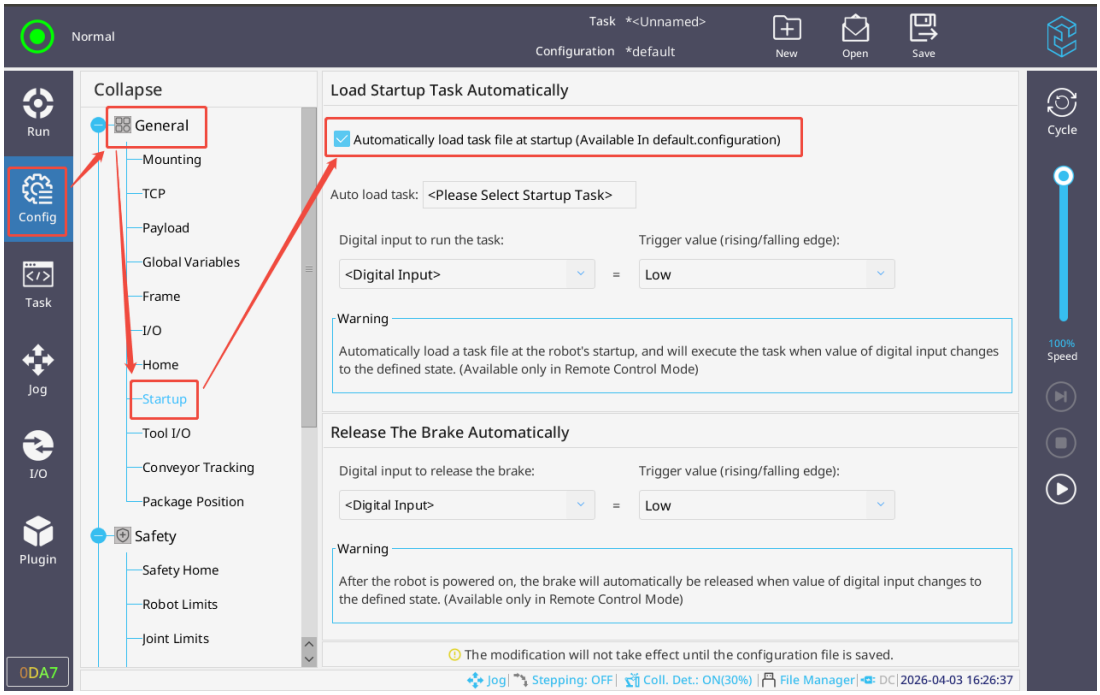


Figure 3-64: Startup

WARNING

1. When Auto Load and Rlease The Brake Automatically are enabled, as the input signal matches the selected signal value, the robot will run the tasks immediately after powering on controller.
2. Please be careful when the signal is set to low. When the input signal is set to low as default, the tasks will run automatically and ignore the external control.
3. Before running the tasks that enabled Auto Load or Rlease The Brake Automatically, the robot must be in ”Remote Control Mode”.

- **Auto load task:**
  Check [Automatically load task file at startup (Available in default.configuration)], set trigger conditions, that is, set [Digital Input] and [Value], and add a task by clicking the box in the right side of [Auto load task] after the robot startup.
  After the robot starts, it will automatically load the set tasks. When the digital input changes and meets the input conditions, the robot will automatically execute the task.
  Note: If the selected startup task file disappears for some reason, the checkbox will turn yellow after start.
- **Rlease The Brake Automatically:**

After setting [Digital Input] and [Value], when the digital input meets the input conditions, the robot will automatically release the holding brakes, and the user can move the robot.

3.5.1.9 Tool I/O

Tap [Config] > [General] > [Tool I/O] to open the [Tool I/O] interface.

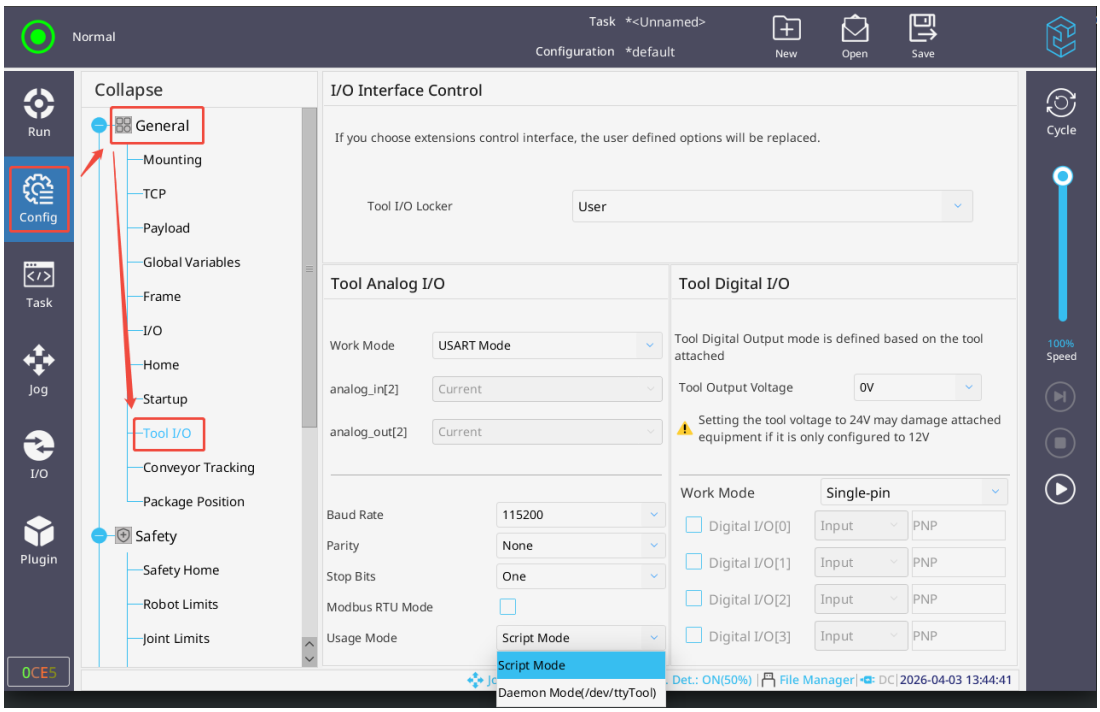


Figure 3-65: Tool I/O

Tool I/O working modes can be configured in this interface. For details, refer to Subsection 2.2.5.

1. Tool Communication

The tool connector provides a serial communication interface based on RS485 for data exchange with the tool.

Configure the Tool Communication Interface(TCI):

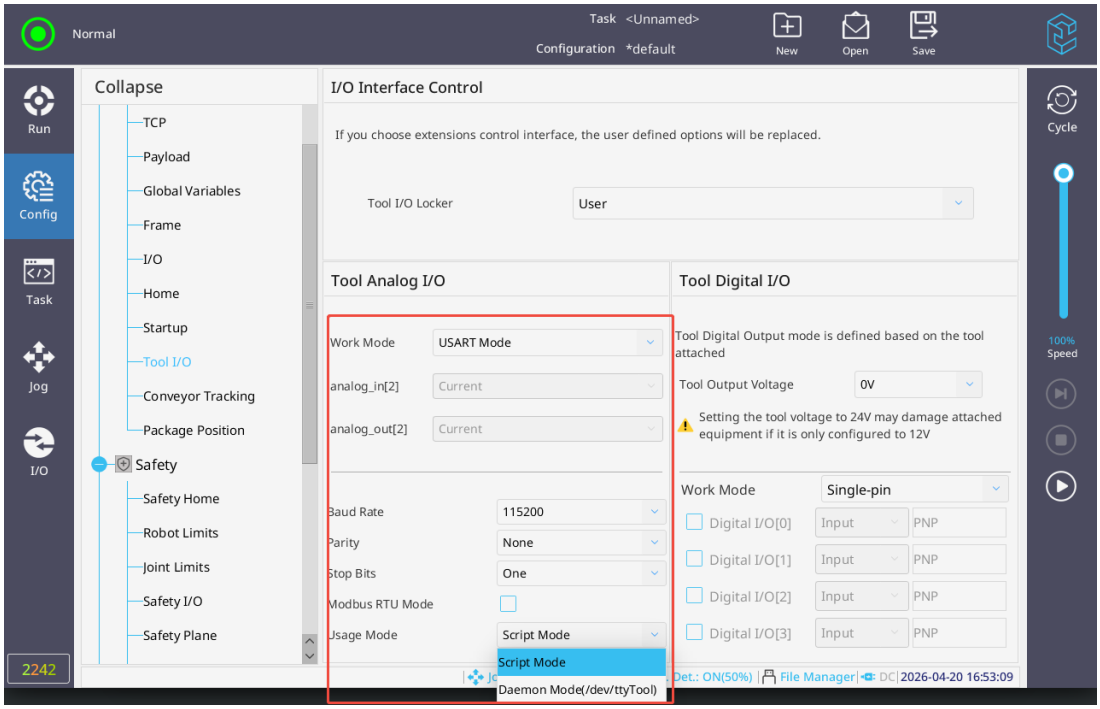


Figure 3-66: Tool Communication

1. Select [USART Mode] to configure the TCI.
   LS Series robots do not support tool analog I/O and only support USART mode.
2. Set parameters such as baud rate, parity, and stop bits from the drop-down menu. The settings take effect immediately. If it is different from the value used by the tool, a warning message will appear.
3. Select [Script Mode] or [Daemon Mode] from the [Usage Mode] drop-down list as required. When [Daemon Mode] is selected, the ttyTool interface is enabled for plugin access.
4. In USART mode, Modbus RTU can be selected as the communication protocol.

2. Tool Digital I/O

The tool I/O provides a 24V power supply to the external tool. The output voltage must be set to 24 V, and only [Single-Pin] mode is supported.

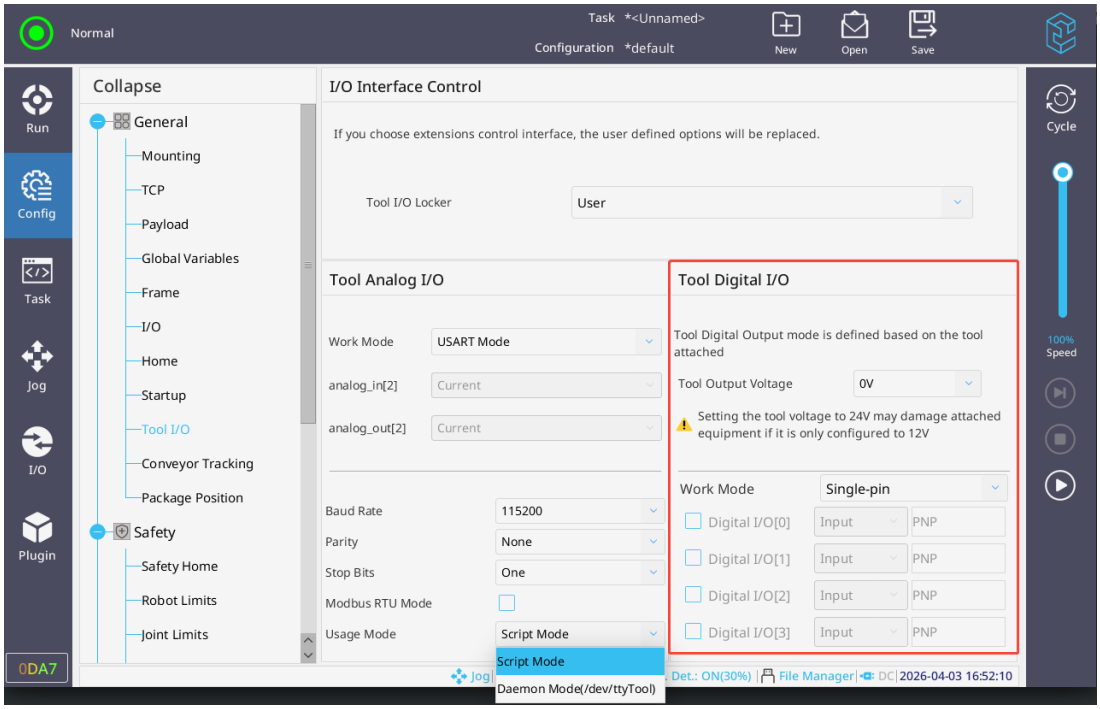


Figure 3-67: Tool digital I/O

Digital outputs support only sourcing (PNP) type. When enabled, the pin outputs a positive voltage (see Section 3.7). When combined with the GND pin, a complete circuit can be formed.

Note: Modifications to the output configuration take effect immediately.

3.5.1.10 Conveyor Tracking

Navigate to [Config] > [General] > [Conveyor Tracking] to access the Conveyor Tracking Settings interface for configuring parameters. This function supports controlling up to two conveyors simultaneously.

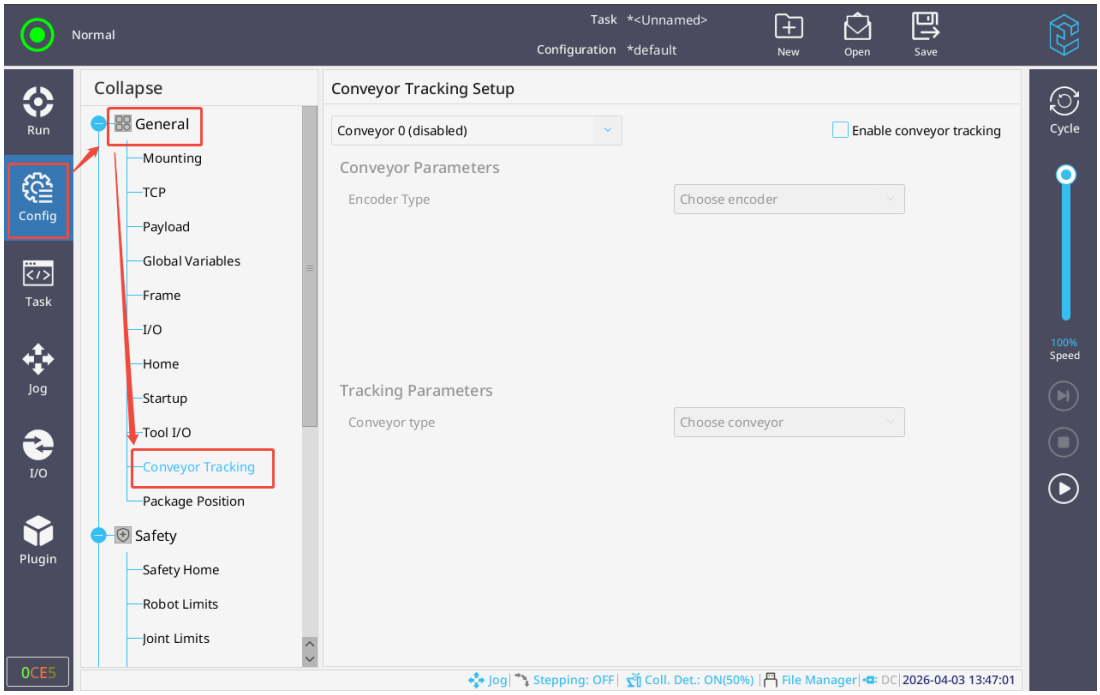


Figure 3-68: Conveyor tracking

Please configure the parameters in accordance with the following instructions.

1. Check [Enable conveyor tracking] in the upper-right corner.
2. Set "Encoder Type" to [Absolute].
3. Select [Variable encoder count] as the Modbus slave connected in [General] > [Communication] > [Modbus].
4. Set [Tracking Parameters] and select [Conveyor type] as [Linear] or [Circular].
   - Linear:
     - "Ticks per inch" is determined by external hardware equipment;
     - Click [Frame] as the frame taught by [Config] > [General] > [Frame] and specify which direction to run in (determined by axes X, Y, Z and whether to reverse).
   - Circular:
     - "Ticks per inch" is determined by external hardware equipment;
     - Select the [Frame] that was taught by [Config] > [General] > [Frame]. Rotation is by default positive around rhe Z-axis.
     - Check [Rotate tool and conveyor], that is, rotate the end tool to follow the target conveyor and keep the object's grasping position unchanged.

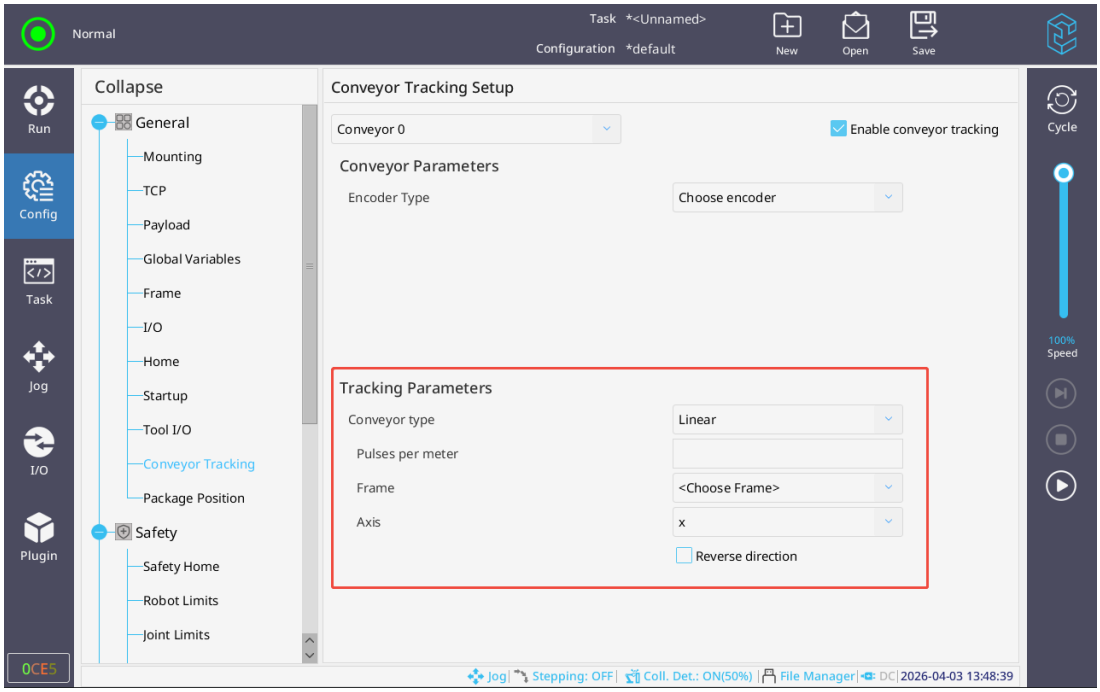


Figure 3-69: Set tracking parameters

NOTICE

Encoder Type can only be selected as [Absolute].

3.5.1.11 Package Position

Click [Config] > [General] > [Package Position] to enter the settings.

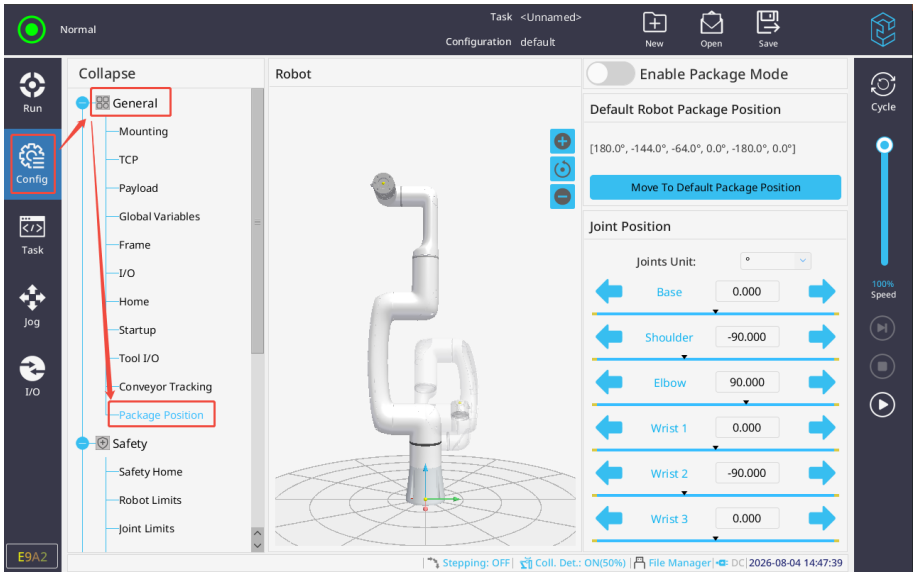


Figure 3-70: Package Position Settings

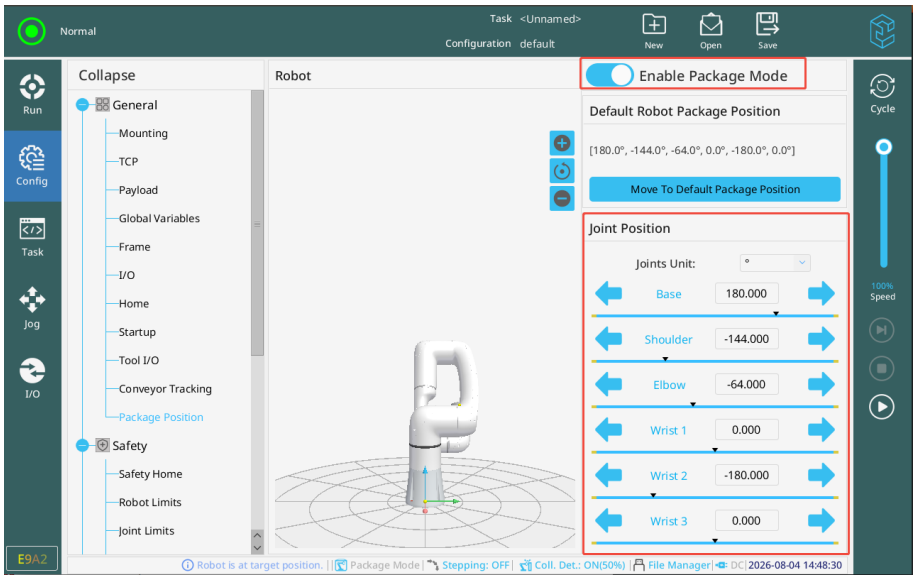


Figure 3-71: Package mode

Click [Move To Default Package Position] to enter the auto move interface. The robot will move to the package position. The user can enable the package mode when the robot cannot reach the package position due to the safety plane, the joint range and other data settings. In the package mode, the safety plane and the joint range will not restrict on the robot movement. The robot can move to the package position which is out of the joint range. After exiting from the package position page, the system will automatically exit from the package mode.

3.5.2 Safety

This subsection describes the configuration of robot safety parameters and pre-

cautions.

Click  on the right of the status and menu bar, choose [Settings] > [Password] > [Safety], and set a safety password to unlock safety configuration parameters.

NOTICE

Before modifying the safety configuration, the user needs to enter the safety password to unlock the safety configuration.

3.5.2.1 Safety Home

The safety home is a user-defined home position. User can select the reference home to set the safety home parameters.

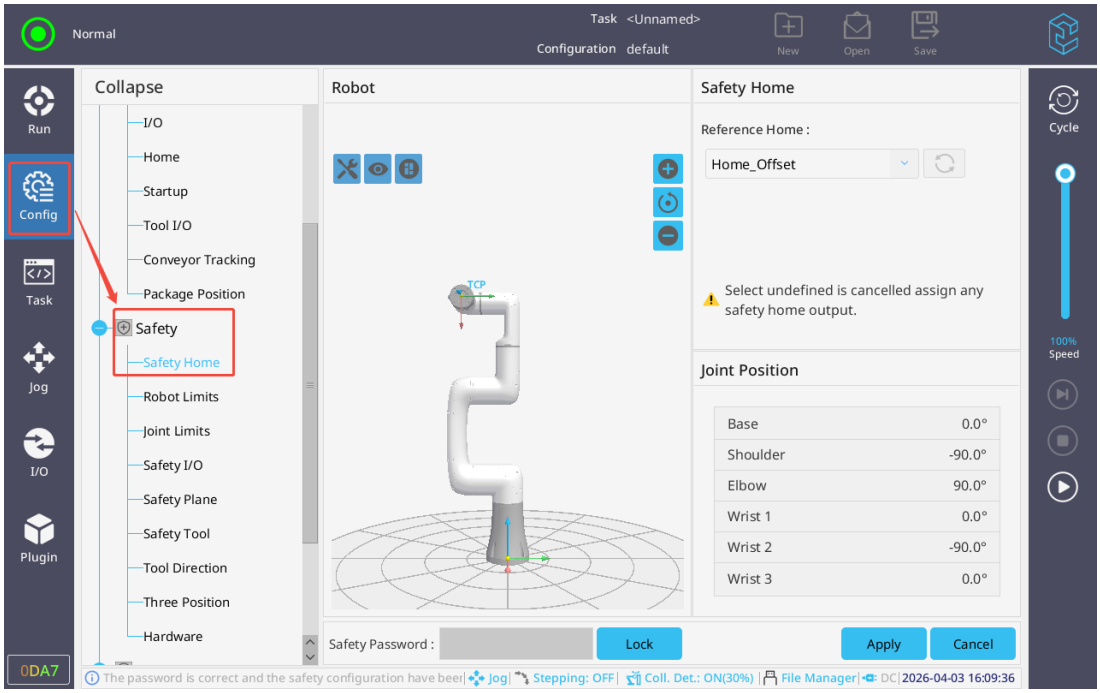


Figure 3-72: Safety home

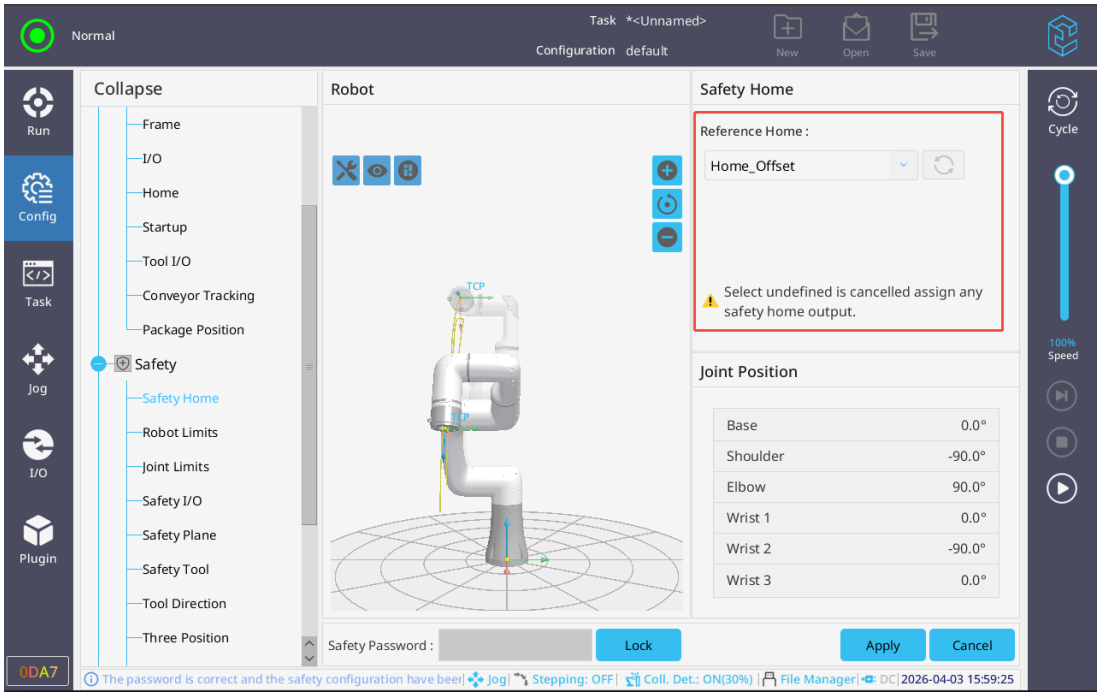


Figure 3-73: Reference home

3.5.2.2 Robot Limits

Robot limits are used to limit robot related safety parameters. The robot limit screen has five configuration options: Least Restricted, 2nd Least Restricted, 2nd Most Restricted, Most Restricted and Custom Restricted. Only the [Custom Restricted] option allows the user to modify the limit parameter of the robot. Parameters are shown in **Figure** 3-74.

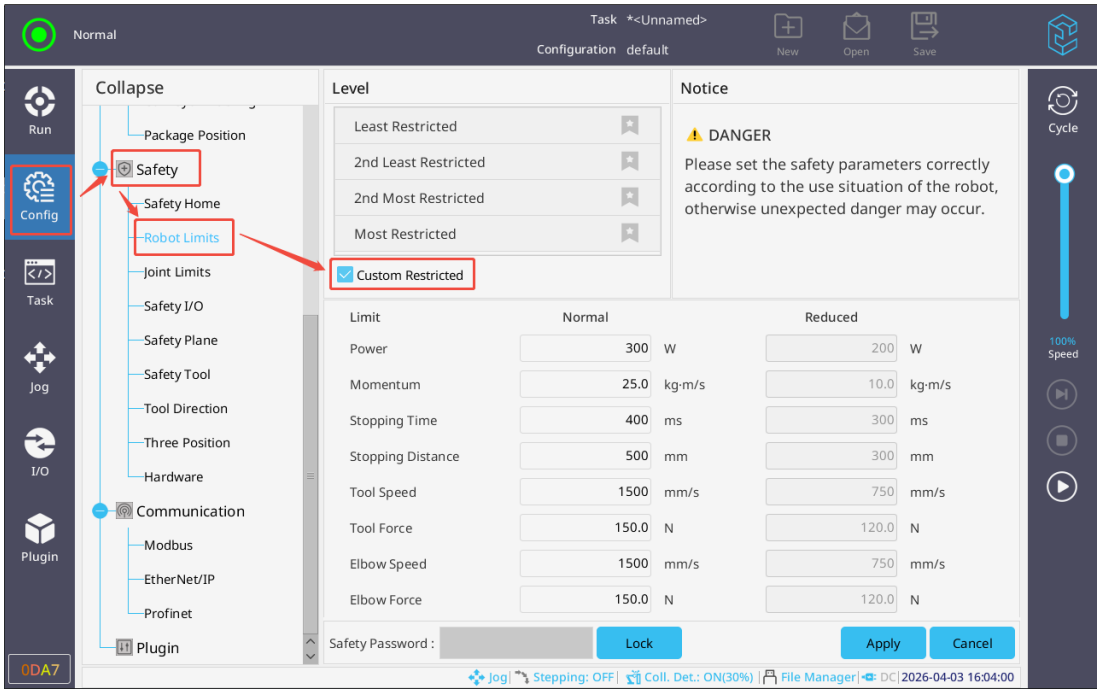


Figure 3-74: Robot limits

The parameter setting description is as follows:

- Stopping Time: limits the maximum time that takes robot to stop from moving;
- Stopping Distance: limits the maximum distance that the robot tool can move before stopping;
- Tool Speed: limits the maximum speed that the robot tool moves;
- Elbow Speed: limits the maximum speed that robot elbow moves.

Note: When setting the robot limit parameters, the values in the normal mode is larger than the values in the reduced mode.

3.5.2.3 Joint Limits

Joint limits are used to limit the range of motion and the maximum angle of each robot in joint space.

In the [Joint limits] interface, there are two joint limiting options: position range and maximum speed.

- Position range defines the position range of each joint;
- Maximum speed defines the maximum angular speed of each joint.

Note: When setting the position range, the difference between the maximum and minimum values should be at least 7°, and the range value in reduced mode must not exceed the range value in normal mode.

REMINDER

If there is no safety plane that triggers the reduced mode, that is, the [Limit] in the safety plane is not configured as [Trigger Reduced Mode], or there is no configurable input I/O configured as [Reduced Mode] in the [Safety I/O], the parameters of the reduced mode cannot be modified.

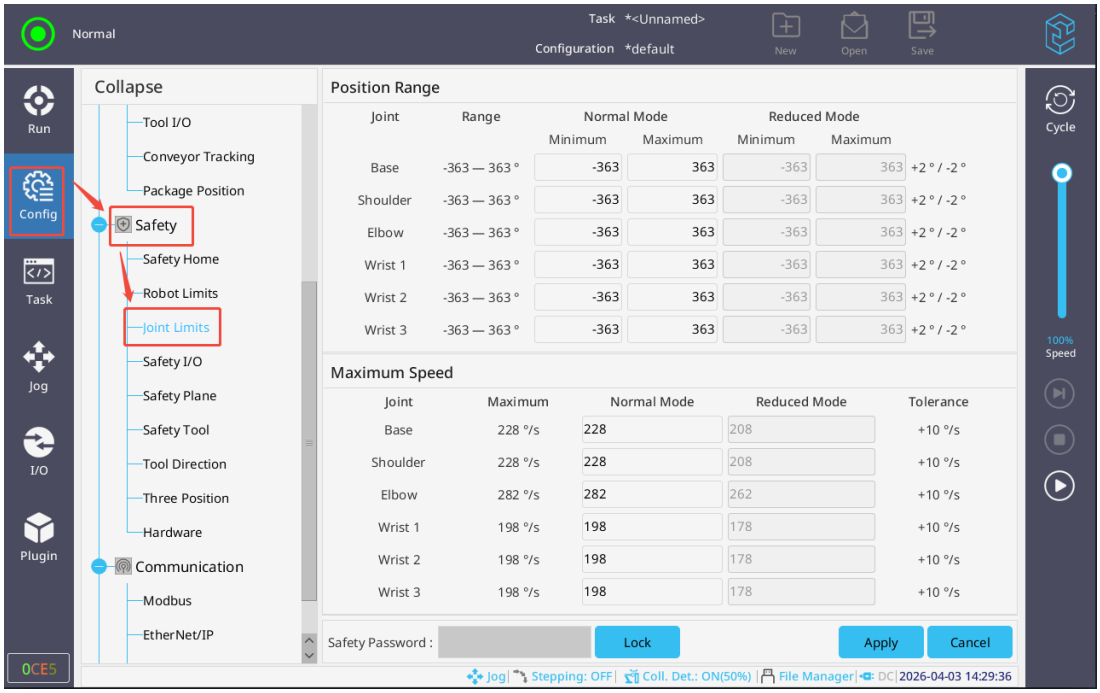


Figure 3-75: Joint limits

3.5.2.4 Safety I/O

The I/O between the input and output terminals are separated and appear in pairs.

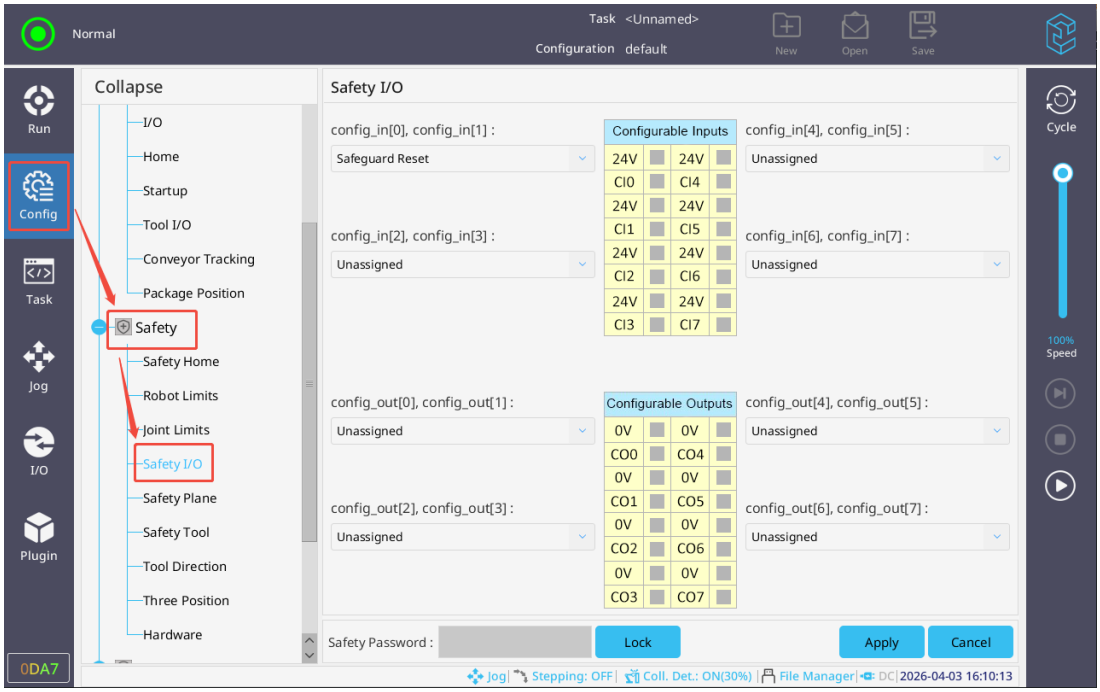


Figure 3-76: Safety I/O

1. Input Signal

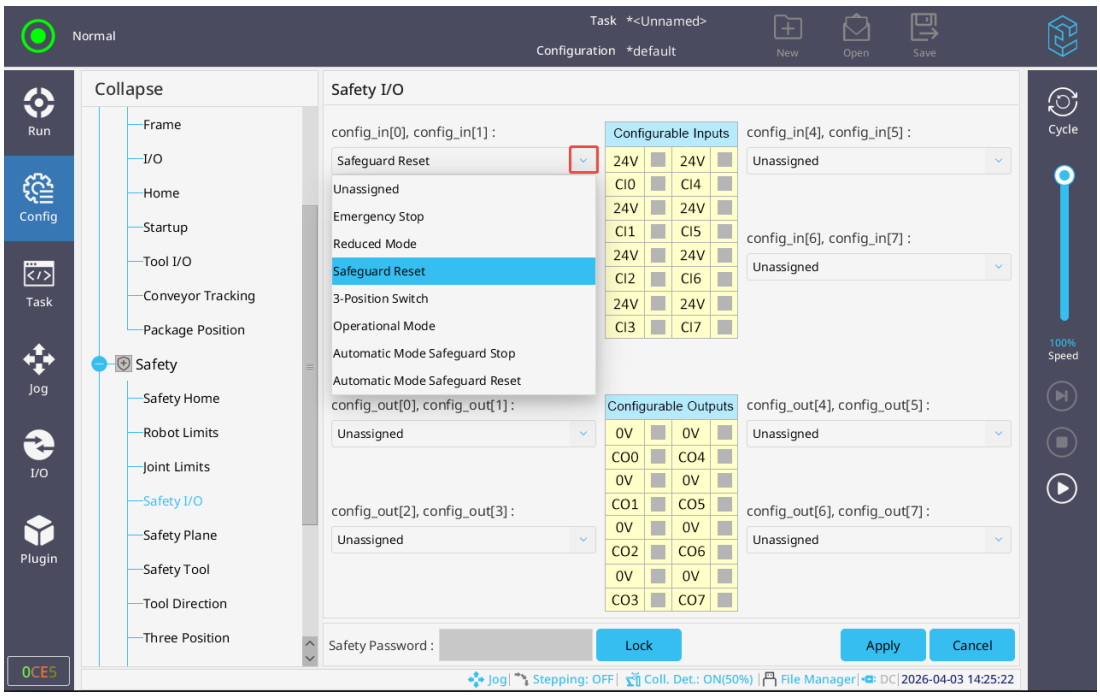


Figure 3-77: Input Signal

The following safety functions can be applied to input signals.

- **Emergency Stop:**

Select the input signals as "Emergency Stop" (active low). When both input signals are low, the robot enters the emergency stop state. When one signal is high and the other is low, an alarm is triggered. When both signals are high, the robot runs normally.

- **Reduced Mode:**
  Select the input signals as "Reduced Mode" (active low). When both input signals are low, the robot is in reduced mode. When one signal is high and the other is low, an alarm is triggered. When both signals are high, the robot is in normal mode.

- **Safeguard Reset:**
  Safeguard Reset is used to manually release the safeguard stop state. After the safeguard stop is cleared, any task suspended by safeguard stop will resume.

- **3-Position Switch:**
  Enables the use of an external three-position switch connected via configurable safety I/O.

  NOTICE

  1. The three-position switch function is valid only in manual mode.
  2. If the three-position switch is not enabled, the robot remains in the safeguard stop state.
  3. After configuring the three-position switch, the manual high-speed function can be enabled, allowing real-time adjustment of speed limit during program execution in manual mode.
  4. After configuration, switching between manual mode and automatic mode is automatically enabled. If a password is set for mode switching, then it is required. Otherwise, no password is needed.
  5. In manual mode, the three-position switch must be pressed and enabled before teaching the target position in [Jog] interface.

- **Operation Mode:**
  This function is used to switch between manual mode and automatic mode via an external selective switch connected to safety I/O.

NOTICE

1. After configuring the operation mode to be controlled by safety I/O, the system enters automatic mode immediately, since the safety inputs are low by default. In this case, mode switching via the interface is disabled, and no password is required when switching modes via safety I/O.
2. In the simulation environment, if the operation mode is mistakenly configured to be controlled by safety I/O and the system enters automatic mode, it may not be possible to switch back via the interface. Restart the simulation software to recover.
3. When the software is started for the first time, if operation mode is configured to be controlled by safety I/O, the system defaults to manual mode (even if the current safety input is low). The configuration can then be removed if necessary.

- **Automatic Mode Safeguard Stop:**
  This function is used to trigger a safeguard stop in automatic mode. When the input signal is at a low level, the robot enters the safeguard stop state in automatic mode, and the currently running task is paused. When the input signal returns to a high level, the system remains in the safeguard stop state and must be released via a safeguard reset signal.

- **Automatic Mode Safeguard Reset:**
  This function is used to clear the safeguard stop state in automatic mode. When the input signal is at a low level, the safeguard stop state in automatic mode is cleared. If the running task was paused, it will resume running after the reset.

2. Output Signal

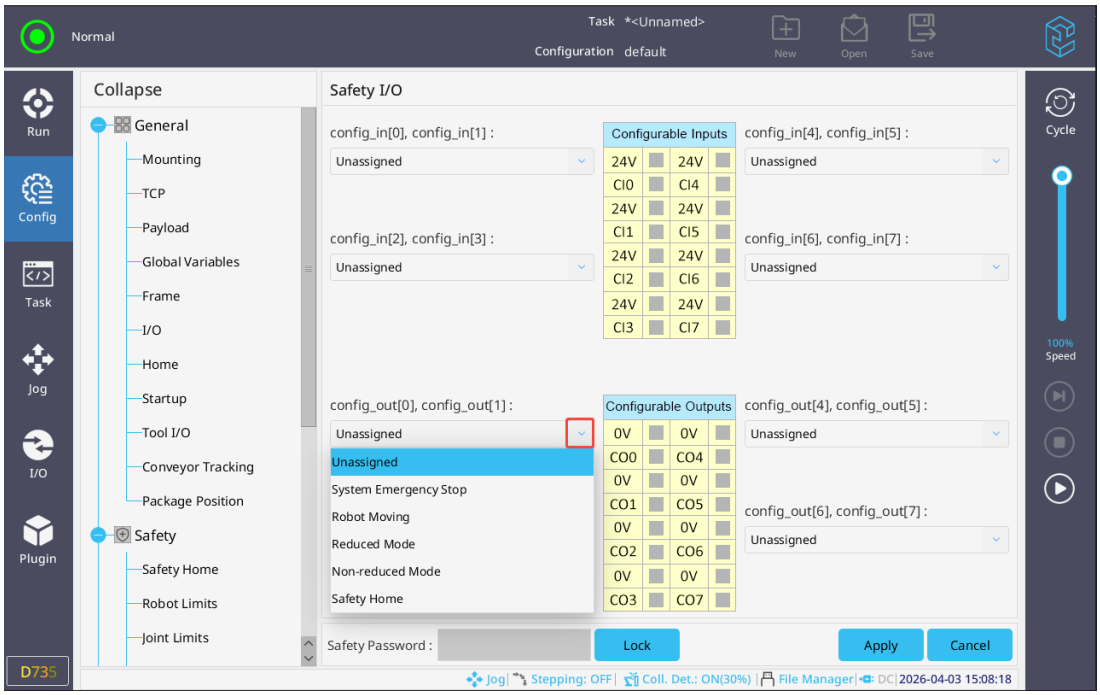


Figure 3-78: Output Signal

The following safety functions can be applied to output signals. After the condition that triggers a high-level signal clears, all signals revert to low level.

- **System Emergency Stop:**
  When the robot is in an emergency stop state (only when the emergency stop button is pressed), a low-level signal is output. In all other cases (including when the system emergency stop is triggered via safety I/O), a high-level signal is output.

- **Robot Moving:**
  A low-level signal is output while the robot is moving, and a high-level signal is output when the robot is stationary.

- **Reduced Mode:**
  A low-level signal is output when the robot is in reduced mode, or when the safety input is configured as ”Reduced Mode” and the current signal is at a low level. Otherwise, a high-level signal is output.

- **Non-reduced Mode:**
  This is the inverse of the Reduced Mode condition.

- **Safety Home:**

A customized reference home position is used to define the safety home position. Before configuration, go to [Config] > [Safety] > [Safety Home] to define the reference home position.

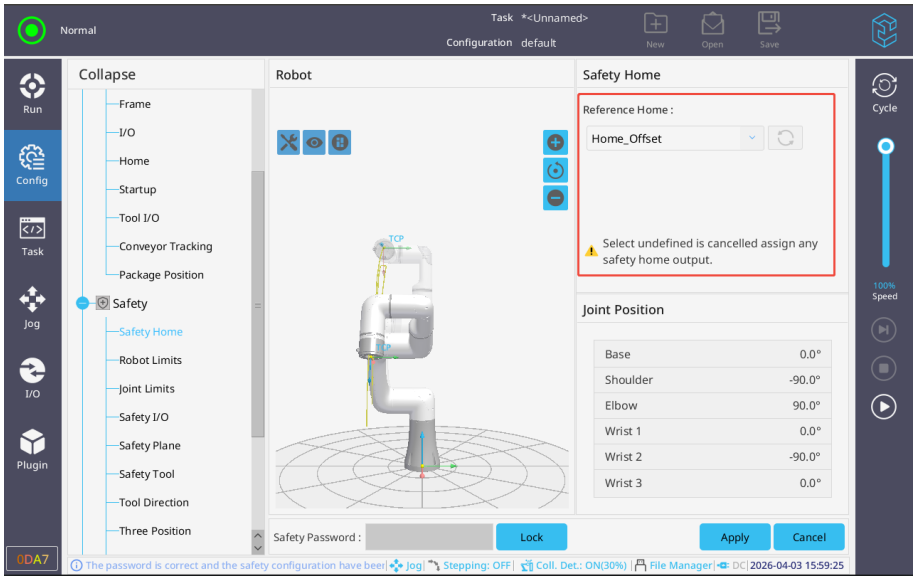


Figure 3-79: Define a reference home position

Then select the output signal for the safety home position in this interface.

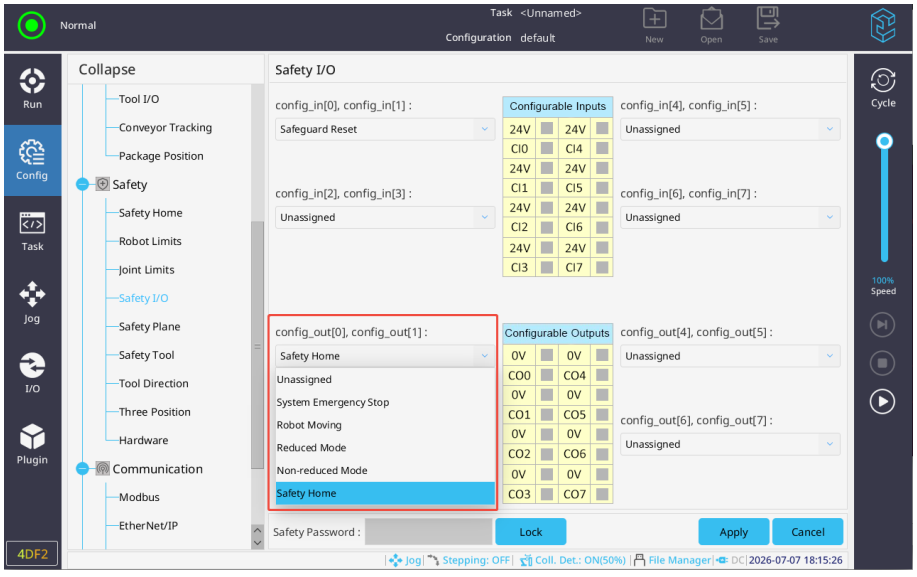


Figure 3-80: Select the output signal for safety home position

3.5.2.5 Safety Plane

REMINDER



The safety plane is configured based on the frame. Before configuring the safety plane, we recommend the user to create all frames.

The safety plane limits the workspace of the robot. Users can define up to eight safety planes to limit robot tools and elbows.

WARNING



The safety plane only limits the tools and elbows of the robot arm, and has no impact on the overall limit of the robot arm.

1. Modes

Users can use the following icons to configure restrictions for each plane.

2. Configuration Safety Planes

1. Select [Config] > [Safety] > [Safety Planes] and click + .

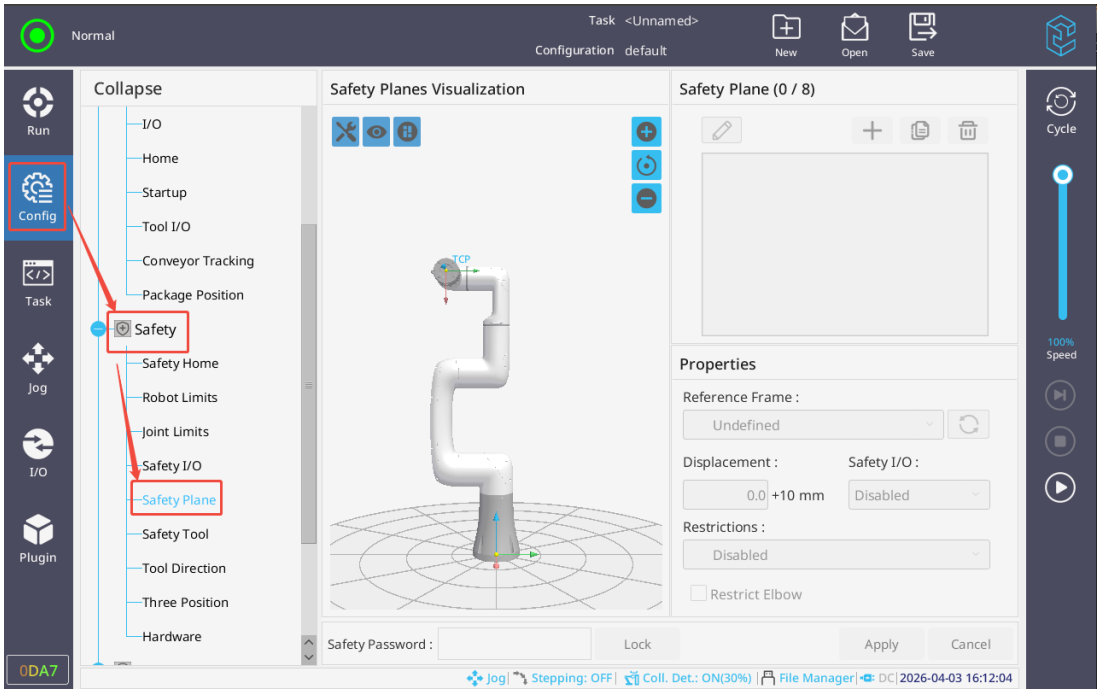


Figure 3-81: Safety planes

2. In the attribute field at the lower right corner of the screen, set reference frame, displacement, and restrictions.
   - Reference Frame: users can select the base and the frame defined in [Config] > [General] > [Frame], It is recommended to create Frame first, then use the Frame to configure Safety Planes.
   - Displacement: If the user enters a number in ”Displacement”, it indicates the moving distance relative to the Z axis of the selected frame. For example, if the frame is selected as [Base], and the displacement is 200, then the coordination of safety plane is the frame that moved 200mm on Z axis from the base frame.
   - Restrictions: the user can configure restrictions for each safety plane.
     - Disabled: in this state, the safety plane is never activated;
     - Normal mode valid: when the robot is in ”Normal” mode, the safety plane takes effect. When the robot tool or elbow contacts or exceeds the safety plane, the robot stops protectively;
     - Reduced mode valid: when the robot is in ”Reduced” mode, the safety plane takes effect. When the robot tool or elbow contacts or exceeds the safety plane, the robot stops protectively;
     - Normal & Reduced mode valid: when select [Both], the safety plane takes effect when the robot is in ”Normal” mode or ”Reduced” mode. When the robot tool or elbow contacts or exceeds the safety plane, the robot stops protectively;
     - Trigger Reduced mode: when the robot tool or elbow contacts or exceeds

the safety plane, the system switches to reduced mode.

Note: If [Restrict Elbow] is checked, the safety plane will limit the elbow of the robot arm.

Under [Frame], if the frame defined in [Config] > [General] > [Frame] is modified, the warning icon appears to the left of the [Frame] text. However, the frame of the safety plane is still the frame before modification and will not be modified synchronously.

3. Other

-  : create a new safety plane.
-  : copy the selected safety plane.
-  : rename the selected safety plane.
-  : delete the selected the safety plane.

3.5.2.6 Safety Tool

In the safety tool, you can add, copy, and delete safety tool items. One of the tool flanges is inoperable by default, and the default radius of the tool flange and TCP position are 0.

You can choose TCP in the general configuration as the basis for defining the location of the new safety tool. Properties at the bottom right of the interface are based on the select TCP. When the value in the edit location field is changed on this basis, the TCP name appearing in the drop-down menu will change to custom tool, indicating that there is a difference between the copied TCP and the actual limit input. The visualization of the safety tool will also display the status attributes of the corresponding tool.

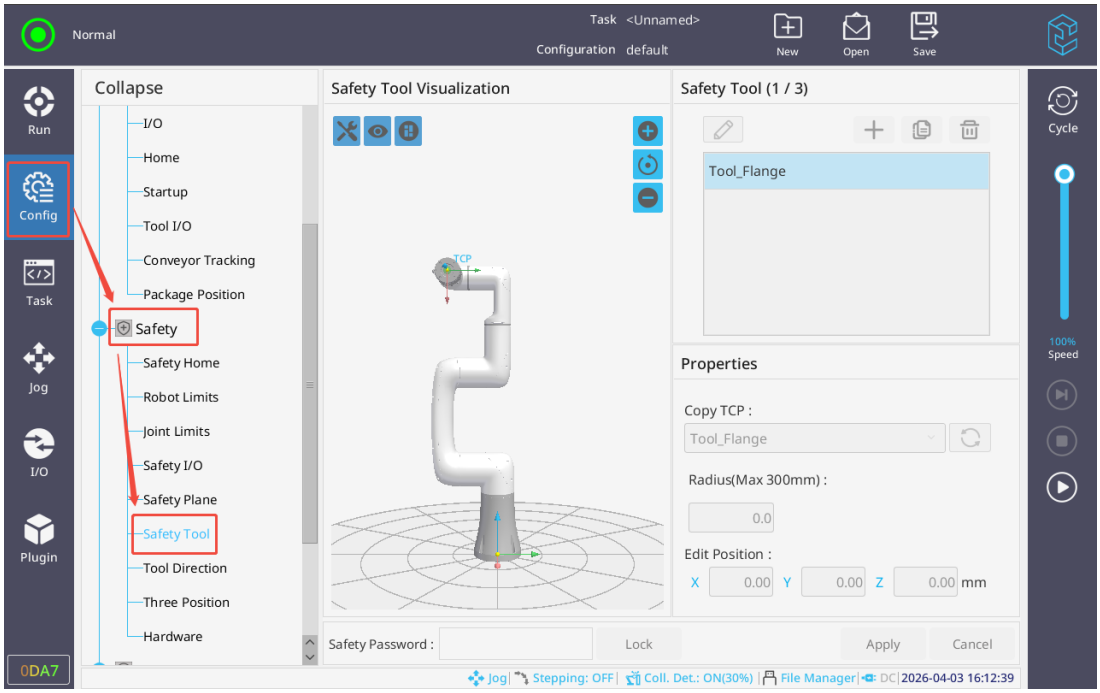


Figure 3-82: Safety tool

3.5.2.7 Tool Direction

In the [Tool Direction] Interface, users can restrict the tool orientation by specifying a fixed direction vector and the maximum allowable angular deviation around that vector, thereby enhancing safety.

NOTICE

The tool orientation configuration is based on the coordinate system and the TCP. Before setting the orientation limits, be sure to create both a coordinate system and a TCP. Note that the Z-axis of the selected coordinate system serves as the central axis of the tool's orientation range.

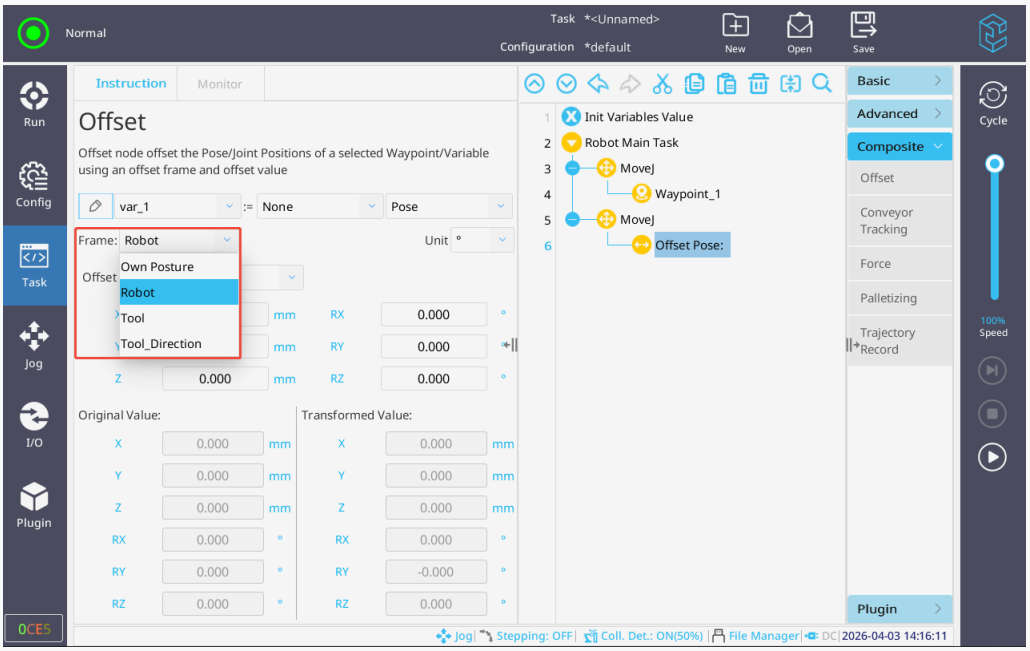


Figure 3-83: Create A Coordinate System

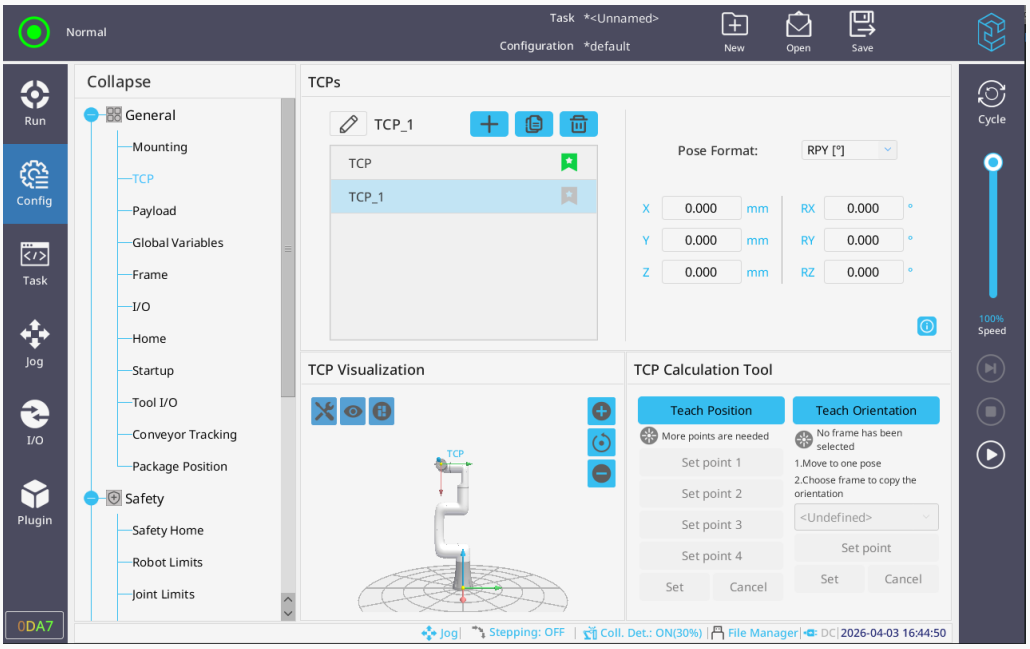


Figure 3-84: Create A TCP

1. Configure Tool Direction

Select [Config] > [Safety] > [Tool Direction], and enter the safety password to unlock the safety settings.

Limit Properties: parameters for setting the tool orientation limits.

- **Reference Frame**: to select either the base frame or a coordinate system customized in [Config] > [General] > [Frame]. It is recommended to create a coordinate system first and then use it to set the tool orientation. The default value is [Undefined], in which case the tool direction function is disabled.
- **Restrictions**: to define when the tool direction restriction is applied.
  - Disable: to disable the tool direction function.
  - Normal: the tool direction is enforced when the robot is in normal mode.
  - Reduced: the tool direction is enforced when the robot is in reduced mode.
  - Both: enforced in both Normal Mode and Reduced Mode.
- **offset**: to set the maximum allowable angular deviation for the tool direction, ranging from 5° to 181°.

Tool Properties

- **Copy TCP**: to select either the tool flange, a TCP, or a customized TCP. The Z-axis of the selected TCP is used as the actual tool orientation for determining whether the orientation limit is exceeded.
- **Edit Direction**: to customize the tool orientation by setting the values of tilting and panning parameters respectively. These two parameters represent a spherical coordinate system with the flange center point as the origin. If a certain TCP is selected, the system automatically calculates the two parameter values based on that TCP. When both parameters are set to 0, the direction corresponds to the normal of the flange surface, i.e., the Z-axis of the flange or tool flange coordinate system.

After completing the settings, tap [Apply] button to save the configuration.

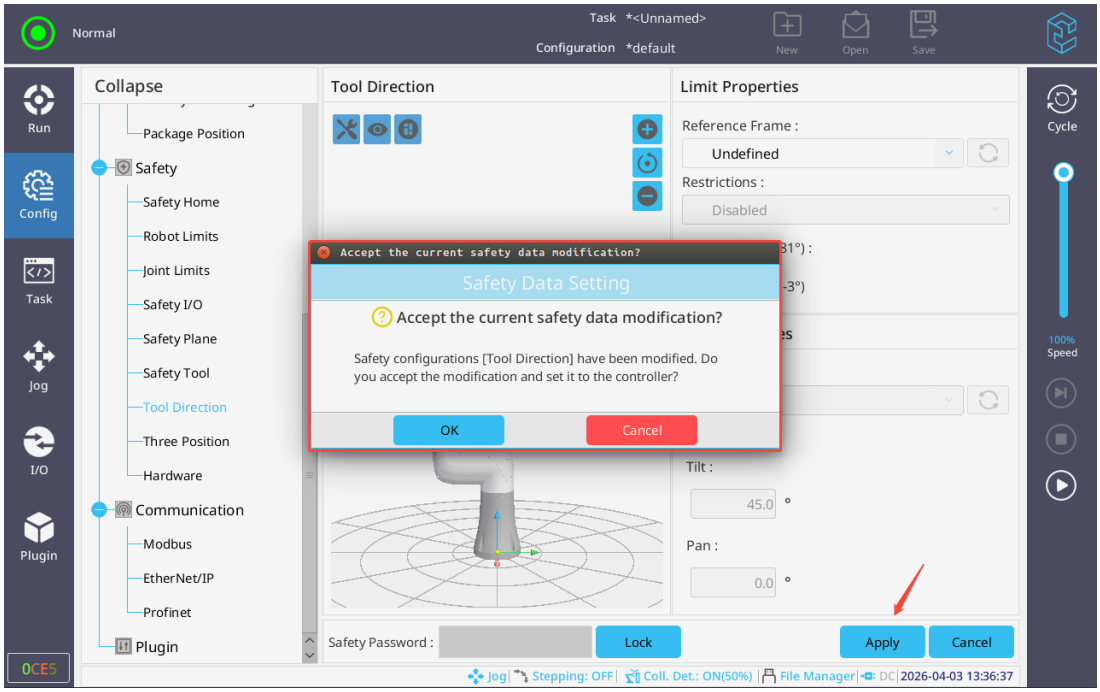


Figure 3-85: Apply the configuration

2. About Operation Interface

After completing the configuration, go to the [Jog] page.

If the robot's current mode matches the constrained mode specified for the tool direction (non-disabled state):

- When the actual tool approaches within 12° of the limit, a green model appears at the robot's end to indicate proximity to the limit.

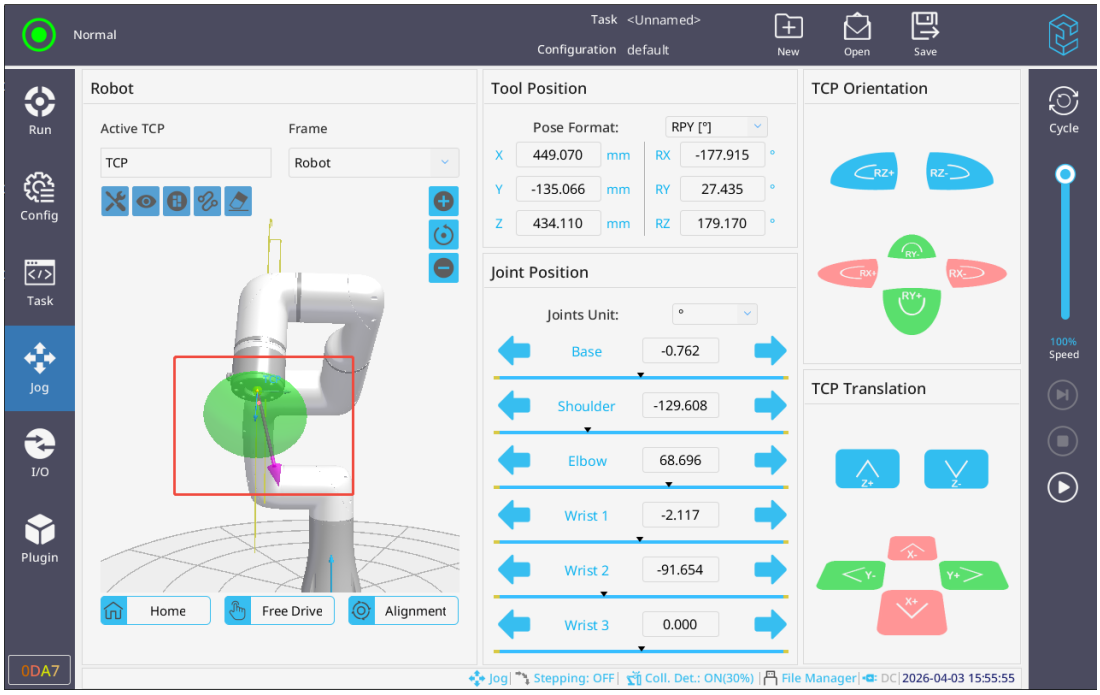


Figure 3-86: Green Model

- When the actual tool direction comes within 3° of the limit, the model turns red, signaling further proximity to the limit.

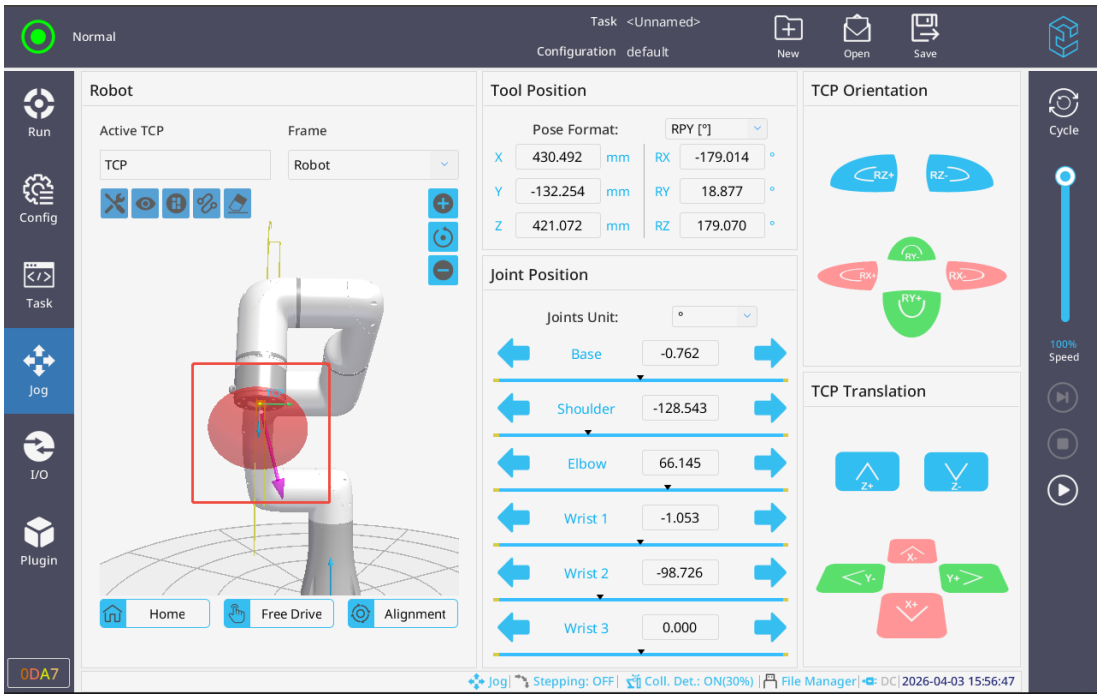


Figure 3-87: Red Model

- The protective stop will be triggered when the actual tool direction approaches the limit of the tool direction limit range. Tap the [Enable Robot] button to release the protective stop and continue to control the robot; if tapping the [Cancel] button, go to the Robot Power Configuration page and click the [Unloce Protective Stop]

button before controlling the robot.



Figure 3-88: Safety System Alarm (Proximity Tool Direction Restriction)

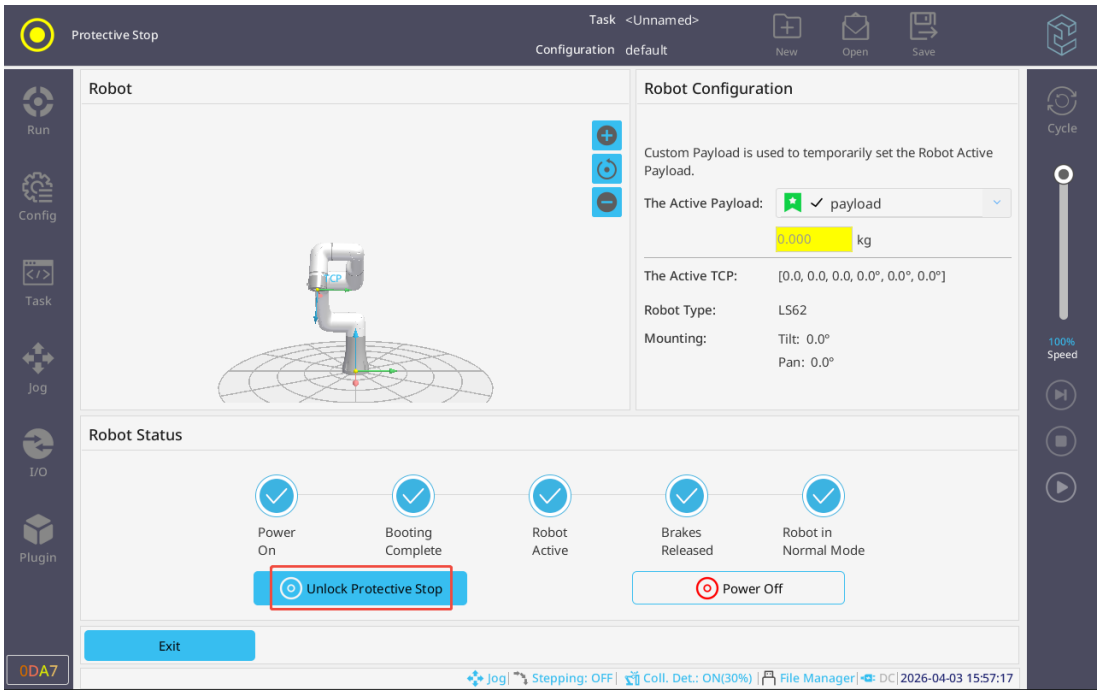


Figure 3-89: Unlock Protective Stop

If the tool orientation has exceeded the limits, enabling the tool orientation restriction function and powering up at this time will trigger an alarm.

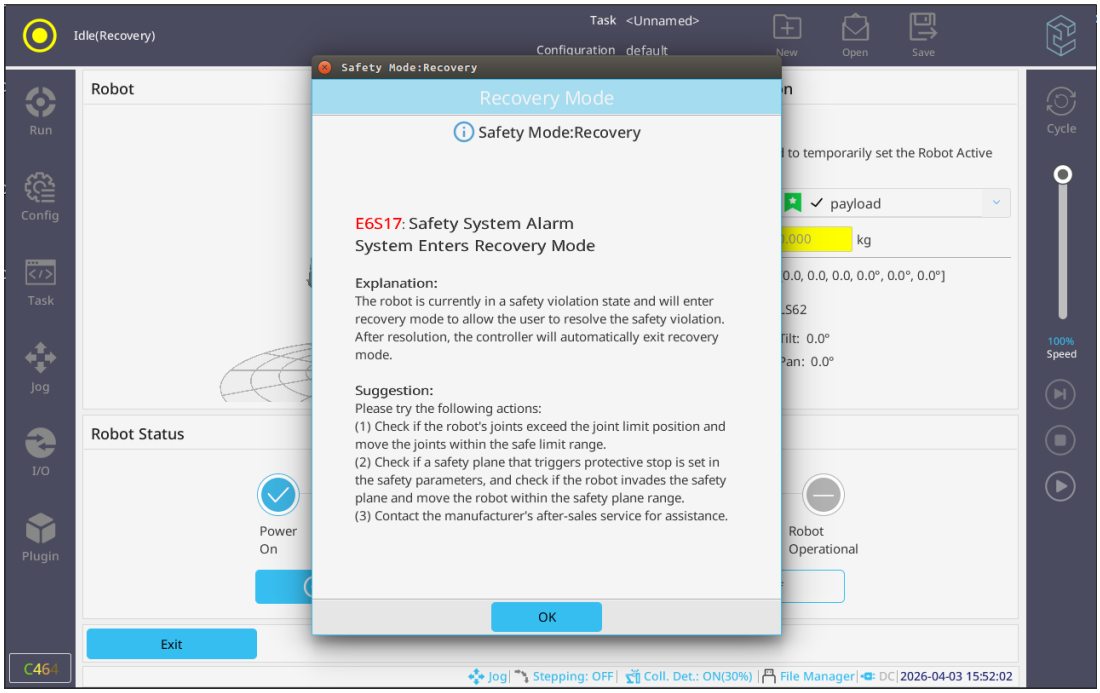


Figure 3-90: Safety System Alarm (Recovery Mode)

NOTICE

If the coordinate system or TCP selected in this interface is modified or deleted, the parameters for this function remain unchanged and the previous settings are still valid. The system will prompt with two exclamation points. To synchronize the corresponding changes, tap the blue button here to synchronize.

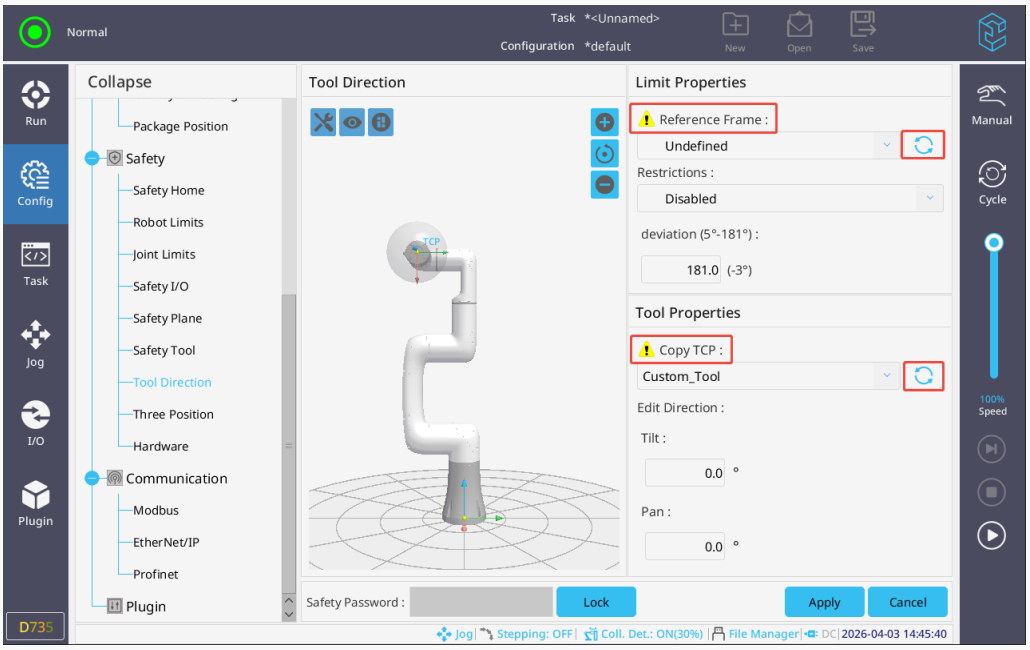


Figure 3-91: After Coordinate System and TCP Modification

3.5.2.8 Three Position

Set whether the three position switch allows manual high speed.

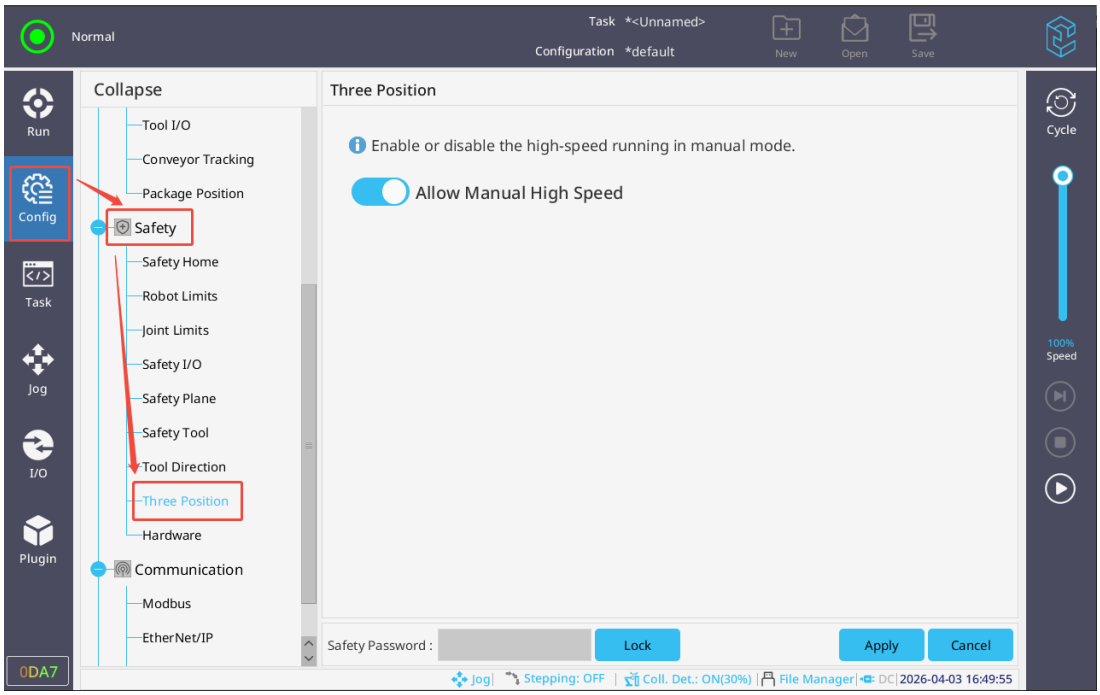


Figure 3-92: Three position

3.5.2.9 Hardware

In the hardware settings, the user can select [None] or [Standard Teach Pendant] from the drop-down list.

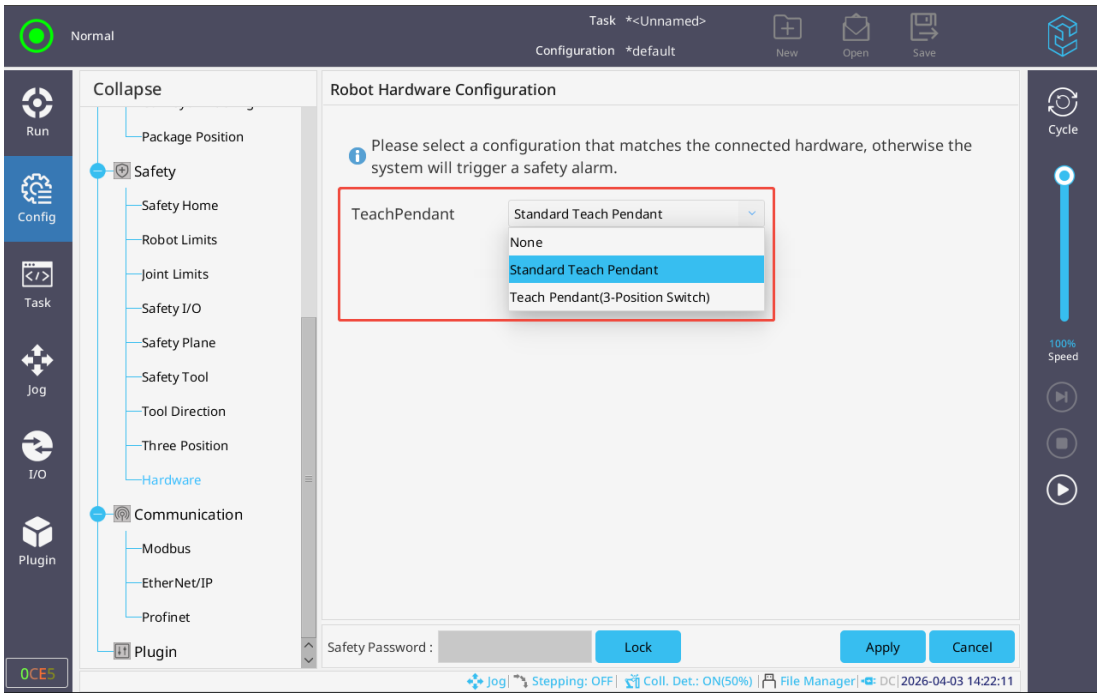


Figure 3-93: Hardware settings

The selected teach pendant mode must be same as what is used actually. Otherwise, it will trigger an alarm. If the user selects [None] and a teach pendant is connected, the alarm E9S3 will be sent out. The prompt that the current safety hardware config prohibits connecting to the teach pendant appears. Instead, it will trigger the alarm E9S1 and prompt that the teach pendant is disconnected.

3.5.2.10 Safety Parameters

The values of the safety parameters can be set in [Config] > [Safety]. Safety parameters include: safety home, robot limits, joint position, joint speed, safety I/O, safety planes, and three position.

Click [safety check code] button, such as ”38EB” in **Figure** 3-94 to display the safety parameter window for data viewing.

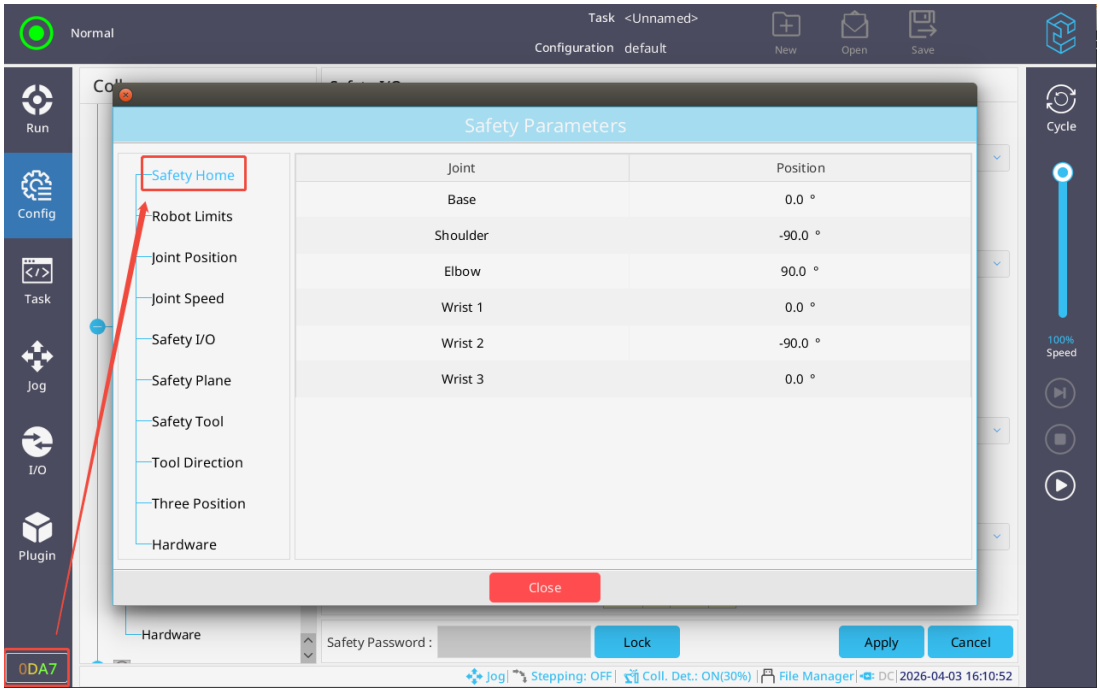


Figure 3-94: Safety parameters

3.5.3 Communication

3.5.3.1 Modbus

This subsubsection describes how to set the Modbus client I/O signal.

1. Click [Config] > [Communication] > [Modbus] to enter the [MODBUS Client I/O Setup] interface.

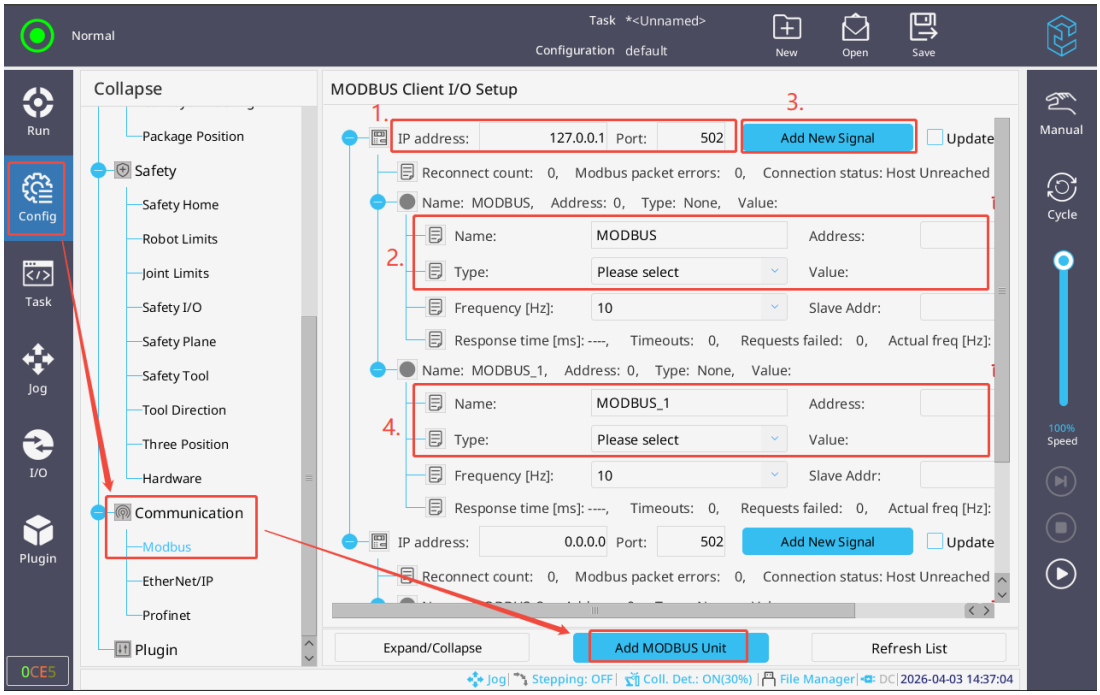


Figure 3-95: Modbus

2. Click [Add MODBUS Unit].
3. Set the ”IP address”, ”Port”, ”Name”, ”Address”, ”Type” of the device and so on.
4. Click [Add New Signal] to set a new value to return to [Type].
5. Repeat steps 2-4 to continue adding.

The [Expand/Collapse] button at the bottom of the page can expand or collapse all nodes with one click. [Refresh List] allows the client to obtain the information of the server immediately, and does not follow the limit of refresh frequency.

When the Modbus device is added, the corresponding IP address can be seen in [I/O] > [Modbus] and the status information can be viewed conveniently.

Color Indicator Description

1. **Communication Status**
   - : Inactive.
   - : Enabled.
   - : Abnormal response time. The Modbus communication response time is relatively long, which may indicate communication delays or network quality issues.

2. **Modbus Exception Status**
   - E1 : Illegal Function (Exception Code 0x01). The slave device does not support the requested function code.
   - E2 : Illegal Data Address (Exception Code 0x02). The requested register or coil address is outside the range supported by the slave device.

- E3 : Illegal Data Value (Exception Code 0x03). The data value included in the request is outside the permitted range or has an invalid format.
- E4 : Slave Device Failure (Exception Code 0x04). An internal error occurred in the slave device while processing the request.
- E5 : Acknowledge (Exception Code 0x05). The slave device has accepted the request but requires a longer time to process it, typically related to programming or writing operations.
- E6 : Slave Device Busy (Exception Code 0x06). The slave device is currently busy and cannot process new requests. Please retry later.
- EA : Gateway Path Unavailable (Exception Code 0x0A). The gateway device cannot access the specified downstream communication path, possibly due to configuration errors or network issues.
- EB : Gateway Target Device Failed to Respond (Exception Code 0x0B). The gateway device received the request but did not obtain a response from the downstream target device.

3. **I/O Status**
   - : The currently selected I/O signal is enabled.
   - : The currently selected I/O signal is disabled.
   - : The unselected I/O signal is enabled.
   - : The unselected I/O signal is disabled.

3.5.3.2 Profinet

Click [Config] > [Communication] > [Profinet] to enter the Profinet interface. The Profinet interface includes the Profinet status bar, notification bar, robot I/O module, and register module insertion status.

In Notice block at the top right, the LED indications are explained. The status of Robot I/O module and Register Modules are not inserted, the running program will trigger the corresponding action. There are three states under each module: 0 (none), 1 (pause) and 2 (stop).

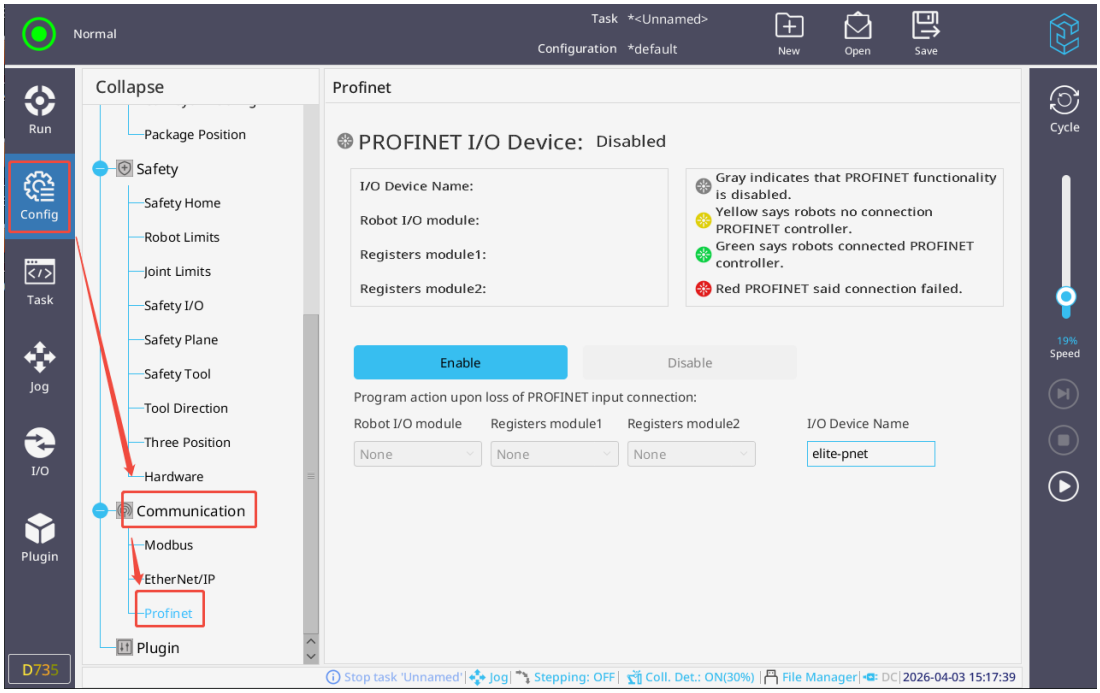


Figure 3-96: Profinet

NOTICE

When Profinet is enabled, the network settings are locked. Click the [Disable] button to unlock the network settings.

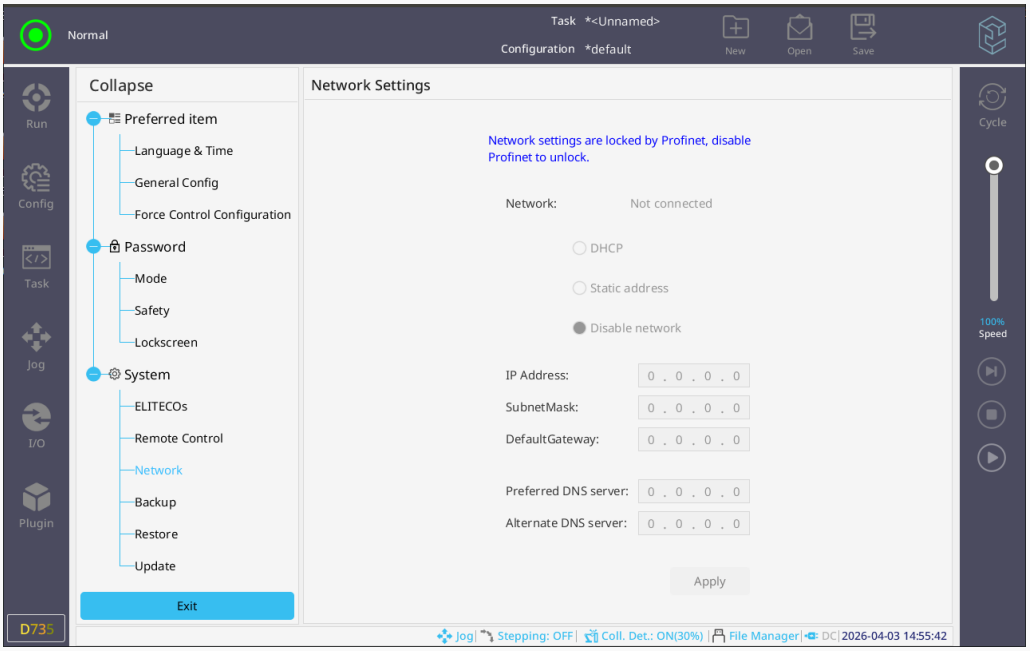


Figure 3-97: Network settings are locked

3.5.3.3 Ethernet/IP

Click [Config] > [Communication] > [Ethernet/IP] to enter the Ethernet/IP interface. The Ethernet/IP interface includes the Ethernet/IP status bar, notification bar and the settings.

The status bar shows the current running status of the Ethernet/IP bus.

In Notice block at the top right, the LED indications are explained. Different colors mean different running status of the Ethernet/IP.

The settings are used to enable or disable the Ethernet/IP function. When the Ethernet/IP scanner is disconnected, the running program will trigger the corresponding action: None, Pause and Stop.

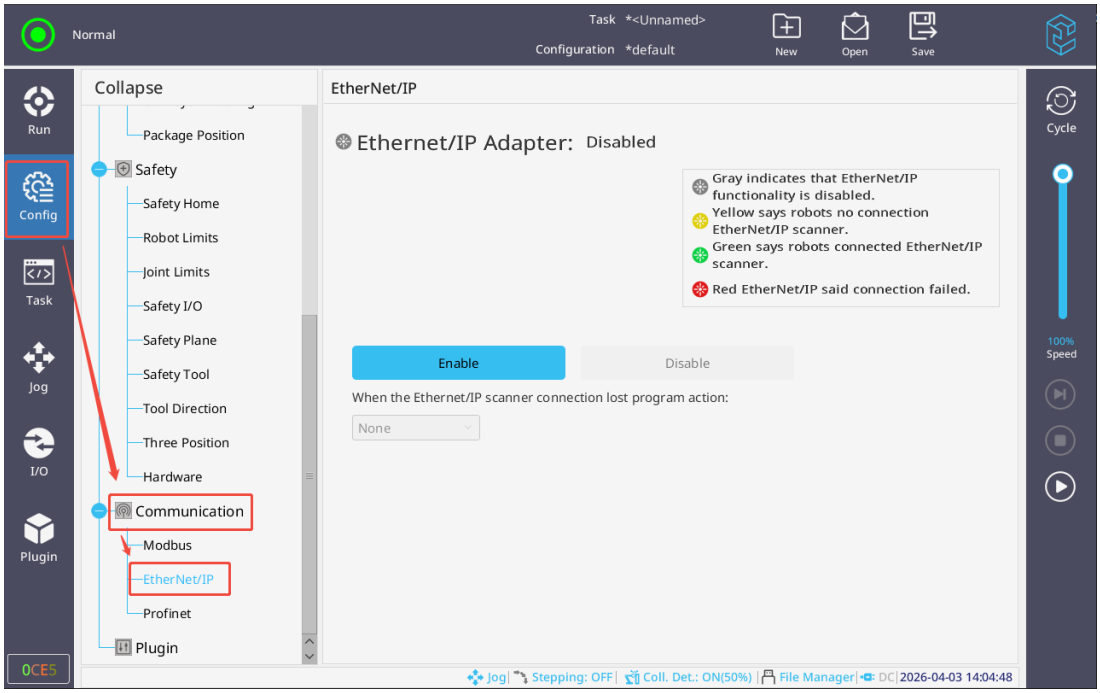


Figure 3-98: Ethernet/IP

3.5.4 Plugin

Plugin is used to display user-defined configuration plugin.

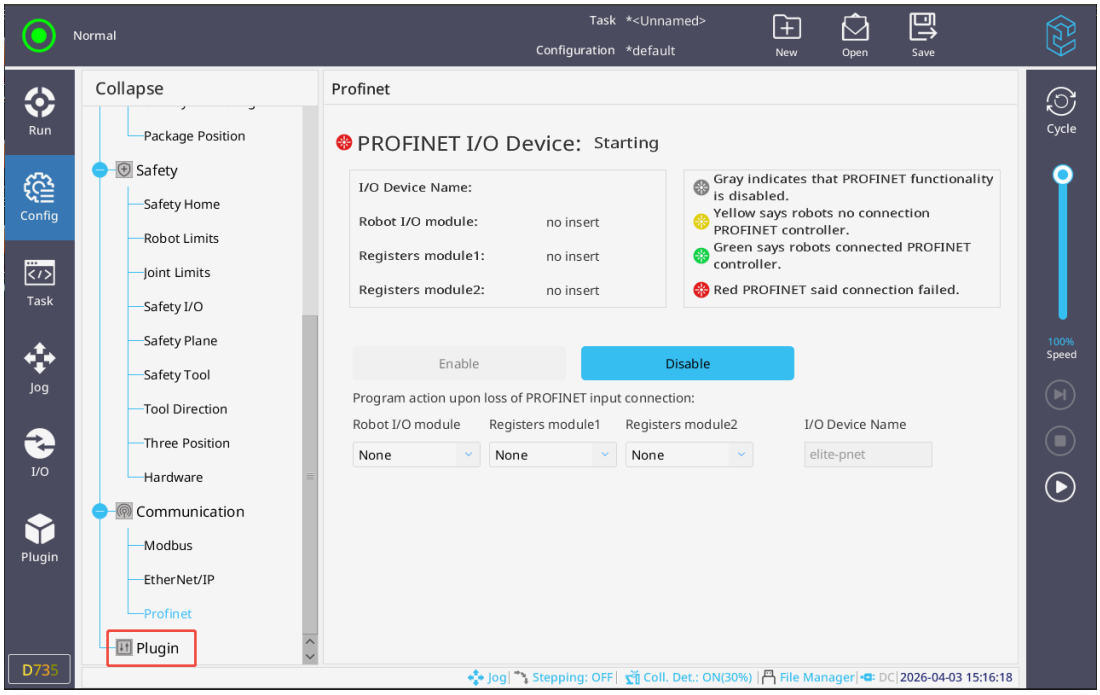


Figure 3-99: Plugin

3.6 Task Tab

This section describes the options and operation instructions in LS65 robot task setting, including Task Tree, Instruction, Monitor, Basic Task Point, Advanced Task Point, Plugin and other options.

The tasks tab displays the tasks that are currently being edited.

The examples of task nodes in this manual are for reference only. Please edit tasks according to actual needs.

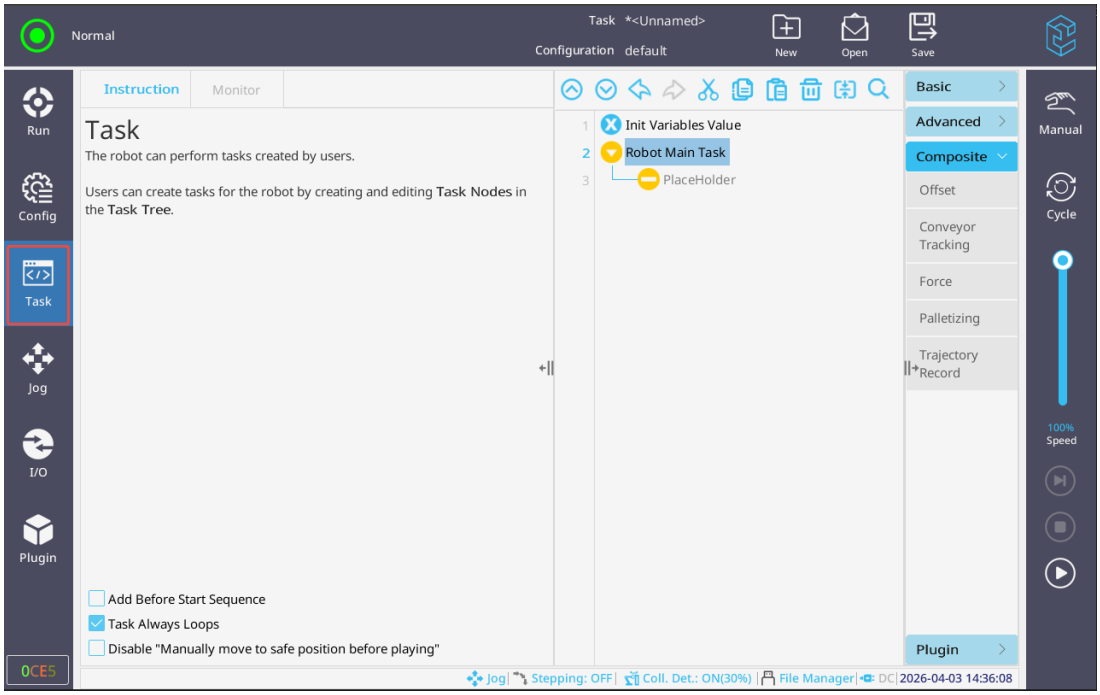


Figure 3-100: Task tab

3.6.1 Task Tree

The user can add a task node in the task tree, and select the required task node in the command bar on the right side of the page.

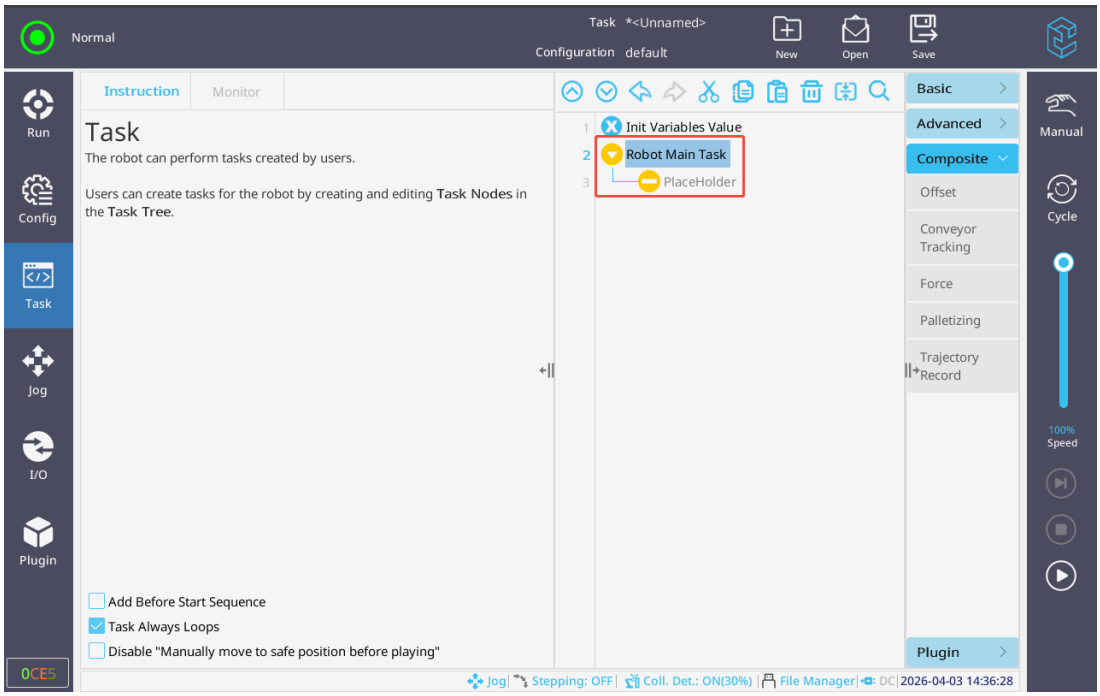


Figure 3-101: Task tree

The user cannot run a blank task tree or a task tree contains an incorrect task node.

If the task node is not defined, the node will display an orange icon.

If there is search content in the task node, the task node will be highlighted in yellow.

If there is an error when the task is running, an exception message will pop up.

The exception information prompt box displays the error information of the task node, including the error type, current error code lines, etc., and supports the following operations:

1. OK: if there is only one error message, click ”OK” to clear the abnormal message and alarm; If there are multiple error messages, click ”OK” and the next error message will be displayed on the page.
2. Close all: clear all abnormal information and alarms.
3. Go to task view: clear all abnormal information and alarms, jump to the [Task] tab, and display the currently running task. The wrong node in the task tree is marked in red.

Note: In case of non UI operation, the exception information prompt box only displays the error description.

In the task tree, a blue arrow to the right  indicates the button which tracks the running status of the current task. Click the blue arrow and it will be hidden. If the user expects not to track the status, just click any task node in the task tree and the blue arrow will reappear on the display.

Tap the expand/contract icon   on the left and right sides of the Task Tree interface. This will expand the width of the task tree view, achieving the maximum window for displaying the task tree. Tapping it again will reverses its orientation and the width of the task tree view will restore to be the default.

3.6.1.1 Task Tree Toolbar

The user can modify the task tree using the toolbar at the top of the task tree.

- Search: Click  , enter the search content in the search box and click [Enter] to complete the search;
- Undo / restore: Click  and  , undo and redo modified commands;
- Move up / down: Click  and  , change the node position up and down. Moving nodes only support the position exchange of peer nodes;
  Note: If node moves, its paired else if and else nodes move together.
- Cut: Click  , cut a node and allow it to be used for other operations;
- Copy: Click  , copy a node and allow it to be used for other operations;

- Paste: Click , paste copied or cut nodes;
- Delete: Click , delete node from task tree;
- Compress: Click , compress the nodes in the task tree. After compression, all relevant nodes will be skipped.

3.6.1.2 Expression Editor

The expression editor is used for text and expressions editing.

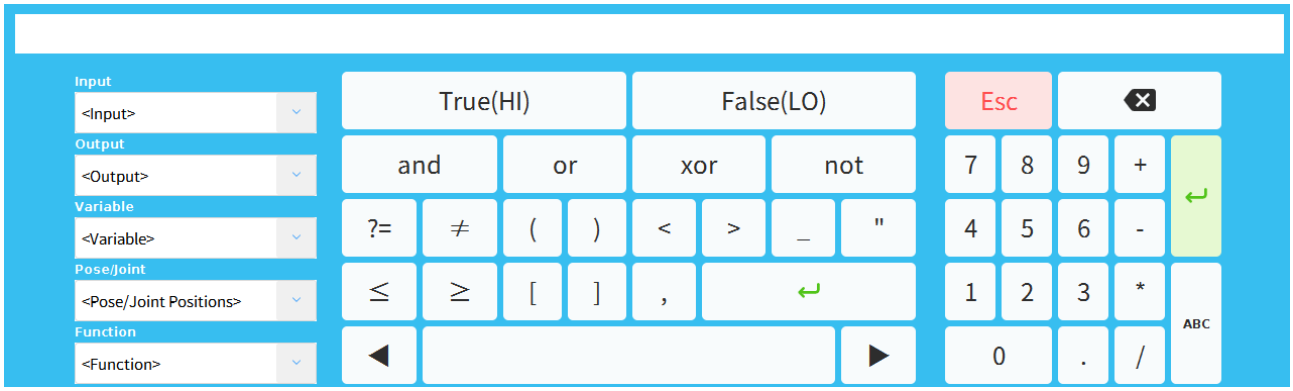


Figure 3-102: Expression Editor

The expression editor allows users to insert input and output names, variables, pose/joint positions, and functions, as well as special symbols used in expressions, such as the “?=” operator.

During expression editing, the system provides an intelligent suggestion feature, which automatically matches available inputs, outputs, variables, pose/joint data, and functions based on the current input, helping users complete expressions efficiently. In addition, the expression input field supports syntax highlighting to visually distinguish entities, logical tokens, and ordinary characters, improving readability. In the expression intelligent suggestion list, input and output I/O items display both the user-defined name and the default system name, allowing users to identify and select I/O items using either name.

Defined variables can be selected from the [Variable] drop-down list. Available input and output ports can be selected from the [Input] and [Output] drop-down lists and functions can be selected from the [Function] drop-down list. Users can also reference coordinate systems, tools, waypoint poses, and joint data from the Pose/Joint Positions drop-down list.

Note that the referenced pose or joint data represents the values calculated at runtime when the program executes the node containing the expression, rather than static

values defined during editing or configuration.

Tap the [ABC] button in the lower-right corner of the screen to switch to text editing mode, and tap [f(x)] to switch back to expression editor.

Tap ↵ to save the expression, or tap Esc to exit the screen and discard all changes.

3.6.1.3 Initialize Variable Node

The initialization variable node demonstrates all task variables that have been created and used in the task, and supports renaming and initializing them.

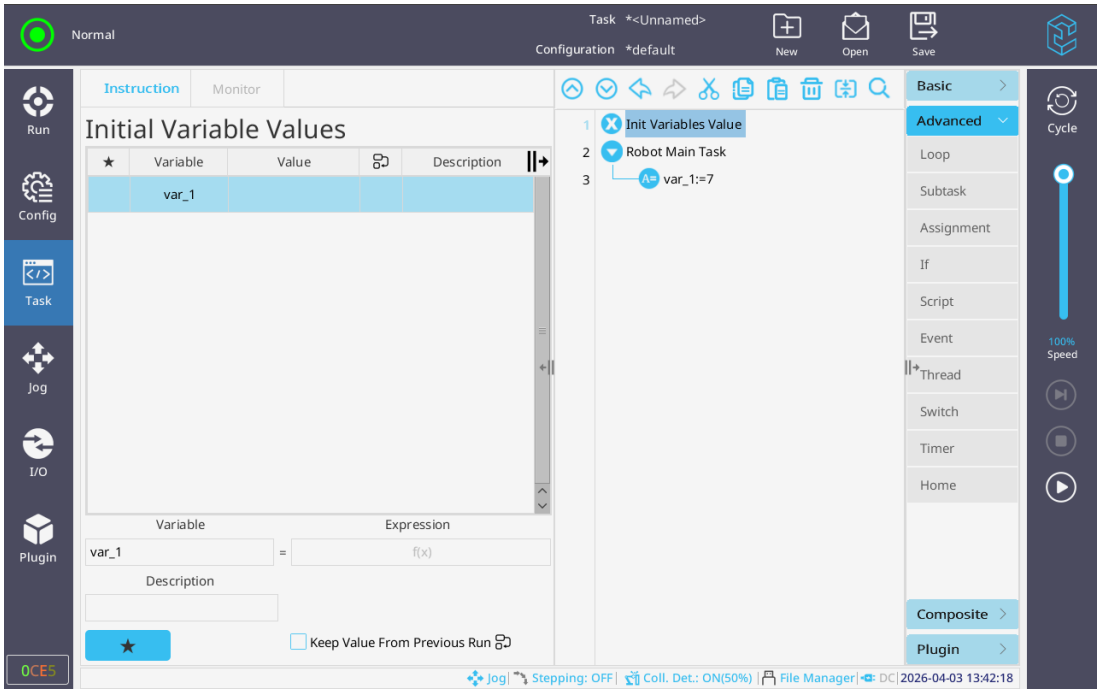


Figure 3-103: Initialize Variable Node

1. Once creating a new variable in [Advanced]-[Assignment], all newly created variables will be displayed in the interface of Initialize Variable and also under the Robot Main Task.
2. Select any variable, enter or modify its expression and description below. Expressions are used to declare and initialize the variable value when the task starts.

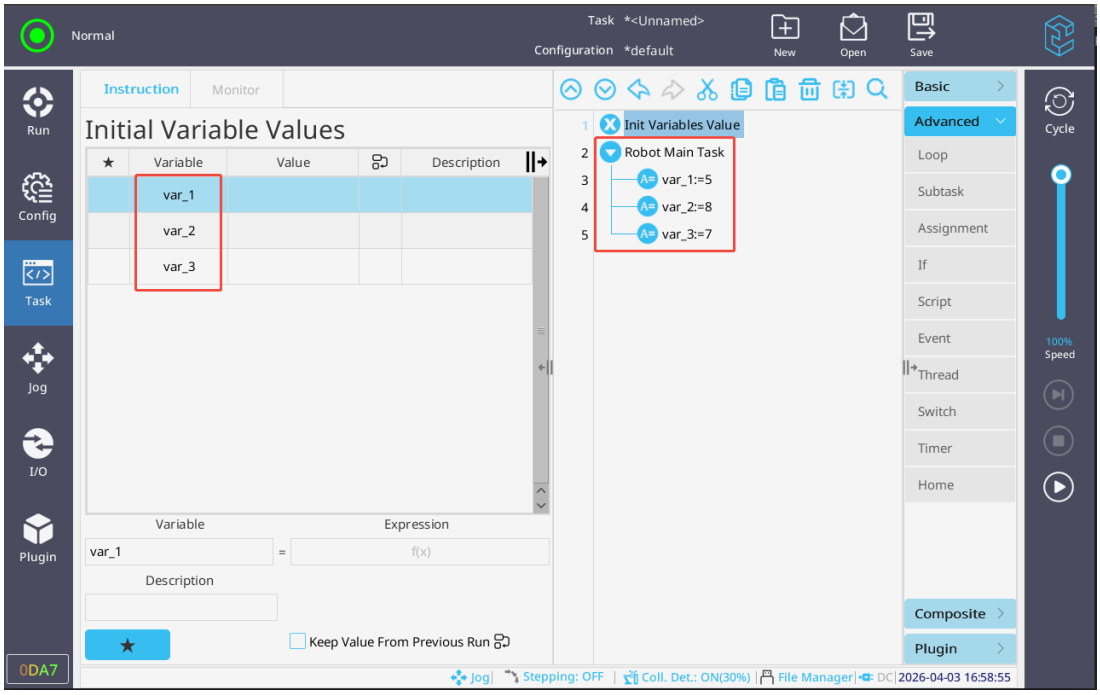


Figure 3-104: Optional Variables

3. Click ★ to favorite variables.
4. If "Keep Value From Previous Run" is checked, the variable can keep its running value. Run the task again without shutting down, clearing the variable value or deleting the initialization node, and the variable will keep the last value.

Note: The variables created by the assignment instruction are local variables. The function of initializing variables is only applicable to local variables, not global variables.

3.6.2 Instruction Tab

The robot task node includes three check boxes that control the overall behavior of the task.

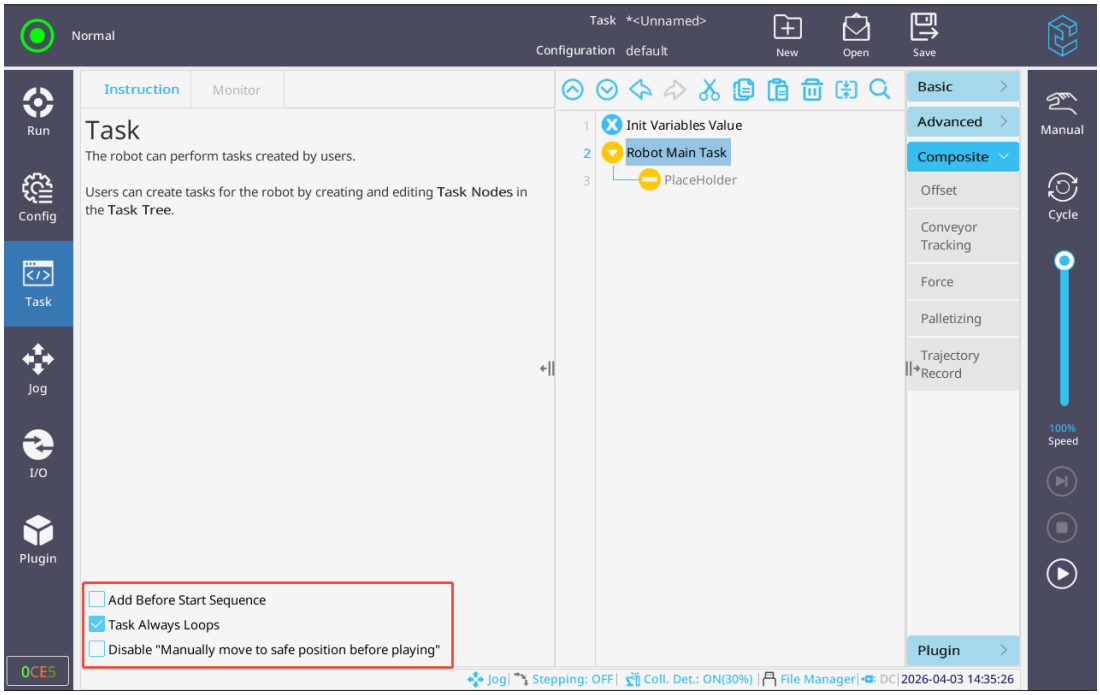


Figure 3-105: Instruction interface

- **Add Before Start Sequence**
  Check or uncheck the check box to add or delete the [BeforeStart] node before the main task. The node under [BeforeStart] will be executed earlier than the robot's main task and will only be executed once. The single or cyclic operation of the robot refers to the single or cyclic operation of the main task of the robot.
  Note: A [BeforeStart] node can only be added by checking this box. [BeforeStart] node can be removed by unchecking the [Add Before Start Sequence] or clicking in the task tree.
- **Task Always Loops**
  Check this box to keep the main task running over and over again.
- **Disable "Manually move to safe position before playing"**
  Generally, the robot's position is uncertain before running the task. If we directly run the task, the robot needs to adjust itself from the current position to the one where the first waypoint in the task. Accidental collisions may happen during the motion. Therefore, the option "Manually move to safe position before playing" is enabled by default to avoid accidental collisions. If the motion safety can be assured in the actual operation, this option may be disabled.
  You can check the box and choose to enable the option "Manually move to safe position before playing" or not in the pop-up window. When the option is disabled, it is only available for the current task. Moreover, when you run the task, the pop-up window will be there to remind you of the option disabled in case accidental collisions happen because the option is forgotten to be enabled or the task is running without being aware of it.

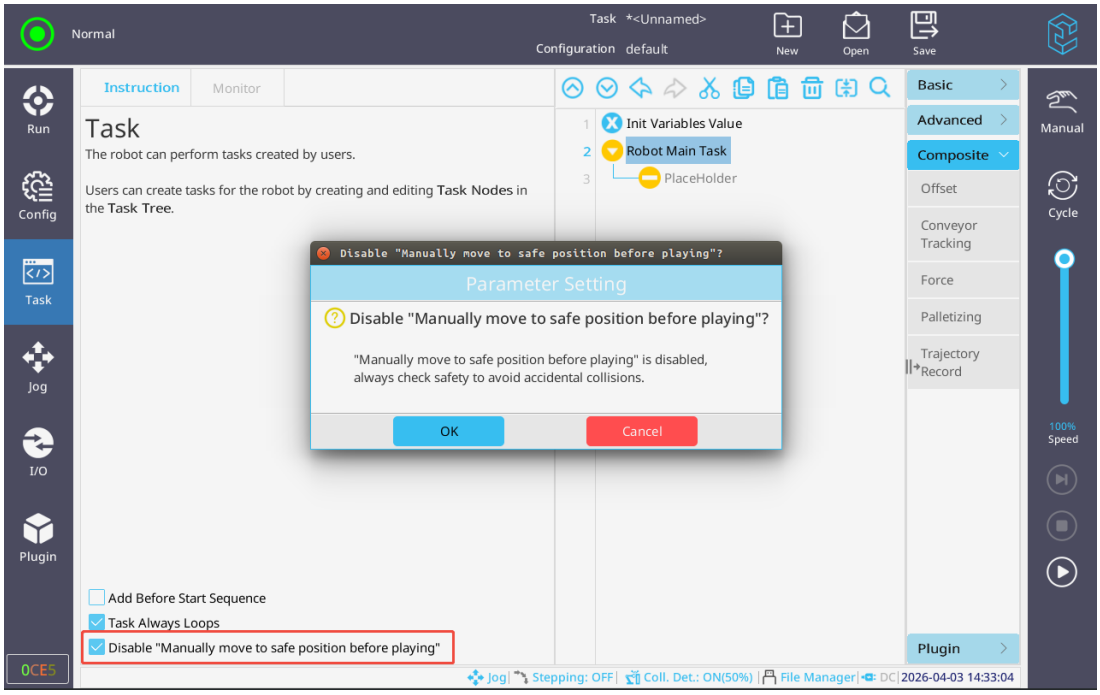


Figure 3-106: Enable/Disable ”Manually move to safe position before playing”

3.6.3 Monitor Tab

The monitor tab monitors variables and robot views.

Besides, when the task is running, the variables tab displays the real-time variable values. When stopping, if the data is not cleared, the variable value at the moment when the task stops will be maintained.

If [Show Waypoint] is checked, the pose information of waypoints in the current task will be displayed in waypoints.

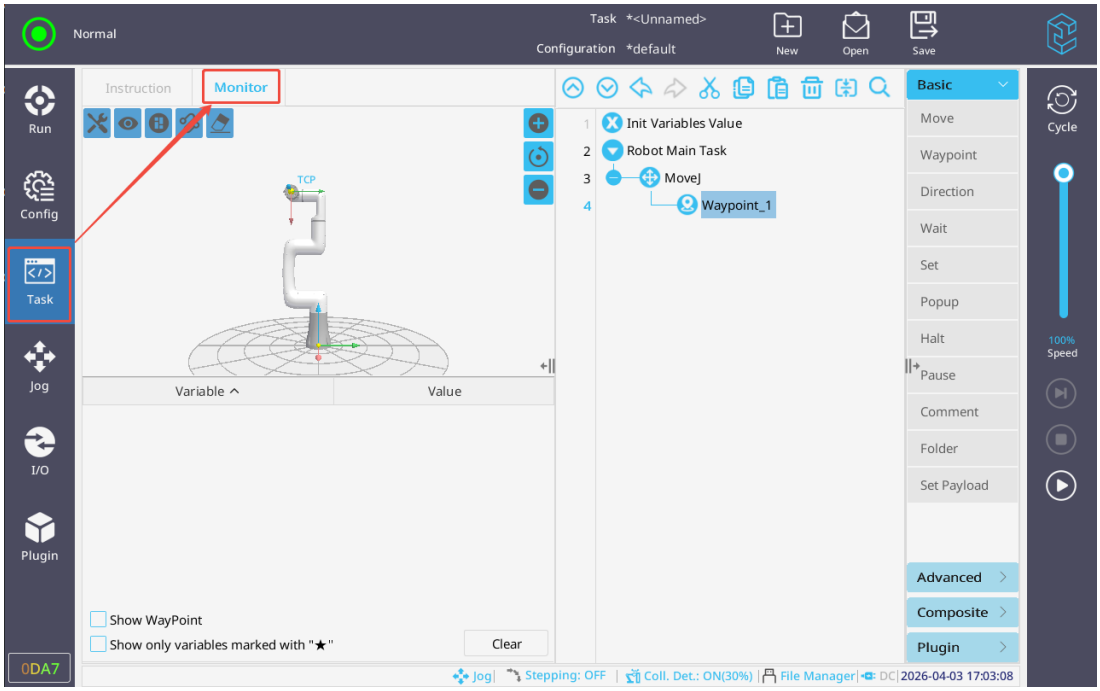


Figure 3-107: Monitor interface

3.6.4 Basic Task Node

Basic task point is used to perform basic level operations like Move, Waypoint, Direction, Wait.

3.6.4.1 Move

The movement command controls the movement of the robot through the basic waypoint. Waypoints must be placed under the motion command. The move command defines the type of movement of the robot between waypoints.

1. Movement Type

Select from the following three movement types: MoveJ, MoveL, and MoveP, and operation steps are shown in **Figure** 3-108.

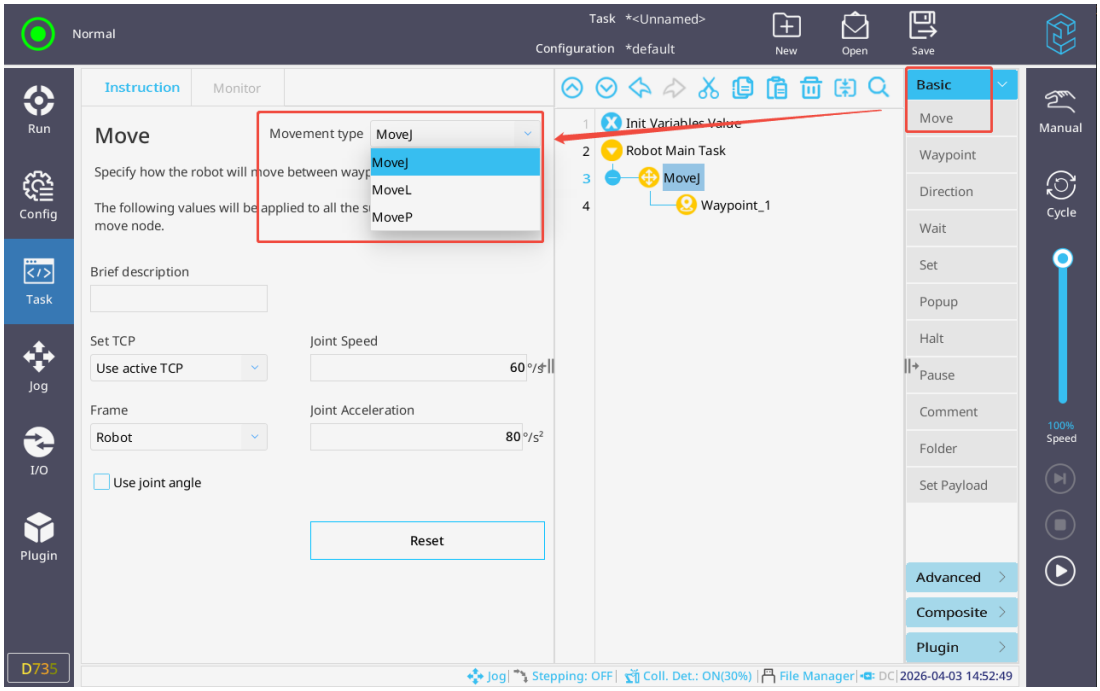


Figure 3-108: Select movement type

- **MoveJ: Joint movement. Move in the space of the robot arm;**
  Control the joints to complete the movement of the robot. This movement type provides a curve path for the tool. The common parameters of MoveJ are joint velocity (°/s) and joint acceleration (°/s^2). If the operation needs the robot to move fast between waypoint, regardless of the movement track of the tool between these waypoints, MoveJ is the option to choose.
  "Waypoint" node can be added under MoveJ node. For details, see Subsection 3.6.4.2.
- **MoveL: Linear movement. Make the tool center point (TCP) move in a straight line between waypoints;**
  The common parameters of MoveL are tool speed, tool acceleration and frame. The first two units are expressed in mm/s or mm/s^2.
  "Waypoint" node can be added under MoveL node. For details, see Subsection 3.6.4.2; "Direction" node can also be added, see Subsection 3.6.4.3 for details.
- **MoveP: Craft movement. Make TCP move in an arc at a constant speed.**
  By default, all waypoints under MoveP node use the transition radius of 25mm. The smaller the transfer radius value is, the larger the path angle is. On the contrary, the larger the value is, the smaller the path angle is.
  "Waypoint" node can be added under the MoveP node. Please read Subsection 3.6.4.2 for details. "Direction" node can also be added. Please read Subsection 3.6.4.3 for details. The circular motion can be added to the MoveP node to make the robot do an arc motion. The arc path is calculated by a starting point (the current point), a passing point (ViaPoint) and an ending point (EndPoint).

Add arc motion:

1. Click [Task] > [Basic] > [Move] to add a move node.
2. Select movement type as [MoveP].
3. Click + , add an arc motion.

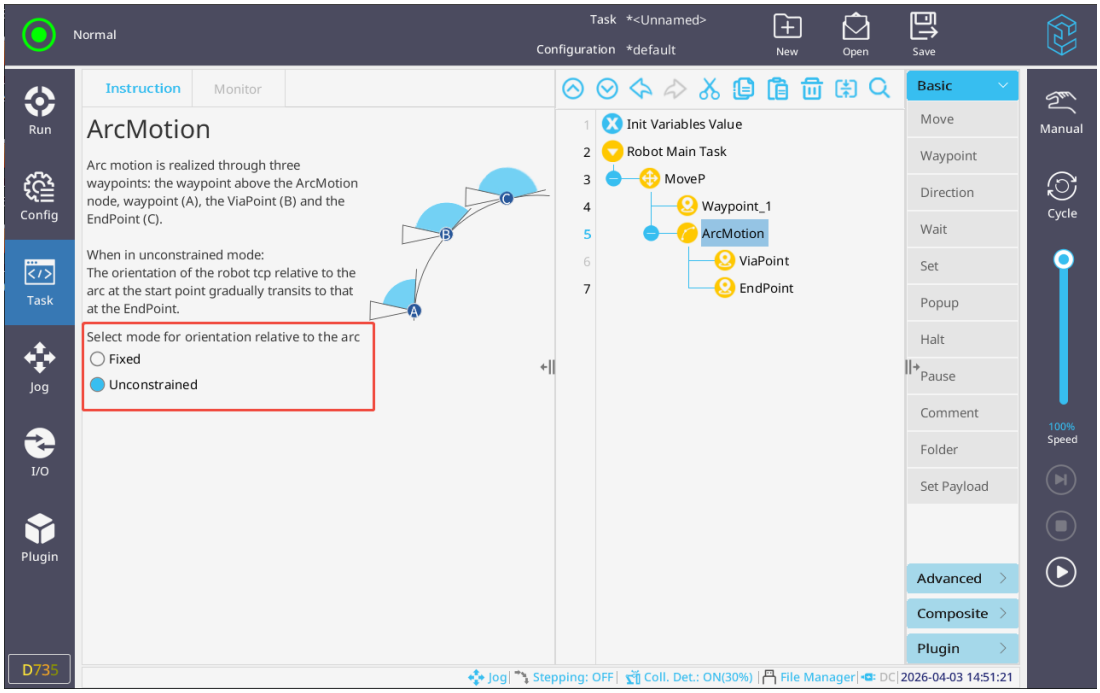


Figure 3-109: Circular motion

4. Select the mode of circular motion: fixed or unconstrained.
   - Fixed: when the robot passes through points A , B and C , the tangent angle between the robot pose and the corresponding point shall be consistent;
   - Unconstrained: when the robot passes through points A, B and C, the tangent angle between the robot pose and the corresponding point shall be subject to the actual needs, which is not consistent.
5. Set [Via Point] and [End Point], see Subsection 3.6.4.2 for details.

2. Set TCP

After setting, TCP is used to mark the tool attitude data when setting the attitude of the waypoint. After switching TCP or changing TCP, the end tool can still reach the target pose.

There are three drop-down menu options:

- Ignore active TCP: Regardless of the existence of the tool, when the robot moves, the center point of the tool flange reaches the target pose;
- Use active TCP: use TCP as the currently activated TCP in [Config] > [General] > [TCP]. As long as the robot runs, use the currently active TCP to do relevant calcu-

lations;

- Customized TCP: the user can select the customized TCP in [Config] > [General] > [TCP]. Whether activated or not, the selected TCP will be used for relevant calculations.

3. Frame

After setting the frame, the selected frame will become the reference frame of the robot.

Selected frame will affect the actual operation effect of sub nodes such as "Waypoint" or "Direction". For details, please refer to Subsection 3.6.4.2 and Subsection 3.6.4.3. If the frame changes, it will affect the actual target pose of the robot.

- Base: the base frame is used as the reference frame for robot motion;
- Custom frame: use the custom frame in [Config] > [General] > [Frame] as the reference frame.

4. Use Joint Angle

This function is only available when the joint type is "MoveJ". After "Use joint angle" is checked, the "Tool" and "Frame" options will be disabled, and the waypoints under this joint type will inherit the parameter "Use joint angle" when running.

Note: If checked, when the waypoint under this motion type moves, the pose will no longer be considered, but the joint angle at the time of recording will be taken as the motion target.

5. Reset

The user can restore all parameters modified by the current joint to the default values.

3.6.4.2 Waypoint

The waypoints are the core element of the robot task, since they are used to record the target points on the path for the robot to reach. The Waypoint can be insert as shown in **Figure** 3-110.

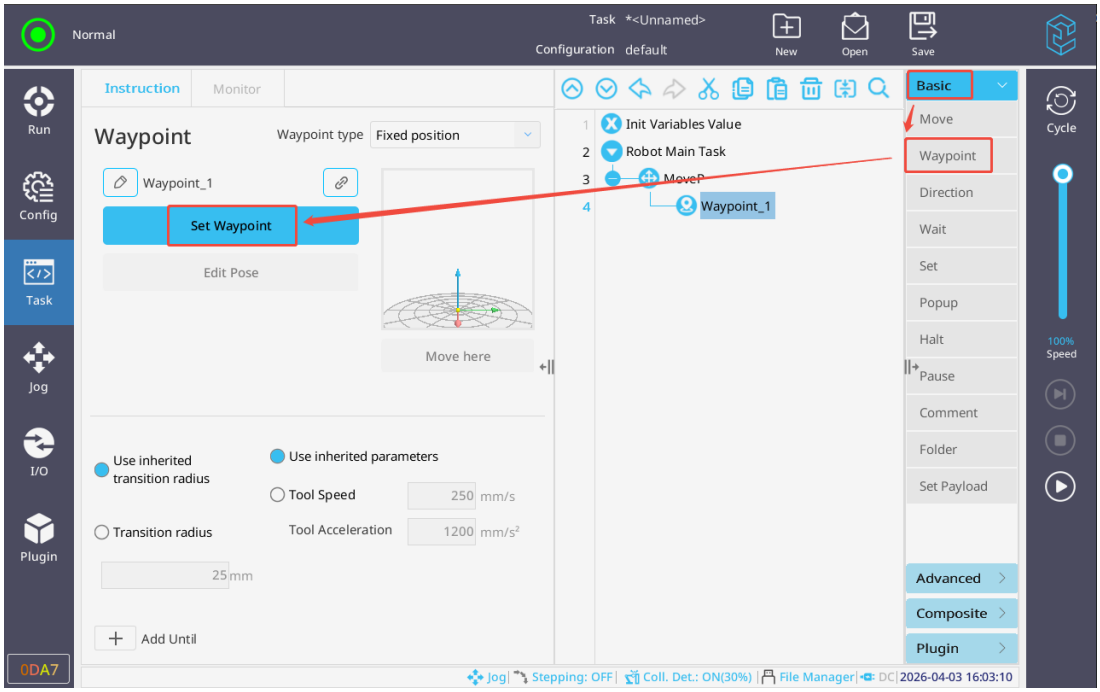


Figure 3-110: Waypoint

1. Waypoint Type

There are three types of waypoints: fixed position, relative position and variable position.

- Fixed position waypoint: after teaching, the robot arm moves with the taught point position data;
- Relative position waypoint: after teaching two waypoints and calculating the pose difference between the two waypoints, the robot will use the current pose plus the calculated pose difference to move;
- Variable position waypoint: variable waypoint refers to the location of the waypoint given by the variable. For the variable waypoint in the MoveJ instruction, it will run as the joint position. For the variable waypoint in the MoveL and MoveP instructions, it will run as the pose. Therefore, please make sure that the variable data matches the motion type. Otherwise, the unexpected problems may occur in the movement.

2. Rename

The Renaming button allows the user to rename waypoint_1, etc. to something else.

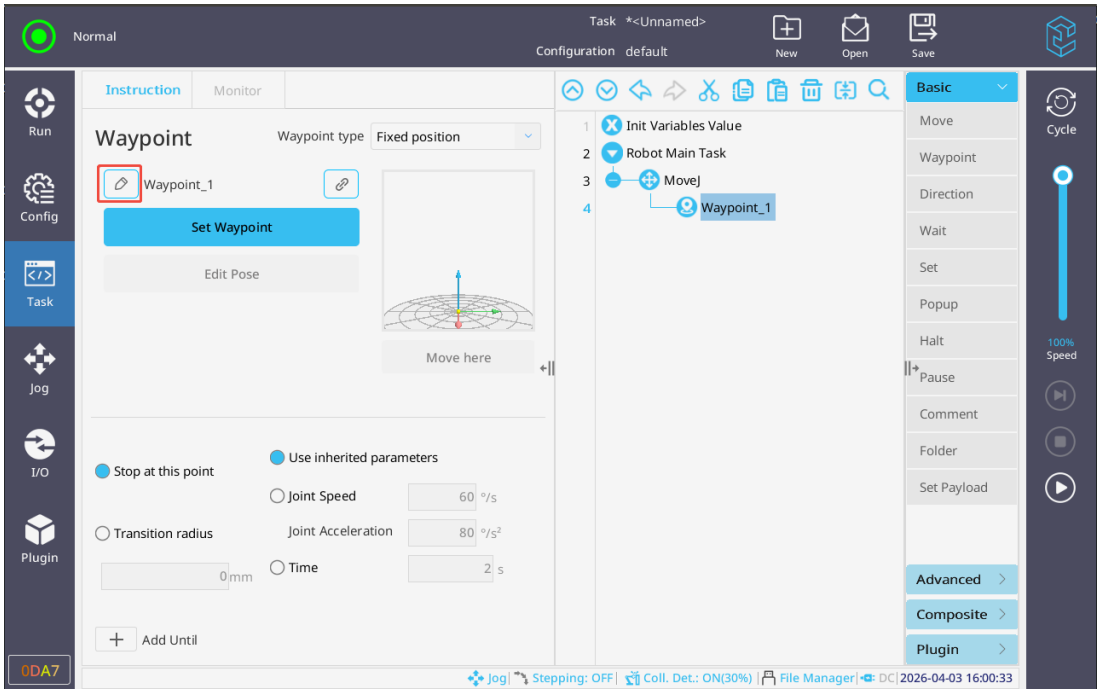


Figure 3-111: Rename

3. Teach Waypoint

The user can teach the fixed position waypoint through [Set Waypoint] or [Edit Pose]; the relative position for a waypoint can be taught by [Set Point]. Please read Section 3.8 for details.

4. Transition Radius

If the transition radius is set, the robot will transition to next waypoint before reaching the current waypoint. The transition radius cannot overlap. Therefore, when setting the transfer radius of a waypoint, it cannot overlap with the transfer radius of the previous waypoint or the next waypoint.

There are three modes of transition radius:

- Stop (no transition radius): When the motion type is ”MoveJ” or ”MoveL”, the waypoint parameter can be set to ”Stop at this point”. After setting, when the robot passes through the waypoint, it will stop first and then move to the next waypoint;
- Custom: for waypoint under all joints, the user can customize the transition radius;
- Inheritance: when the joint type is ”MoveP”, the waypoint parameter can be set to ”Use inherited transition radius”. In this case, the transition radius of the waypoint will be same as the configuration under the ”MoveP” node.

5. Add Until

Under the "Waypoint" node, click + to add the "Until" node. Multiple stop conditions can be added. The "Until" node sets the stop condition for the motion. When the stop condition is reached, the robot stops moving.

In the task tree, the user can add the "Until" node under the "Waypoint" node or the "direction" node.

The user can add multiple stop condition for single movement.

When the stop condition of the first "Until" is met, the robot stops moving.

Click the "Until" node, and the user can set the following stop conditions:

- Expression: Custom task expression. Users can use I/O, variables, pose or script functions to specify the stop condition;
  If "Use Inherited Deceleration" is checked, the deceleration of the waypoint will be same as the configuration under the waypoint node.
  If "Use Custom Deceleration" is checked, the robot will decelerate at the customized deceleration when the conditions are met.
- Waypoint reached: The robot runs to the waypoint;
- I/O input: Control the robot to stop movement through digital input signal or analog input signal.

6. Add Action

After "Add Action" is enabled, under the "Until" node, the user can add other actions to be executed when the stop conditions are met. If this function is disabled, the defined actions under the "Until" node will be deleted.

7. Insert Waypoint

The operation steps of inserting waypoints are as follows:

1. Insert a [Move] node in the "Task" tab.
2. Click [Waypoint].
3. Select [MoveJ] node, set movement type.
4. Set [Waypoint type] and configure the parameters of waypoints.
5. After setting, the waypoint node is displayed in blue.

3.6.4.3 Direction

The task specifies that the robot moves in a specific direction. The robot moves linearly in the direction of the selected frame until it is stopped by the "Until" condition.

1. Add Directional Movement

1. Select [Task] > [Basic] > [Direction].
2. Under [Frame], define linear movement.

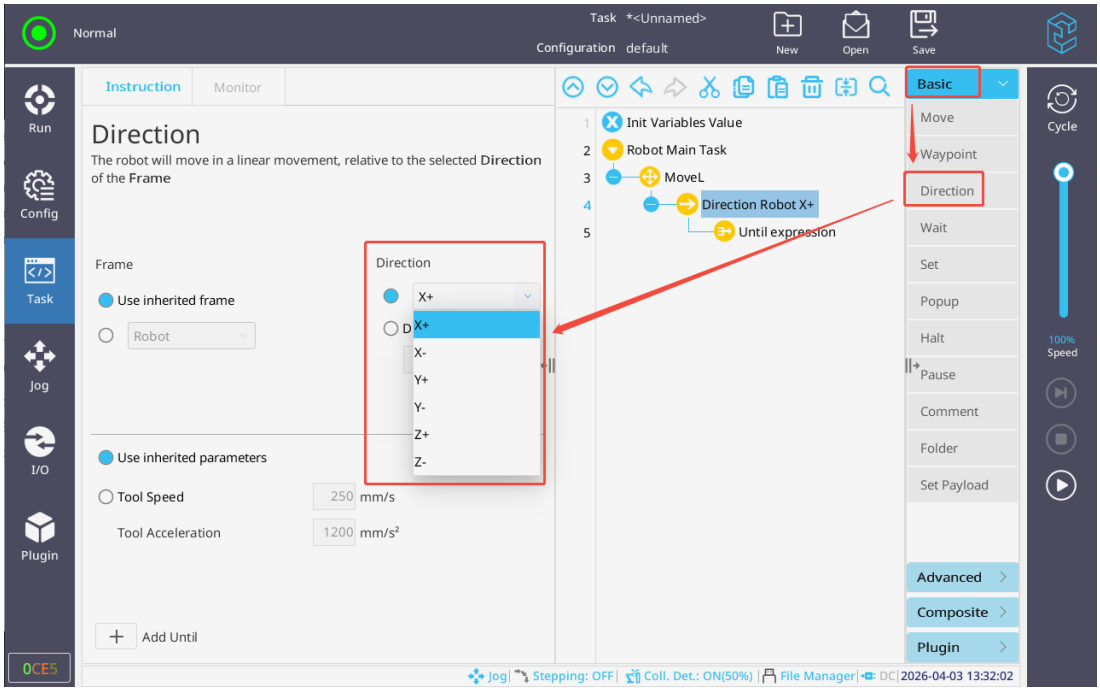


Figure 3-112: Add directional movement

2. Add Until

Under [Direction], an Until expression will be automatically generated. To add more Until, click [Add Until] button at the lower left corner, click [Until Expression] in the task tree to add stop conditions.

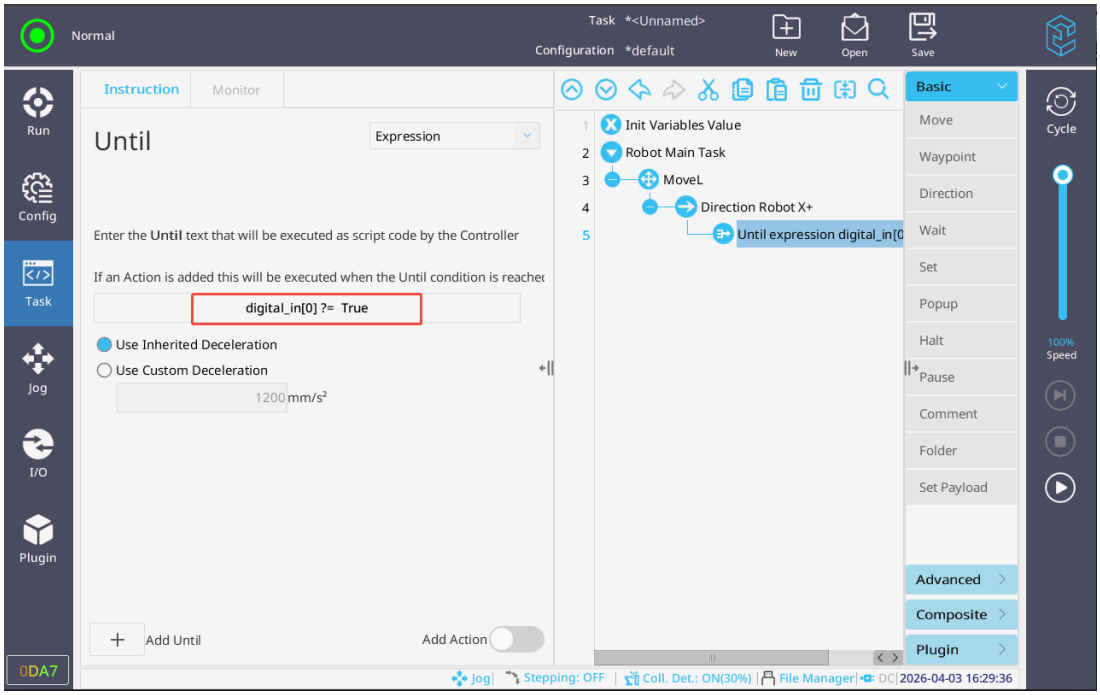


Figure 3-113: Stop directional movement

The stop conditions that can be defined are as follows:

- Distance: The robot stops moving in the direction after moving a certain distance; If [Stop at this point] is checked, the robot moves the specified distance and the speed decreases to 0.
  If [Transition radius] is checked, when the robot is about to reach the specified distance, the speed will gradually decrease and move with arc transition.
- Expression: Custom task expression. The user can use IO, variable, pose or script function to specify the stop condition. For details, see 5.;
- I/O input: Control the robot to stop movement through digital input signal or analog input signal. See 5. for details.

3.6.4.4 Wait

The user can set the conditions to stop waiting in the [Wait] node. When the conditions are met, end the waiting and continue to run the task.

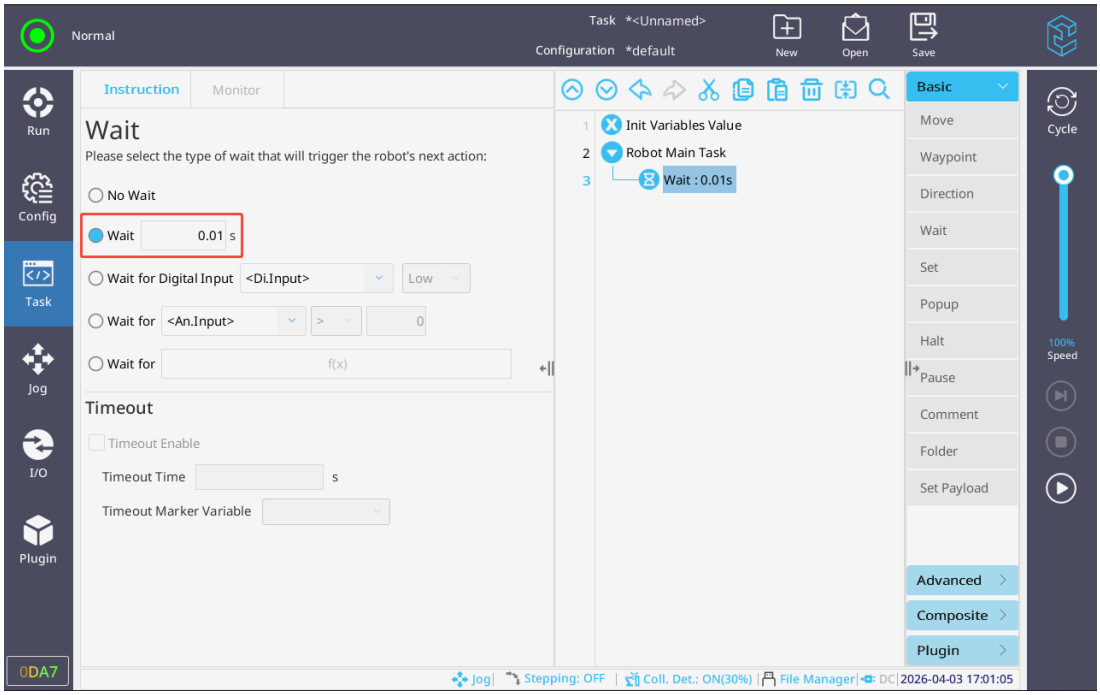


Figure 3-114: Wait

Wait condition including:

- No Wait;
- Specific Time;
- Digital Input Signal;
- Analog Input Signal;
- Expression.

"Timeout" is supported for the [Wait] node. When the condition is not met, the node will stop waiting and continue running the tasks after the timeout period ends.

Note:

1. If the tool communication interface is enabled, the waiting condition can not select the analog input signal AI [2].
2. When the wait type is "Digital Input Signal", "Analog Input Signal", or "Expression", a timeout is supported to be set. Once the timeout occurs, it will stop waiting and continue executing the tasks.
3. When the wait type is set to "No Wait" or "Specific Time", "Timeout Enable" will be disabled, related data will be reset, and the timeout settings will be grayed out.

3.6.4.5 Set

The user can set the trigger action in the [Set] node.

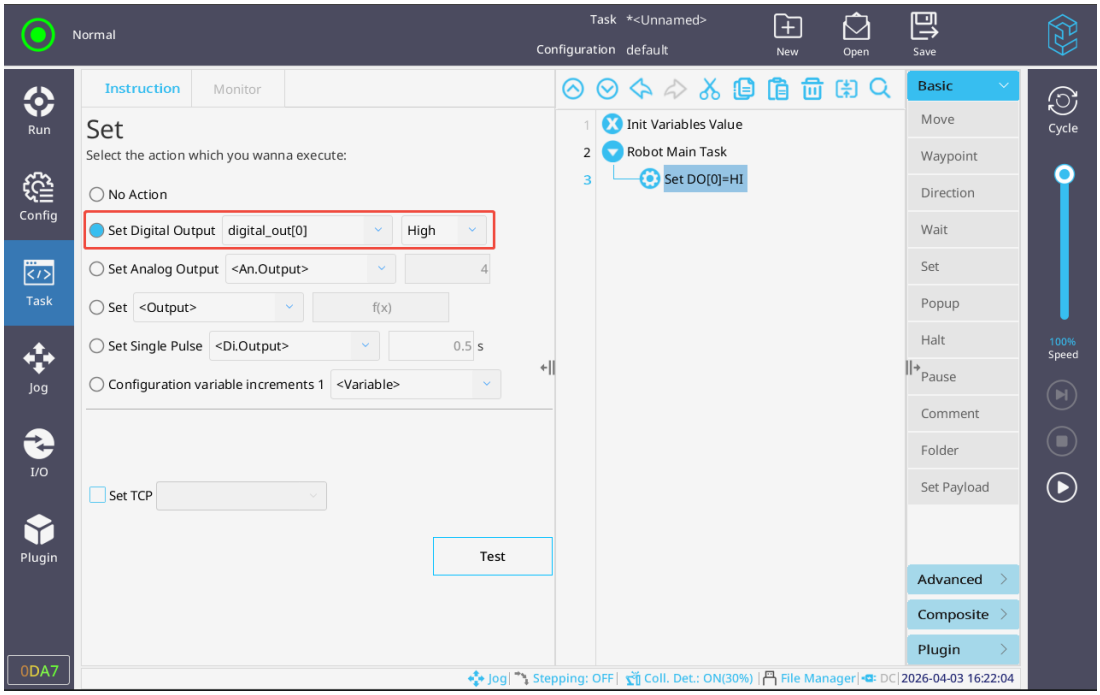


Figure 3-115: Set

Trigger actions include:

- No Action;
- Set the digital output signal, the value type is high or low (True or False);
- Set analog output signal: the value is current or voltage, depending on the type of analog output in the "I/O" tab;
- Set general signals, including digital, analog, configurable, tools and Modbus output signals: the value is an expression;
- Set the single pulse of digital, configurable, tool and Modbus output signal, that is, first set the corresponding signal to high (True), and then set the corresponding signal to low (False) after a specified time;
- Set configuration variable increment 1: the selected configuration variable is incremented by 1.

3.6.4.6 Popup

The "Popup" node can set text or variables. When the task runs to this node, the message or text will be displayed on the screen.

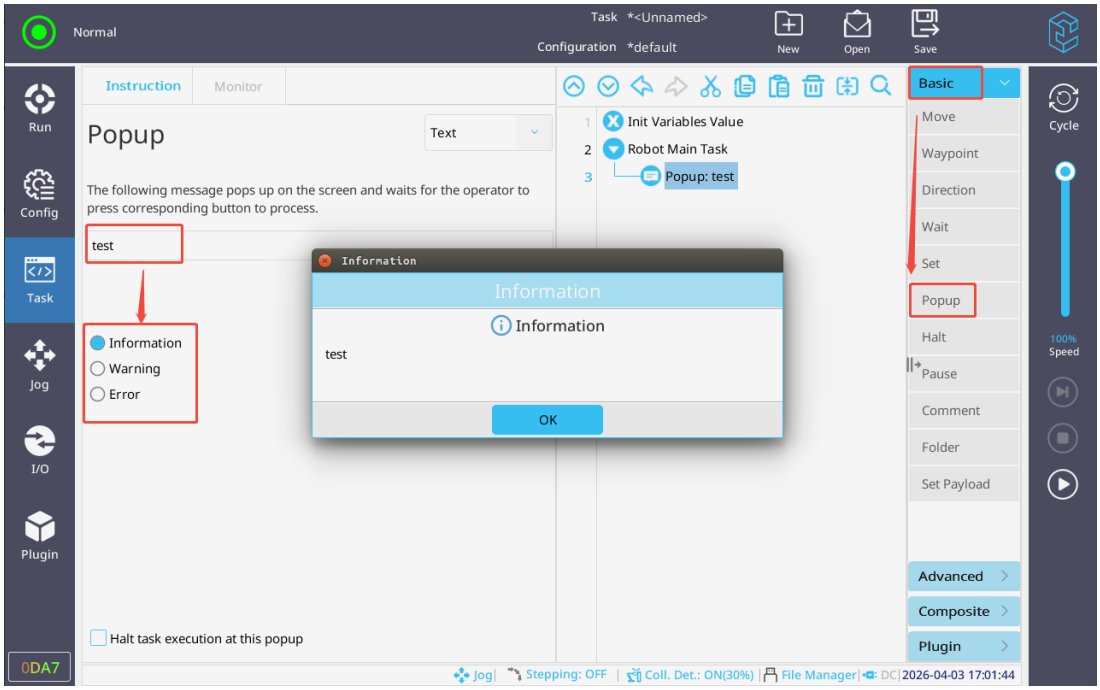


Figure 3-116: Popup

The user can select the type of pop-up message as information, warning or error.

There are two kinds of pop-up contents:

- Text: when running program reached the pop-up node, a text message entered by the user will pop up;
  Click [Preview Popup] to preview the popup window information.
- Variable: if [variable] is selected, when running program reached the pop-up node, the current value of the variable will pop up.

After the pop-up window showing up, the robot will wait for the user to press the [OK] button in the window and continue to run the task. If "Stop Task" is pressed, the task stops running.

If [Halt task execution at this popup] is checked, the robot task will stop running when the message window pops up.

Note: The message can contain up to 255 characters.

3.6.4.7 Halt

The task will stop running at this point.

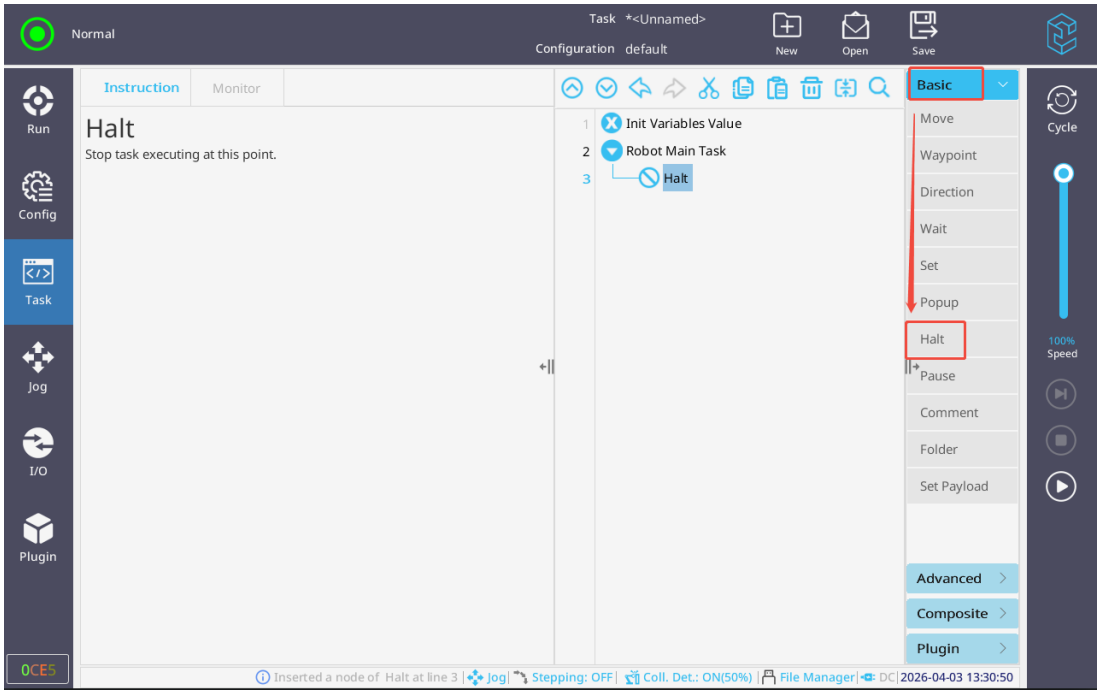


Figure 3-117: Halt

3.6.4.8 Pause

Add a pause instruction and the task will automatically pause its running at this node.

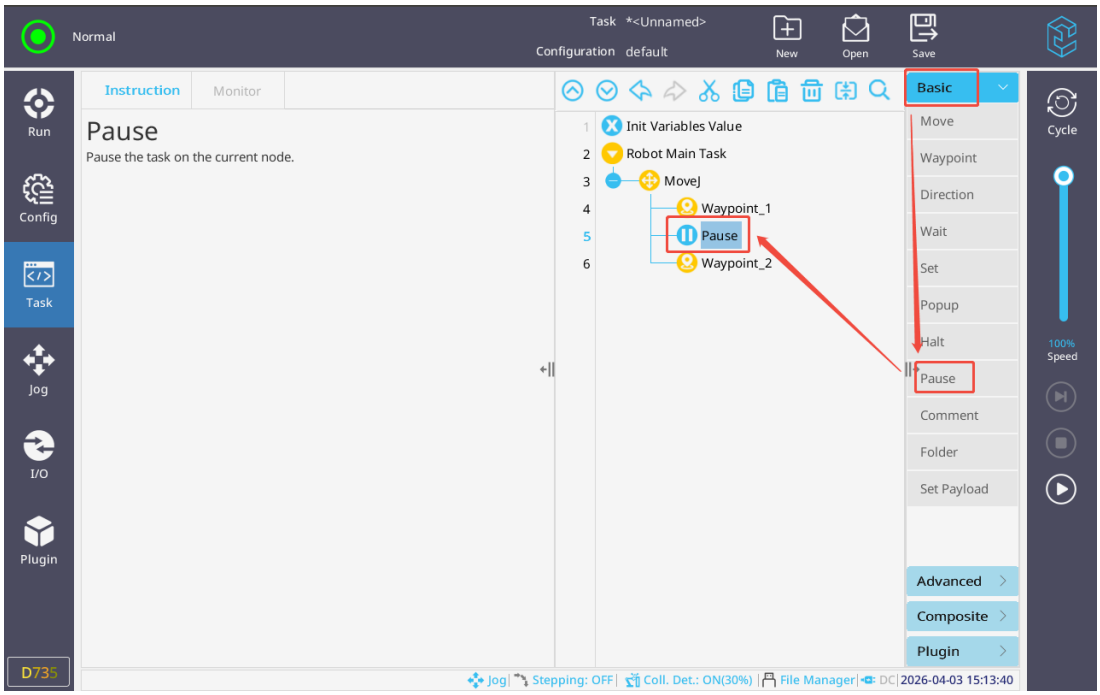


Figure 3-118: Pause

3.6.4.9 Comment

This command allows the user to add a line of text to the task to explain the task. When the task is running, this line of text will not perform any operation.

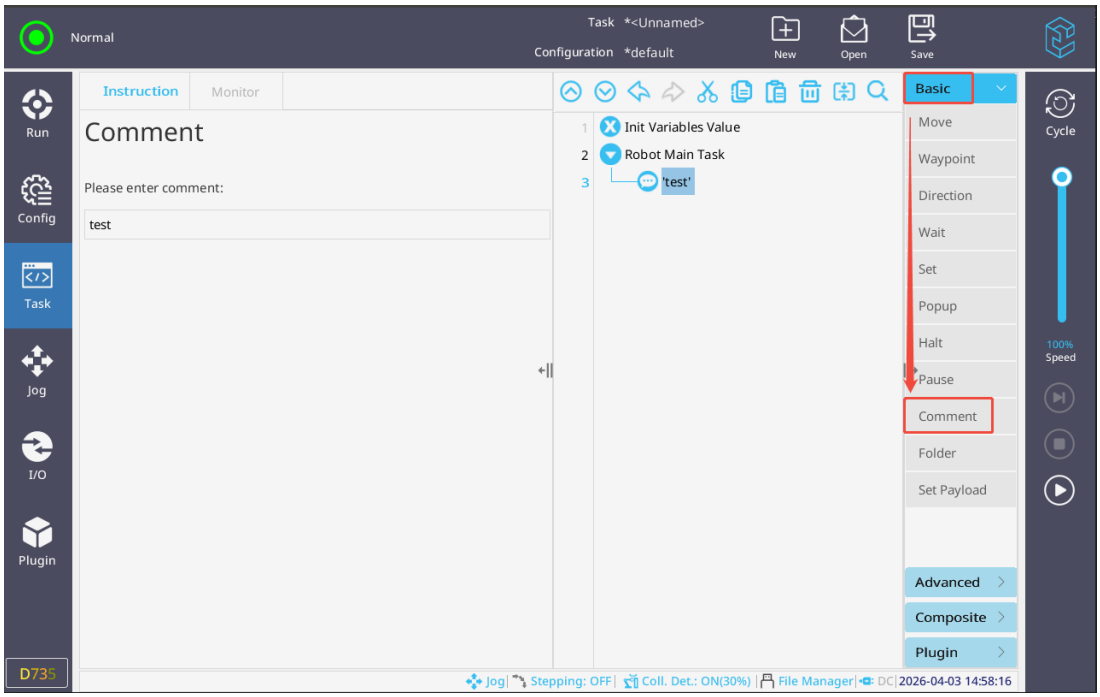


Figure 3-119: Comment

3.6.4.10 Folder

The folder command is used to organize tasks and label specific task parts, which will make the task tree easier for users to read and modify.

Folders have no effect on tasks execution.

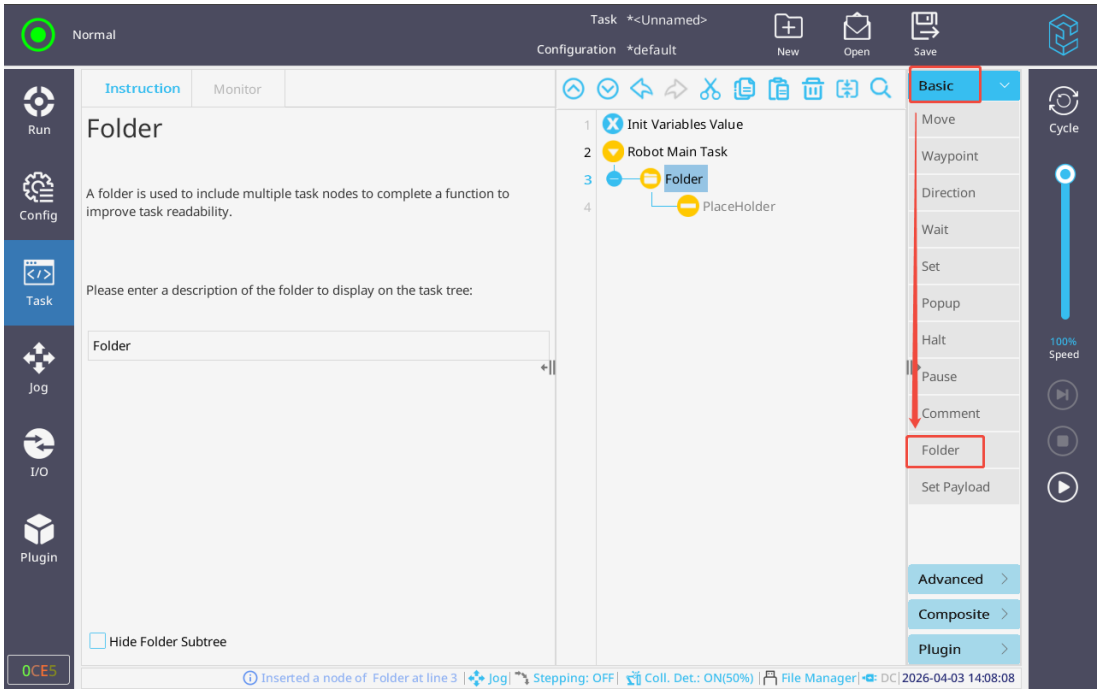


Figure 3-120: Folder

3.6.4.11 Set Payload

The [Set Payload] node allows the user to customize the payload by editing the Mass (unit: kg) and Center of Gravity (unit: mm). Click the "Set Now" button and the custom settings will take effect. The user can also click the drop-down list in the right of the [Custom Payload Config] to switch over to the payload previously set at the runtime.

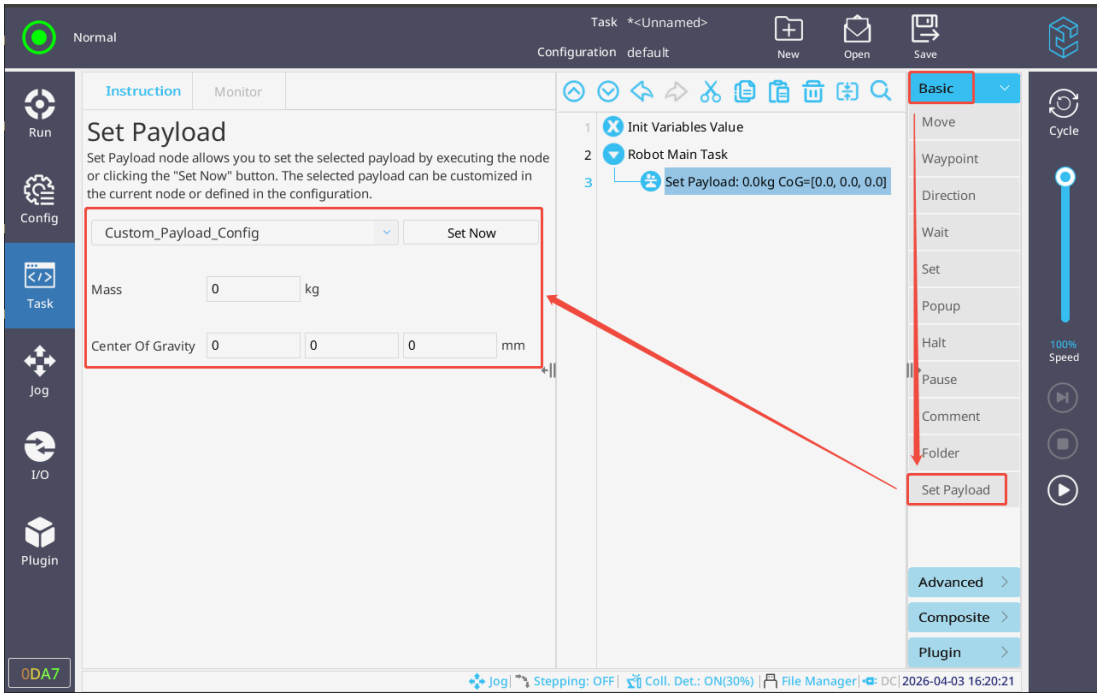


Figure 3-121: Set Payload

3.6.5 Advanced Task Node

Advance task point is used to perform operations like task loop, setting subtasks, assignment, etc.

3.6.5.1 Loop

The [Loop] node can configure the looping method of its child node tasks.

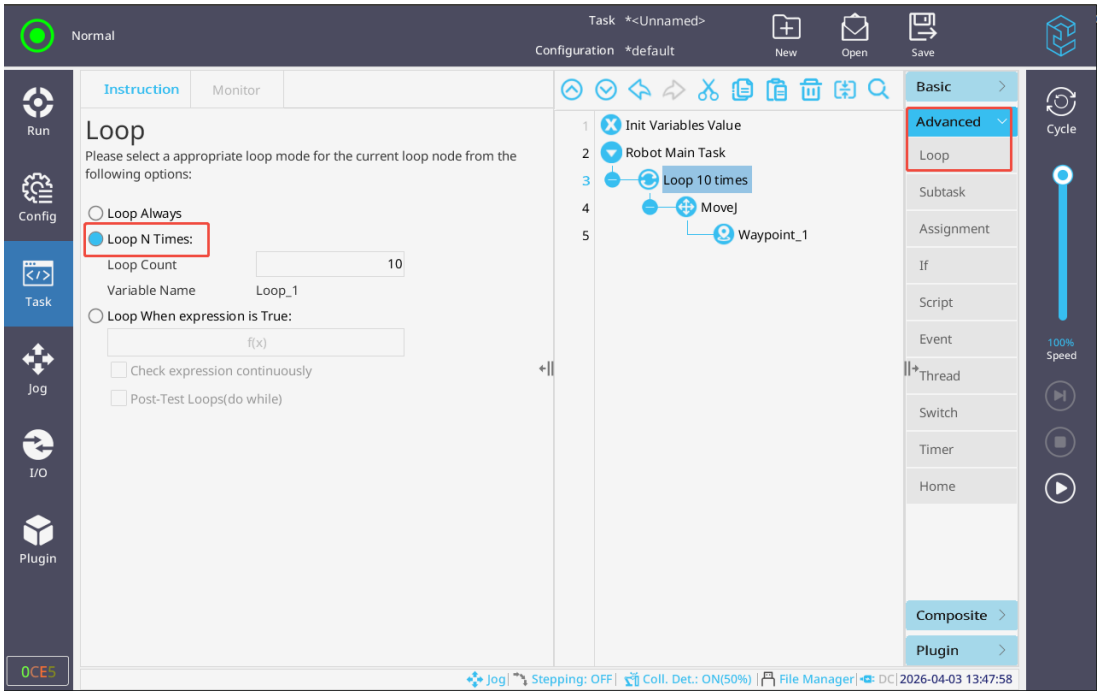


Figure 3-122: Loop

Loop mode including:

- Loop Always : The task loops all the time;
- Loop N Times: Defines the loop times;
  When the specified number of loops is run, the task will create a special loop variable, which is used to count the number of loops.
- Loop When the expression is True: when the expression is true, the tasks of the child nodes will be executed in a loop all the time.
  Note:
  1. If [Check expression continuously] is checked, during the loop, as long as the expression is not true, it will immediately jump out of the loop and execute down.
  2. When the loop mode of a loop node is set to an expression, it supports [Post-Test Loops(do while)]. If [Post-Test Loops(do while)] is checked, the loop will execute once before checking whether the condition is met.

3. ”Check expression continuously” and ”Post-Test Loops(do while)” are mutually exclusive and can not be checked simultaneously.

3.6.5.2 Subtasks

Subtask defines a reusable set of operations. You can either edit the content directly or load an existing task file. Both the main task and subtasks can call other subtasks via the [Call] node.

All subtasks appear at the same level in the task tree. The [Call] nodes within each task define the call relationships.

1. Creating a Subtask Node

1. Select the [Robot Main Task] node or any node under it, then tap [Advanced] > [Subtask] on the right to add a [Call] node.
2. Select [New] from the drop-down menu on the [Call] node’s parameter page. A blank subtask node is then added to the task tree.

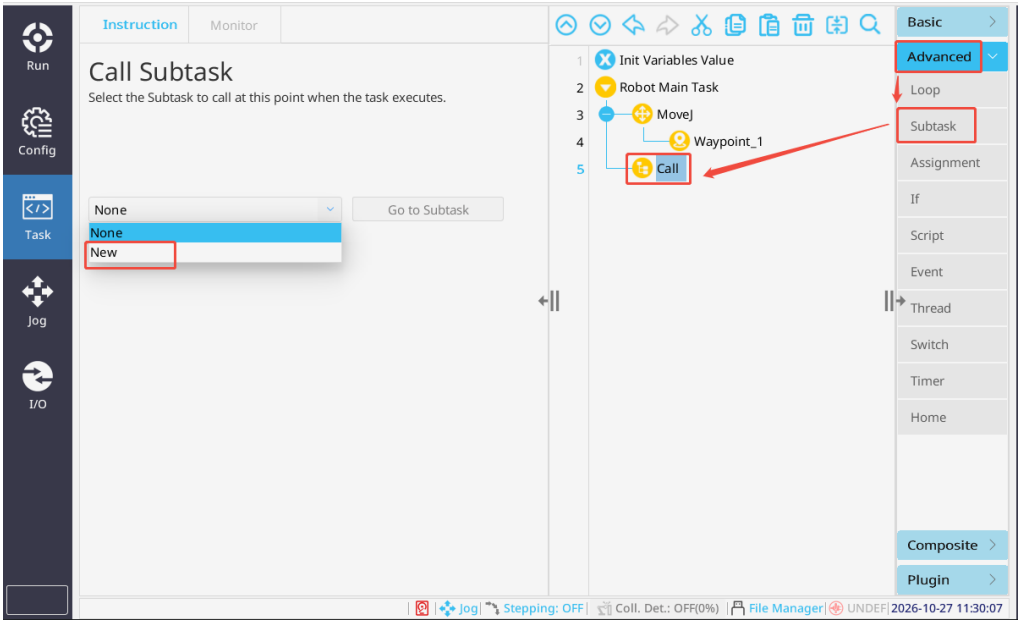


Figure 3-123: Creating a Subtask Node

2. Editing or Loading a Subtask

Tap the newly added subtask node and add content in either of the following ways:

- **Editing:** Add the required nodes using the command bar on the right.

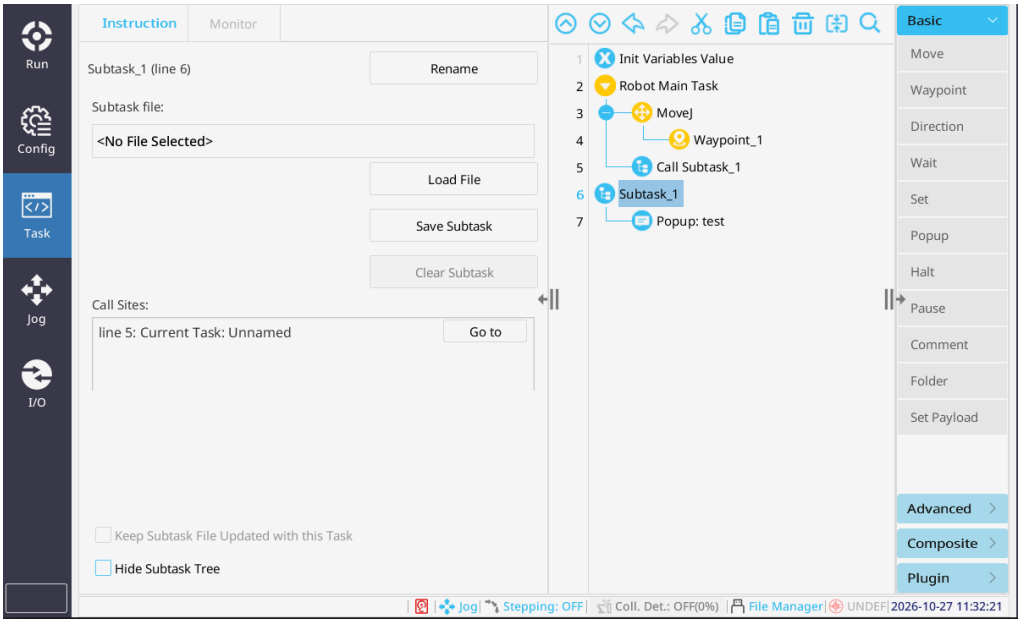


Figure 3-124: Editing A Subtask

- **Loading an existing file:** Tap [Load File] or [<No File Selected>], select a task file in the pop-up window, and tap [Open]. The file's main task content is loaded into the current subtask. The subtask node takes the file name, and the corresponding [Call] node displays [Call <Subtask Name>].

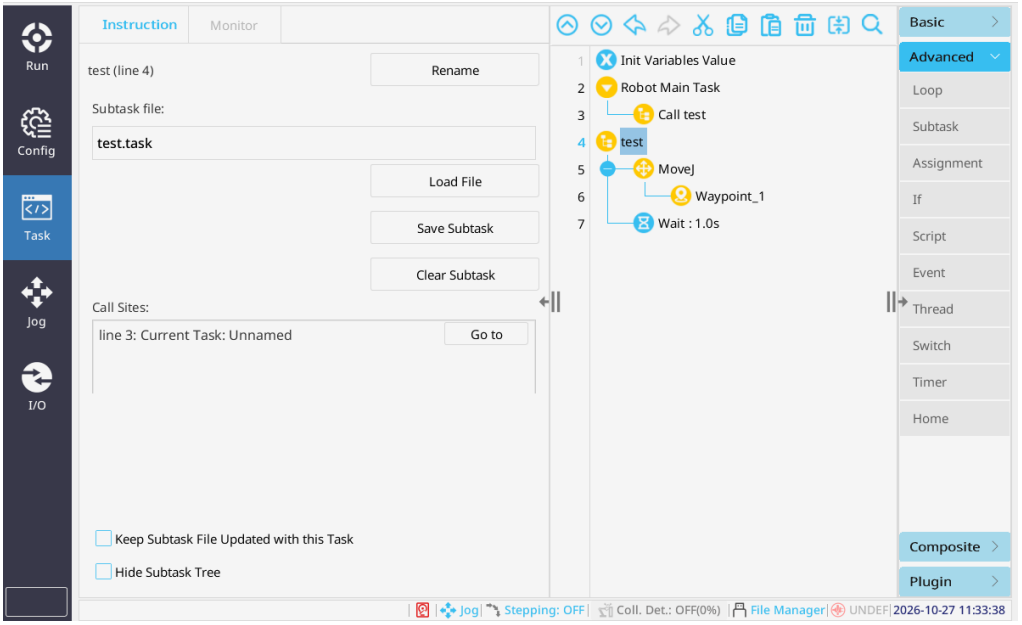


Figure 3-125: Loading a Task File

If the loaded file calls other subtasks, those subtasks are also loaded, and their call relationships are preserved. Each subtask is loaded only once; unused nodes are not loaded. For instance, if a file loaded into subtask A calls subtask B, the file's main task content is loaded into A. B is added as a separate subtask at the same level in the task tree but is labeled [Managed by A].

The subtasks loaded along with the file, including their internal nodes, are read-only. Their [Load File] and [Save/Clear Subtask] buttons and synchronization options are disabled. To modify these subtasks, open the source file separately, make and save the changes, then return to the current task and reload the file through the subtask node that manages them.

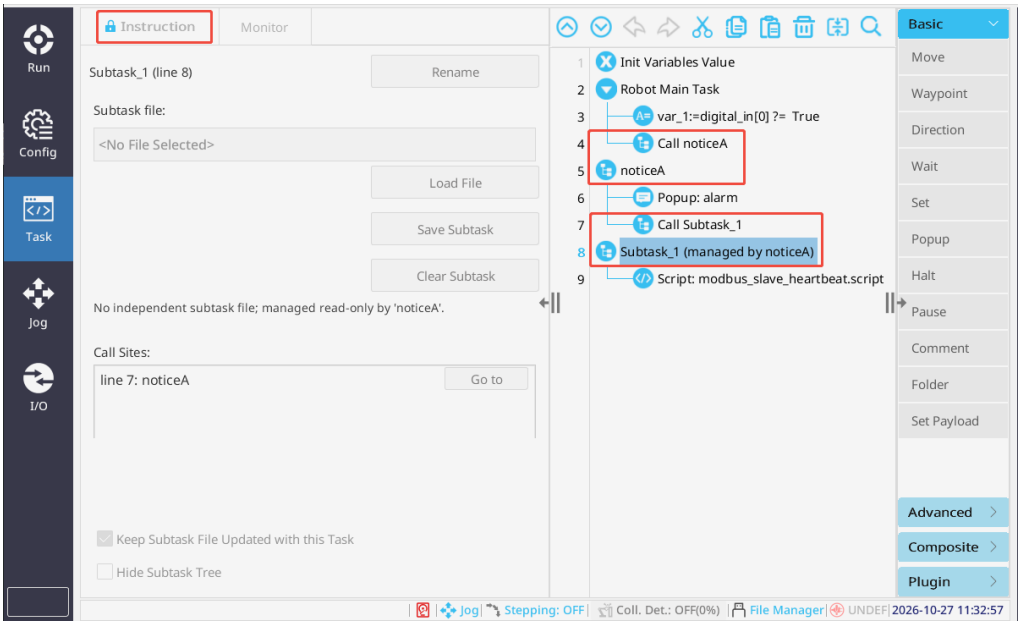


Figure 3-126: Loading a Task File That Calls Other Subtasks

If an imported subtask has the same name as an existing subtask in the current task, the system automatically adds a suffix and displays the source name and gives an explanation of the naming conflict on the parameter page.

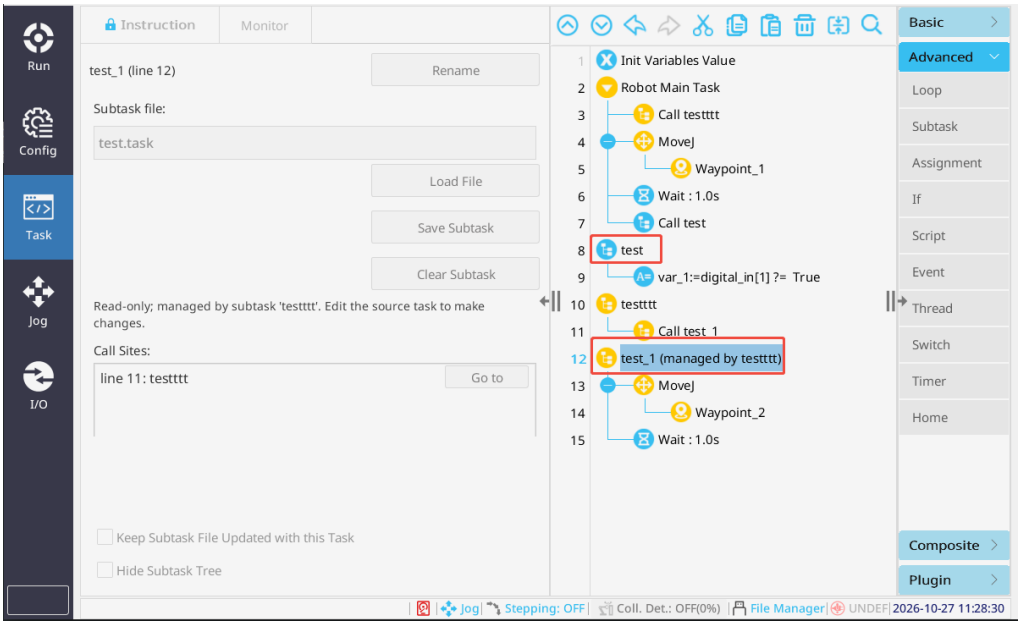


Figure 3-127: Subtask Naming Conflict Example

NOTICE

- When using [Load File], you cannot select the currently open main task file.
- The main task and its all subtasks share the configuration file associated with the current task. After loading, please verify that the variables, coordinate systems, tools, and I/O used are available in the current configuration.
- Locally created subtasks remain editable.

3. Calling a Subtask

A subtask can be called from multiple locations without being created or loaded repeatedly:

1. Select an insertion point under the main task or an editable subtask, then tap [Advanced] > [Subtask] to add a [Call] node.
2. Select an existing subtask from the [Call Subtask] drop-down menu. Each entry is shown in the format [Line No.: Subtask Name].

When execution reaches the [Call] node, the corresponding subtask runs. When it finishes, execution returns and continues with the nodes after the [Call] node.

On the [Call] node's parameter page, tap [Go to Subtask] to navigate to the corresponding subtask node.

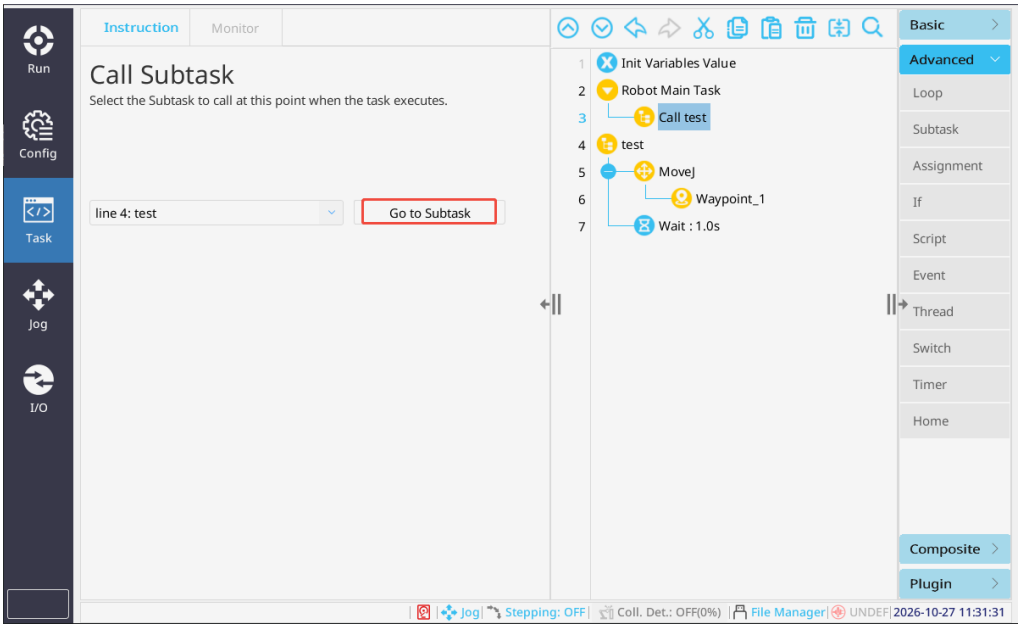


Figure 3-128: Jump to Subtask Node

On the subtask's parameter page, tap [Go to] to navigate to the corresponding call node. This button is disabled for subtasks loaded along with a file.

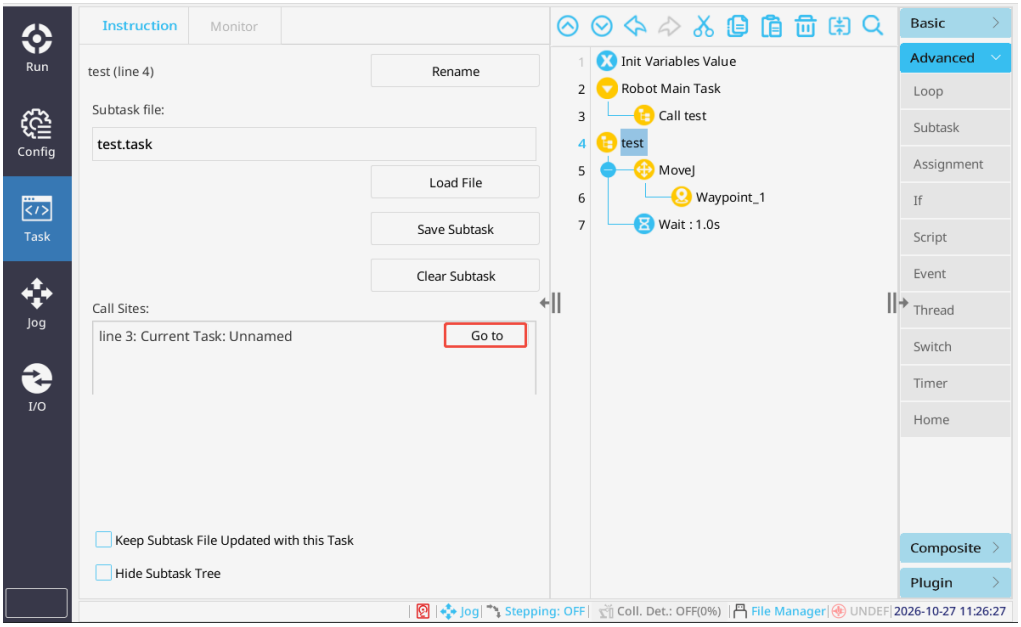


Figure 3-129: Navigating to a Call Node

NOTICE

- If a [Call] node is compressed, that node is skipped during execution, and the subtask is not called at that location.
- If a subtask node is compressed, all calls to that subtask are skipped during execution.
- After the node is expanded, calls resume if the subtask content is valid.
- Collapsing or hiding the subtask tree does not affect calls.

4. Nested Subtask Calls

A nested call occurs when a subtask calls another subtask. The procedure is the same as calling a subtask from the main task. For instance, the main task calls subtask A, A calls B, and B calls C. When C finishes, execution returns to B, then to A, and finally to the main task as each subtask finishes. Each calling task resumes execution after its [Call] node.

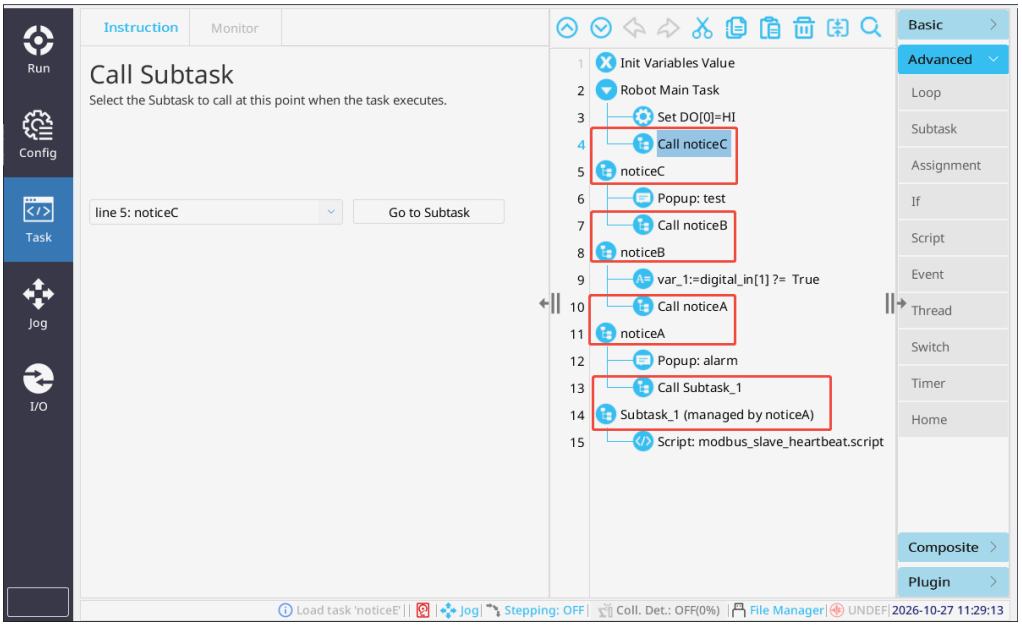


Figure 3-130: Nested Subtask Calls

The following rules apply to nested calls:

- **Nesting depth:**
  A single call chain supports up to 32 subtask levels, excluding the main task. For instance, A is at level 1 when called by the main task, and B is at level 2 when called by A. The depth of each call branch is counted separately. If a call chain exceeds 32 levels, the relevant [Call] node configurations are invalid. Reduce the nesting depth before running the task.

- **Recursive calls are not allowed:**
  A subtask cannot call itself, directly or indirectly. For example, if subtask A calls subtask B, B cannot call A. If the opened task file already contains recursive calls, correct the call relationship before running the task.

5. Loading, Saving, and Synchronization

The top-level subtask node into which an external file is loaded manages both the file's main task content and any subtasks loaded with it. The following operations are available:

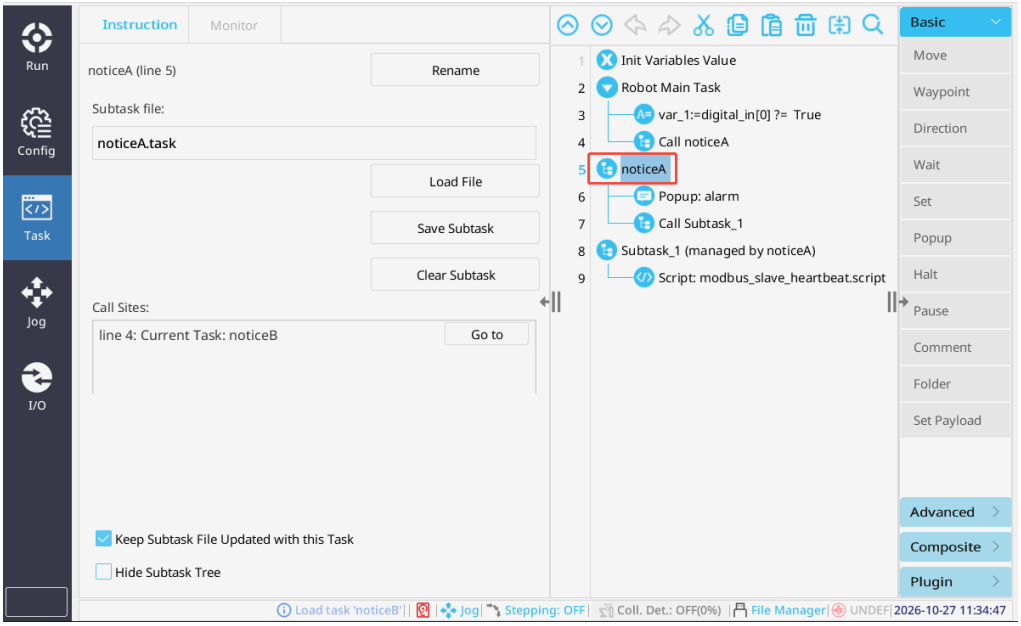


Figure 3-131: Subtask Node Operations

- **Load File:**
  Loads a file's main task content and any subtasks it calls.
  To update the content from the source file, select the file again to reload it. The system updates all content loaded from that file. If the file cannot be read or parsed, the existing content is retained.

- **Save Subtask:**
  Saves the current subtask and any subtasks it calls together in a task file. The separate files associated with those other subtasks are not overwritten.

- **Clear Subtask:**
  Clears the loaded content and removes the other subtasks managed by this node. Source files on disk are not deleted.

- **Rename:**
  This operation only modifies the subtask node name in the current task. The associated source file name keeps unchanged.

When [Keep Subtask File updated with this Task] is checked:

- Opening the main task automatically updates the subtask content from the associated file.
- Saving the main task saves the current subtask content to the associated file.

This option also applies to the subtasks loaded with the file. Clearing the option retains the current content and stops automatic updates. Those subtasks remain read-only. Changing this option does not immediately update the content.

Checking the [Hide Subtask Tree] option hides the nodes within the subtask without affecting calls to the subtask or its execution.

NOTICE

- Saving the main task with synchronization enabled overwrites the existing content in the source file. External changes to the file are not merged. If an associated file has been modified elsewhere, back it up first, or reload it and verify its content before saving.
- The main task and its associated subtask files are saved separately. Saving the main task successfully does not guarantee that all associated subtask files have been updated. If a subtask save failure is reported, check the corresponding file and save again.
- If a called subtask no longer exists after content is cleared, deleted, or reloaded, the corresponding [Call] node turns yellow. Select a valid subtask or select [None] to cancel the call.

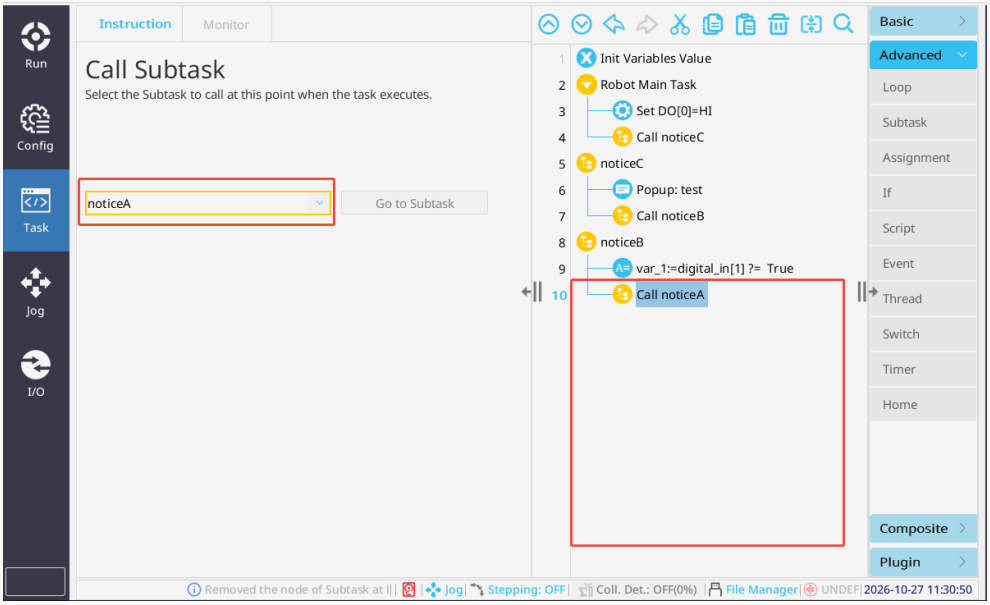


Figure 3-132: Subtask Deleted

6. Handling File Synchronization Cycle

A file synchronization cycle occurs when A.task loads B.task with synchronization enabled, and B.task in turn loads A.task with synchronization enabled. The system displays the cycle and stops further loading. The affected node configurations are invalid.

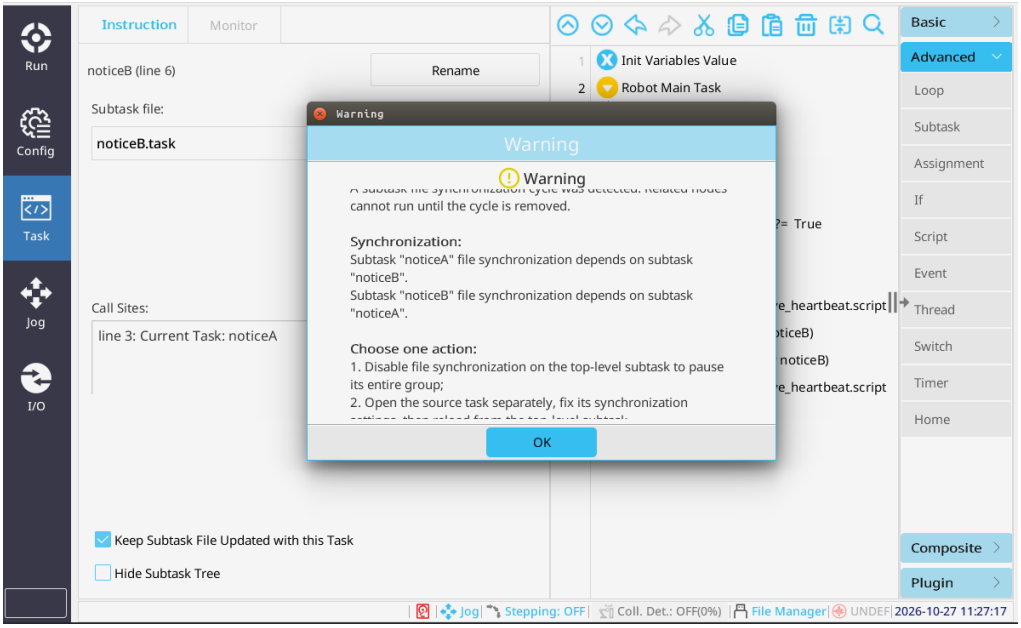


Figure 3-133: File Synchronization Cycle Alert

When this alert appears, open the source file separately and either disable the synchronization option that causes the cycle or select a different file to load. Save the changes, then return to the current task and reload the file.

You can also disable synchronization in the subtask node that loads the file to retain the current content. If the cycle prevented some content from loading, you must still correct the source file and reload it.

NOTICE

Setting the [Call] target to [None] does not remove the file synchronization relationship and therefore does not resolve the file synchronization cycle.

3.6.5.3 Assignment

The process of assigning a value to a variable is called assignment. The variables created by the assignment instruction are local variables, which can be initialized.

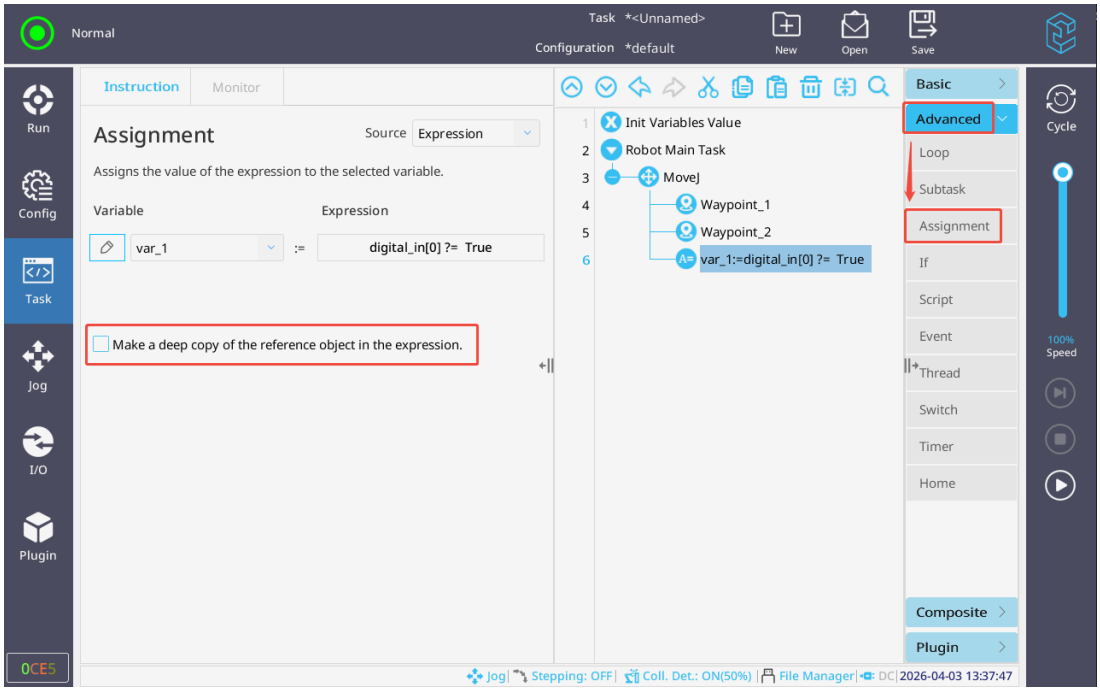


Figure 3-134: Assignment

The user can select a variable from the drop-down list. To rename the variable, click and enter a new name in the text keyboard (note: the text keyboard supports for typing Chinese). To cancel the input, click the [ESC] key on the upper right to cancel the input. In the display, the user can select the checkbox in front of "Make a deep copy of the reference object in the expression" and when selected, the new copy of the node will not change with the source data. If not selected, the user makes a shallow copy of the node and the changes of the newly copied node will be subject to the source content.

The statement that assigns a certain value to a variable is called an assignment statement.

The source of assignment statement is:

- Expression: Custom assignment statement can be specified by I/O, variable, pose or script function;
- Operator: After the user needs to operate in the pop-up window, the task will continue to run.
  - Yes or No: Select Yes or no in the pop-up window or [Cancel] twice to cancel the entry;
  - A decimal integer: Enter an integer or click twice to cancel input;
  - A decimal fraction: Enter a decimal number or click twice to cancel input;
  - A text string: Enter a string or click [ESC] twice on the upper right to cancel the input.

3.6.5.4 If

If and If...Else statement structure can execute corresponding branches according to the expression.

1. Select [Task] > [Advanced] > [If].
2. Click [If] in the task tree to modify the expression.

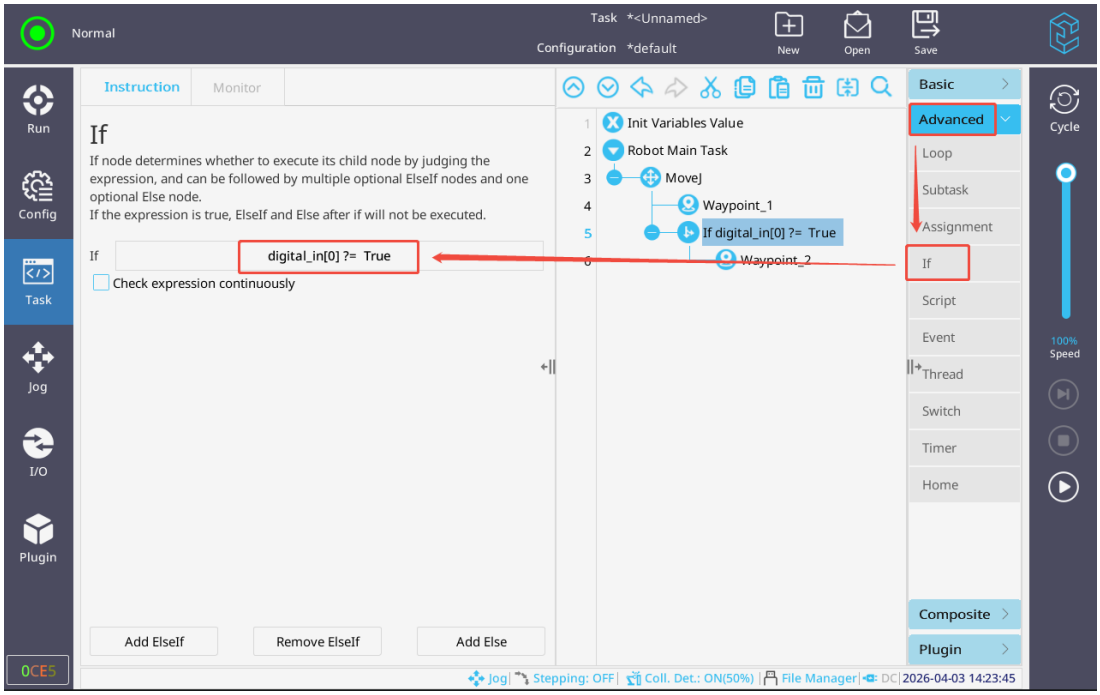


Figure 3-135: If

3. On the empty node, edit the node in If node.

If the expression is true, the node in If will be executed. An If statement can have at most one else statement.

Use [Add ElseIf] and [Remove ElseIf] to add or remove ElseIf expression.

If [Check expression continuously] is checked, it will always check whether the expression meets the trigger conditions when running the sub node of if. When the expression is not satisfied, the program will immediately jump out of the current If branch and continue to run the follow-up task.

3.6.5.5 Script

The drop-down list of [Script] provides the following options.

Line allows users to write single line code using the expression editor;

File allows users to load local existing script files; Or edit the script content directly and save it.

Please refer to the script manual for details about the script file.

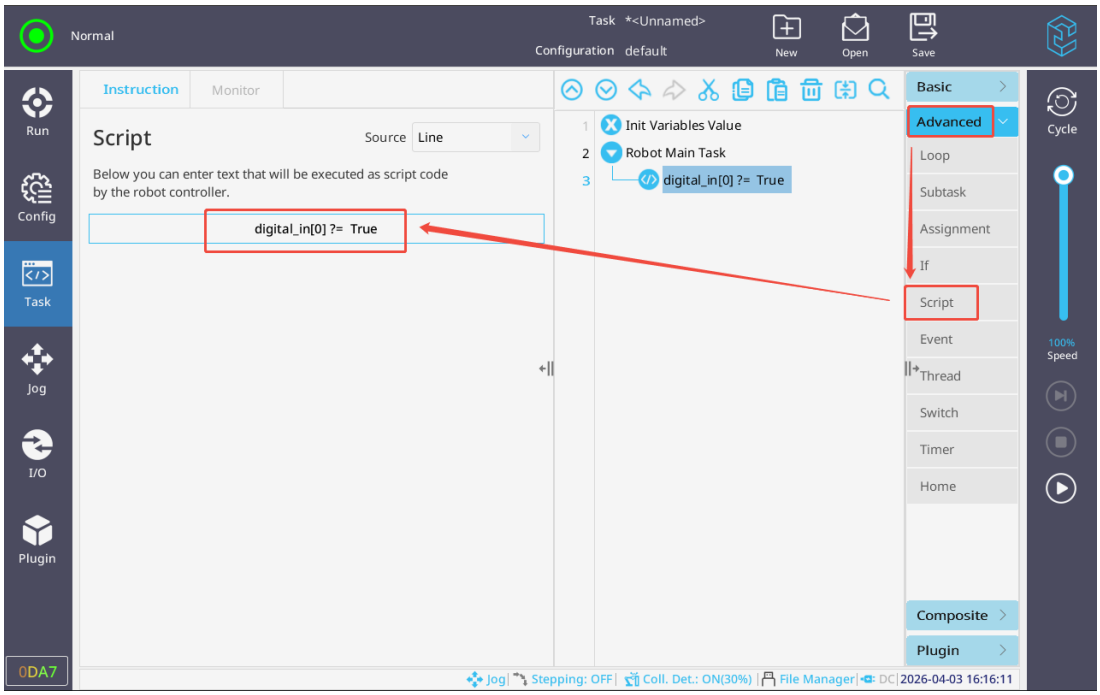


Figure 3-136: Script

3.6.5.6 Event

The [Event] node can be used to monitor the expression. When the expression is true, the child nodes in the [Event] will be executed. Expressions usually can include signals, task variables, etc. Therefore, the [Event] node is often used to monitor input signals or variables and execute child nodes when conditions are met.

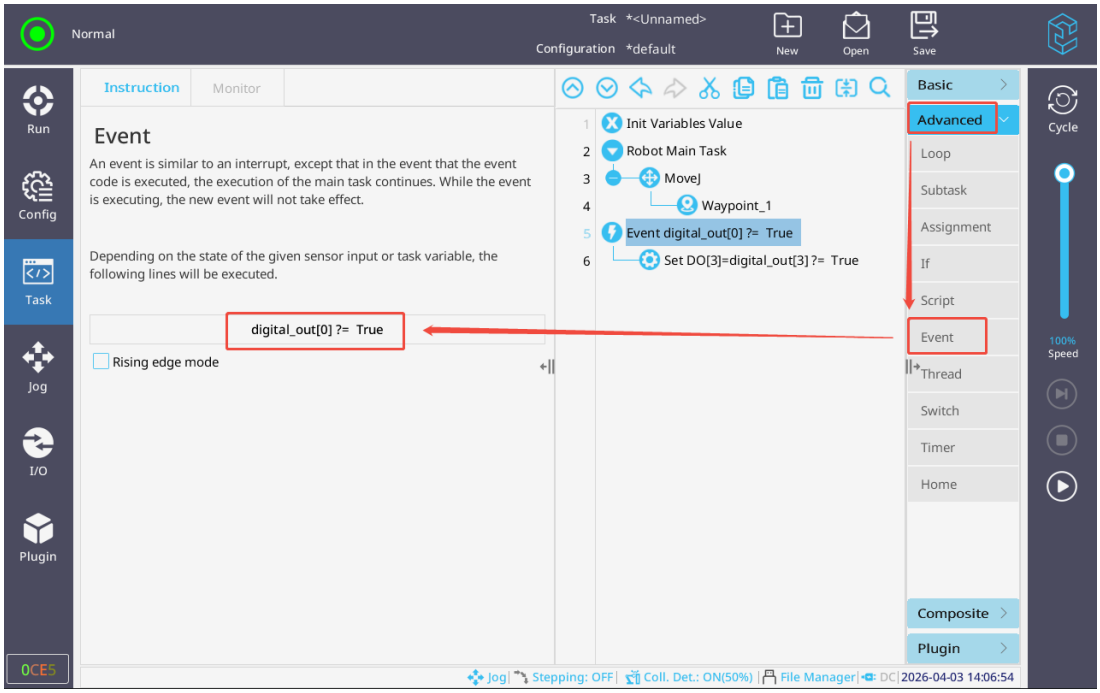


Figure 3-137: Event

Note:

1. When multiple events meet the conditions simultaneously, priority is given to executing the events that are ranked higher. Remaining events will not be executed regardless of whether they meet the conditions.
2. When [Rising edge mode] is checked, events will only be triggered when the condition changes from false to true. It is recommended not to trigger multiple events simultaneously to avoid overly complex execution logic, which can make it difficult to achieve the expected execution flow.

3.6.5.7 Thread

Thread is a parallel task running together with the main task. It is a parallel process of robot task. It is mainly used to control external machines and is not recommended to control the movement of robot arm. Therefore, the ”Thread” node is mainly used to execute I/O actions, wait for signals and set variables.

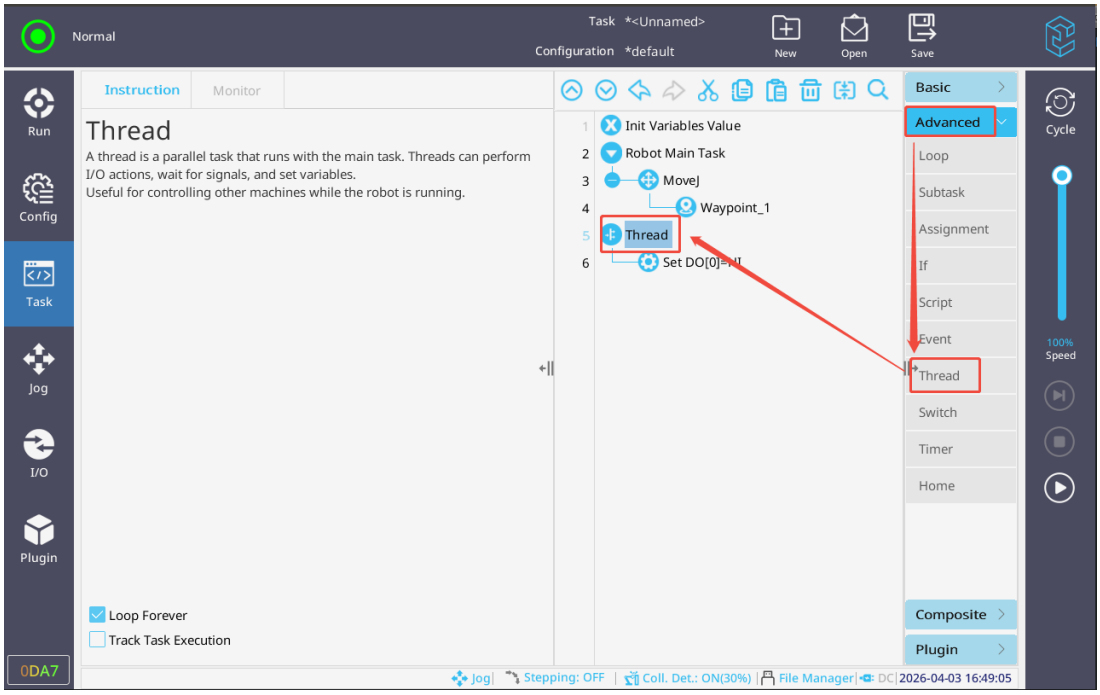


Figure 3-138: Thread

3.6.5.8 Switch

Each [Switch] node can contain multiple [Case] nodes and one [Default Case] node.

When running to the [Switch] node, the task judges the value of the expression first. If it matches the case value, the corresponding case node will be executed. If it does not match, the default case will be executed or none will be executed.

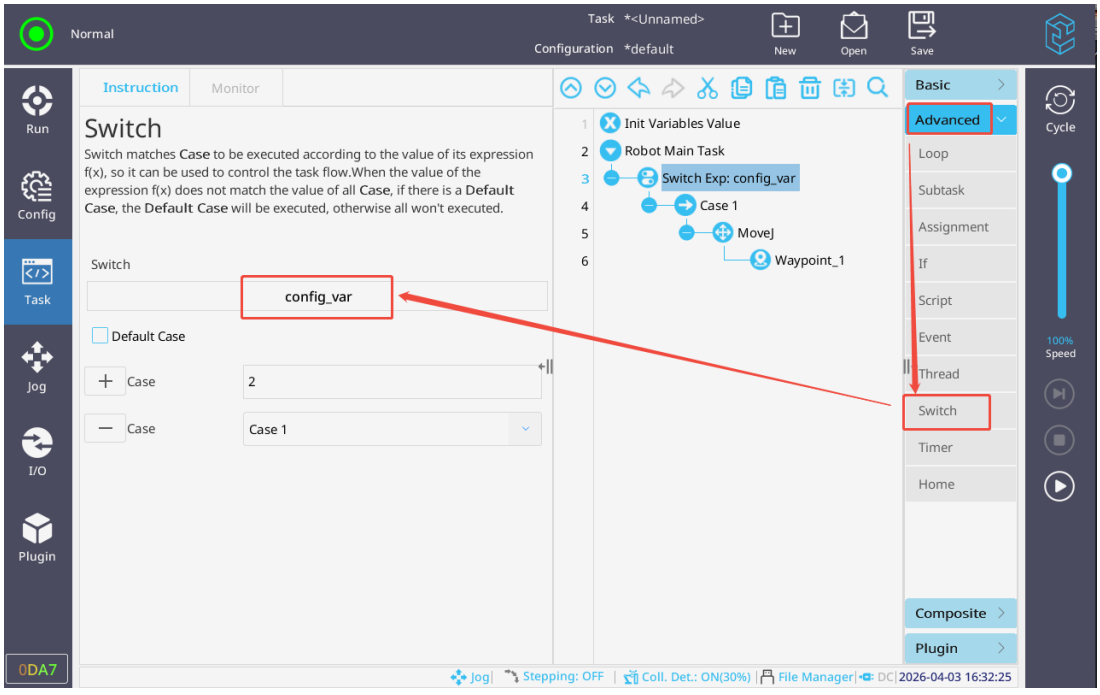


Figure 3-139: Switch

The user can fill in the value of the situation first, then add ”Case” node.

3.6.5.9 Timer

A timer is used to measure time. The measured time appears in the variable.

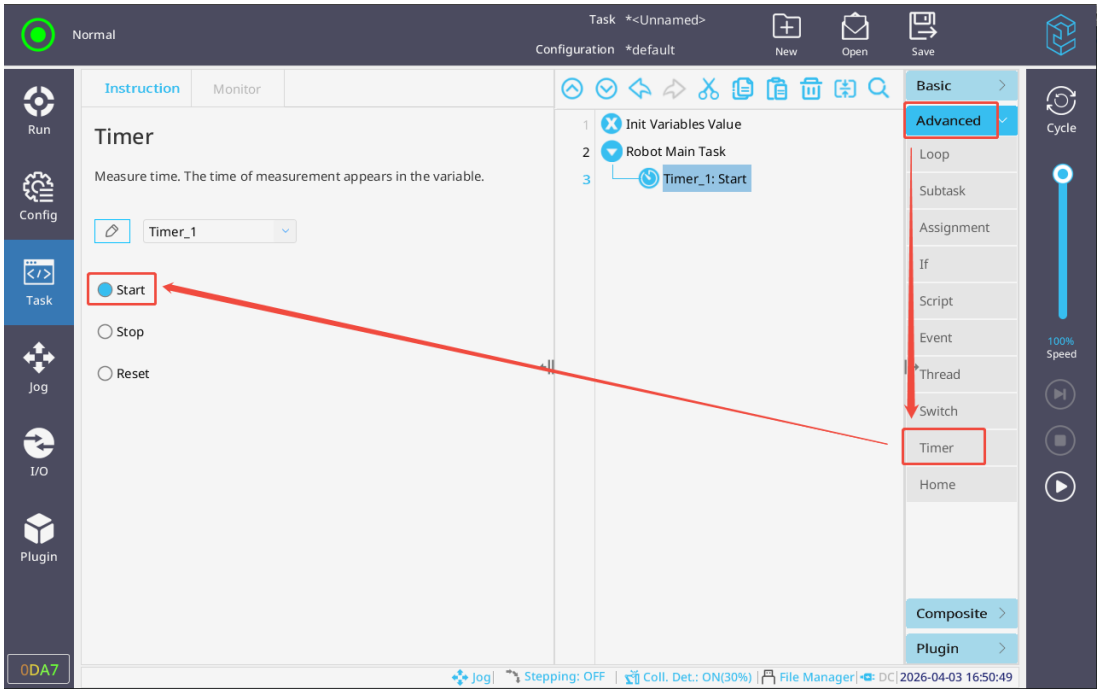


Figure 3-140: Timer

The timer nodes include:

- Start: the timer starts counting;
- Stop: the timer stops. The measured time can be viewed through the [monitoring] > [variables] interface;
- Reset: resets the variable value of the current timer.

3.6.5.10 Home

The user can run the robot to the home position defined in [Config] > [General] > [Home] and select [Active Home] or [Safety Home] from the drop-down list of the source. Please refer to Subsection 3.5.2.1 for the details about the safety home, the Subsection 3.5.2.4 for the details about the I/O settings and the Subsection 3.6.4.2 for details about movement mode.

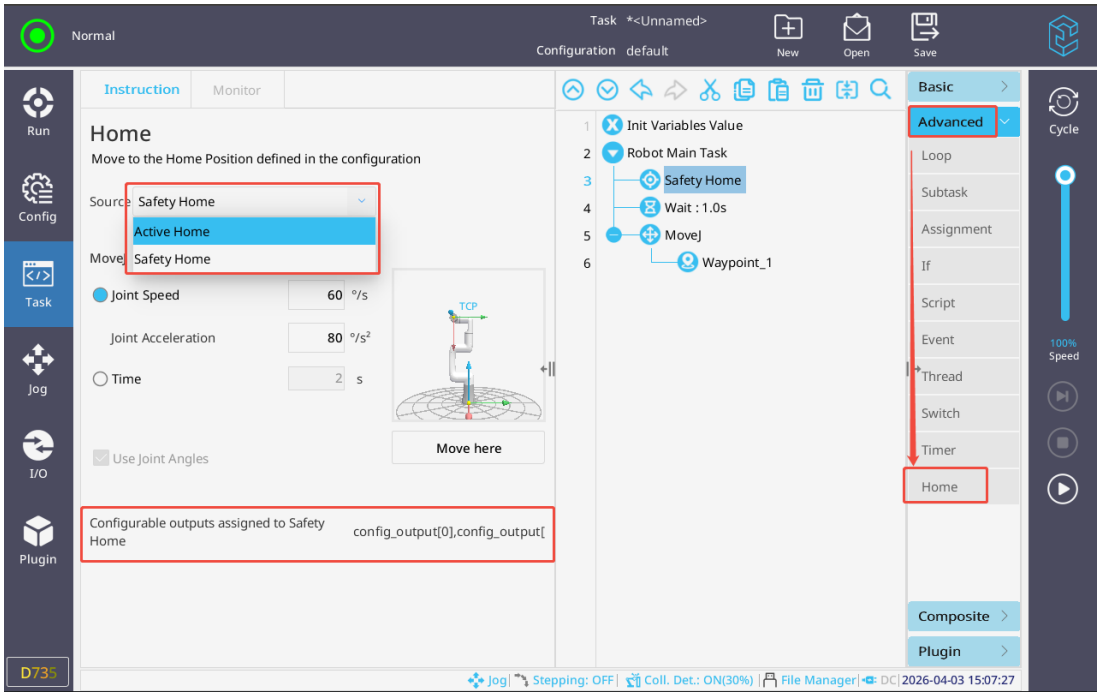


Figure 3-141: Home

3.6.6 Composite

The Composite node provides such function options as offset, conveyor tracking, force, palleting, and conveyor belt tracking, and trajectory recording for users to achieve various application scenarios.

3.6.6.1 Offset

Tap [Task] > [Composite] > [Offset] into the Offset interface, which allows for parameters configuration pertaining to the offset based on a certain waypoint or variable, and supports pose or joint offset modes. To be specific, users can perform offset operations on the pose or joint data of the chosen waypoint or variables via the offset frame or data.

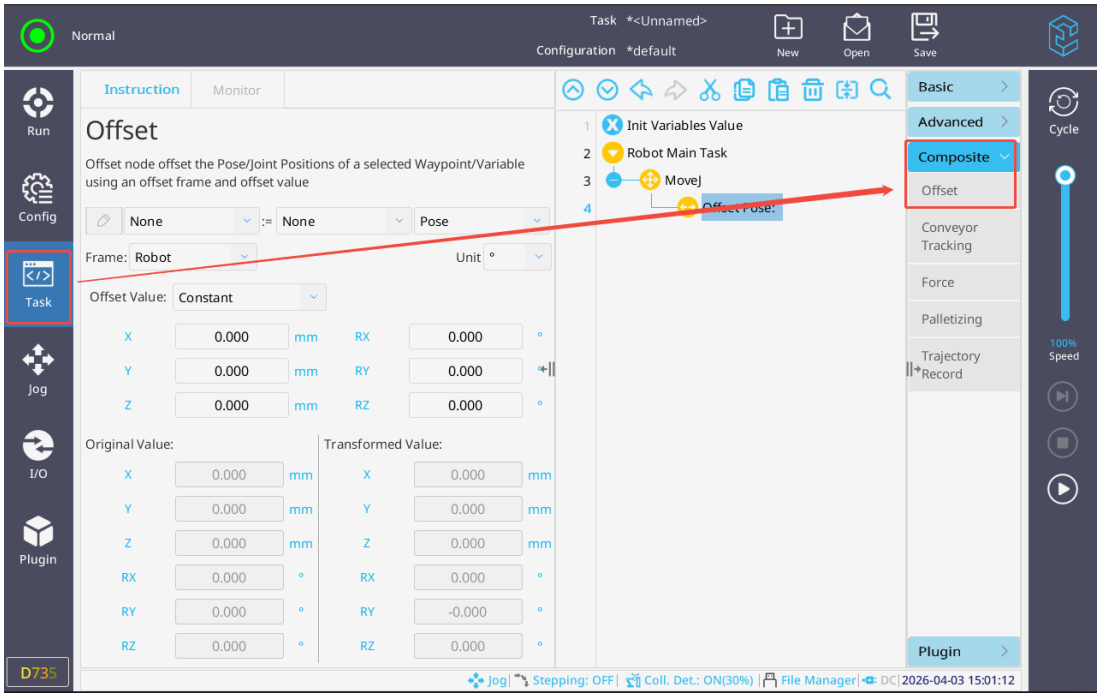


Figure 3-142: Offset

Options Menu

1. **Offset Results**
   - Create a new task variable or choose any configuration variable to receive the offset result data.
   - To create a new task, tap the first drop-down box and then select [Create New].

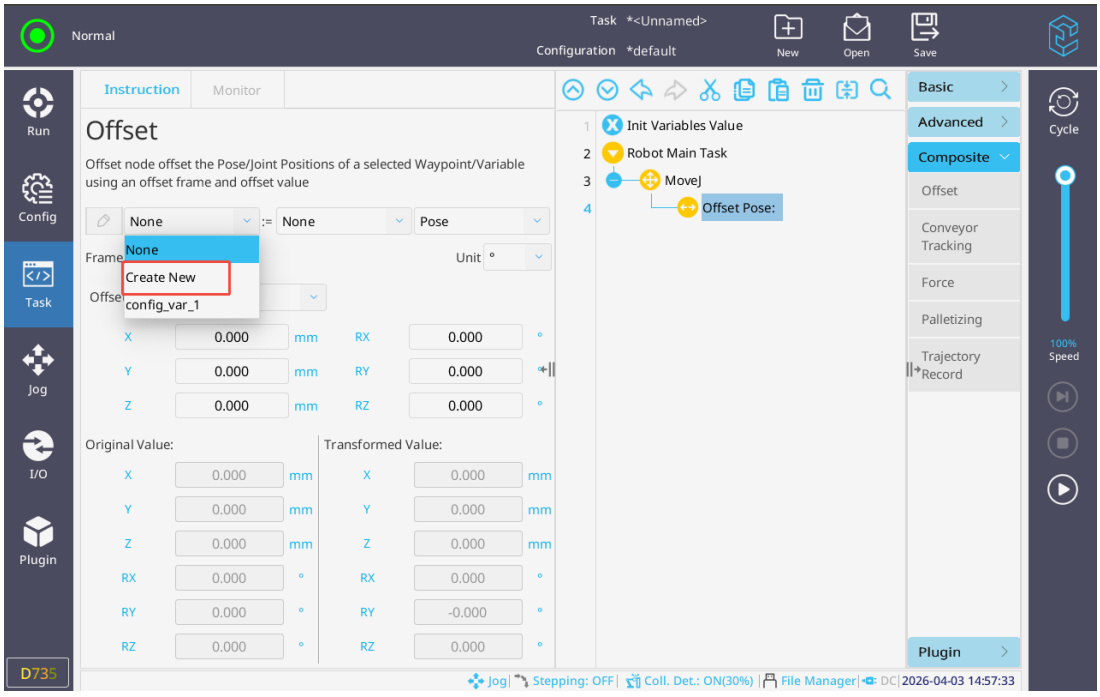


Figure 3-143: Create A New Task Variable

- Tap the same box and select any required configuration variable.
- If the offset result is a task one, tap the first icon to rename it; yet if being a configuration one, the system does not support the renaming operation.

2. **Data Source & Type**
   - Tap the second drop-down box to select a waypoint at a fixed location, or a task variable or a configuration one as the source of pose or joint offset.

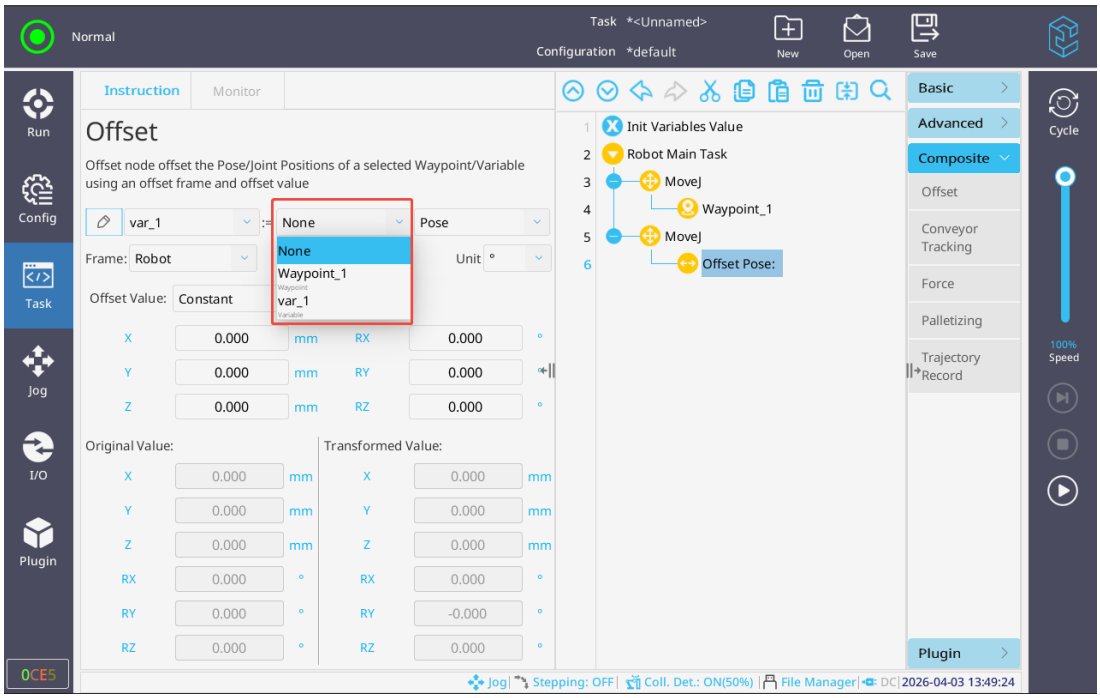


Figure 3-144: Select Data Source

- If the data source is a waypoint, then tap the last box at the first line to select [Pose] or [Joint Positions] as the data type for the waypoint.

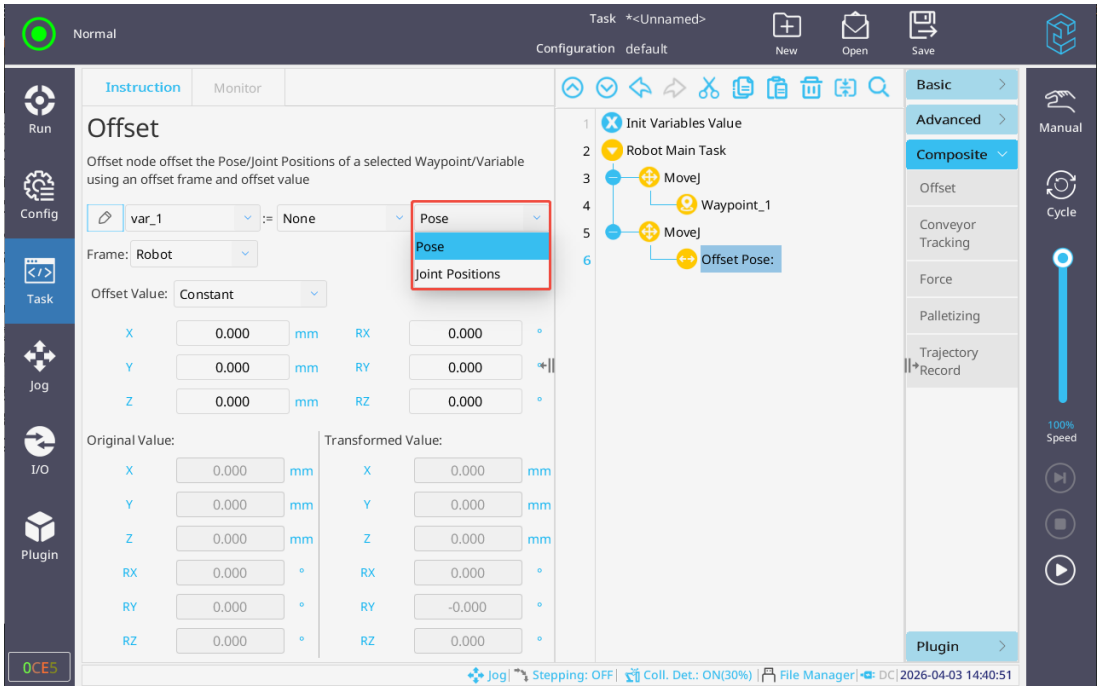


Figure 3-145: Select Data Type for the Waypoint

- if the source is a task or configuration one, then the data type of the variable need to be coincide with that in the variable.

3. Offset Mode

- Select Pose or Joint as the offset mode as required.
- The interface of offset based on the pose is illustrated in **Figure** 3-146.

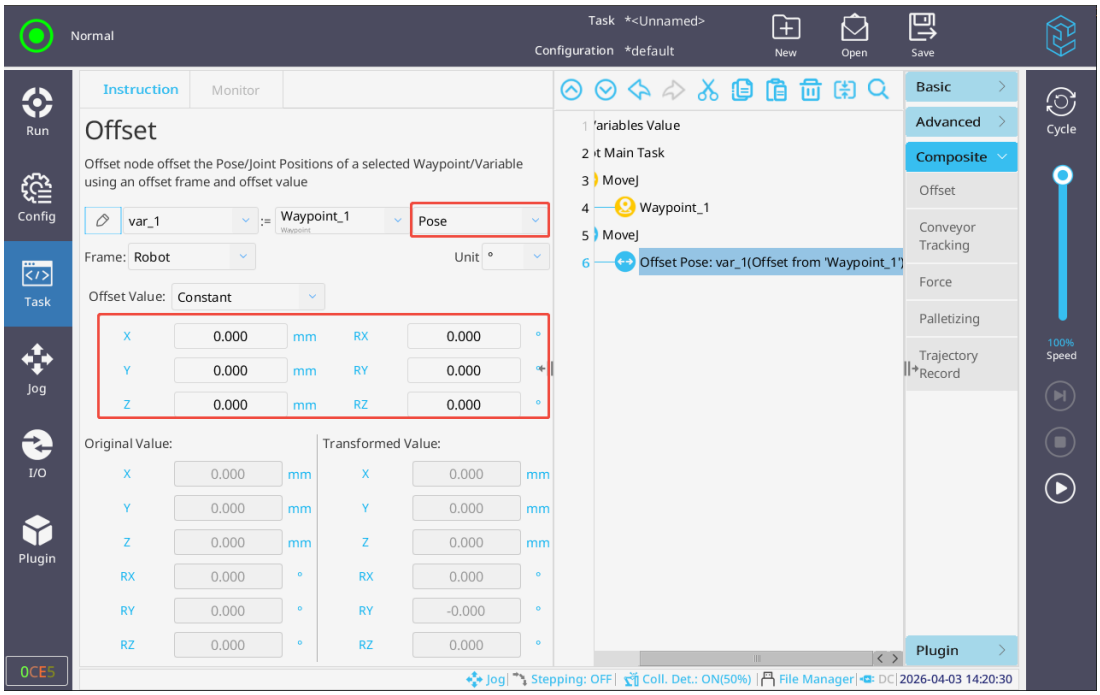


Figure 3-146: Offset Pose

- As for the joint-based offset (see **Figure** 3-147), the raw data of the same unit can be directly added to the offset values to generate the new joint angle data.

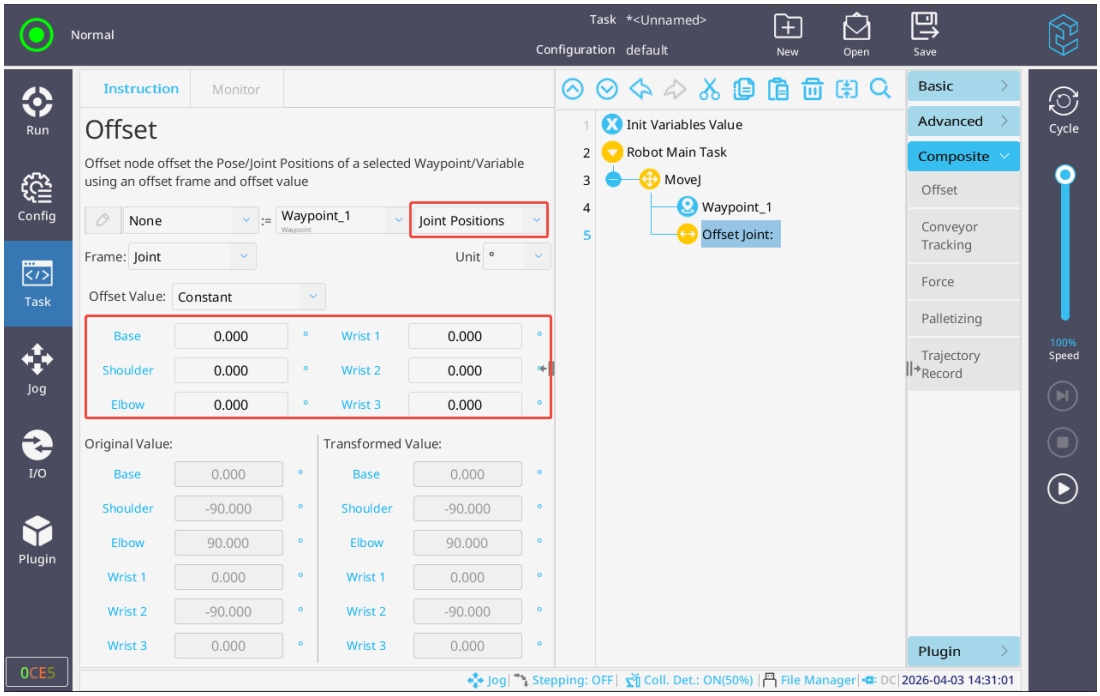


Figure 3-147: Offset Joint

4. **Frame**
   - The frame for the pose-based or joint-based offset can be specified.
   - For the pose-based offset, its frame can be the robot, tool or own gesture, as presented in **Figure** 3-148.

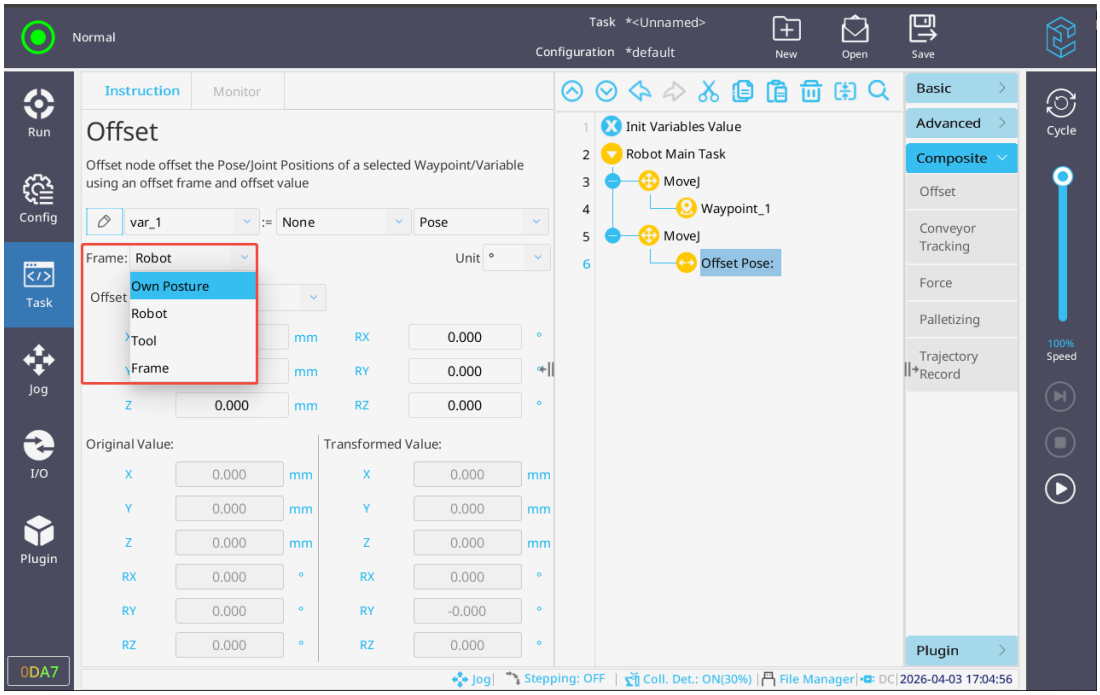


Figure 3-148: To Specify the frame for Pose-based Offset

- The robot coordinate system is a coordinate system that takes the installed base of the robot as its reference.
- The tool coordinate system represents the coordinate system corresponding to the real-time position and pose of the end effector.
- The own posture coordinate system means the current coordinate system of the robot's position and pose.

- For the joint-based offset, the coordinate system defaults to be the joint one.

NOTICE

To achieve offset pose based on a certain waypoint,

- if the Tool Coordinate System is selected:
  - Since the data of the tool coordinate system varies during operation, it is necessary to ensure that the offset function node is located below this waypoint(this means only if there is no move node between them, for instance, Move- waypoint and direction), so as to execute accurate calculation based on the real-time tool coordinate system, achieving the desired pose offset.

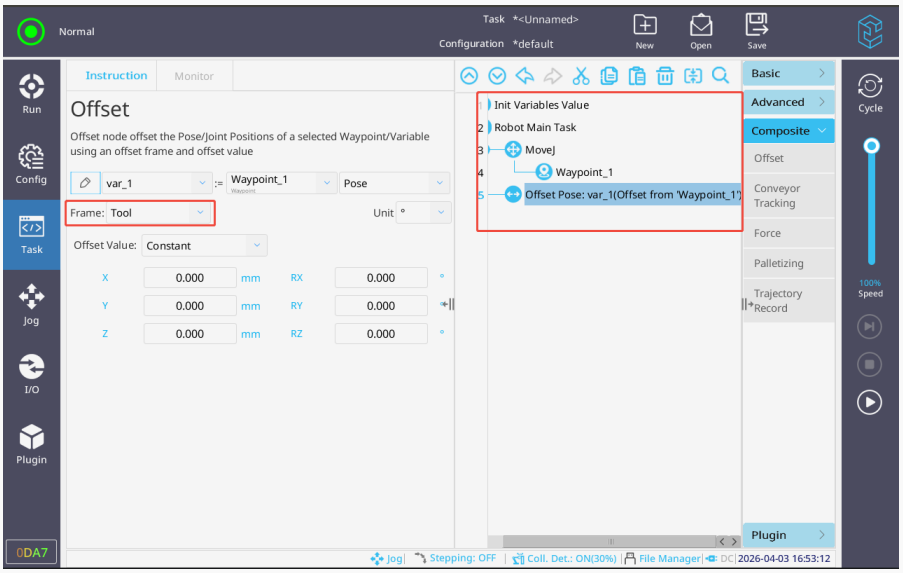


Figure 3-149: Set Tool Coordinate System for Offset Pose

- however, selecting [Own Posture] as the coordinate system can greatly simplify operations:
  - Since this coordinate system is nearly same to the robot's real-time tool coordinate system at this time, it only needs to select [Own Posture], without restricting the location of the offset node. The program will directly perform offset operation according to the coordinate system of the preset or the actual pose.

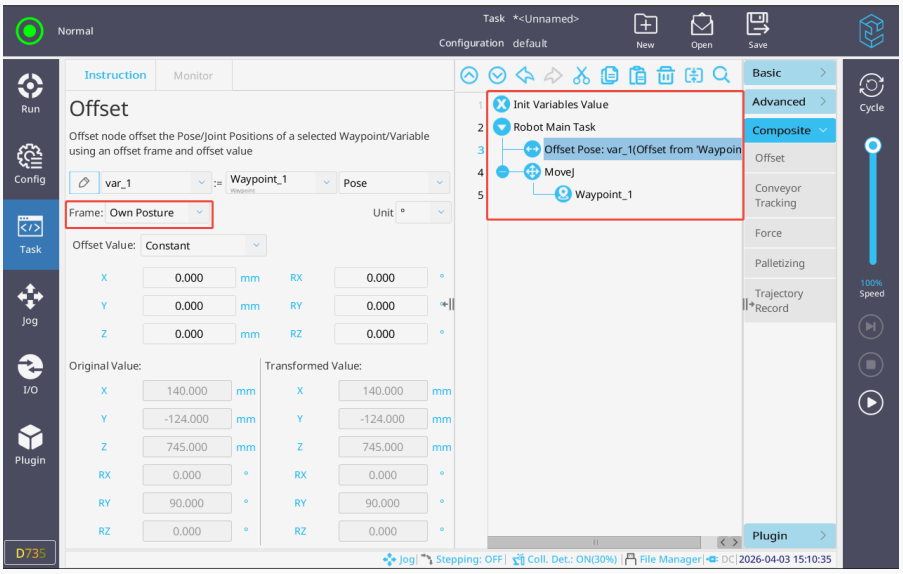


Figure 3-150: Set Own Posture for Offset Pose

5. **Angle Data Unit**
   - Select degree [°] or radian [rad] as the unit type for angles in offset data,

original values, or offset result data.

- Here the setting is only for display and it does not affect the actual data. Moreover, all offset nodes share this type.

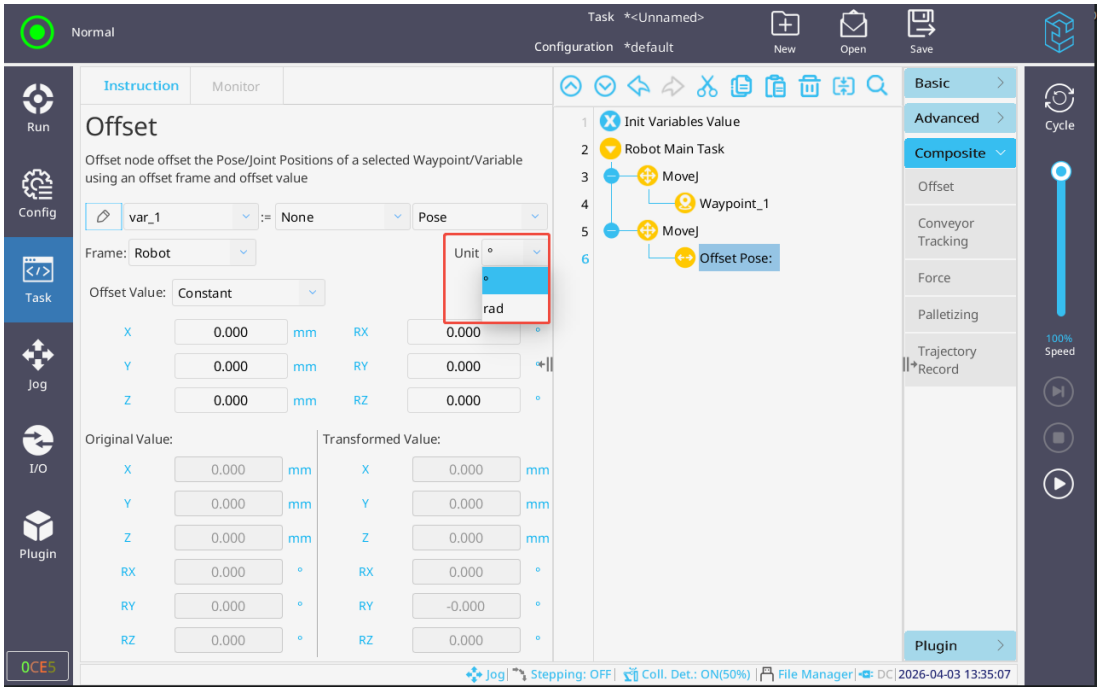


Figure 3-151: Select Angle Data Unit

6. Offset Value

- To specify the offset value to be a constant or variable one.
- If a constant is specified, then manually set the values for the X, Y, and Z axes, and these values need to remain unchanged during operation.
- If a variable is specified, a task or configuration variable can be the source of the offset data, but it is necessary to ensure consistency in data unit.

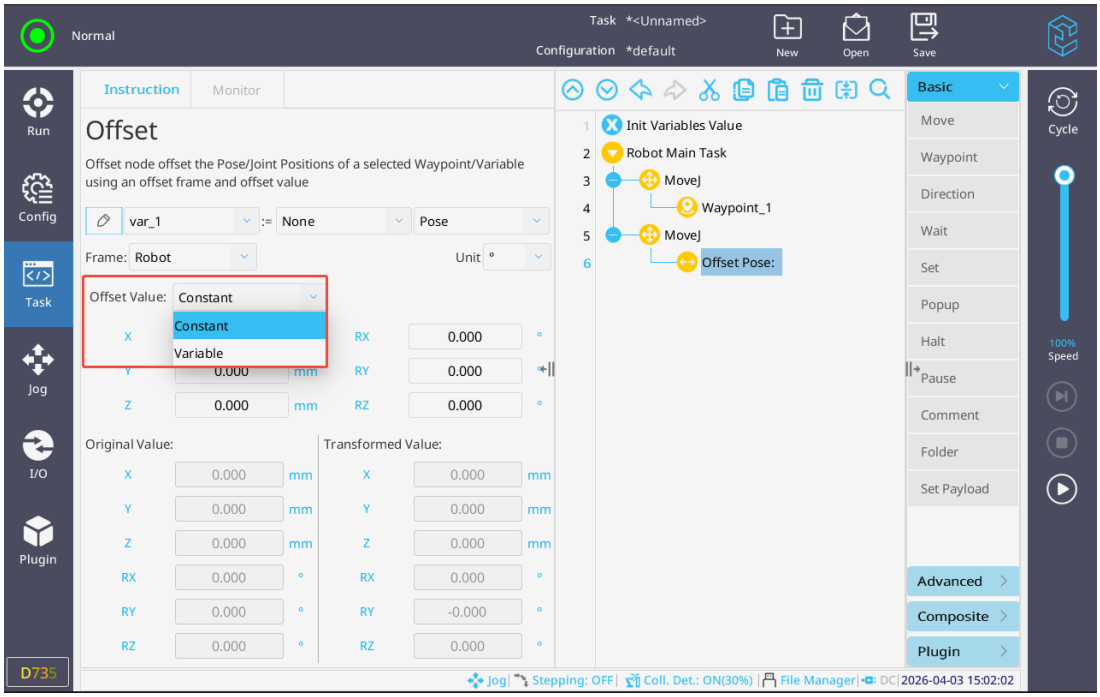


Figure 3-152: To Specify Offset Values

7. Data Display

- Users can preview the original values and transformed results.
- Since the task variable is not a global variable and their data values cannot be obtained when the robot is not in operation, here the data before and after the offset will not be displayed when the data source is a task variable.

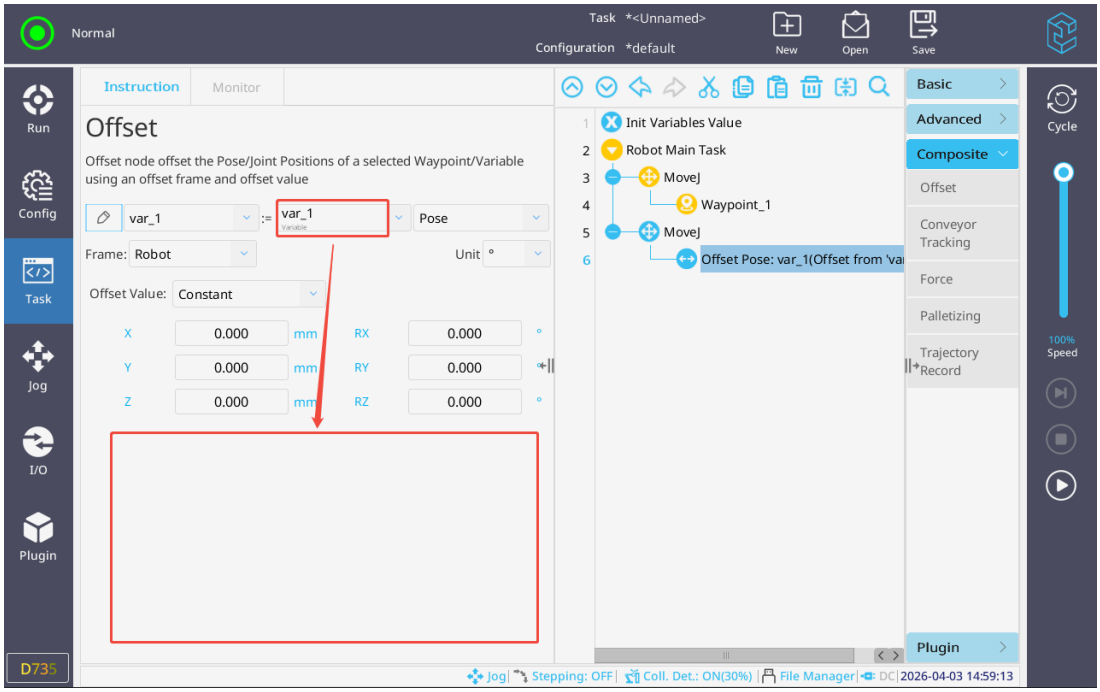


Figure 3-153: Data Display Interface when Data Source is A Task Variable

- Similarly, if the offset value is a task variable, since the data is not assigned a value when the task is not running, and the variable may change during runtime, the data is not be displayed when the offset value is a task variable.

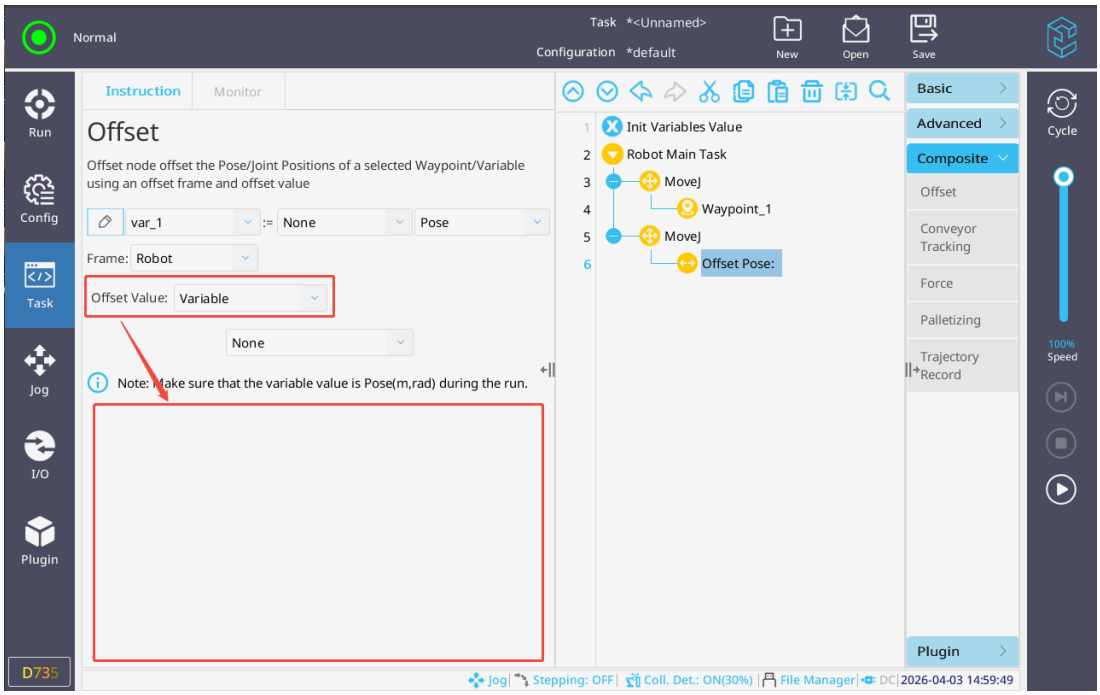


Figure 3-154: Data Display Interface when Offset Value is A Task Variable

- Since the tool coordinate system is actually the real-time pose and position of the robot's end effector, its data changes with the robot's operational status. Therefore, the data before and after the offset is still not displayed during the

running of the tool coordinate system.

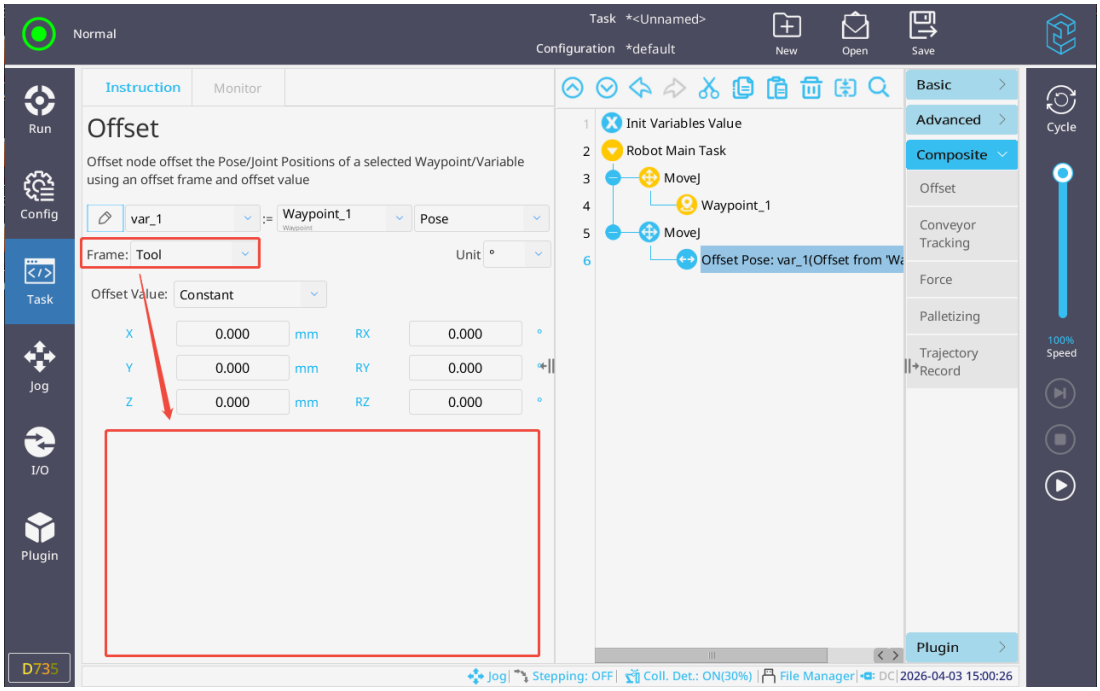


Figure 3-155: Data Display Interface when the Frame is the Tool Coordinate System

3.6.6.2 Palletizing

Palletizing supports user-defined layout type, number of layers, reference points, etc. to write palletizing and depalletizing tasks.

1. Create Palletizing Task

The steps are as follows:

1. Choose [Task] > [Composite] > [Palletizing].
2. Set the palletizing task name, frame, and cargo height.

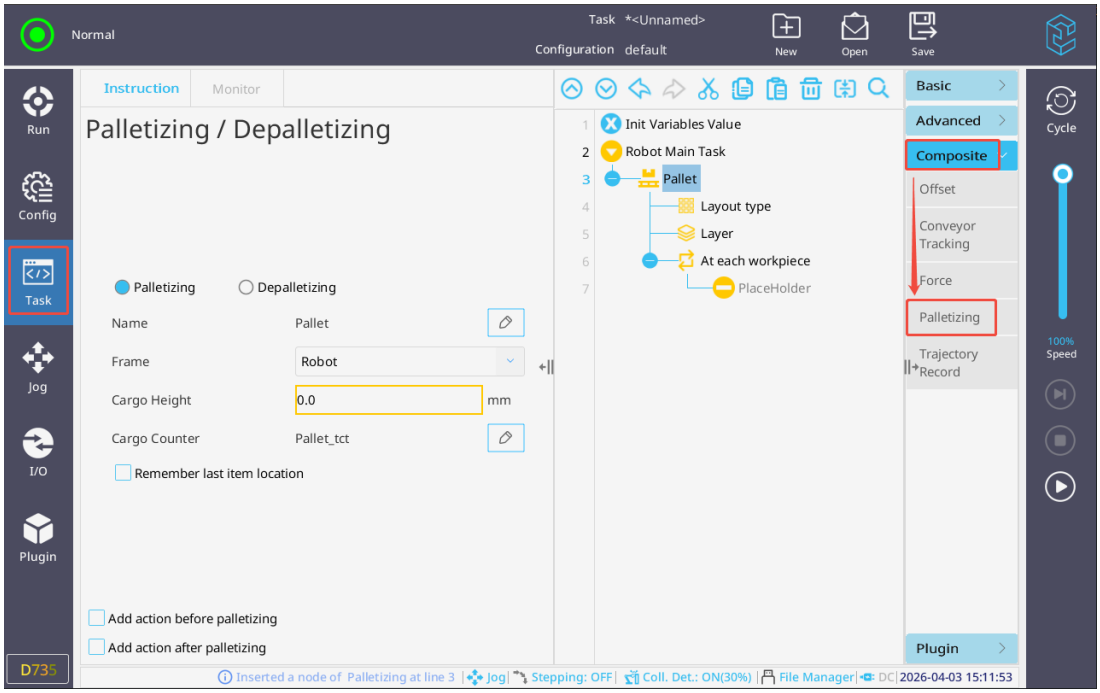


Figure 3-156: Set palletizing task parameters

- Frame: supports base and user-defined frame;
- Cargo height: the height of palletizing cargo;
- Cargo counter: Define a variable to calculate the number of palletized cargo. When the task is running, the user can view the variable value in [Monitor];
- Add action before palletizing: After checking, insert the [Palletize Before Action] node under the palletizing task, then the user can add actions based on the needs;
  If unchecked, the node will be deleted directly.
- Add action after palletizing: After checking, insert the [Palletize After Action] node under the palletizing task, then the user can add actions based on the needs.
  If unchecked, the node will be deleted directly.

3. Click the [Layout type] node in the task tree, then the user can set it to [Line], [Matrix] or [Custom].

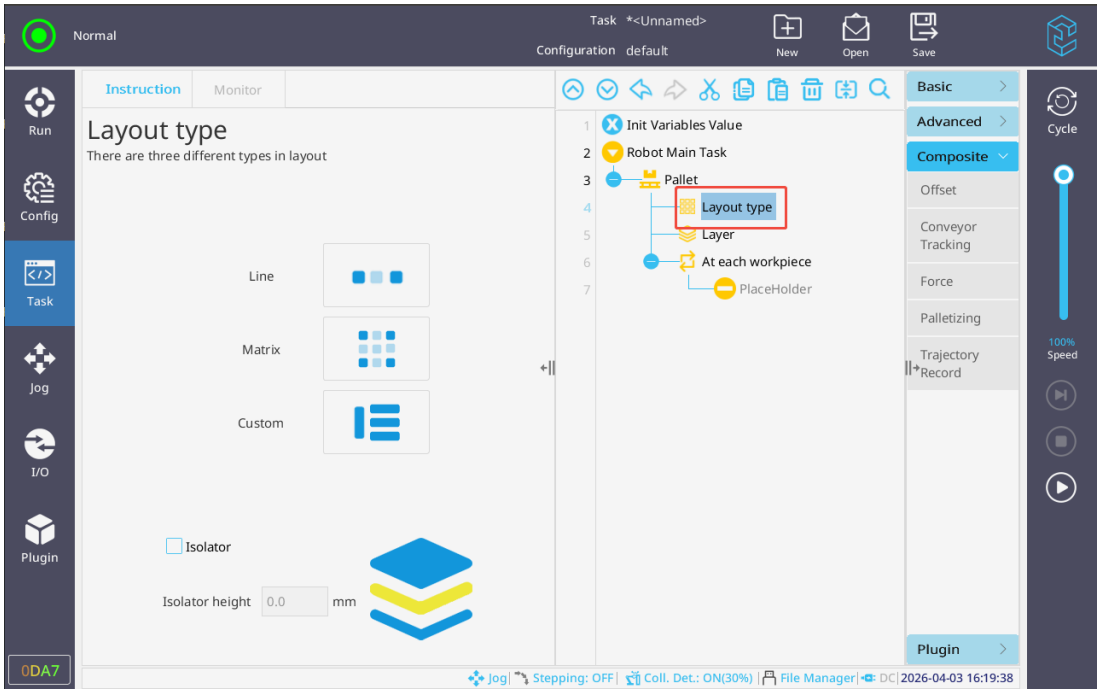


Figure 3-157: Set layout type

- Line layout: click the line layout node to access configuration window in Instruction tab. Line node can be renamed and set number of the workpiece; Click the [Workpiece] nodes (named "LineItem_#" by default) to set the start position and end position of layout.
- Matrix layout: click the matrix layout node to access configuration window in Instruction tab. Matrix node can be renamed and set number of the rows and columns of the workpiece;
  Click the four sub "Workpiece" nodes (named "MatrixItem_#" by default) under layout type to set the start position and end position of layout.
- Custom layout: configuration window in Instruction tab. Custom node can be renamed. [Workpiece] node can be added or delete;
  Note: The [Workpiece] node of linear layout and Matrix layout cannot be deleted; The [Workpiece] node of custom layout can be deleted through the delete button on the [Instruction] tab.
- Isolation layer: isolator is the object that is sandwiched between two workpieces. After check [Isolator] under Layout type, [IsolatePoint] node will be insert under [Layout Type], and [Isolator action] node will be added to task tree. Then the user can add actions based on the needs. If unchecked, [IsolatePoint] node and [Isolator action] node will be deleted directly.

4. Click the "Layer" node in the task tree and click [Add layer] to set the number of layers of the pallet, the layout type of each layer, and whether to include the isolation layer.

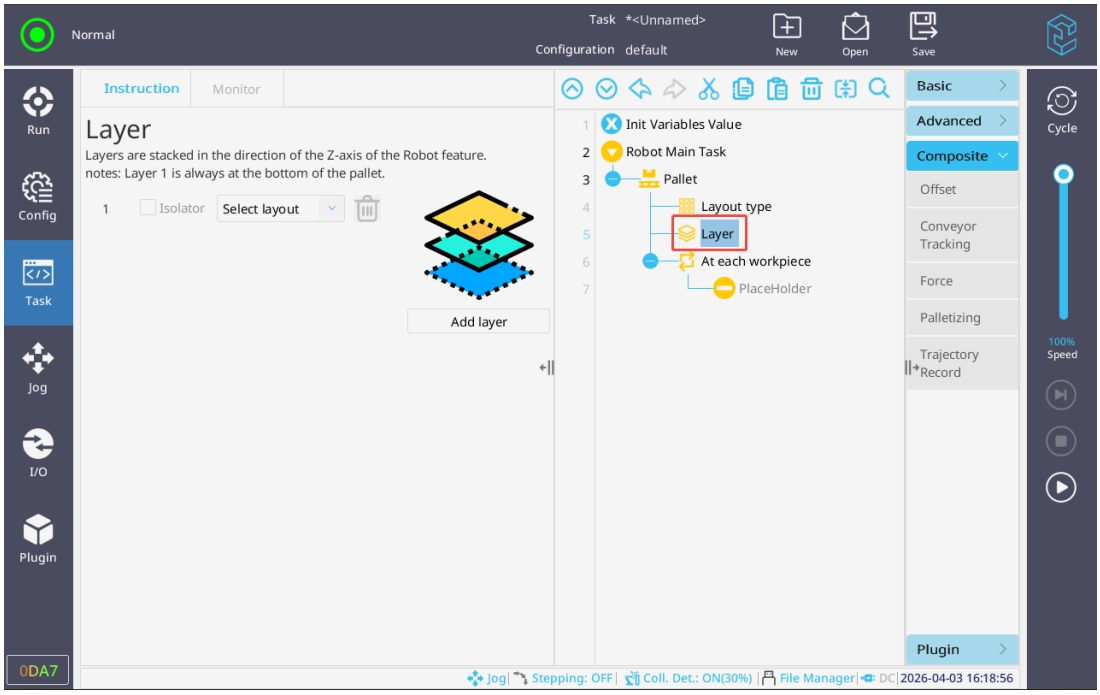


Figure 3-158: Set layer

5. Click the node [At each workpiece] in the task tree, and the user can set reference points and generate movement.

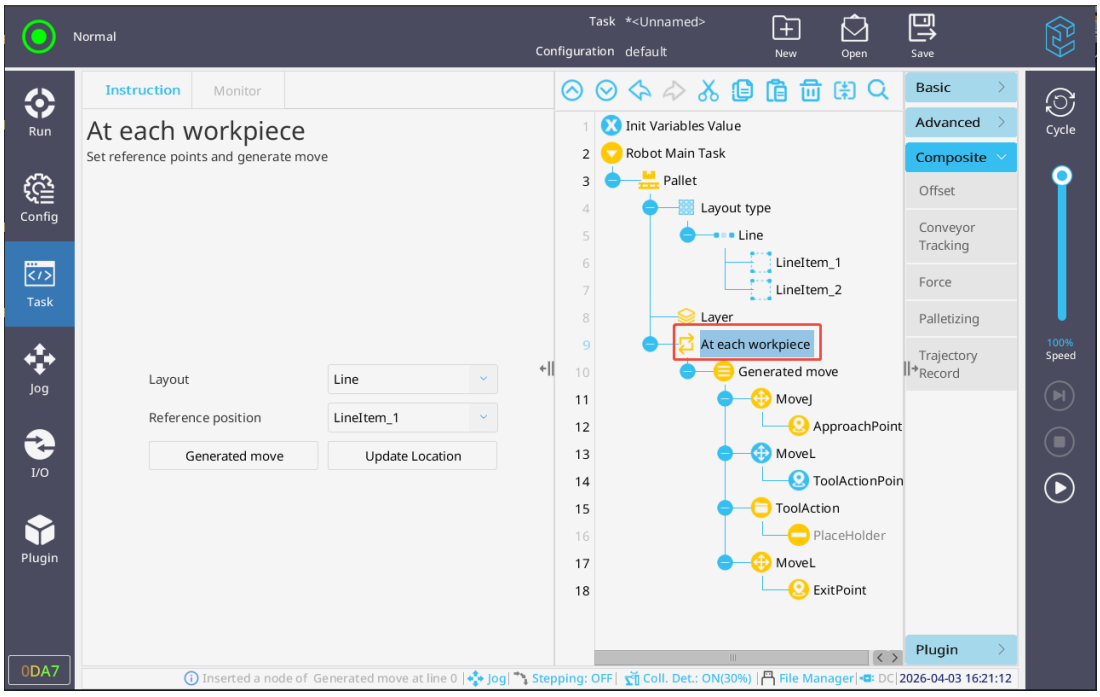


Figure 3-159: Set workpiece parameters

The reference point is generally the position of the first workpiece on the first layer. The user can directly select the [Workpiece] node in the drop-down list as the reference point.

Under the [Generated move] node, set the approach point, tool action point, tool

action and departure point.

After setting, the tool will repeat these actions for each workpiece.

- Approach Point: approach the reference point without collision;
- Tool Action Point: The default is the reference point, which can be modified according to actual needs;
- Tool Action: under the [Tool Action] node, add the corresponding tool action;
- Exit Point: leave the reference point without collision.

6. Under the [Isolator action] node, click [Generate isolation action].

The user can set the [pickup isolator] node and set the approach point, isolator action, tool action and exit point.

3.6.6.3 Conveyor

The conveyor function uses Modbus as a communication means to obtain the real-time operation data of the external drive belt and realize the tracking of the conveyor.

1. Configure Modbus Client

1. Click [Config] > [Communication] > [Modbus] to enter the [Modbus client I/O setting] interface.
2. Click [Add Modbus device].
3. Set the ”IP address”, ”Name”, ”Address”, and ”Type” of the device.

Note: The type must be set to ”Register Input”.

2. Configure Conveyor Parameters

1. Click [Config] > [General] > [Conveyor Tracking] to enter the [Conveyor Tracking Setup] interface.
2. Check [Enable conveyor tracking] in the upper right corner.
3. Set ”Encoder type” to [Absolute].
4. Select ”Encoder count variable” as the [Modbus] setting.

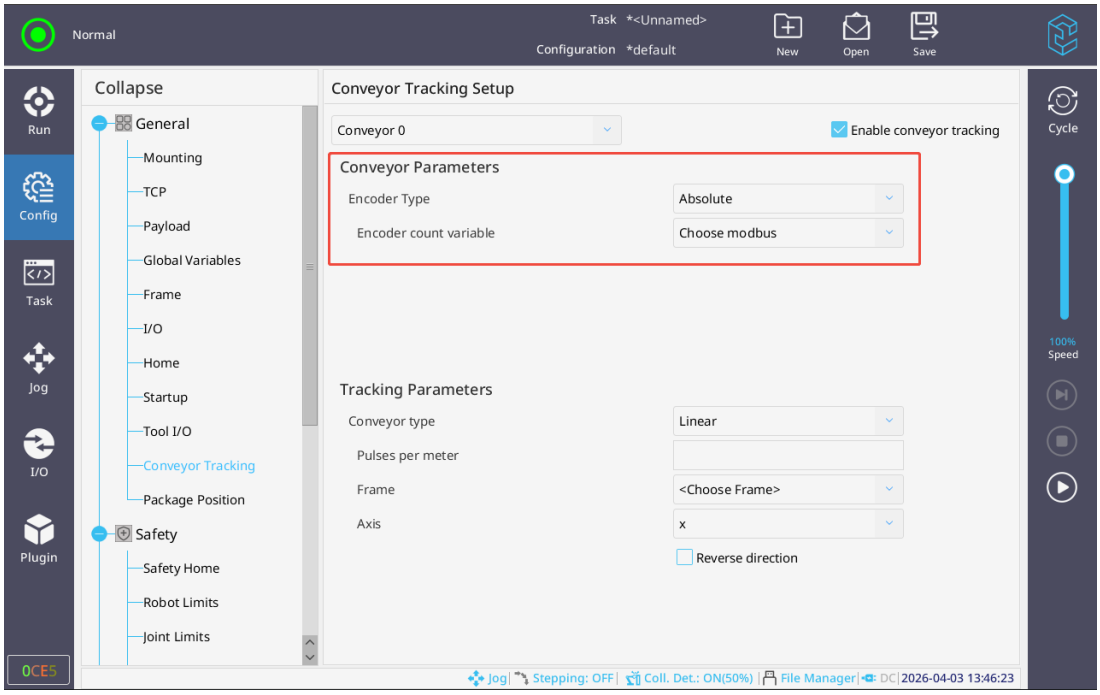


Figure 3-160: Configure conveyor parameters

5. Set ”Tracking Parameters” and select ”Conveyor type” as ”Linear” or ”Circular”.
   - Linear:
     - ”Ticks per inch” is determined by external hardware equipment;
     - Select frame as the frame taught by “Config > General > Frame” and specify the running direction (determined by axes: x, y, z and whether to reverse).
   - Circular:
     - ”Ticks per revolution” is determined by external hardware equipment;
     - Select ”frame” as the frame taught through ”Config > General > Frame”. By default, it rotates in a positive direction around the Z axis of the frame;
     - Check ”Rotate tool and conveyor” to allow the end effector to rotate and track the target conveyor.

3. Select Conveyor

Select ”Task > Composite > Conveyor Tracking” and select the conveyort type, as shown in **Figure** 3-161. The robot main task is under the node of conveyor tracking, and the fixed plane is stationary relative to the conveyor.

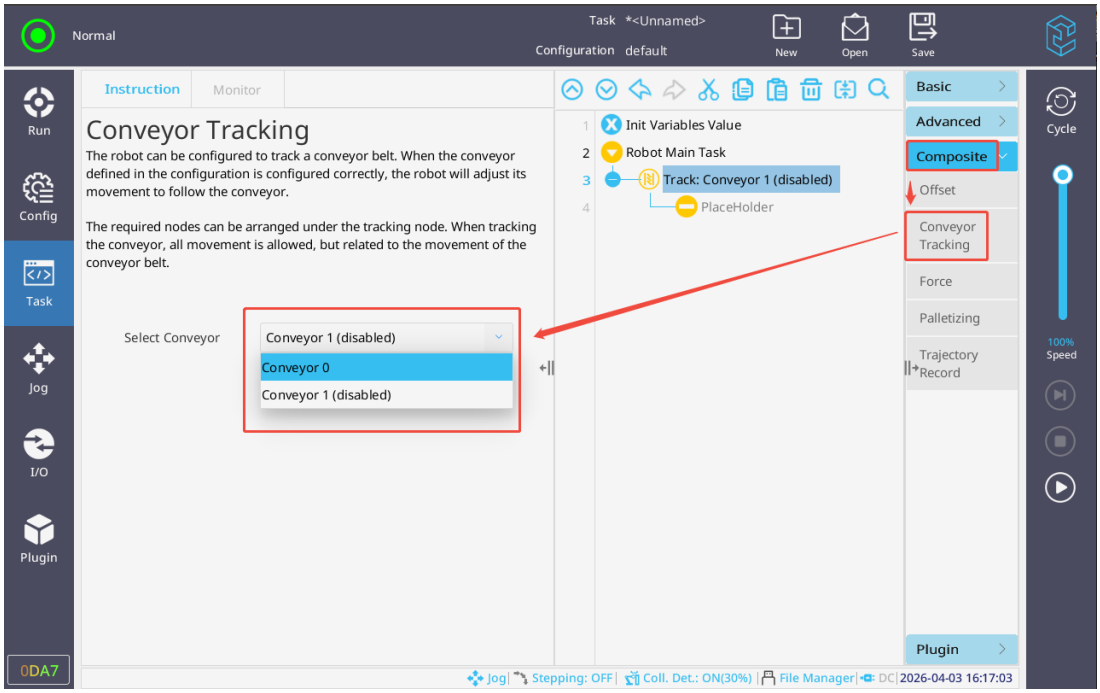


Figure 3-161: Conveyor

3.6.6.4 Trajectory Record

The Trajectory Record plugin is used to record and play back the robot's motion trajectory over a specified period of time.

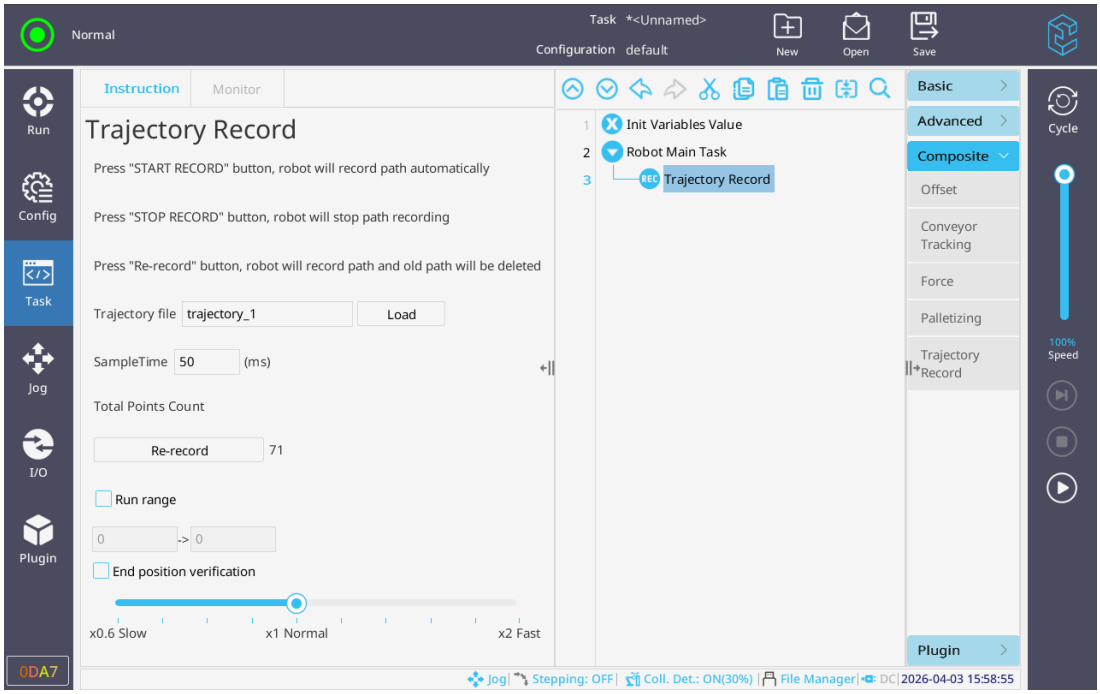


Figure 3-162: Trajectory Record

Record New Trajectory

1. Tap [Task] > [Composite] > [Trajectory Record] to enter the Trajectory Record interface.
2. Click [Start Record] to start trajectory recording (the icon turns orange).
3. Click [Stop Record] to stop trajectory recording (the icon turns blue).

Parameter Setting

[Sample Time]: Sets the time interval for trajectory recording, in milliseconds (ms). The range is 50–100 ms.

Run

After recording, the recorded trajectory can be played back and adjusted as follows:

- **Run Range**: When enabled, the start and end points of the trajectory can be specified. For example, if the recorded trajectory contains 64 points and the run range is set to 10–44, the robot will execute only the path from the 10th to the 44th point.
- **Running Speed**: Adjusts the playback speed using the slider below. The default Normal speed corresponds to the original speed during recording.
- **End position verification**: Ensures that the robot accurately reaches the final point. When enabled, the system continuously sends the final point data to the robot until the target position is reached.

Trajectory File Management

- **Re-record**: Tap [Re-record], then tap [OK] in the pop-up window. The robot starts recording again, and the original trajectory is overwritten.

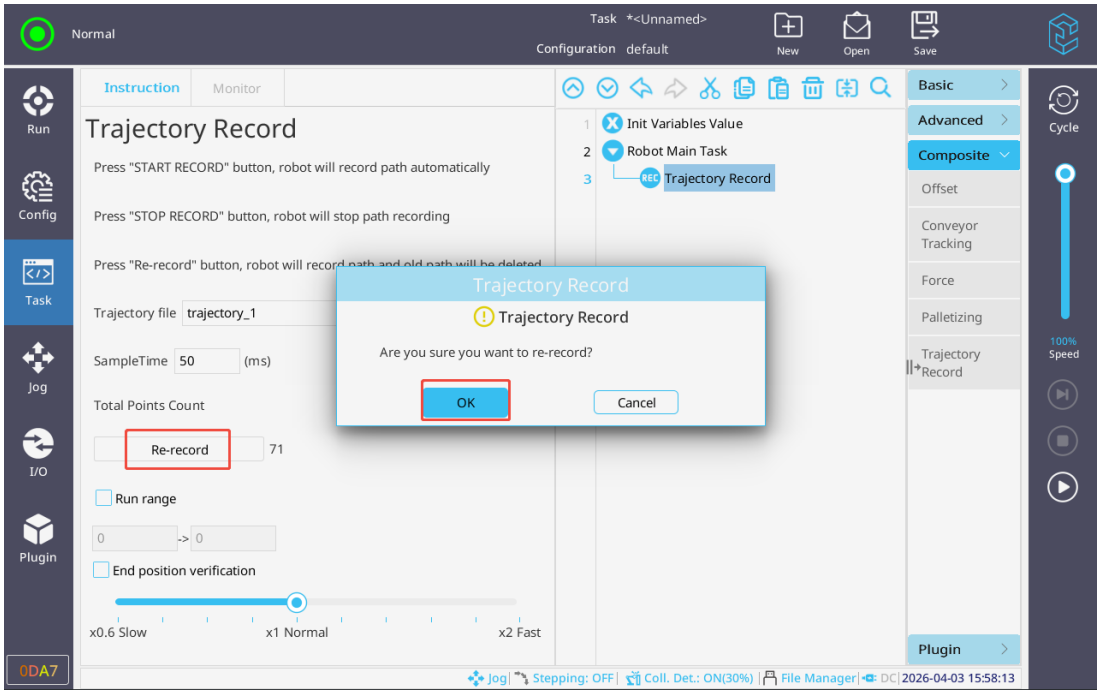


Figure 3-163: Re-record a trajectory

- **Load**: Loads an existing trajectory file for playback.
- To restore trajectories recorded before a version update, save the task file prior to the update. Then, load the previously saved trajectory file in the Trajectory Record interface.

NOTICE

During trajectory recording, the process automatically stops if an alarm is triggered, the power supply is disconnected, or any robot or safety status changes occur.

3.6.6.5 Force

Force node can specify the desired force along a selected compliant axis (compliant degree of freedom), which is suited to a pplications where the actual TCP pose changes and desired force along the axis must be achieved. For example, the robot is grinding on a curved surface.

Force node also can specify desired torque along a selected compliant axis (compliant degree of freedom). If there is no obstacle along an axis where a non-force/torque is set, the robot will attempt to move along it. Even though the axis is set to be com-

pliant, the robot will still try to move along the axis, and the force node will ensure that the desired force is achieved.

Moreover, force node can specify the force application mode and data of the robot during the operation of its descendant nodes.

NOTICE

- Do not use force node at the same time as conveyor tracking. Otherwise, there are program conflicts.
- Do not perform movements with high deceleration or parallel to compliant axes before force node. It is recommended to add the command sleep (at least 2s) before the force control mode is enabled to tackle this issue.
- Do not perform movements with high acceleration during force node enabled. Otherwise, they will decrease force control accuracy.
- If there is a force node in an If, ElseIf, or Loop, and Check Expression Continuously is selected, end_force_mode() can be added at the end of the expression to exit force control mode.

The operation steps are as follows:

1. Tap [Task] > [Composite] > [Force].

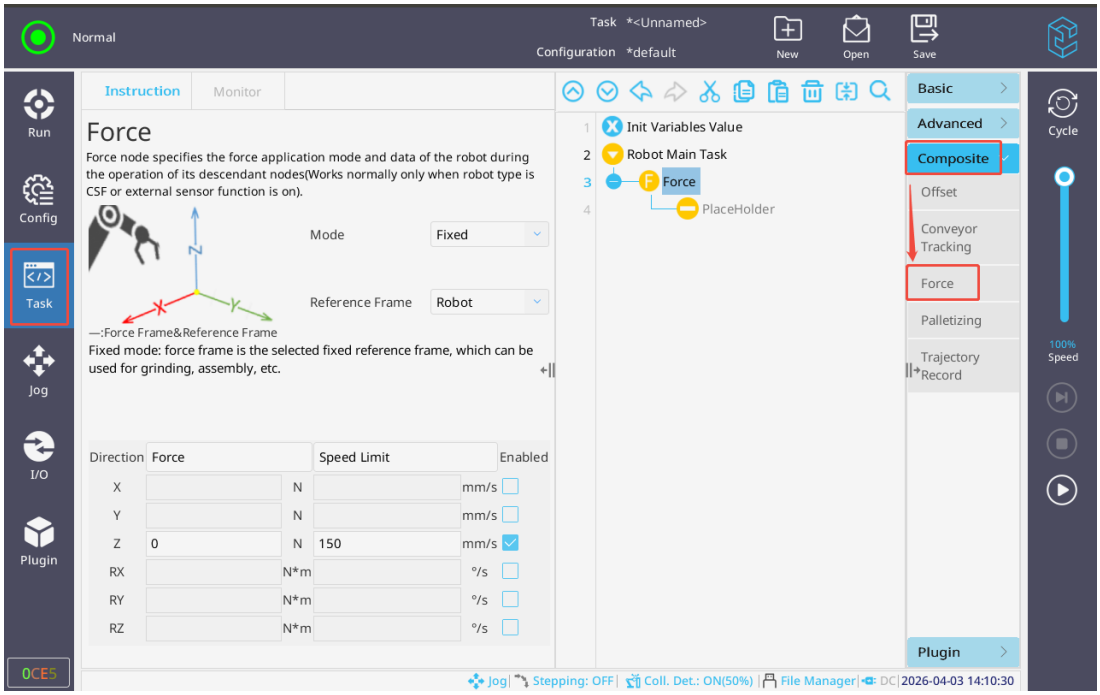


Figure 3-164: Force

2. Set a force mode.

- Fixed mode: the task frame is the fixed frame, which can be set through the drop-down menu in the reference frame; all six degrees of freedom may be set to be compliant and force/torque and speed limit for them are independently selected. This mode is suited to applications of grinding, assembly, etc.
- TCP mode: the task frame coincides with robot TCP frame; all six degrees of freedom may be set to be compliant and the force/torque and speed limit for them are independently selected; the direction for force control changes with TCP poses. This mode is suited to applications of therapy, assembly, grinding, etc.
- Point mode: the Y-axis in the task frame points from the robot TCP origin to that in the reference frame; the X- and Z-axis in the task frame are dependent on that in the reference frame; the task frame changes with robot TCP poses during motion. The distance must be at least 10mm between the reference frame and the robot TCP origin.
- Motion mode: the X-axis i n t he t ask f rame i s t he p rojection o f t he TCP motion direction vector in the X-Y plane belonging to the reference frame; the Y-axis is perpendicular to the TCP motion direction in the X-Y plane belonging to the reference frame; the task frame changes with robot TCP poses. The X-axis can not be set as compliant in this mode, which is suited to applications of de-burring along a complex path.
  If a robot is still when the force node is enabled under motion mode, there are compliant axes after the TCP speed is above zero. If later robot stands still again with the force node enabled, the direction of the task frame is the same as that the last time of TCP speed was above zero.

3. Set a reference frame
   You can choose [robot] or a customized frame as the reference frame. For details about customizing the frame, see Subsection 3.5.1.5.
4. Check the box below [Enabled] to choose compliant axes (compliant degrees of freedom) and set parameters for force control.
   Force/Torque:
   - The target force/torque can be set for compliant axes (compliant degrees of freedom). The unit of force is Newton [N] for translation axes (X, Y, and Z) and the unit of torque is Newton meter [Nm] for rotation axes (RX, RY, and RZ). The robot will adjust its pose to achieve the target force/torque after setting.
   - For non-compliant axes, the robot moves in the trajectory based on the original program.

NOTICE

- Read actual force/torque with the script function of get_tcp_force() in a separate thread.
- If the actual force/torque is lower than requested, correct the target force/torque.

Speed limit:

- The maximum Cartesian speed can be set for compliant axes (compliant degrees of freedom). The robot moves along compliant axes at the speed of force control before having contact with an object whose maximum speed is the one set here.

5. Click the placeholder in the task tree to add nodes from the list as requested.

3.6.7 Plugin

If you need to realize more functions, you can install some plugins according to your needs. After installation, click [Task] > [Plugin] to find the node of installed task plugins. These plugins are automatically sorted by their vendor name and bundle symbolic.

3.6.8 Breakpoint debugging

The function allows the user to set the breakpoint before or after the node. It is composed of a red spot and a red line. The red spot means that the program will stop at the point. The red line indicates when the function will be triggered.

- If the red line is above the red spot, it indicates that the function will be triggered before running the node;
- If the red line is below the red spot, it indicates that the function will be triggered before running the next node;
- When the red spot turns dark, it indicates that the function has already been triggered and the task is paused.

The user can set the breakpoint by clicking the line number of the node. To cancel the breakpoint, the user can click the line number again.

In addition, the user can also set and delete the breakpoints dynamically when the task is running. The changes will take effect when running the same task next time.

Please note that it is impossible to set the breakpoints in some nodes, i.e. the compressed node, the place-holder node, the thread node and other nodes in the plugin that do not allow the users to insert from the command line (e.g. the layer node and the layout node in the palletizing). For the line of nodes, the color of the line number is lighter.

- If these nodes are selected, the line number goes to light blue (see the line number “6” in **Figure** 3-165);
- If they are not selected, the line number is marked as light gret (see the line number “4” in **Figure** 3-165)s.

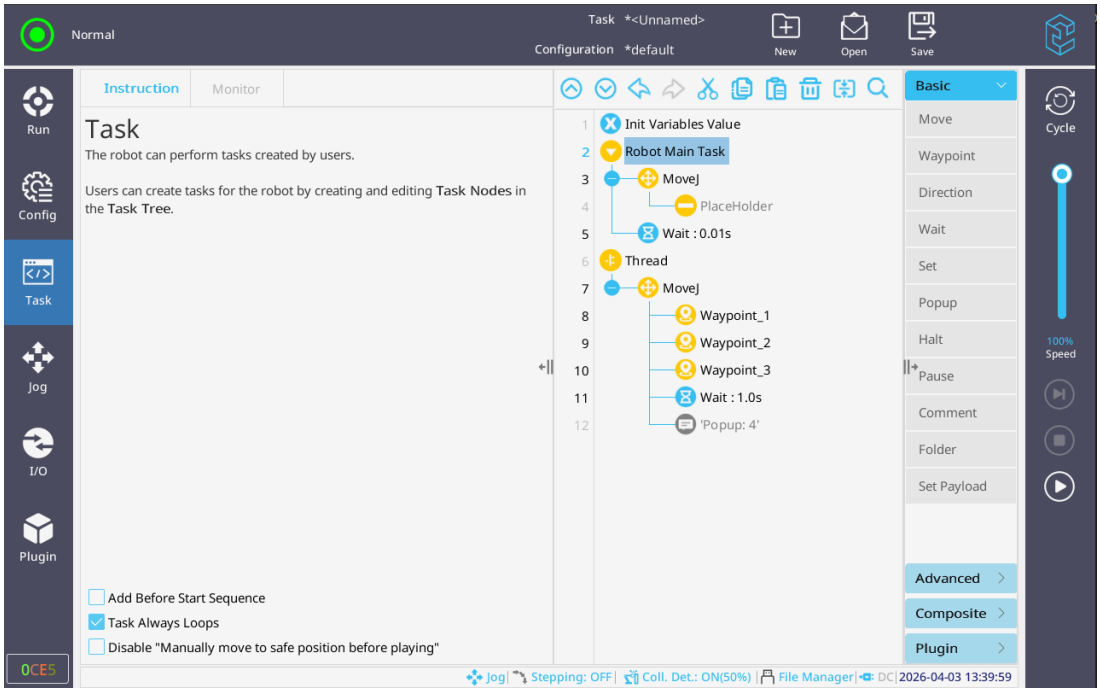


Figure 3-165: Breakpoint

3.6.9 Single-step function

The function allows the users to run a node in the single-step mode, incl. the movement nodes and the thread nodes. The currently running task can be paused by clicking the ”Pause” button in the right side of the menu. After the pause, the single-step button will be highlighted. Click the button and the node will run. The user can dynamically switch over between the running states in the single-step mode and non single-step mode. This will not stop the proceedings of the current running task. Here are the notes:

- Please set a breakpoint in the main task of the program if the user expects to execute the single-step function from the first node. After the program starts, the task will be paused and the single-step function can be carried on then;

- The next node of the single-step function is namely the next thread node where is set a breakpoint. If other threads are set the breakpoints, then it will switch over to the other threads;
- The motion node of the operation in the single-step mode will go directly to the target point;
- If the user executes the single-step function after clicking the Pause button in the process of moving the waypoints, the next task node will be paused. The user will not enter the single-step mode until the next task node is triggered.

3.7 I/O Tab

This section mainly describes the options and operation instructions in the I/O setting of LS65 robot, including robot, Modbus and other options. The user can monitor and set the real-time I/O signals sent and received by the robot.

3.7.1 Internal

3.7.1.1 Robot

On the screen, in the [I/O] tab, the user can monitor and set the real-time I/O signals sent and received by the robot.

This page displays the current status of I/O, including I/O status during task running. When the task stops running, all output signals will remain in their state, as shown in **Figure** 3-166.

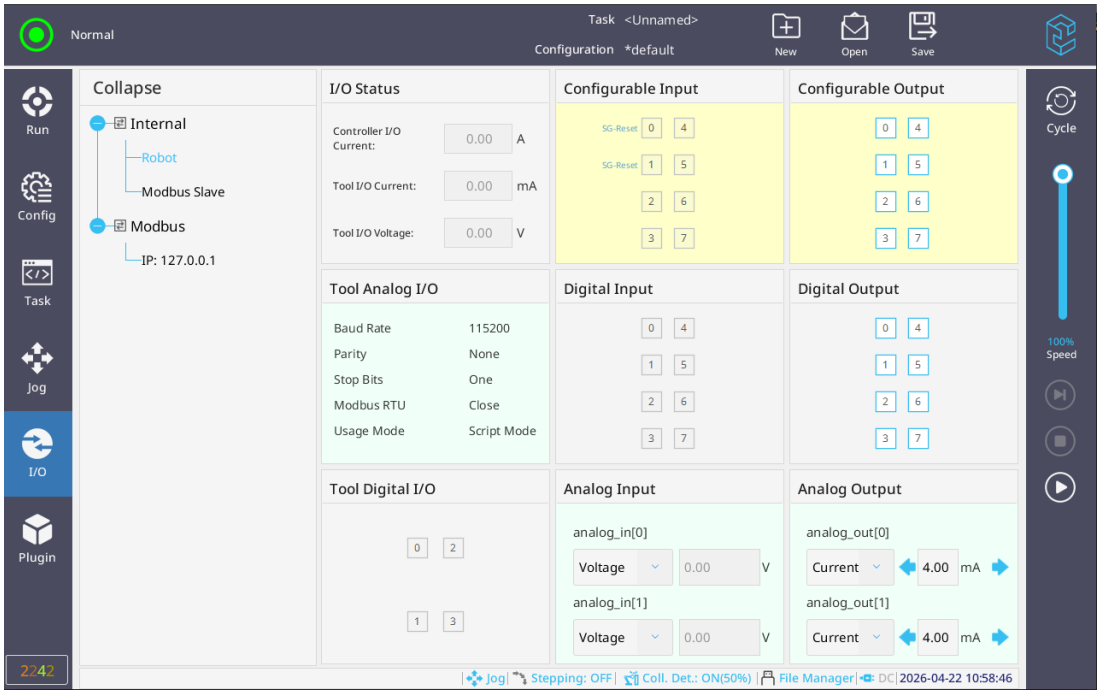


Figure 3-166: I/O current status

Note: If the signals change too fast, then their status may not be displayed correctly.

Configurable I/O can be modified under [Config] > [General] > [I/O] or [Config] > [Safety] > [Safety I/O]. After configuration, the I/O table will display the function name instead of default name or user-defined name; and the corresponding configurable output cannot be switched.

Analog input / output setting:

- Analog output can be set with current of 4-20mA or voltage of 0-10V.
- Analog input can view the specific value of current or voltage.

3.7.1.2 Modbus Slave

When Elite robot controller is used as a Modbus slave, it shows the slave status and slave protocol. The functions, meanings and configuration descriptions of various registers of Modbus Server are shown in **Figure** 3-167.

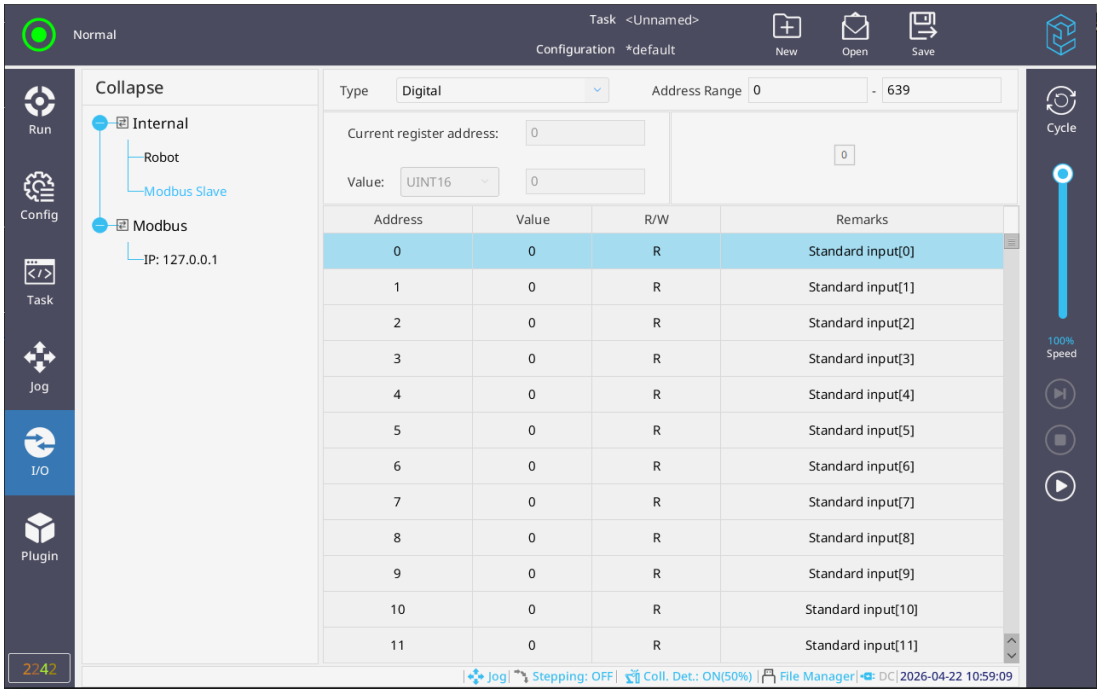


Figure 3-167: Modbus Slave

3.7.2 Modbus

This subsection shows the Modbus client I/O signals added in [Config] > [Communication] > [Modbus].

If the number of settings is more than one, use the drop-down menu at the top of the page to change the displayed content according to the signal type. Each signal in the list contains the connection status, value and address.

If the connection succeeded and the [I/O tab control] of [Config] > [General] > [I/O] configuration output Modbus is [Enabled], the user can set the output signal.

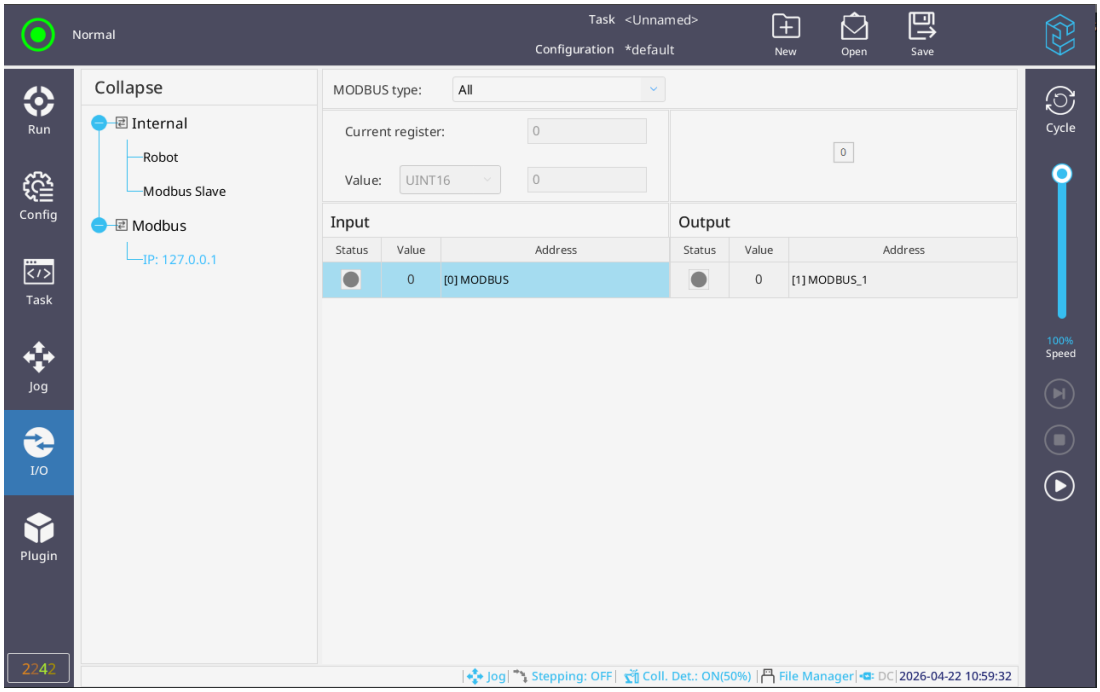


Figure 3-168: Modbus

3.8 Jog Tab

This section describes the options and instructions under [Jog] Tab for LS65 including robot, tool position, joint position, editing pose page, move interface, etc. The user can set the tool and frame setting in the robot, carry out origin, drag and operation, and carry out tool translation or tool orientation in the joint position.

The user can operate the robot motion by translating, rotating the robot tool or moving the robot joints one by one.

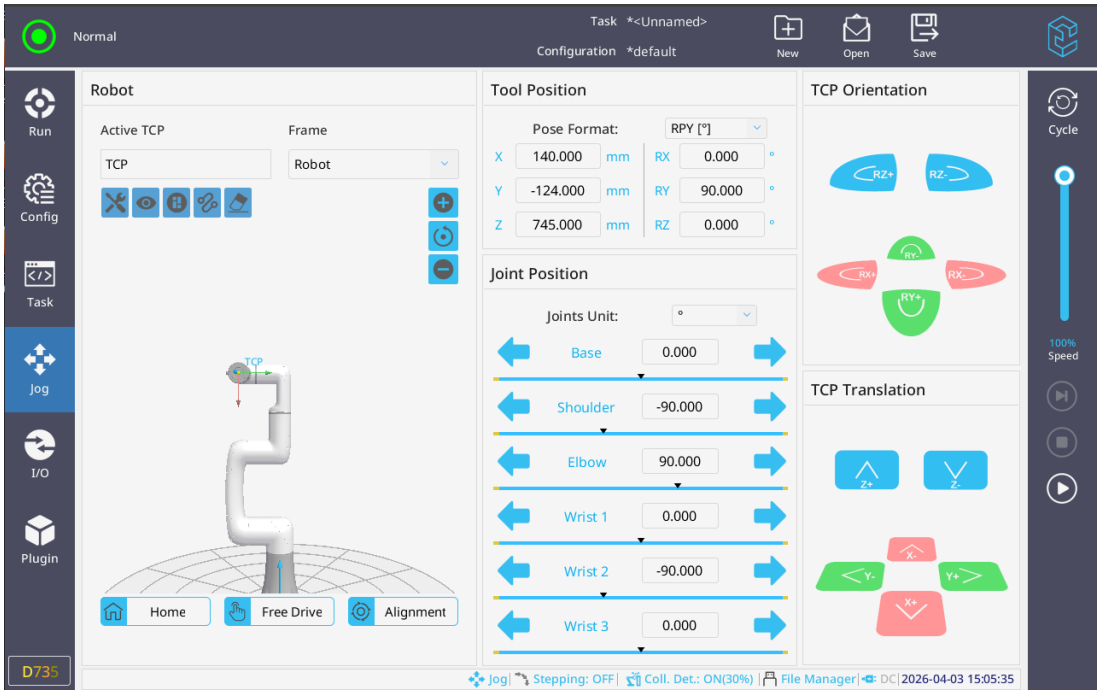


Figure 3-169: Jog the robot

3.8.1 Robot

3.8.1.1 Tool and Frame

TCP: the currently active TCP. To switch, go to the [Config] > [General] > [TCP] interface. For details, see 4..

Frame: coordination of the robot, the frame can set as observation, base, tool or user-defined frame.

The difference of frame is as follows:

- View: keep the view pose consistent with the robot pose currently observed by the user. Always keep the x-axis of the frame facing itself and the z-axis upward. Under the observation frame, the pose data under the tool position has no practical significance;
- Tool: The currently active TCP;
- Robot: base frame;
- Custom frame: Frame added by the user under [Cconfig] > [General] > [Frame].

Note: To facilitate the movement of robot arm, the user can observe the frame, then use ”TCP Translation” and ”TCP Orientation” to move then robot.

3.8.1.2 Home, Free Drive, and Alignment

The user can also perform the following operations:

- Home: The robot returns to the currently active origin set in [Cconfig] > [General] > [Home].
- Free Drive: in this state, the robot can be safely moved by hand for teaching or position adjustment.
- Alignment: Keep TCP and the currently selected frame parallel in XOY plane.

To enable the free drive state, please press and hold the [Free Drive] button, then slide downward more than 40 pixels before releasing to enter the locked state.

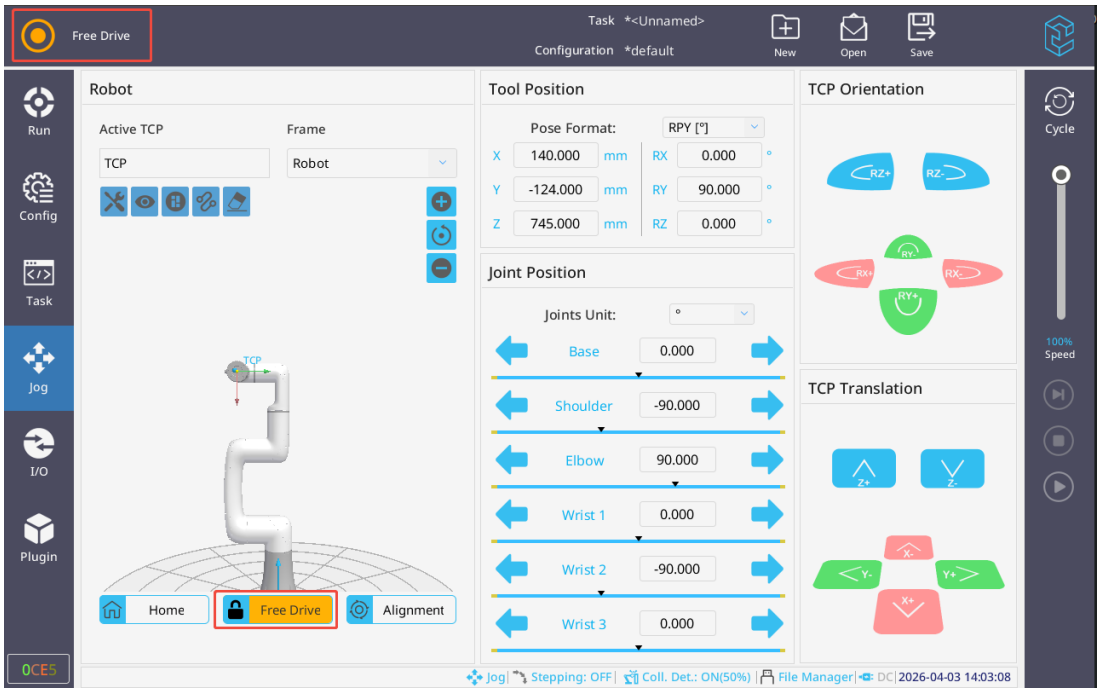


Figure 3-170: Free Drive Locked (Non-constrianed Freedrive Mode)

If your finger is pressed within the horizontal range of the [Free Drive] button but slides less than 40 pixels, the robot enters free drag mode without locking. Holding the finger down and sliding back and forth in these areas will toggle the robot and button states.

Clicking the [Free Drive] button again or any other button on the page will unlock the state, returning the robot to normal mode.

3.8.2 Tool Position

The tool position displays the coordinate value of the currently active TCP relative

to the selected frame. X, Y, Z coordinates specify the tool location. RX, RY, RZ coordinates specify the direction.

The user needs to select the representation form of the direction in the drop-down menu of [Pose Format]:

- RPY[rad]: Roll, pitch and yaw angles expressed in radians;
- RPY[°]: Roll, pitch and yaw angles expressed in degrees.

3.8.3 Joint Position

Specify the position of each joint directly. Limits of the joints can be set in [General] > [Safety] > [Robot limits].

The user can perform the following operations:

- Click the input box to enter the desired angle. See Subsection 3.8.4 for details;
- Click the arrow buttons to increase or decrease the current value.
- Click the "Stepping" icon in the bottom of the menu to switch on or off the stepping mode, as shown in **Figure** 3-171.

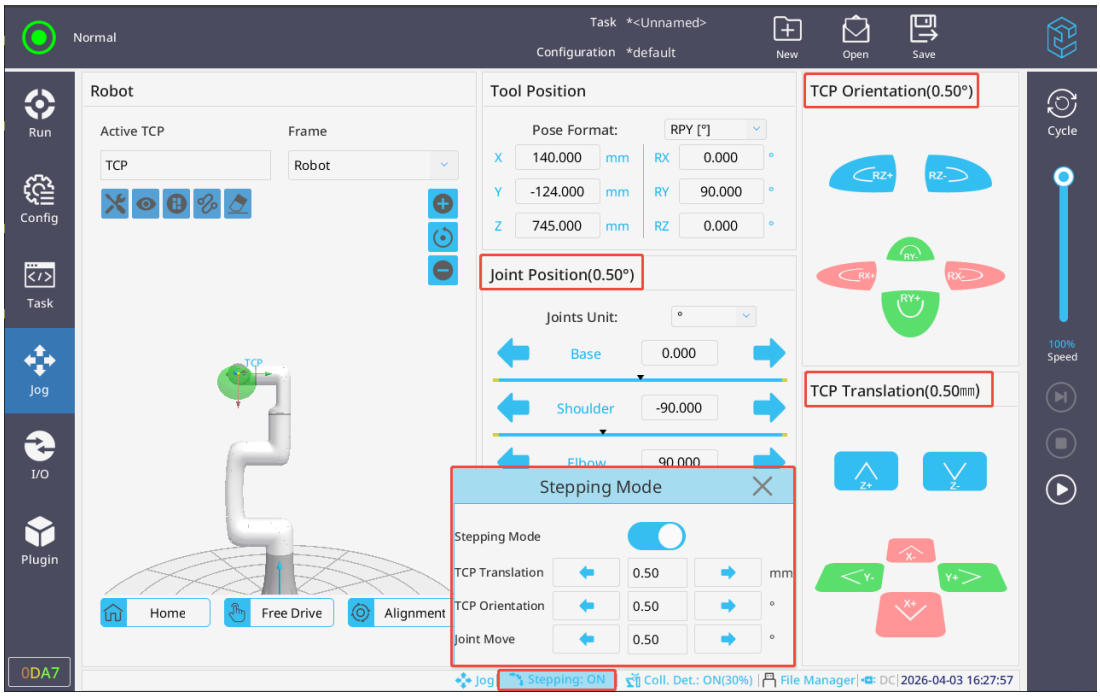


Figure 3-171: Stepping mode

3.8.3.1 TCP Translation or TCP Orientation

Under the selected frame, press and hold the "TCP Translation" or "TCP Orientation" arrow to move the robot arm in a specific direction.

3.8.4 Edit Pose Page

The user can also click the input boxes of the ”Tool Position” or ”Joint Positions” to enter the ”Edit Pose” page, as shown in **Figure** 3-172.

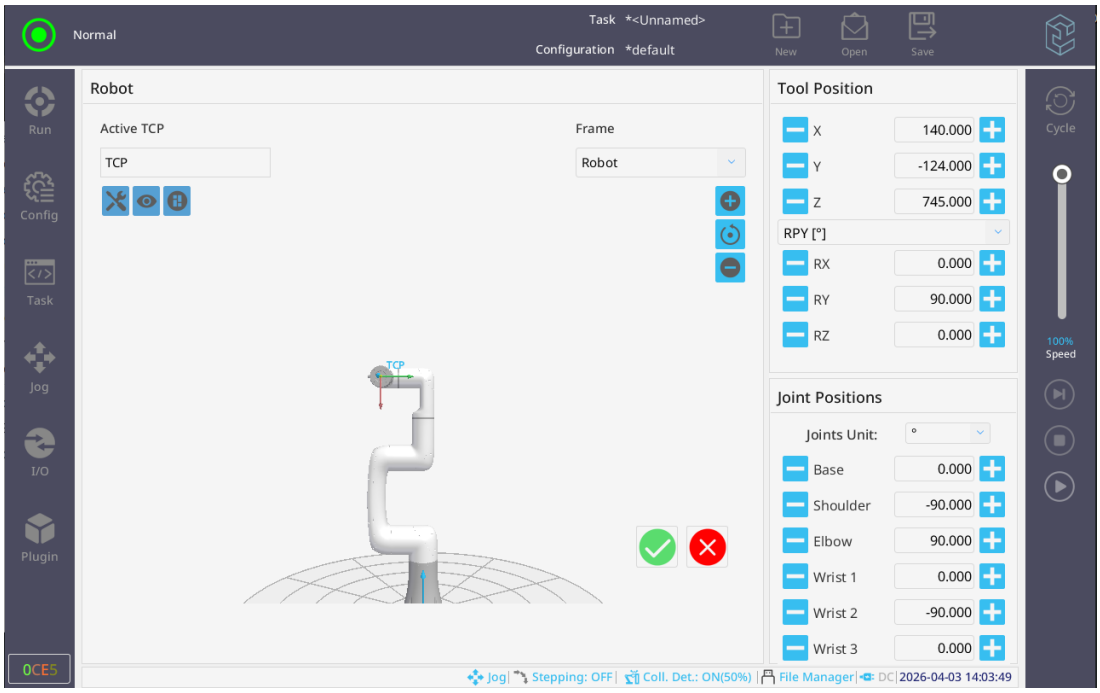


Figure 3-172: Edit pose

On the ”Edit Pose” page, the value of joint position or tool position can be directly entered. After input, a transparent image of the target pose will appear in the view.

When the left arrow is hold: the number in the input box will reduce the value. The transparent robot image previewing the target pose will update synchronously;

When the right arrow: the number in the input box will increase the value. The transparent robot image previewing the target pose will update synchronously;

When the left arrow is tapped: an input keyboard will pop out. After inputting the value with the keyboard, the number in the input box will subtract the value inputted with the keyboard, and the transparent robot image previewing the target pose will update instantly.

When the right arrow is tapped: an input keyboard will pop out. After inputting the value with the keyboard, the number in the input box will add the value inputted with the keyboard, and the transparent robot image previewing the target pose will update instantly.

Once the value adjustment is done, press ”Accept” button, then the screen will enter Move Interface.

3.8.5 Move Interface

After editting pose completed, the screen will automatically jump into Move Interface as **Figure** 3-173.

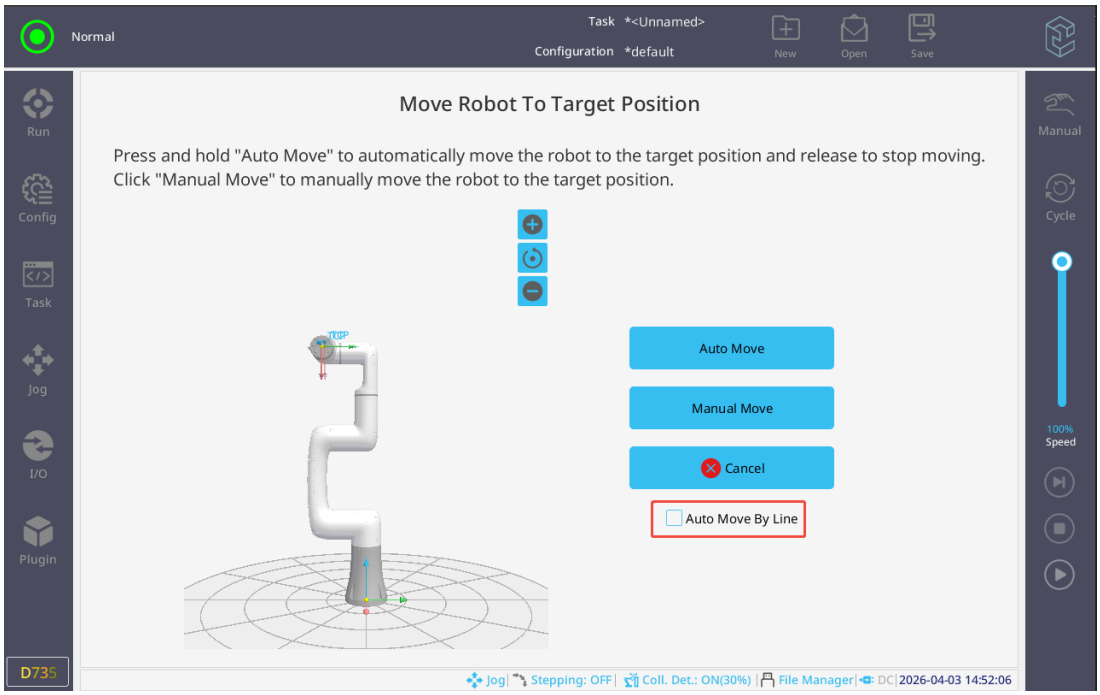


Figure 3-173: Move Interface

The user can select ”Manual Move” or ”Auto Move” to move the robot to the target pose. After selecting the check-box ”Auto Move By Line” and long press ”Auto Move”, the robot will be moved in a straight line (MoveL) to the target position.

3.9 Bus Protocol

The LS65 robot supports Modbus, RTSI, Profinet, 30001, 29999, and other bus protocols.

3.9.1 Modbus Protocol

Modbus is a serial communication protocol, which was published by Modicon (now Schneider Electric) in 1979 for the use of Programmable Logic Controller (PLC) communication. Modbus has become the industry standard (Defacto) of the communication protocol in the industrial field, and is now a common connection method between industrial electronic devices.

The Elite CS series supports obtaining or modifying the internal data of the robot through the standard Modbus TCP protocol. It can be used as a master station to access other slave devices that support the Modbus protocol; it can also be used as a slave station to accept access requests from other Modbus master stations. This article mainly introduces some of its characteristics as a slave.

3.9.1.1 Working Principle

The Modbus TCP protocol works at the application layer of the OSI network model, and uses TCP for data transmission. When the controller acts as a Modbus server, the client establishes a connection with it via TCP port, which defaults to 502 and can also be customized, and uses standard format application layer messages for data communication. Also, one Modbus TCP slave station can be accessed by multiple master stations at the same time.

NOTICE

1. The Modbus slave device is always the requested station, so it is also called Modbus Server, and the master device is also called client.
2. From V2.14.0, customized port settings for Modbus TCP within the range [0, 65535] can be supported, and it defaults to 502. Furthermore, during the data serialization and deserialization process in Modbus communication, the storage and retrieval of port number data are allowed. For details, please refer to **Section 5.1 Modbus in CS Series Script Manual**.

3.9.1.2 Register Description

The data types supported by the CS series that can be read and written using the Modbus protocol are boolean and unsigned short integers (16 bits). Each type contains a set of input and a set of output registers, so there are 4 sets of registers in Modbus that can be accessed by the master station. Among them, the input type register only allows the read operation, the output type register is readable and writable.

For detailed descriptions of Modbus slave registers and coils, refer to the Modbus server data document. To download the document, please visit Elite Robots Official Website, or contact ELITE ROBOTS after-sales service.

1. Boolean register (8 bits): mainly used to manipulate digital I/O, the effective address range of the digital I/O register currently accessible by the CS series is 0-63, although the value type is bool, each I/O still occupies one byte of space, so digital I/O occupies a total of 2*64 bytes.
2. Unsigned short integer (16 bits): used to save and modify the robot version, TCP, system status and other information; also used to map digital I/O. The effective address range of the input/output registers currently accessible by the CS series is 0-415.

3.9.1.3 Modbus Function Code

The Modbus master device can read/write slave registers through the following function codes:

1. 0x01: read one or more output digital signals (read output bits)
2. 0x02: read one or more input digital signals (read input bits)
3. 0x03: read one or more output registers (read output registers)
4. 0x04: read one or more input registers (read input registers)
5. 0x05: write a single output digital signal (write output bit)
6. 0x06: write a single output register (write output register)
7. 0x0F: write multiple output digital signals continuously (write multiple output bits)
8. 0x10: write multiple output registers continuously (write multiple output registers)

3.9.1.4 Modbus Function Code

Exception codes and meanings are as follows:

-2: Disconnect.

-1: Connecting.

1: The signal type is incorrect.

2: The slave register (coil) address is incorrect.

3: The value is incorrect.

4: Slave exception.

5: The master station received a message that the slave station might time out.

6: The slave station is busy.

8: The slave parity check error.

10: The gateway is misconfigured or overloaded.

11: The failure to receive a response from the slave usually means that the slave is not in the network.

3.9.1.5 Register Mapping Relationship and Configuration Instructions

1. Digital I/O and Register Mapping

In the CS series of equipment, there are 64 operable digital I/O. The first 32 I/O addresses are closely related to the general I/O on the motherboard of the controller. The remaining 32 addresses are reserved for subsequent development.

Therefore, the digital I/O is currently mapped to the Modbus register. The specific mapping relationship is:

Standard digital input ————> Register address: 0

Configurable digital input and tool I/O ————> Register address: 1

Standard digital output ————> Register address: 2

Configurable digital output and tool I/O ————> Register address: 3

The m apping above shows the unsigned I/O register is 16 bits per register address. The value of each bit from low to high represents the state of a digital I/O signal. For example, on the unsigned register address 0, if the register value is 0x2 (the first bit is set to 1), it means the value on the digital input bit address 0 is set to 0; the value on the bit address 1 is set to 1; and the values on the bit addresses from 2 to 15 are all set to 0.

3.9.2 RTSI Protocol

RTSI (Real-time Synchronization Interface) provides a standard TCP/IP connection for real-time data interaction with external programs.

Interactive data content such as:

- Output: the robot outputs values of integer registers, terminal load, etc;
- Input: status settings for the robot float input register and digital input I/O.

RTSI consists of three steps: protocol check, setting, and synchronization. Because the protocol will be updated iteratively, when the RTSI client is connected, the protocol version needs to be verified first to determine whether the communication can continue. Note: The protocol is version 1. When the version verification is able to communicate, the subscribe variables need to be configured. After verification and configuration are completed, send the start signal to start communication.

When linked to the RTSI server, the client is responsible for setting the variables to subscribe to. The clients can subscribe to any combination of input or output subscriptable items. To do this, the client needs to send the server the variable names to subscribe to, which must be the names listed in the "Subscription Items" section below. Upon receiving the subscription request sent by the client, the server replies with a list of variable types. When the setup is complete, send the start signal and the server will start the synchronization cycle. When the synchronization cycle needs to be paused, send the pause signal.

After starting the synchronization cycle, the server will send data in the order requested by the client. If the value needs to be changed, the client will send the data after binary serialization according to the order of subscription.

All data packets have a uniform structure in the form of message header + message content (some data packets do not need message content). In the two steps of "Protocol Check" and "Setting", there is a reply message, but there is no reply message in the step of "Synchronization Cycle". Note that "Message Packets" can be sent and received at any time in all packets. The network port of the RTSI is 30004.

For details on RTSI and how to use it, refer to the RTSI User Manual. To download the document, please visit Elite Robots Official Website, or contact ELITE ROBOTS after-sales service.

3.9.3 Profinet Protocol

Profinet communication protocol is a new generation of automation bus standard based on industrial Ethernet technology. Data is transmitted through network cables.

Profinet provides a complete network solution for the automation communication field, covering current hot topics in the automation field such as real-time Ethernet, motion control, distributed automation, fault safety and network safety.

3.9.3.1 PROFINET Communication Modules and Configuration Files

1. **Slots and Modules**
   The PROFINET I/O device has 10 slots, each corresponding to a communication module. The modules and their functions are listed below:
   - R2P_State: The robot sends status data to the PLC.
   - R2P_IO: The robot sends I/O data to the PLC.
   - R2P_Joints: The robot sends joint data to the PLC.
   - R2P_TCP: The robot sends TCP data to the PLC.
   - R2P_BIT_REG: The robot sends data from output Boolean registers 0–63 to the PLC.
   - R2P_INT_REG: The robot sends data from output integer registers 0–23 to the PLC.
   - R2P_FLOAT_REG: The robot sends data from output floating-point registers 0–23 to the PLC.
   - P2R_IO: The PLC sets the robot's I/O states.
   - P2R_REG1: The PLC writes to the robot's input registers.
   - P2R_REG2: The PLC writes to the robot's input registers.

   PROFINET data is transmitted as a sequence of bytes. Refer to the relevant communication documentation for the data format of each module.

2. **User-Defined Data Types (UDT)**
   When using an S7-1200 or S7-1500 PLC (with PLC firmware version 4.0 or higher), you can import the UDT file Elite_datastruct.udt into TIA Portal to define the data structures used for communication between the robot and the PLC.

3. **Device Description File (GSDML)**
   Before configuring PROFINET communication, import the GSDML file into the PLC programming software so that the software can recognize the robot device and allow you to configure its communication modules.

The PROFINET communication package contains the data format descriptions for the modules listed above, along with the UDT and GSDML files. To download the package, please visit Elite Robots Official Website, or contact ELITE ROBOTS after-sales ser-

vice.

3.9.4 Ethernet/IP Protocol

Ethernet/IP (Industrial Protocol) is an extended TCP/IP network protocol for real-time control that combined with the Common Industrial Protocol (CIP). It will better help the users to obtain more open, integrated industrial automation and information-based solution.

CS series products support the Ethernet/IP slave applications. Users do not need to reconfigure when the controller is used as the salve station. The communication between the master-slave stations is established through a RJ 45 twisted-pair cable. The master station will make a connection request and give the feedback of the connection status.

Please note that here the FB1 network port is used.

The EtherNet/IP communication package contains data format descriptions, EDS files, and other related resources. To download the package, please visit Elite Robots Official Website, or contact ELITE ROBOTS after-sales service.

3.9.5 30001 Communication Interface Protocol

The controller is always providing data representing the robot's state, such as positions, temperatures. The data transmitted from each server socket. This port is "Primary Port" and it send data of robot's state.

3.9.5.1 Package Format

The protocol port is 30001, the frequency is 10 Hz, and the package format is shown in **Table** 3-1.

Table 3-1. Package format

Bytes	Content
4	Length of whole package

Bytes	Content
1	Type of package = MESSAGE_TYPE_ROBOT_STATE = 16
4	Length of sub-package
1	Type of sub-package
n	Sub-package data
4	Length of sub-package
1	Type of sub-package
n	Sub-package data
.....	.....

Robot's state package includes package header, robot mode sub-package, joint sub-package, cartesian sub-package, robot configure sub-package, robot motherboard sub-package, robot additional information sub-package, robot tool data sub-package, robot satety mode sub-package, robot communication sub-package, and ELITE internal use sub-package.

For detailed descriptions of the robot status message and its sub-messages, refer to the TCP/IP communication interface protocol document. To download the document, please visit Elite Robots Official Website, or contact ELITE ROBOTS after-sales service.

3.9.5.2 Script Control and Rules

1. Script Control
   Port 30001 receives and executes the correct script.
2. Script Rules
   * Scripts are classified into def script and sec script:
   * def script, this script is the script generated when the task is running, can be

called the main script, its running status is consistent with the task control button on the interface, when the def script is executing, if the new def script is received again, the previous def script will be stopped.
* sec script, this script can be executed at the same time as the def script, will not stop the current running def script, this script is mainly used to control I/O state and other operations, can not run motion script.
* The script needs to start with ”def script():\n” or ”sec script():\n” and end with ”\nend”, where ”script” is the script name and \n’ is the escape character, which defines an executable script. The contents of the script must conform to python’s programming rules.
For example:

```
```

def HelloWorld():
    count = 0
    for i in range(10):
        count = i
    popup("Hello World %d" % count)
end

```
```

3.9.6 29999 Communication Interface Protocol

EliRobot has enabled Dashboard functions: Connect to EliRobot 29999 port through TcpSocket and send commands to control EliRobot.

3.9.6.1 Connect EliRobot

To connect to the dashboard shell remotely, use the TcpSocket tool, telnet command line, and development code to bind the robot IP address and dashboard shell port 29999. As shown in **Figure** 3-174, the TcpSocket client is created.

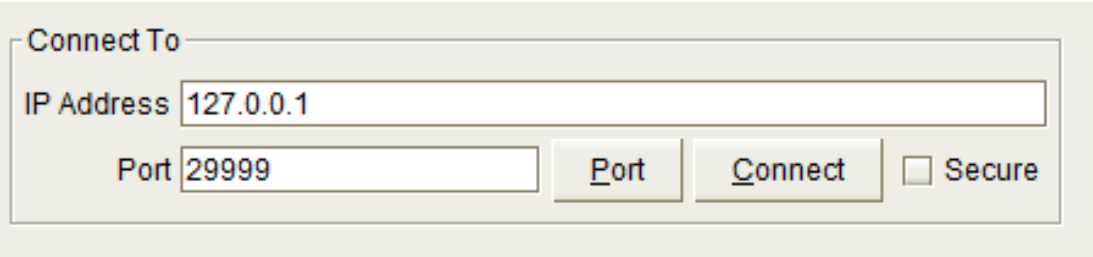


Figure 3-174: Connect to the EliRobot dashboard server

After the TcpSocket client is created and connected to the dashboard shell, the system receives the text shown in **Figure** 3-175 prompting the client or developer to run the help or usage command to query commands supported by the dashboard shell and their usage descriptions.

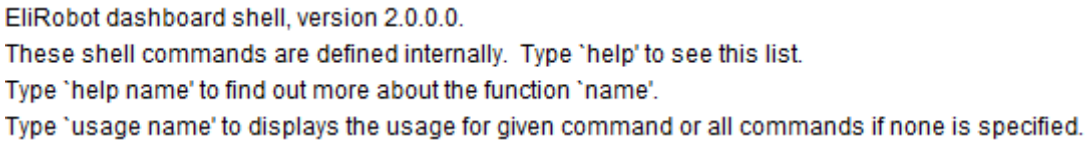


Figure 3-175: EliRobot dashboard server connection succeeded

It should be noted that dashboard shell commands need to end input with ”\n” by default. Therefore, when sending commands, end with ”\n”. Otherwise, the input will be considered incomplete and will not be responded to.

3.9.6.2 Dashboard Shell Commands

EliRobot Dashboard Shell provides basic and functional commands for interacting with the robot platform. For details on each command and how to use it, refer to the EliRobot Dashboard User Manual. To download the manual, please visit Elite Robots Official Website, or contact ELITE ROBOTS after-sales service.

Chapter 4 Maintenance and Quality

4.1 Maintenance and Disposal

4.1.1 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.eliterobots.com. All dealers of Elite Intelligent Robot Co., Ltd. can visit this website.

After changing the control system, the robot joints or the tool, the robot and the tool zero should be re-calibrated on the spot. 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 Intelligent Robot Co., Ltd. When the parts are returned to Elite Intelligent 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 regulations must be followed, and all safety functions run normally must be tested. The purpose of maintenance is to ensure the system operate properly. Repairment helps the robot to recover to normal state from system failure. Maintenance includes fault diagnosis and actual maintenance.

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

Safety procedure:

1. Disconnect the main power cable to ensure the robot is completely de-energized Take necessary precautions (such as lockout/tagout) to prevent unauthorized personnel from restoring the power supply during maintenance. While the lockout/-tagout is in effect, the robot I/O must not be powered by any other equipment. After de-energizing the system, verify once again that the system is 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 after 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 Intelligent 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 the supplier or Elite Intelligent Robot Co., Ltd.

4.1.2 Disposal

The LS65 robot must be disposed of in accordance with the local and national laws, regulations, and standards.

4.1.3 Maintenance

The safety-related control functions of the robot shall be tested at least once per year to verify that they operate correctly.

4.2 Quality Assurance

4.2.1 Product Quality Assurance

Elite Intelligent 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 Intelligent Robot Co., Ltd. shall possess the ownership of the equipment or components replaced or returned to Elite Intelligent Robot Co., Ltd.

If the product is no longer under warranty, Elite Intelligent 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 Intelligent 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.

4.2.2 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. Mounting, 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 LS65 is used outside the specification or standards shown in this user manual.
3. This product is applied to the non-designated 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 Intelligent 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 Intelligent 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 Intelligent 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 Intelligent Robot Co., Ltd.

In accordance with the product quality assurance agreement, Elite Intelligent 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 Intelligent Robot Co., Ltd. shall not bear the related liability to guarantee.

In addition, Elite Intelligent 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.

Chapter 5 Appendix

5.1 Glossary

Stop Category 0 (Cat.0 Stop): Uncontrolled stop achieved by immediately removing power from the actuators.

Stop Category 1 (Cat.1 Stop): Controlled stop in which the actuators actively brake; the stop is not guaranteed to follow the intended trajectory. Once the robot has stopped, the power supply is disconnected.

Stop Category 2 (Cat.2 Stop): Controlled stop in which the actuators actively brake and the stop is ensured along the intended trajectory. Once the robot has stopped, the power supply remains connected.

Enabling Device: A manually operated device used in conjunction with start control that permits machine operation only while it is continuously actuated.

Risk Assessment: The process of identifying, analyzing, and evaluating potential hazards associated with equipment during use, and implementing appropriate measures to control them. A risk assessment shall be carried out based on the specific application, and necessary protective measures shall be implemented to ensure safety.

5.2 Technical Specifications

Table 5-1. Technical specifications

	Payload	5kg
	Working radius	850mm
	Pose repeatability	±0.03mm
	Degrees of freedom	6
	Joints range	±360°
	Max. joint speed of joint 1	125°/s
	Max. joint speed of joint 2	125°/s

Robotic Arm	Max. joint speed of joint 3	125°/s
	Max. joint speed of joint 4	180°/s
	Max. joint speed of joint 5	180°/s
	Max. joint speed of joint 6	180°/s
	Max. TCP speed	1.5m/s
	IP rating	IP65
	ISO 14644-1 class cleanroom	5
	Ambient temperature	-10-50℃
	Relative humidity	90% RH (No Condensation)
	Typical power consumption	240w
	Mounting	Any angle
	Tool I/O	2 x DI/2 x DO (only PNP)
	Tool I/O power supply	24 V, 1 A
	Tool communication	RS485
	Footprint	Ø 126mm
	Weight	15kg
	Material	Aluminum alloy, plastic, steel, rubber
	Cable length	5.5m
	Cabinet size (L x W x H)	164.2mm x 130mm x 72mm
	Weight	1.5kg
	Material	Aluminum alloy
	IP rating	IP20

Controller: ERB1C600MET-Mini	I/O interface	8 x DI (PNP), 8 x DO (PNP) Configurable I/O: 8 x CI(PNP/NPN switchable), 8 x CO
	I/O power supply	24V/2A
	Communication	Ethernet, Profinet slave, Ethernet/IP slave, FINS TCP, Modbus TCP/RTU, RS485, CCLink slave (optional)
	Power supply	45-55 VDC
	Ambient temperature	-10-50℃
	Relative humidity	90% RH (No Condensation)
Teach Pendant: ERP500	Screen display size	10.1”
	Resolution	1280 x 800 pixeis
	Material	Aluminum alloy, plastic, silicone rubber
	Weight	0.96kg
	Cable length	5.5m
	IP rating	IP54
	Ambient temperature	-10-50℃
	Relative humidity	90% RH (No Condensation)

ELITE ROBOTS
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