

ROKAE

ZR6-6/0.98C

Hardware Installation Manual

A Partner You can Rely on in Production



ZR6-6/0.98C

Hardware Installation Manual

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Your corrections and suggestions are welcome if you find any errors or have any improvements or additions.

The original language of this manual is Chinese. All other language versions are translated from the Chinese version.

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1 Manual overview

1.1 About this manual

Thank you for purchasing our robot system.

This manual provides the following instructions for the correct installation and use of the robot:

- Mechanical and electrical installation of the robot.
- Maintenance and calibration of the robot.

Before installing and using this robot system, please read this manual and other related manuals carefully.

After reading, please keep this manual in a safe place for future reference.

1.2 Intended audience

This manual is intended for:

- Installation personnel.
- Maintenance personnel.

Please ensure that the above personnel have the required knowledge of mechanical and electrical installation and maintenance, and have received relevant training from ROKAE.

1.3 How to read the product manual

This manual contains a dedicated safety chapter. Installation or maintenance work may only be carried out after reading the safety chapter.

1.4 Illustrations in this manual

Due to product upgrades or other reasons, some images in this manual may differ from the actual product, but the operation steps are correct.

In addition, for some general-purpose information, images of other robot models may be used for illustration.

1.5 Related product documents

This manual is the product manual for the ZR6-6/0.98C robot and should be used together with the following manuals: ZR6-6/0.98C

- xCore Robot Control System User Manual

1.6 Inquiries

For robot maintenance, repair, and related matters, please contact ROKAE's after-sales department or your local distributor.

When contacting us, please prepare the following information:

- Robot model/serial number;

- Software name/version;
- Description of the issue with the system.

2 Safety

2.1 Introduction

This chapter describes the safety principles and procedures that must be observed when using the ZR6-6/0.98C robot. Before the first power-on, the integrator of the ZR6-6/0.98C robot must carefully read and understand this information. ZR6-6/0.98C ZR6-6/0.98C Topics related to the design and installation of external safety safeguards for the robot are outside the scope of this chapter; please contact your system integrator for such information.

2.1.1 Safety responsibility statement

ROKAE is committed to providing reliable safety information, but assumes no liability in this regard. Even if all operations are carried out in accordance with the safety instructions, it cannot be guaranteed that the ZR6-6/0.98C robot will not cause personal injury or property damage. ZR6-6/0.98C

In addition to the safety chapter, please note that additional safety notices are provided in relevant sections of this document.

2.1.2 Intended use

ZR6-6/0.98C

Use of the robot in accordance with its intended use also includes following the product manual instructions for each individual component, including the described operation, installation, and maintenance instructions.

The following uses of use are prohibited:

- Transporting people and animals
- Use in potentially explosive environments
- Use in flammable environments
- Use beyond the permitted range
- Use underground

ZR6-6/0.98C ZR6-6/0.98C

Collaborative operation is intended only for non-hazardous applications, i.e., complete applications including the tool/end effector, workpiece, obstacles, and other machines that have been proven, through a risk assessment of the specific application, to pose no significant hazard.

Any use or application that deviates from the intended use is not permitted.

This includes but is not limited to:

- Use in potentially explosive environments
- Use in medical or life-critical applications
- Use without a risk assessment

- Use beyond the specified ratings
- Use as a climbing aid
- Operation outside the permitted operating parameters

2.2 Safety statement

- Before operating or controlling the robot, a safety risk assessment must be performed and the robot must be used in accordance with the safety specifications in this document.
- For risks associated with the use of the robot that are uncertain, please consult ROKAE's technical support personnel. Issues arising from use not recommended by ROKAE are not covered by support.

2.3 Safety equipment

2.3.1 Emergency stop

The emergency stop is the highest-priority function in the robot system. Pressing the emergency stop button triggers the emergency stop action: all other control functions of the robot are stopped, the robot halts its movement, and the power to each joint motor is cut off. The control system switches to the emergency stop state, which is maintained until the emergency stop button is released.

To resume operation, first release the emergency stop button, and then click 'Emergency Stop Reset' on the HMI interface. Only then will the joint motors execute the power-on command again.

The emergency stop button is located at the upper right of the Teach Pendant. See 3.3.2 for details.



Note

Do not use the emergency stop as a normal program stop, otherwise the brake system and transmission system of the robot will experience additional and unnecessary wear, reducing the service life of the robot.

According to safety standards ISO 13850 and IEC 60204, the stop categories used by the robot are:

- STOP0, the robot motor power is cut off and the brake is engaged at the same time;
- STOP1, the robot stops its motion through planned deceleration, then the motor power is cut off and the brake is engaged.

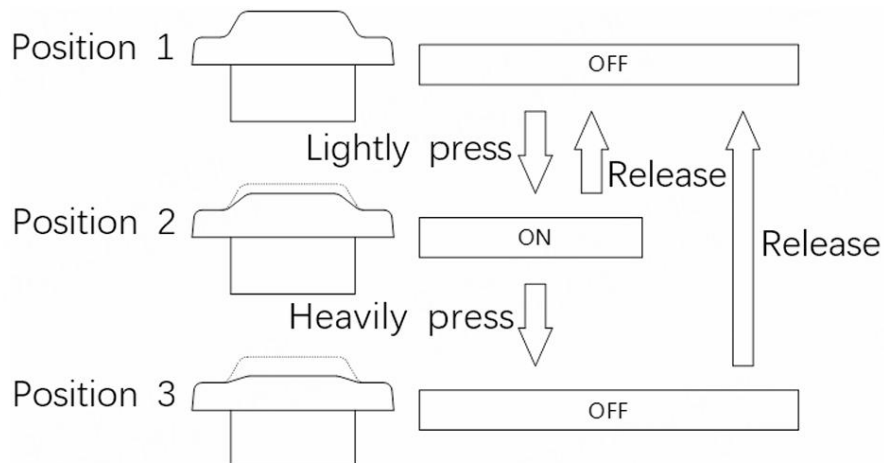
The stop category corresponding to the emergency stop button on this Teach Pendant is STOP0.

2.3.2 Enabling device

The enabling device is a special switch with a 2-stage, 3-position press, also known as the 3-position enabling switch (hereinafter referred to as the enabling switch). It is used in

manual mode to control the on/off of the joint power supply of the robot, thereby enabling robot motion.

The motor power is only turned on when the enabling switch is pressed and held in the middle position, putting the robot in a state where motion is allowed.



The enabling switch is located on the back of the Teach Pendant. See 3.3.2 for details.



Note

In manual mode, when the enabling switch is pressed to the middle position, the joint motor power is turned on and enabled, and the system is in Motor On state, allowing jogging or program execution. When released or pressed all the way down, the motor power is cut off and the system returns to Motor Off state.

To use the robot safely, the following requirements must be observed:

Under no circumstances must the enabling switch be allowed to fail to function properly;

During programming and commissioning, release the enabling switch as soon as robot motion is not required;

Any person entering the robot's working space must carry a handheld enabling device to prevent others from starting the robot without the internal personnel's knowledge.



Warning

It is strictly forbidden to use any external device to latch the enabling switch in the middle position.

2.4 Operational safety

2.4.1 Operator safety

The following simple principles must be observed to operate the robot safely:

- When personnel are inside the robot's safeguarded space, only manual mode may be

used to operate the robot;

- When entering the robot's safeguarded space, you must carry a handheld emergency stop device to ensure that the robot is under your control;
- Pay attention to any moving tools mounted on the robot. Before approaching the robot, make sure these tools have stopped running;
- Pay attention to the robot gripper and the parts being gripped. If the gripper opens, the workpiece may drop and cause personal injury or equipment damage. In addition, the grippers used on the robot may be very powerful, and improper use may also cause injury;

2.4.2 Teach Pendant safety

2.4.2.1 Safely storing the Teach Pendant

When the Teach Pendant is not in use, any Teach Pendant not connected to the robot should be stored in a location away from the robot workstation so that operators do not mistakenly believe the Teach Pendant is still connected to the robot, which could lead to attempts to stop the robot with a disconnected Teach Pendant in the event of danger.

2.4.2.2 Teach Pendant cable

The Teach Pendant is connected to the control cab via the Teach Pendant cable. To avoid personal injury or equipment damage when using the Teach Pendant, observe the following requirements:

- Make sure personnel cannot trip over the Teach Pendant cable, which could cause the Teach Pendant to fall or personnel to fall.
- Do not pinch or press on the Teach Pendant cable, otherwise the internal conductors may be damaged.
- Do not place the Teach Pendant cable on sharp edges, otherwise the cable sheath may be damaged.
- Ensure that the bending radius of the Teach Pendant cable is greater than 80 mm, otherwise the cable may be damaged.

2.4.2.3 Teach Pendant access permissions

Generally, only personnel who have received safety training and basic operation training are considered authorized to use the Teach Pendant. Operators of the Teach Pendant interface should also have differentiated access permissions, so that commissioning and maintenance personnel can use the Teach Pendant correctly and reasonably according to their respective responsibilities.

The control system has five built-in user levels. From lowest to highest operation permission they are: Operator, Trainer, Programmer, Administrator, and Super Administrator. Switching from a lower-permission user to a higher-permission user requires a password, but switching in the reverse direction does not. Higher-permission

users can change the passwords of users at the same or lower level. The password of an Operator-level user cannot be changed.

2.4.2.4 Teach Pendant-less mode

When the control system is set to Teach Pendant-less mode, pay particular attention to safety during commissioning and programming. Make sure an emergency stop button device is installed or placed within the operator's close range, and the emergency stop button signal is wired into the safety I/O interface of the robot system, so that personnel can press the emergency stop button in time to protect themselves and the equipment in case of emergency.

2.4.3 Recovering from emergency stop

2.4.3.1 Description

When the system is in emergency stop state, a reset operation must be performed to return to normal state. The reset procedure is very simple but very important, as it ensures that the robot system does not enter production operation in a hazardous state.

2.4.3.2 Emergency stop button and reset

The emergency stop button is located at the upper right of the Teach Pendant and has a safety lock mechanism. Once pressed, it must be manually released to reset the robot's emergency stop state. Twist the button in the direction indicated on the button surface to release the emergency stop state.

2.4.4 Manual mode safety

2.4.4.1 About manual mode

In manual mode, the robot's motion is under manual control. The robot can be jogged or a program run only when the enabling switch is in the middle position. The enabling switch is located at the grip of the Teach Pendant.

Manual mode is used to write and debug robot programs, as well as to participate in workstation commissioning and trial runs.

2.4.4.2 Speed limits in manual mode

In manual mode, the speed of the robot end is limited to 250 mm/s or less. Whether jogging the robot or running a program, the maximum robot motion speed will not exceed 250 mm/s, regardless of the speed set in the program.

2.4.4.3 Bypassing external safety signals

In manual mode, external safety devices such as safety doors and safety light curtains are bypassed. Even if the safety door is opened in manual mode, the system will not enter the emergency stop state, to facilitate commissioning.

2.4.5 Automatic mode safety

2.4.5.1 About automatic mode

Automatic mode is used to run robot programs during formal production.

In automatic mode the enabling switch is bypassed, so the robot can run automatically without personnel involvement.



Danger

In automatic mode, the robot moves at the speed set in the user program, and the maximum speed of the robot end can reach 3.0 m/s. Note that in this mode personnel must not enter the robot's range of motion, or serious personal injury is very likely to occur.

2.4.5.2 Enabling external safety signals

External safety signals such as safety doors and safety light curtains are enabled in automatic mode. Opening the safety door will trigger an emergency stop.

2.4.5.3 Safely handling production faults

In the vast majority of cases, the robot is part of a production line, so a robot fault often affects more than just the robot workstation itself. Similarly, when other parts of the production line have issues, the robot workstation may also be affected. Fault remediation plans should therefore be designed by personnel very familiar with the entire production line in order to improve safety.

- Pay attention to other equipment that continues to run near the robot

For example, on a production line, the robot needs to pick workpieces from a conveyor belt. If the robot fails, to keep production running, the conveyor belt keeps running while the robot is being repaired. Robot maintenance personnel should additionally consider safety measures for working next to a running conveyor belt.

- Pay attention to other equipment that interacts with the robot

For another example, when a welding robot requires routine maintenance and needs to be taken off the production line, the robot that feeds parts to that welding robot must also be stopped to avoid personal injury.

2.4.6 Fire incident handling

2.4.6.1 Handling a minor fire

When there is an imminent fire hazard, or a fire has started but has not yet spread, do not panic. Stay calm and use the fire extinguishing equipment provided on site to put out the flames. Never use water to extinguish a fire caused by a short circuit.



Warning

Fire extinguishing equipment used at the robot work site must be provided by the user.

The user must select appropriate fire extinguishing equipment based on the actual site conditions. If the controller catches fire, use a carbon dioxide (CO2) extinguisher.

2.4.6.2 Handling a major fire

When the fire has spread and is out of control, on-site personnel should not attempt to extinguish it. They should immediately notify other personnel, abandon personal belongings, and evacuate through the emergency exits as quickly as possible. Do not use elevators during evacuation, and call the fire brigade while evacuating.

If a person's clothing catches fire, do not let them run. Have them quickly lie flat on the ground and use clothing or other suitable items or methods to smother the flames.

2.4.7 Electric shock handling

2.4.7.1 Handling an electric shock

When someone is found to have received an electric shock, do not panic. First, cut off the power as quickly as possible, and take decisive and appropriate measures according to the specific conditions on site:

- If the power switch or button is close to the location of the electric shock, quickly open the switch to cut off the power.
- If the power switch or button is far from the location of the electric shock, use insulated pliers or an axe, knife, or shovel with a dry wooden handle to cut the power supply side (i.e., the incoming side) wires. The cut wires must not touch any person.
- When a wire is on or pressing against the body of the electric shock victim, use a dry wooden stick, plank, bamboo pole, or other tool with an insulated handle (holding the insulated handle) to quickly push the wire away. Do not use any metal rod or wet object to push the wire, to avoid the rescuer being electrocuted.



Warning

Do not touch the electric shock victim directly, or the rescuer may also be electrocuted!

2.4.7.2 Handling the electric shock victim after separation from the power source

- If the electric shock victim is conscious, they should lie on their back on the spot and be closely monitored. They should not stand or walk for the time being.
- If the electric shock victim is unconscious, they should lie on their back on the spot, ensure the airway is clear, and call the victim or gently tap their shoulder at 5-second intervals to determine whether they have lost consciousness. Do not shake the victim's head to call them. Contact the hospital as soon as possible while performing on-site rescue.
- If the electric shock victim has lost consciousness, their breathing and heartbeat must be assessed within 10 seconds. If there is neither breathing nor an arterial pulse, respiration and heartbeat can be determined to have stopped, and cardiopulmonary

resuscitation (CPR) must be performed immediately.

2.5 Personnel and task requirements

2.5.1 Personnel definition

Personnel can be classified into the following three categories:

- Operator

Operators can turn the robot power on and off, and can start robot programs via the Teach Pendant or other interface.

- Commissioning personnel

Commissioning personnel can operate the robot, enter the safeguarded space, and perform setup, teaching, programming, and similar operations on the robot.

- Maintenance personnel

Maintenance personnel can operate the robot, enter the safeguarded space, perform setup, teaching, and similar operations on the robot, and can perform adjustments, repairs, and similar operations on the robot.



Warning

Commissioning and maintenance personnel who are allowed to enter the safeguarded space must have received and passed the professional training for the robot in advance.



Warning

When operating, programming, or maintaining the robot, personnel must pay attention to safety and, based on the actual situation, select and wear the necessary items for the work, including work clothes, safety shoes, safety helmets, etc., appropriate to the work content.

2.5.2 Personnel requirements

2.5.2.1 Operator requirements

Operators must meet the following conditions:

- Operators must be within the legal working age range of the local jurisdiction.
- Operators must be in good physical condition. Good physical condition includes: good vision (glasses or contact lenses may be worn), good hearing, and good coordination. Operators must not take any substances that may reduce their mental capabilities (such as medication, alcohol, or drugs) during work.
- Understand the locally applicable safety regulations, such as occupational safety and health regulations and industrial accident prevention regulations.

2.5.2.2 Commissioning personnel requirements

Commissioning personnel must meet the standards for operators. In addition,

commissioning personnel must also meet the following conditions:

- Commissioning personnel must have the basic technical knowledge to understand robot-related technical documents and drawings, and to complete their work tasks in accordance with the manual.
- Commissioning personnel must be very familiar with the use of the robot system, and be able to reasonably achieve the desired goals through robot operation based on actual needs.

2.5.2.3 Maintenance personnel requirements

Maintenance personnel must meet the standards for operators. In addition, maintenance personnel must also have certain other professional knowledge (such as electrical, mechanical, pneumatic, etc.) to complete their work tasks in accordance with the manual.

2.5.3 Task content requirements

2.5.3.1 Safety requirements for installation and operation

- When handling and installing robot equipment, the methods described in the ROKAE manual must be followed. Failure to do so may cause the robot to tip over due to incorrect operation, resulting in personnel injury or death, or equipment damage.
- When using the robot equipment for the first time after installation, always start at low speed and gradually increase the speed. Do not run at high speed on the first use.
- Programs and system variables are stored by default in the storage device of the control cab. To prevent data loss caused by accidents, users are advised to perform regular data backups.

2.5.3.2 Safety requirements for commissioning

Commissioning should be carried out outside the safeguarded space whenever possible. When commissioning must be carried out inside the safeguarded space, pay particular attention to the following:

- Carefully inspect the conditions inside the safeguarded space, and confirm there is no danger before entering.
- Confirm the location of all commissioning personnel inside the safeguarded space.
- Confirm the state of the entire system before performing any operation.
- Make sure the emergency stop button can be pressed at any time.
- Run the robot at low speed.

After commissioning is complete, commissioning personnel must operate from outside the safeguarded space.

2.5.3.3 Safety requirements for maintenance

- Carefully inspect the conditions inside the safeguarded space, and confirm there is no danger before entering.
- Confirm the location of all maintenance personnel inside the safeguarded space.

- When power is on, some maintenance operations pose a risk of electric shock. Disconnect the power to the robot equipment and system as much as possible before performing maintenance.
- During maintenance, prevent other personnel from inadvertently turning on the power.
- Do not place any part of your body on any part of the robot equipment during work, to avoid unnecessary personal injury or adverse effects on the equipment.
- Provide appropriate lighting equipment when performing maintenance.
- When replacing parts, always use parts specified by ROKAE. Use of parts other than those specified may cause damage to the robot equipment.
- Parts removed when replacing components (such as screws) must be reinstalled in their original positions. If parts are missing or left over, recheck and install them correctly.

2.6 Safety training

2.6.1 Overview

On-site operators, commissioning personnel, and maintenance personnel must receive formal robot safety and operation training and pass the assessment before they are allowed to operate, commission, or maintain the robot. Non-professionals or personnel who have not passed the training are prohibited from operating, commissioning, or maintaining the robot, to avoid serious harm to personnel and the robot equipment.

All personnel working on the equipment must:

- Determine the current state of the equipment and ensure the equipment is fault-free before operating, commissioning, or otherwise working on the robot equipment.
- In the event of an emergency, be able to select the safest method to handle the situation, minimizing loss of life and property.
- Fully understand ROKAE's product manual documents, and work on the equipment in accordance with the requirements of the documents.

2.6.2 Personnel safety

The following general precautions are listed; please consider taking them to ensure personnel safety:

- When the equipment is running, even if the robot appears to have stopped, it may be in a state about to run because it is waiting for a start signal. This state should also be regarded as the equipment being in operation.
- All peripheral equipment must be properly grounded.
- Peripheral equipment should be installed outside the robot's range of motion whenever possible.
- Use methods such as floor markings to clearly indicate the range of motion of the robot equipment.

2.6.2.1 Operator safety

Operators must not enter the safeguarded space to perform work:

- Operate the robot from outside the safeguarded space.
- To prevent unrelated personnel from accidentally entering the safeguarded space, install guardrails or safety doors.
- When the robot does not need to be operated, disconnect the power or press the emergency stop button.
- An emergency stop button must be installed within the operator's reach.

2.6.2.2 Commissioning personnel safety

When performing commissioning work, in some cases it is necessary to enter the robot's range of motion. Pay special attention to safety in such cases:

- Before performing commissioning work, confirm that the equipment is in a safe state.
- Confirm in advance the locations and states of safety devices (such as the emergency stop button).
- Pay special attention to ensuring that no other personnel enter the robot's range of motion.
- Before starting the robot, fully confirm that there is no personnel inside the robot's range of motion.

After commissioning is complete, be sure to perform test runs according to the following steps:

- At low speed, single-step execute the program for at least one cycle and confirm there are no abnormalities.
- At low speed, continuously run the program for at least one cycle and confirm there are no abnormalities.
- At the actual application operating speed, continuously run the program for at least one cycle and confirm there are no abnormalities.

2.6.2.3 Maintenance personnel safety

To ensure the safety of maintenance personnel, pay close attention to the following:

- Before performing maintenance work, confirm that peripheral equipment is in a safe state.
- Before performing maintenance work, disconnect the equipment power as much as possible. Use a lock or similar device to lock out the main circuit breaker as needed to prevent other personnel from inadvertently turning on the power.
- When it is unavoidable to enter the robot's range of motion while power is on, press the emergency stop button before entering. Maintenance personnel should hang a 'Maintenance in progress' sign to prevent other personnel from inadvertently operating the equipment.

- Never enter the robot's range of motion while the robot is moving.
- Never run an automatic program when there are other personnel inside the robot's range of motion.
- During maintenance, station a person who is familiar with the robot system and able to detect hazards next to the equipment, so that they can press the emergency stop button in an emergency.
- When replacing parts or reassembling, take care to prevent foreign matter from adhering to or mixing into the equipment.
- When servicing the inside of the robot and contacting the power supply unit, printed circuit boards, etc., to prevent electric shock, always disconnect the robot power first before proceeding.

2.7 Pre-use assessment

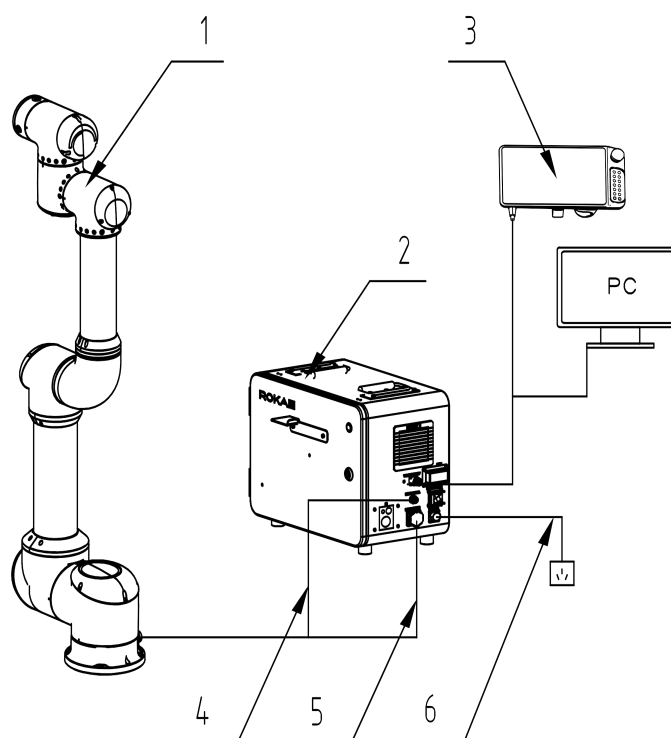
Before using the robot for the first time or after any modification, the following tests must be performed. Confirm that all safety inputs and outputs are correct and properly connected. Test that all connected safety inputs and outputs function properly. The tests include:

- Test that the Teach Pendant emergency stop button can stop the robot and engage the brake.
- Test that the operation mode can be switched between manual and automatic.
- Test that the Teach Pendant enabling switch must be pressed to start motion in manual mode, and that the robot is under reduced-speed control.

3 Product overview

3.1 System structure

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Label	Name
1	Manipulator
2	Control cab
3	Teach Pendant
4	Signal relay cable
5	Power relay cable
6	Control cab power supply cable

3.2 Manipulator

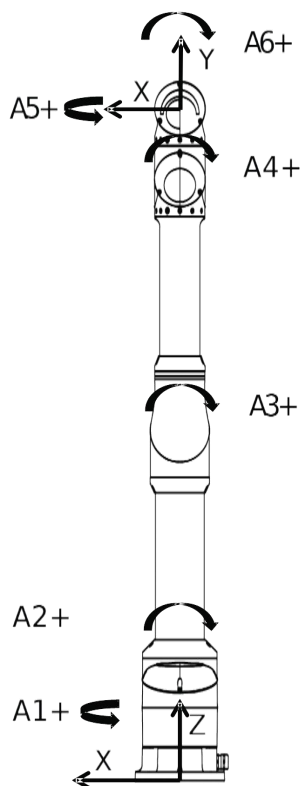
ZR6-6/0.98C

Base coordinate system: the direction in which cables exit the base is the -X direction, the upward direction perpendicular to the mounting surface is +Z, and the Y axis is determined by the right-hand rule.

Flange coordinate system: with the robot in the zero pose, the upward direction perpendicular to the mounting surface is +Y, the direction opposite to the cable exit direction at the base is +X, and the Z axis is determined by the right-hand rule.

Rotation axis direction definition: when each axis is at its mechanical zero, the positive

direction of the A1/A5 rotation axis is aligned with the +Z direction of the base coordinate system, and the positive direction of the A2/A3/A4/A6 rotation axes is aligned with the -Y direction of the base coordinate system.

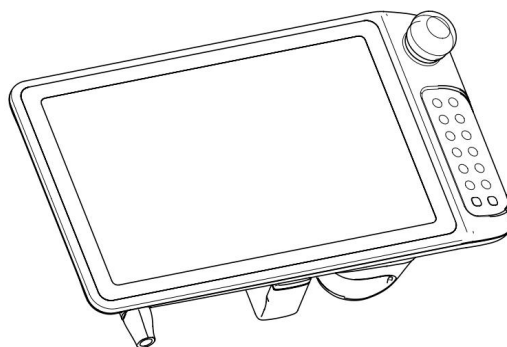


3.3 Teach Pendant

3.3.1 Teach Pendant overview

The Teach Pendant is an embedded handheld device with complete hardware and software built in. You can use the Teach Pendant to perform all robot-related functions, such as writing and debugging programs, viewing system status, and setting system parameters.

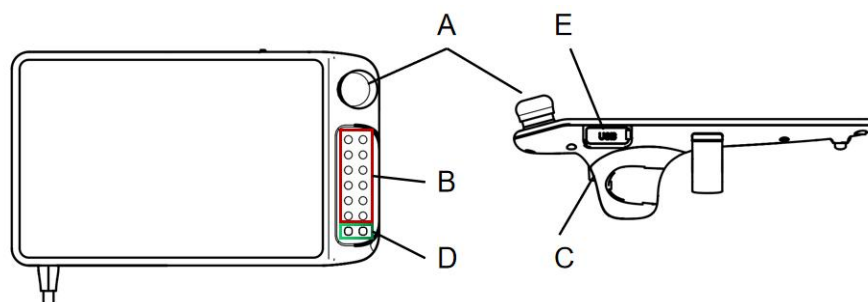
The Teach Pendant equipped with this robot system is called xPad2. It is a carefully designed, reliable, and easy-to-use product. Proficient use of xPad2 will effectively improve the efficiency of robot operation.



3.3.2 Teach Pendant structure and description

The xPad2 Teach Pendant consists of the following parts:

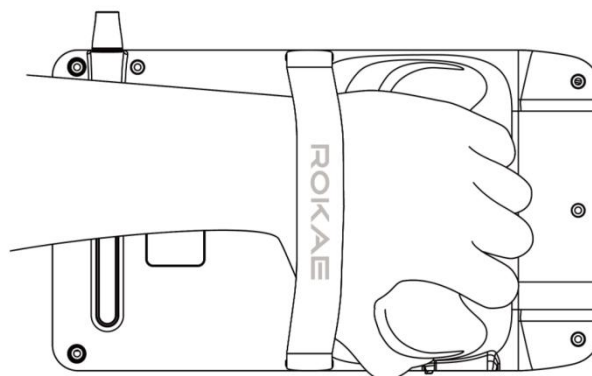
- Capacitive touch screen
- Buttons
- Emergency stop button
- 3-position enabling switch
- USB interface, etc.



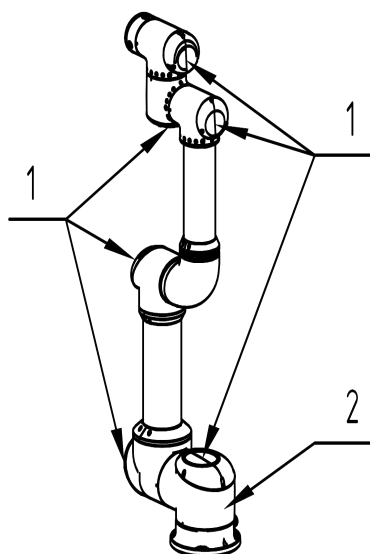
Label	Description
A	Emergency stop button, used to trigger emergency stop in dangerous situations.
B	Jog buttons, 6 groups of 12 in total, corresponding to the 6 joints of the robot or the 6 degrees of freedom in Cartesian space.
C	3-position enabling switch, used to enable robot motion in manual mode.
D	Function buttons, used to page through the functions currently indicated on the touch screen.
E	USB interface, used to connect a USB flash drive, protected by a rubber cover.

3.3.3 How to hold the Teach Pendant

Normally the Teach Pendant is operated by hand. Users who are accustomed to right-handed operation should hold the Teach Pendant with their left hand and use their right hand to operate the buttons and touch screen on the Teach Pendant. The recommended holding method is shown in the figure below



3.4 Signs and labels



Label	Content
1	Manipulator logo
2	Manipulator nameplate

4 Technical specifications

This section describes the performance parameters of the ZR6-6/0.98C flexible collaborative robot product.ZR6-6/0.98C

4.1 Manipulator

4.1.1 Basic parameters

Item		Content
Product name		ZR6-6/0.98C
Number of axes		6
Maximum reach		980 mm
Repeatability		± 0.05 mm
Maximum payload		6 kg
Range of motion	Axis 1	$\pm 360^\circ$
	Axis 2	$\pm 360^\circ$
	Axis 3	$\pm 162^\circ$
	Axis 4	$\pm 360^\circ$

	Axis 5	$\pm 360^\circ$
	Axis 6	$\pm 360^\circ$
Maximum speed	Axis 1	$180^\circ /s$
	Axis 2	$180^\circ /s$
	Axis 3	$180^\circ /s$
	Axis 4	$240^\circ /s$
	Axis 5	$240^\circ /s$
	Axis 6	$240^\circ /s$
Operating ambient temperature		0°C to $+50^\circ\text{C}$
Storage ambient temperature		-10°C to $+55^\circ\text{C}$
Max. relative humidity for operating/storage environment		93%, no condensation, no frost
IP rating		IP54
Mounting mode		Mounting at any angle
Manipulator weight		Approx. 20 kg
Noise (average)		$\leq 70\text{ dB(A)}$



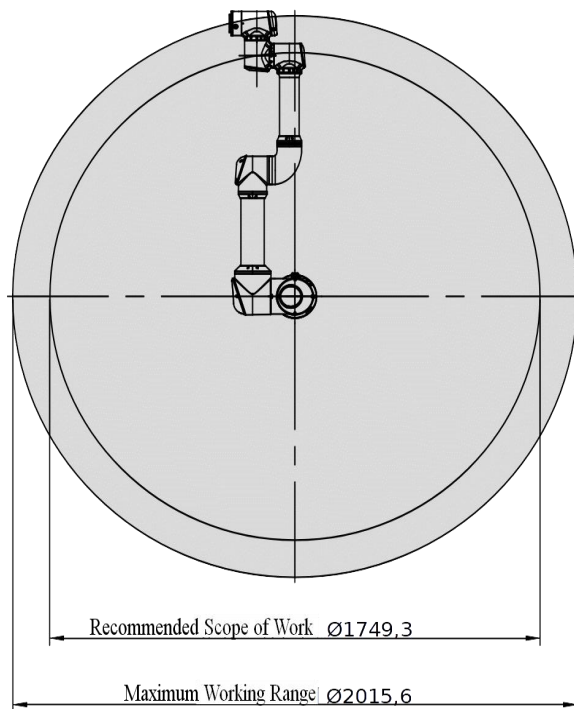
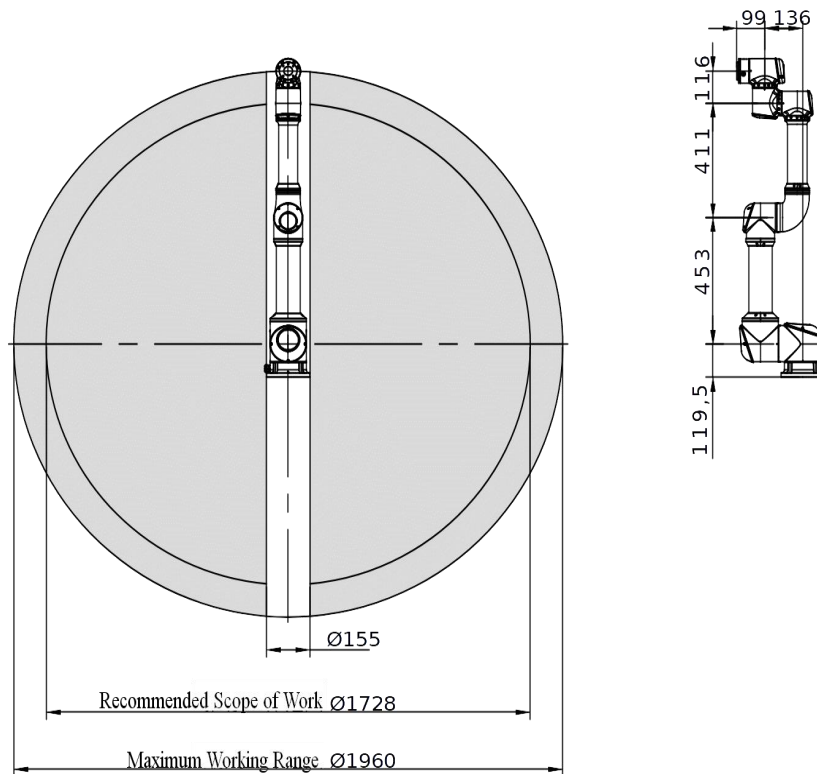
Warning

At factory shipment, the software limits of the default range of motion of each axis do not exceed $\pm 180^\circ$. The user may modify the range of motion of the corresponding axes according to the actual application scenario and the contents of this manual, but the user must ensure:

- The user is fully aware of the description of the range of motion of each axis of this model in this document;
- The user ensures that the software limit values modified for the axis do not exceed the range of motion described for that axis in this document;
- The user must fully consider factors such as the mounting mode of the robot, characteristics of the end tool, surrounding environment, and ensure that the modified software limits and robot programming operations will not result in collisions;
- If the user changes the software limit values and makes them effective, it means that the user has confirmed that the above rules have been complied with, and agrees that the user shall bear all consequences arising from any failure to comply with the above rules.

4.1.2 Working space

ZR6-6/0.98C



4.1.3 Allowable payload



Warning

It is critical to always define the correct actual load data and calibrate the robot's

payload. Incorrect load data may cause the robot to become overloaded.

If incorrect load data and/or loads outside the load diagram are used, the following components may be damaged due to overload:

- Motors
- Reducers
- Mechanical structure

The total weight of all loads mounted on the robot, including the EOAT, workpiece, etc., must be less than the maximum payload of the robot.

Robots operated with incorrect load data and/or loads outside the load diagram are not covered by the robot warranty.

4.1.3.1 Allowable wrist torque and inertia

To fully exploit the performance of the robot and avoid robot faults or damage due to overload, the payload mounted on the robot must not exceed the allowable torque and allowable inertia. The ZR6-6/0.98C allowable torque and inertia are shown in the table below ZR6-6/0.98C

Axis	Allowable torque (N • m)	Allowable inertia (kg • m ²)
Axis 4	15	0.42
Axis 5	12	0.26
Axis 6	8.5	0.14



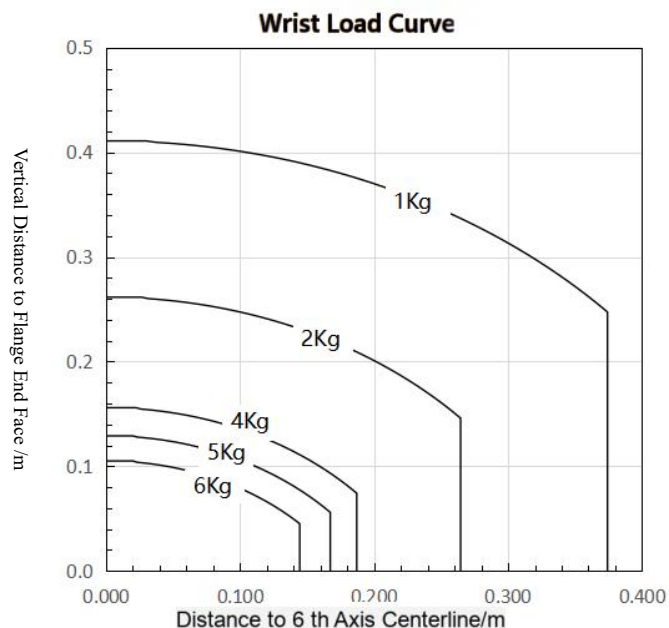
Warning

Payload parameters must not exceed the allowable torque and allowable inertia!

Always match the load to the robot's load capacity. Exceeding the robot's load capacity will cause robot alarms or even damage to robot components and shorten the robot's service life.

4.1.3.2 Wrist maximum allowable load curve

The position of the load center of gravity is determined by the distance from the load center to the flange surface. L_{xy} is the distance from the load center to the A6 axis line, and L_z is the distance from the load center to the output flange mounting surface. The distances for each load are shown in the wrist load curve diagram



Warning

When calculating the load weight, the weight of the end effector must be included and ensured to comply with the robot load specifications. Ensure that the system never exceeds the maximum allowable load.

4.1.3.3 Load and inertia calculation

To ensure the best robot performance, the load (weight of the end effector and workpiece) and load inertia must be clearly within the robot's maximum allowable values. When an end mechanism is mounted on the robot end and moves, the moment of inertia of the end mechanism must be considered.



Note

Generally, when an accurate 3D model is available, the mass, center of mass, and inertia information of the load can be quickly obtained in 3D CAD software!

4.1.3.4 Joint torque limit

Joint torque must be considered in the risk analysis prior to a specific application. The table below shows the torque limits for each joint. Use must be within the torque limits; use beyond the limits may cause robot overload and damage.

Axis	Joint torque limit (N • m)
1	204
2	204
3	108
4	66

5	66
6	66

4.2 Teach Pendant

Item	Content
Product name	xPad2
Screen size	10.1 inches
Screen resolution	1920×1200
Touch type	Capacitive
External dimensions	290×170×80 mm
Weight	Approx. 840 g (excluding cable)
Minimum cable bending radius	50 mm
IP rating	IP54
External interface	USB 3.0
Operating ambient temperature	0°C to +45°C
Storage ambient temperature	-25° C to +55° C
Max. relative humidity for operating/storage environment	90%, no condensation, no frost

5 Unpacking and installation

This chapter describes the matters requiring attention when unpacking and installing the ZR6-6/0.98C flexible collaborative robot after receipt.ZR6-6/0.98C

5.1 Installation flowchart

The installation flowchart is used to check the progress of robot installation. After each operation step is completed, check the corresponding box in the 'Completed' column

Step	Operation	Completed
1. Preparations before robot installation		
①	Installation personnel	
②	Installation environment	
③	Installation foundation	
④	Support column	
2. Confirm sufficient installation space for the robot		
3. Unpacking and handling		
①	Unpacking	
②	Check the packing list	

③	Handling	
4. Installing the manipulator		
①	Fix the robot at the installation position	
5. Cable connections		
①	Connect the power and signal relay cables between the manipulator and the control cab	
②	Connect the control cab to the power outlet with the control cab power cable	
③	Connect the Teach Pendant (if required)	
6. User wiring		
①	Connect I/O signal cables (if required)	



Note

Please prepare your own M8 hex wrench, packaging removal tools, and necessary protective equipment such as gloves.

5.2 Environmental conditions

The robot is suitable for general industrial environments. Use must comply with the description of the operating conditions of each component in Chapter 4. In addition, the following conditions must be met:

- Indoor installation, avoid direct sunlight;
- Keep away from dust, metal powder, oil mist, salt mist, etc.;
- Keep away from flammable and corrosive liquids and gases;
- Prevent water splashes from any direction from entering;
- Do not transmit shock or vibration;
- Altitude below 1000 m;
- Keep away from sources of electrical interference;

and ensure:

- EFT burst interference is below ± 2 kV;
- ESD interference is below ± 8 kV



Warning

Do not place or use the robot in explosive environments!



Note

At low ambient temperatures ($<10^{\circ}\text{C}$), the grease (or lubricating oil) inside the reducer (or gearbox) becomes more viscous, which may cause the robot to stop or operate inefficiently. In this case, it is recommended to warm up the robot together with other supporting equipment.

The ambient conditions for robot storage must comply with the description of the storage conditions for each component in Chapter 4.

5.3 Unpacking

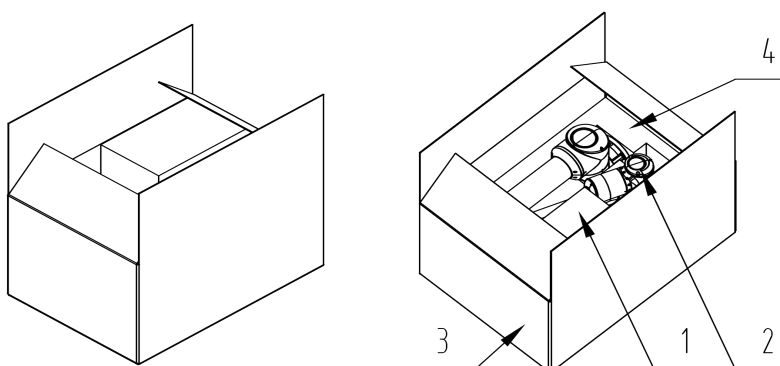
Please prepare the tools required for unpacking according to the table below:

No.	Tool	Quantity
1	Utility knife/scissors	1
2	Protective gloves	1

Unpacking steps:

- 1) Step 1: Remove the outer packaging carton

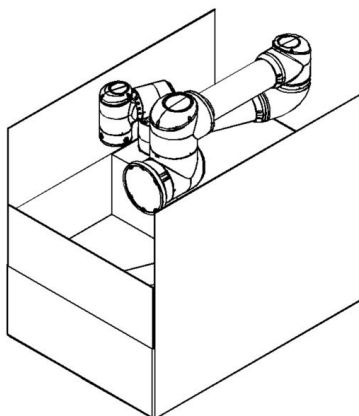
Wear protective gloves, use a utility knife/scissors to open the packaging carton, and remove the upper layer of pearl cotton.



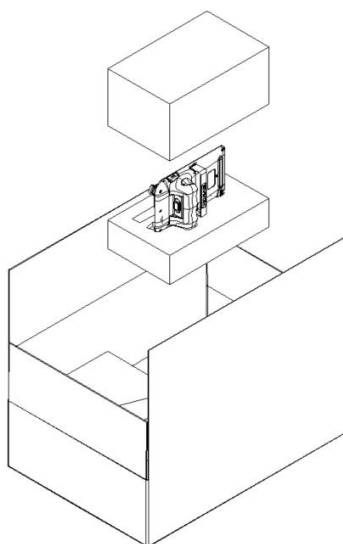
Label	Name
1	Teach Pendant + protective pearl cotton
2	Manipulator
3	Carton
4	Robot protective pearl cotton

- 2) Step 2: Remove the manipulator

Take the manipulator out of the carton and place it in a safe location. After placing, take care to prevent the robot from tipping over or being bumped;



3) Step 3: Remove the Teach Pendant

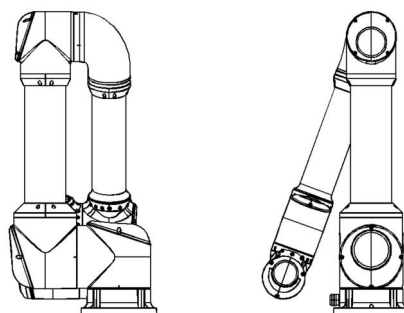


Take care to keep loose parts safe. Handle accessories such as USB flash drives, calibration blocks, and cables with care.

5.4 Transportation and handling

5.4.1 Robot transport angle and handling points

During transportation, to maintain stability, the transport pose angle of each axis of the robot has been defined. See the table below for details.



The axis angles in the transport pose are

Axis 1	Axis 2	Axis 3	Axis 4	Axis 5	Axis 6
0°	0°	160°	0°	180°	0°



Warning

The positions and directions of the arrows in the figure indicate the recommended force application points and directions for the robot in the packaging and transport pose. It is strongly discouraged to apply force at other positions to transport the robot, as improper handling and force application points may cause damage to the robot!

5.4.2 Handling

- Because this product consists of precision parts, when handling the robot and the control cab, be sure to avoid subjecting the robot and the control cab to excessive impact and vibration;
- To ensure safe handling and installation, clear all obstacles in advance to keep the handling passage clear;
- When handling the robot and the control cab, the ambient conditions must comply with the description of the storage conditions for each component in Chapter 4.



Danger

Make sure that all power to the robot is turned off during transport.

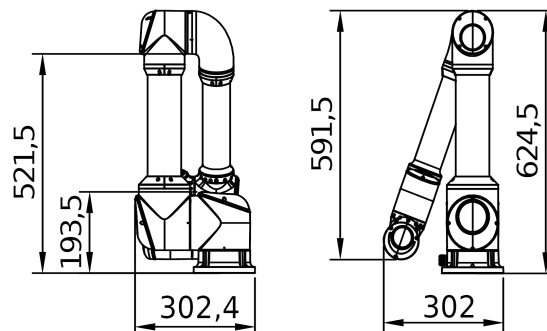
5.4.2.1 General description

In principle, lifting equipment such as cranes should be used for handling. Lifting operations and the operation of cranes and forklifts must be entrusted to personnel with the appropriate qualifications; otherwise, personal injury or equipment damage could result.

5.4.2.2 Tipping risk

If the robot is not fastened to any base and remains stationary, the robot is unstable. Any movement may cause the robot's center of gravity to shift or tip, or even overturn;

5.4.2.3 Handling dimensions



5.5 Installation

5.5.1 Pre-installation check

Personnel installing or operating the robot must have the knowledge required for mechanical and electronic equipment installation/maintenance/repair work and must comply with all relevant national and regional regulations.

Checking installation prerequisites

No.	Operation
1	Visually inspect the robot to ensure it is not damaged
2	Ensure that the expected operating environment of the robot complies with the description in this section
3	Ensure that the installation site meets the requirements
4	If not installed directly, ensure that the site meets the environmental requirements
5	After the above prerequisites are met, install the robot according to the next section

5.5.2 Installing the manipulator and control cab

Pay attention to the following when installing the control cab:

To ensure effective heat dissipation to avoid overheating of the control system, and to reserve space for control cab operation, when placing the MCC control cab, ensure that at least 300 mm of space is reserved on the right side of the control cab and at least 120 mm of space at the rear. If the front door of the control cab does not need to be opened, reserve at least 120 mm of space.

- Reserve wiring space at the relay cable interface on the right panel of the control cab.

The bending radius of the power relay cable must not be less than 100 mm, and that of the signal relay cable must not be less than 60 mm.

- A Teach Pendant cable interface is provided on the front panel of the control cab. The

bending radius of the Teach Pendant cable must not be less than 80 mm.



Danger

The control cab contains high-voltage components. Unauthorized personnel are strictly forbidden from opening the control cab enclosure, as this may cause serious or even fatal personal injury!

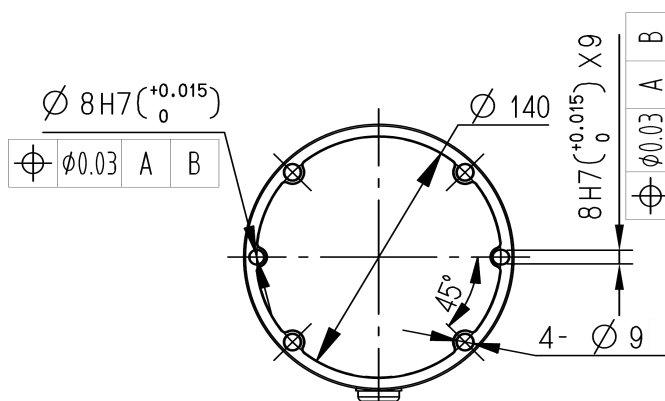
5.5.2.1 Mounting and fixing

Name of parts required for installation	Specification	Bracket mounting
Hex socket head cap screw	M8x30 (grade 12.9), 4 pcs	√
Mounting base	Mounting plate thickness at least 20 mm	√

Note:

- There must be no insulating material between the robot fixing plate and mounting base and the operator machine or concrete;
- '√' indicates that this mounting mode is required;
- The fixing strength of the mounting bracket must not be lower than that of the robot fixing plate and the foundation during foundation mounting.

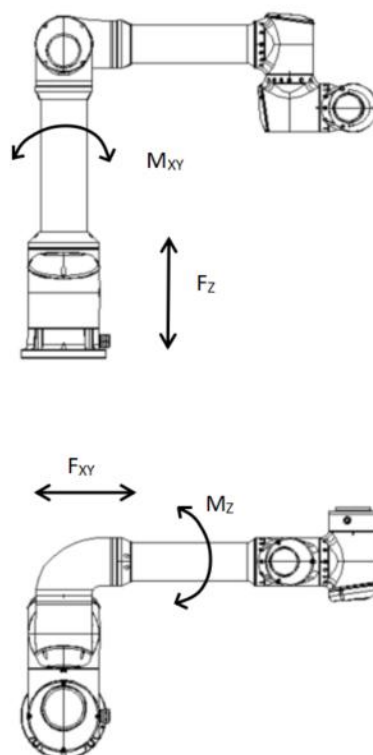
The robot fixing method and specific parameters are shown in the figure below,



To ensure accurate positioning, dowel pins can be used in the reserved cylindrical pin holes for positioning. Then use 4 M8x30 hex socket head cap bolts (strength grade 12.9) to fix the robot base to the bracket.

5.5.2.2 Robot reaction force at the base

After the robot is installed, its mounting base is subjected to large reaction forces due to the robot's static and dynamic loads. As shown in the figure, the robot base must be able to withstand these reaction forces.



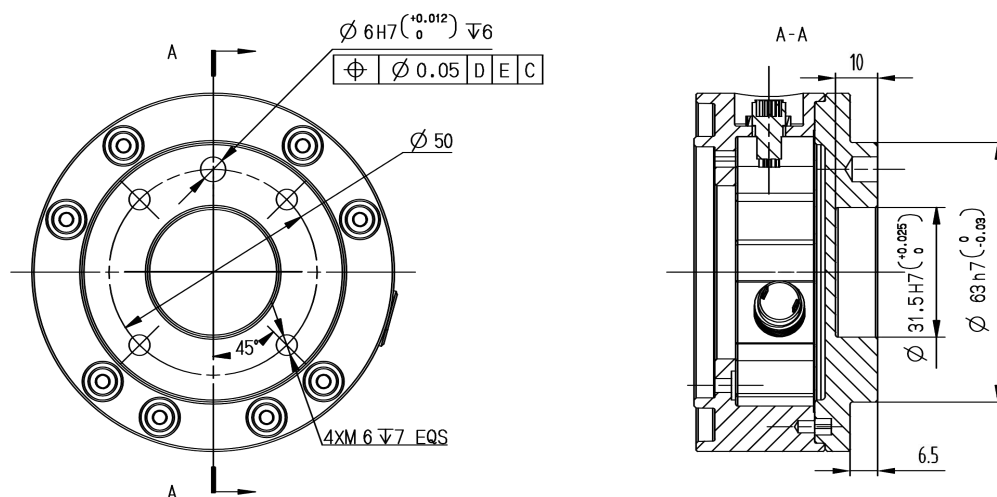
Force	Max.	Unit
F_{xy}	1848	N
F_z	1848	N
M_{xy}	910.5	N • m
M_z	480	N • m

**Note**

The above force and torque values are extreme values that may occur during robot motion; they rarely occur, and the above values cannot reach the maximum at the same time.

5.5.3 Tool flange

To accurately position the tool, please use the reserved $\Phi 6$ pin holes for accurate positioning. The robot end flange has 4 M6 threaded holes that can be used to connect the tool to the robot flange. M6 bolts must be tightened to a torque of 15 N • m. Refer to the figure below for specific dimensions



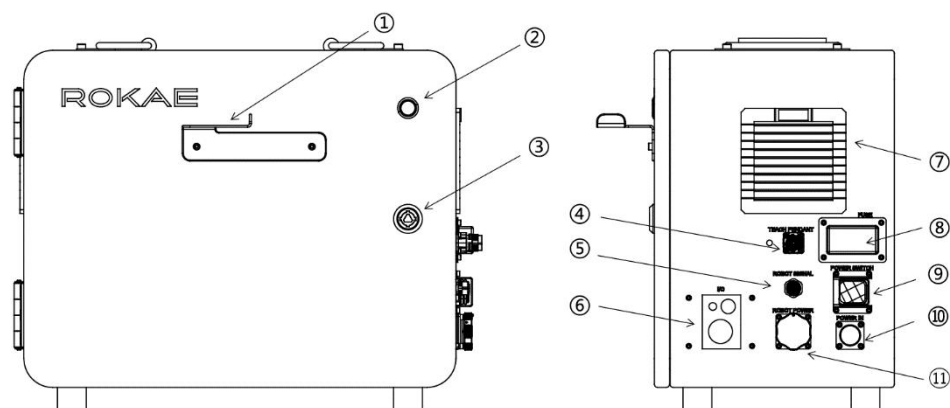
Warning

- Make sure the tool is correctly and safely mounted in place. Pay attention to whether the range of motion of the mounted tool affects the robot's working space;
- Make sure the M6 screws for mounting the tool do not exceed the thread length shown in the figure, to avoid irreparable damage;
- Make sure the tool is safe and there is no risk of any parts accidentally falling off.

6 Electrical connection

6.1 Control cab interfaces

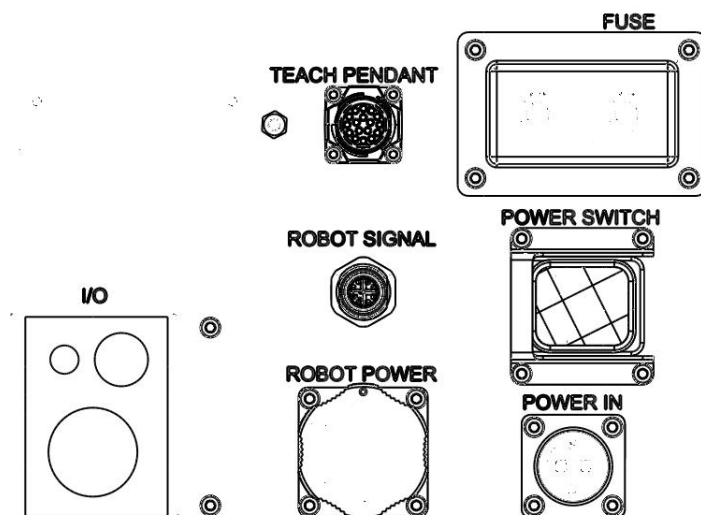
6.1.1 Panel interfaces



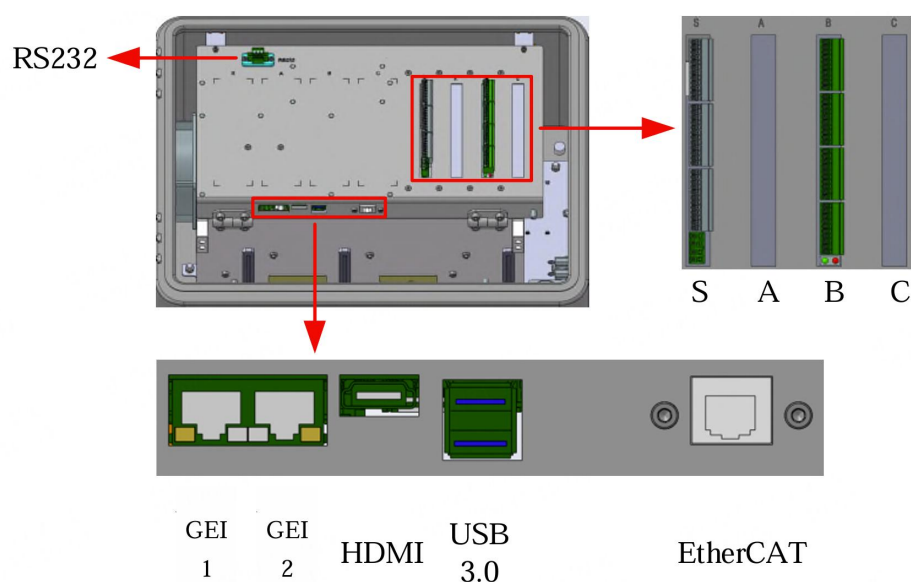
Each part of the panel is described as follows:

No.	Description
①	Teach Pendant hanger, used to hang the Teach Pendant. The Teach Pendant hanger must be assembled by the user.
②	Power indicator; the power indicator lights up white when the control cab is properly powered and the power switch is turned on
③	Door lock
④	Teach Pendant interface, marked 'TEACH PENDANT'
⑤	Signal relay cable interface, marked 'ROBOT SIGNAL'
⑥	User wiring outlet, marked 'I/O'
⑦	Vent
⑧	Fuse, marked 'FUSE'
⑨	Control cab power switch, marked 'POWER SWITCH'
⑩	Control cab power supply interface, marked 'POWER IN'
⑪	Power relay cable interface, marked 'ROBOT POWER'

Enlarged view of the side panel interface



6.1.2 Internal interfaces



Identifier	Description
RS232	Serial communication interface, available for user use.
Gigabit Ethernet port 1	Dedicated to the Teach Pendant; not for user use.
Gigabit Ethernet port 2	Gigabit Ethernet, available for user use
USB3.0	USB3.0 interface for internal debugging or data import/export.
HDMI	Display interface
ECAT port	Used for EtherCAT extended communication
S	Safety I/O interface, standard, cannot be changed.

A	This slot is empty in the standard control cab. An incremental encoder signal acquisition module, general-purpose digital I/O module, or analog voltage/current I/O module can be optionally configured.
B	General-purpose digital I/O interface, standard, cannot be changed.
C	This slot is empty in the standard control cab. A general-purpose digital I/O module or analog voltage/current I/O module can be optionally configured.

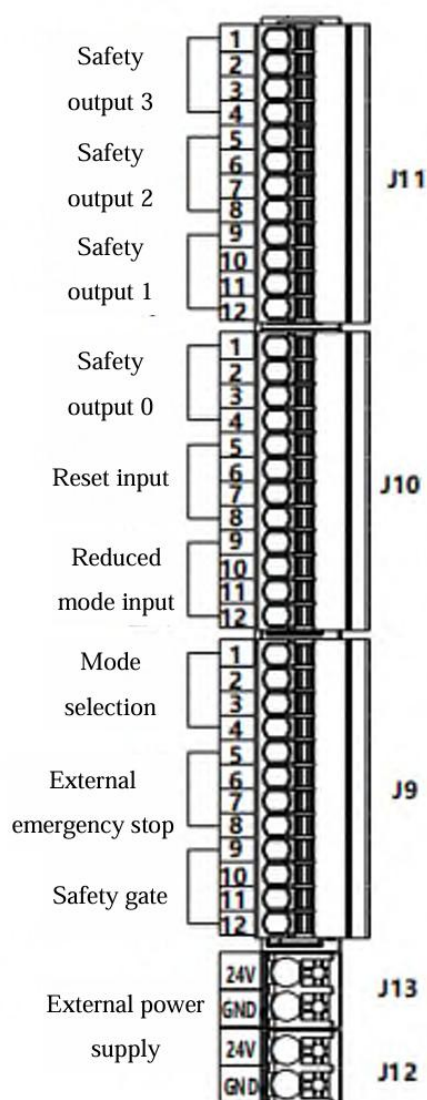
**Danger**

- The control cab contains high-voltage components. Non-professionals must not open the control cab door with power on;
- Before opening the control cab door for wiring, ensure that the power is turned off. After wiring is complete, close the front door before turning on the control cab power switch.
- Operation with power on may cause device damage, and may cause serious or even fatal personal injury if performed improperly!

**Note**

The safety I/O and general-purpose digital I/O interfaces use spring-type plug-in terminals. Plug carefully. If plugging is not smooth, check whether the terminal crimping is proper to avoid damage to the terminal by forced plugging/inserting.

6.1.2.1 Safety I/O interface description



Each group of safety input or safety output signals is dual-redundant, so each group of safety signals contains two groups of I/O points, 'Loop 1' and 'Loop 2', with 4 wiring terminals in total. The pin definitions are as follows:

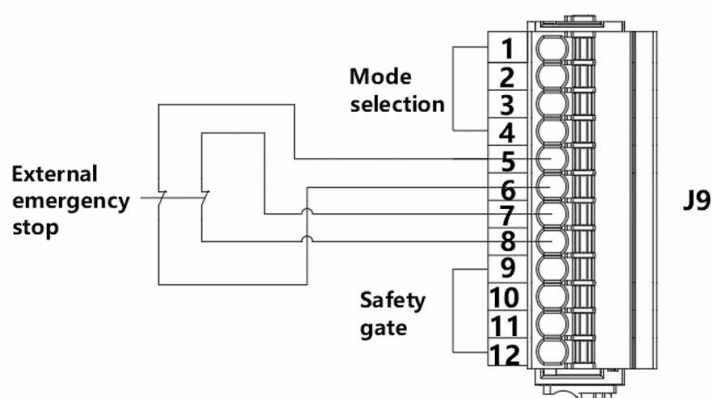
Pin	Function	Description
J9-1	Mode select AP	Shorted: automatic mode; open: manual mode
J9-2	Mode select AN	
J9-3	Mode select BP	Shorted: automatic mode; open: manual mode
J9-4	Mode select BN	
J9-5	External emergency stop AP	External emergency stop Loop 2; must be shorted when not in use.
J9-6	External emergency stop AN	
J9-7	External emergency stop BP	External emergency stop Loop 1; must be shorted when not in use.
J9-8	External emergency stop BN	
J9-9	Safety door AP	Safety door Loop 2; must be shorted when

J9-10	Safety door AN	not in use.
J9-11	Safety door BP	Safety door Loop 1; must be shorted when not in use.
J9-12	Safety door BN	
J10-1	Safety output 1 AP	GND
J10-2	Safety output 1 AN	Outputs 0 V or 24 V according to the bound safety function
J10-3	Safety output 1 BP	GND
J10-4	Safety output 1 BN	Outputs 0 V or 24 V according to the bound safety function
J10-5	Reset input AP	Reset input; reset is triggered when shorted, not triggered when open
J10-6	Reset input AN	
J10-7	Reset input BP	Reset input; reset is triggered when shorted, not triggered when open
J10-8	Reset input BN	
J10-9	Reduced-speed mode AP	Reduced-speed mode input; must be shorted when not in use
J10-10	Reduced-speed mode AN	
J10-11	Reduced-speed mode BP	Reduced-speed mode input; must be shorted when not in use
J10-12	Reduced-speed mode BN	
J11-1	Safety output 3 AP	GND
J11-2	Safety output 3 AN	Outputs 0 V or 24 V according to the bound safety function
J11-3	Safety output 3 BP	GND
J11-4	Safety output 3 BN	Outputs 0 V or 24 V according to the bound safety function
J11-5	Safety output 2 AP	GND
J11-6	Safety output 2 AN	Outputs 0 V or 24 V according to the bound safety function
J11-7	Safety output 2 BP	GND
J11-8	Safety output 2 BN	Outputs 0 V or 24 V according to the bound safety function
J11-9	Safety output 1 AP	GND
J11-10	Safety output 1 AN	Outputs 0 V or 24 V according to the bound safety function
J11-11	Safety output 1 BP	GND
J11-12	Safety output 1 BN	Outputs 0 V or 24 V according to the bound safety function
J12-J13	External power supply	The total current of the two external power supply outputs must not exceed 2 A

E0308-spec tube-type insulated terminals are recommended for J9, J10, and J11;

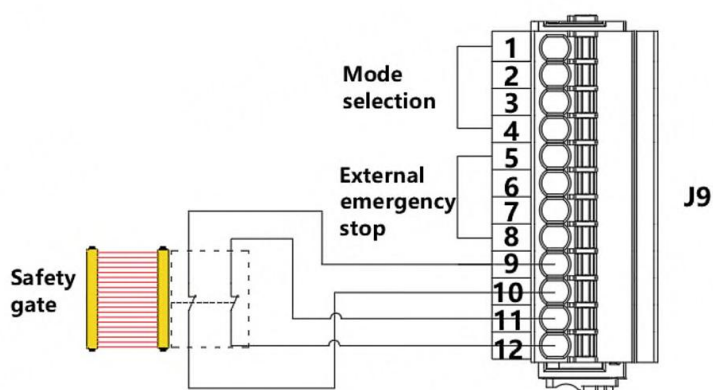
E0508-spec tube-type insulated terminals are recommended for J12 and J13.

- External emergency stop wiring schematic



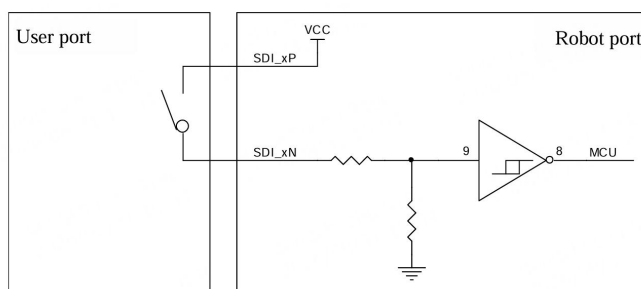
Through this interface, an emergency stop button or emergency stop handle, etc., can be connected. For example, when using an emergency stop button, because this interface is an active interface, it is only necessary to connect the input/output loop of the emergency stop switch to the external emergency stop interface. See the figure above.

- Safety door wiring schematic



Through this interface, safety door devices (photoelectric switch/limit switch/safety light curtain, etc.) can be connected. For example, when using a safety light curtain, because this interface is an active interface, it is only necessary to connect the switch input/output loop to the safety door interface. See the figure above.

● Safety input loop interface description

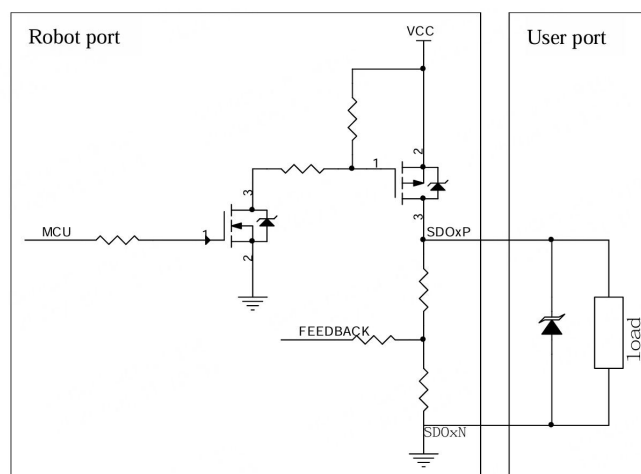


The circuit principle of the two loops is the same; both support 24 VDC signals.

During wiring, safety signals 1AP and 1AN, and 1BP and 1BN shorted simultaneously represent valid safety input. 1AP and 1AN, and 1BP and 1BN open simultaneously represent invalid safety input. All other states are abnormal.

Item	Parameter
Input current	≤ 50 mA per loop
Wire resistance	$\leq 15 \Omega$ per loop
Quantity	5 groups

● Safety output loop interface description



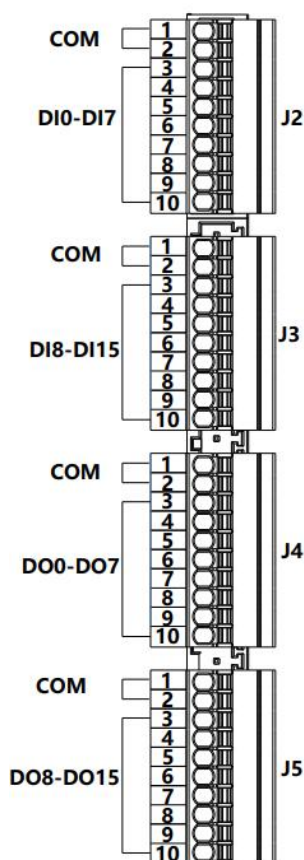
Note

It is strongly recommended to connect a freewheeling diode in parallel across inductive loads!

The safety output loop uses MOSFET outputs, and the MOSFET voltage is sampled. The circuit principle of the two loops is the same; both support 24 VDC signals. When the output signal is active, 24 VDC is generated between SDOxP and SDOxN.

Item	Parameter
Type	Semiconductor output
Voltage range	High level: 20 V to 30 VDC; low level: -5 V to +5 VDC
Drive current	100 mA per loop channel
Quantity	4 groups

6.1.2.2 General-purpose digital I/O interface description



The control cab is equipped with 16 general-purpose digital inputs and 16 general-purpose digital outputs by default. The pin definitions are as follows:

Terminal	Function	Description
J2-1	Common terminal	DI power supply; to be provided on site
J2-2	Common terminal	
J2-3	DI0	User-defined
J2-4	DI1	User-defined
J2-5	DI2	User-defined

J2-6	DI3	User-defined
J2-7	DI4	User-defined
J2-8	DI5	User-defined
J2-9	DI6	User-defined
J2-10	DI7	User-defined
J3-1	Common terminal	DI power supply; to be provided on site
J3-2	Common terminal	
J3-3	DI8	User-defined
J3-4	DI9	User-defined
J3-5	DI10	User-defined
J3-6	DI11	User-defined
J3-7	DI12	User-defined
J3-8	DI13	User-defined
J3-9	DI14	User-defined
J3-10	DI15	User-defined
J4-1	Common terminal	DO power supply; to be provided on site
J4-2	Common terminal	
J4-3	DO0	User-defined
J4-4	DO1	User-defined
J4-5	DO2	User-defined
J4-6	DO3	User-defined
J4-7	DO4	User-defined
J4-8	DO5	User-defined
J4-9	DO6	User-defined
J4-10	DO7	User-defined
J5-1	Common terminal	DO power supply; to be provided on site
J5-2	Common terminal	
J5-3	DO8	User-defined
J5-4	DO9	User-defined
J5-5	DO10	User-defined
J5-6	DO11	User-defined

J5-7	DO12	User-defined
J5-8	DO13	User-defined
J5-9	DO14	User-defined
J5-10	DO15	User-defined

E0308-spec tube-type insulated terminals are recommended for J2, J3, J4, and J5.

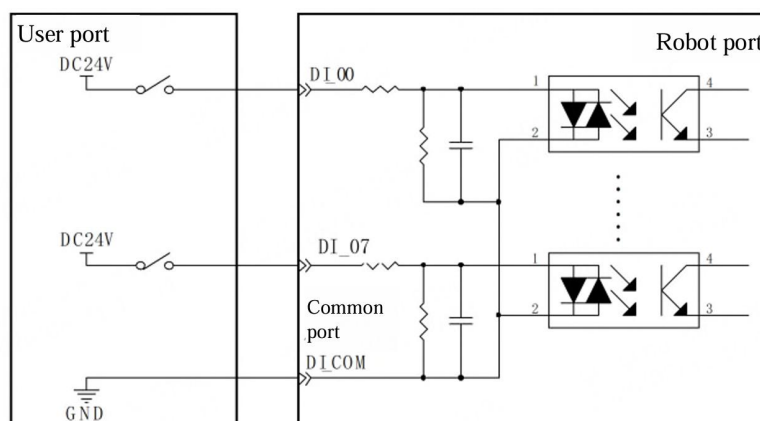
● General-purpose digital input interface description

The 16 digital inputs support sink type and source type inputs. Active high input (sink type) connects to a PNP-level signal; active low input (source type) connects to an NPN-level signal:

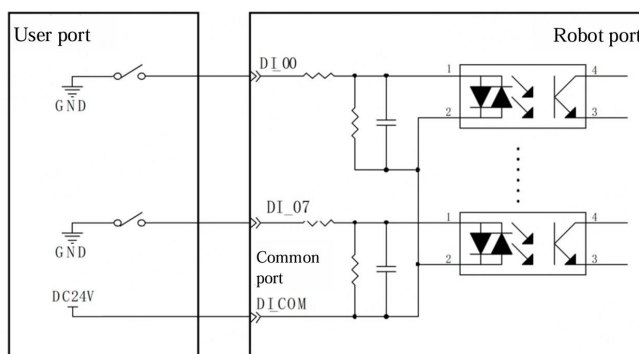
Item	Parameter
Input voltage range	0 VDC to 28 VDC
Turn-on voltage	Common terminal to 0 VDC: high input, 15 VDC to 28 VDC Common terminal to 24 VDC: low input, 0 VDC to 10 VDC
Turn-off voltage	Common terminal to 0 VDC: high input, 0 VDC to 5 VDC Common terminal to 24 VDC: low input, 19 VDC to 24 VDC
Input impedance	7.5 k Ω

The electrical schematics for the different configurations are as follows:

Common terminal to 0 VDC, with PNP input signal; refer to the figure below.



Common terminal to 24 VDC, with NPN input signal; refer to the figure below.



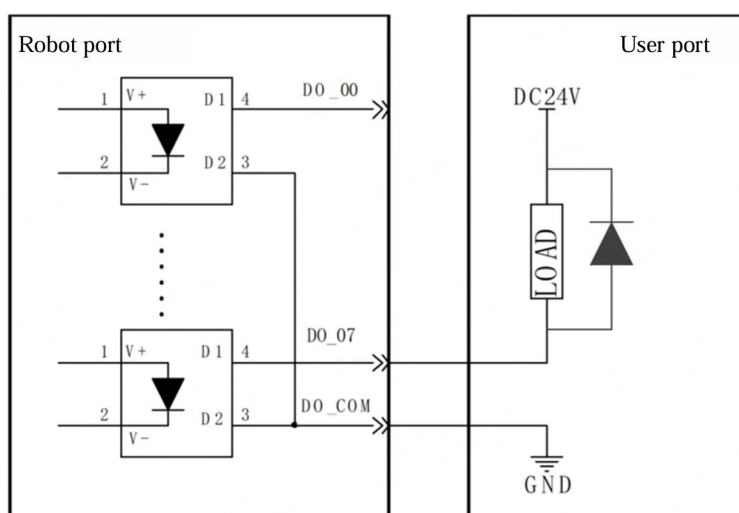
● General-purpose digital output interface description

The 16 digital outputs support sink type and source type outputs, and can be configured as active high output or active low output. The electrical parameters of the output are:

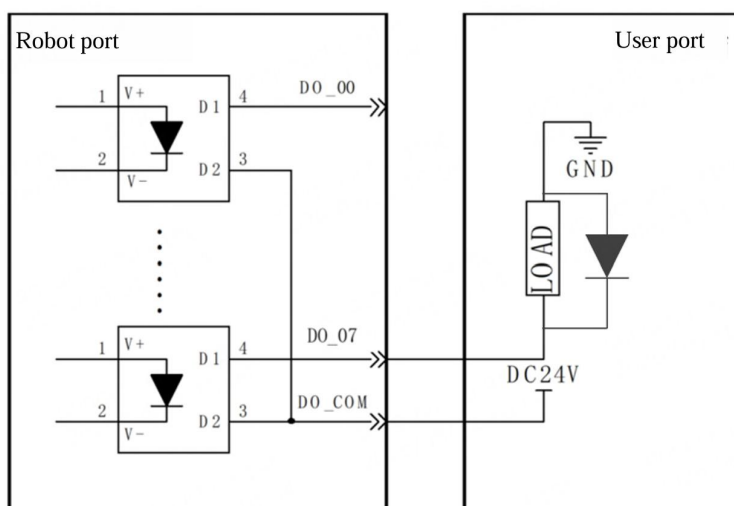
Item	Parameter
Load voltage range	$\leq 28 \text{ VDC}$
Rated load current	Maximum: 300 mA (continuous load current must not exceed the maximum)
Output impedance	$\leq 2.5 \Omega$
Leakage current	Maximum 5 μA

The electrical schematics for the different configurations are as follows:

Active low output: connect DO_COM (common terminal) to 0 VDC; refer to the figure below.



Active high output: connect DO_COM (common terminal) to 24 VDC; refer to the figure below.

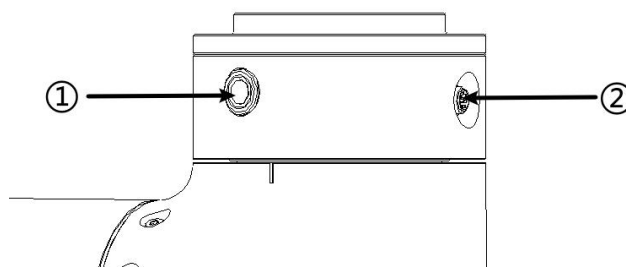


Note

It is strongly recommended to connect a freewheeling diode in parallel across inductive loads!

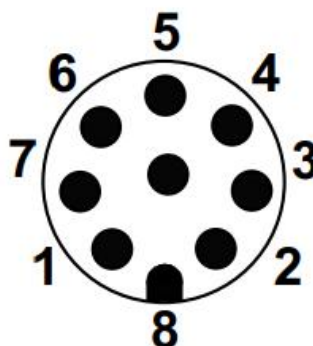
6.2 EOAT I/O interface description

The robot end flange is equipped with a hand-guiding teach button and a tool I/O interface, as shown in the figure. ① is the hand-guiding teach button, and ② is the tool I/O interface.



Press and hold the hand-guiding teach button to put the robot into hand-guiding teach mode.

The tool I/O interface provides the corresponding electrical expansion interface for the end effector mounted on the robot end. It is an M8 circular connector that can be used with the M8-FS-8CON-PVC-2.0 industrial cable.



Label	Wire color	Definition
1	White	AI_0/RS485+
2	Brown	AI_1/RS485-
3	Green	DI_1
4	Yellow	DI_0
5	Gray	0V/12V/24V
6	Pink	DO_1
7	Blue	DO_0
8	Red	GND

6.2.1 Special-purpose tool I/O

The robot can be optionally equipped with a dedicated gripper as the end effector. The electrical and dedicated communication interfaces of the gripper are integrated directly into this connector.

6.2.2 Tool power output

When users use grippers and sensors on this robot tool, the M8 connector can provide power. The electrical specifications are as follows:

	Min.	Typ.	Max.	Unit
Tool power supply voltage	12	24	24.8	V
Tool power supply current	—	1	2	A



Warning

The peak current of the tool power supply is 2 A, and the peak duration must not exceed 1 s



Note

It is strongly recommended to connect a freewheeling diode in parallel across inductive

loads!

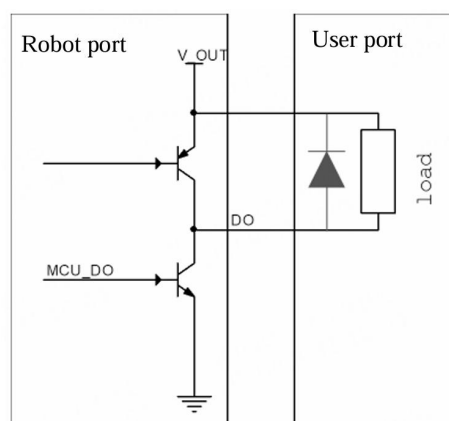
6.2.3 Tool digital output

The end provides 2 channels of tool digital output. The outputs support both NPN and PNP modes, and can be configured through the HMI. When working in PNP mode, ensure that the tool power output is active, and the PNP output level is consistent with the tool power supply voltage output.

The electrical specifications for NPN-mode digital output are as follows

Item	Min.	Typ.	Max.	Unit
Operating voltage	-0.5	-	26	V
Sink current	0	-	150	mA
Output active voltage (sink current 200 mA)	0	0.05	0.2	V

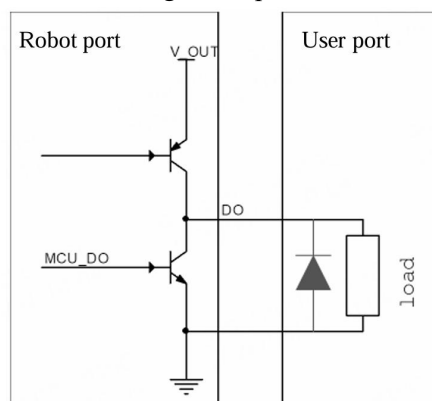
Connection schematic for NPN-mode digital output



The electrical specifications for PNP-mode digital output are as follows

Item	Min.	Typ.	Max.	Unit
Operating voltage	0	-	26	V
Sink current	0	-	150	mA
Output active voltage (source current 200 mA)	0	12/24	26	V

Connection schematic for PNP-mode digital output



**Warning**

The digital output terminals in the tool have no current limit protection. Exceeding the specified values may cause permanent damage.

**Note**

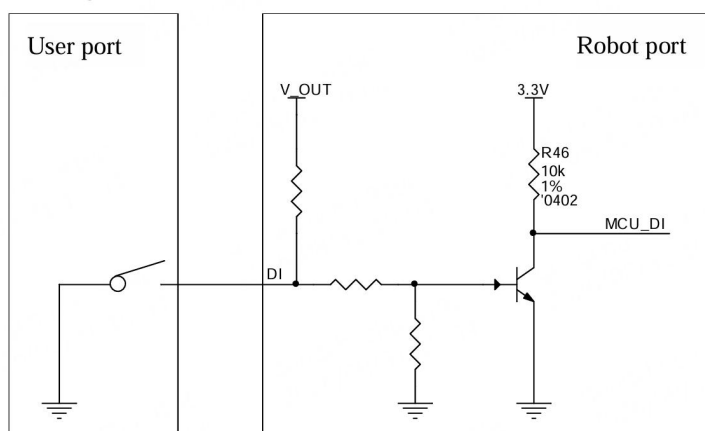
It is strongly recommended to connect a freewheeling diode in parallel across inductive loads!

6.2.4 Tool digital input

Two channels of tool digital input are provided. The tool digital input only supports NPN mode, with an internal weak pull-up. In the floating state the digital input is always invalid. The electrical characteristics are as follows:

Item	Min.	Typ.	Max.	Unit
Input voltage	0	-	26	V
Logic active level	0	-	3	V
Logic inactive level	8	-	26	V
Input resistance	-	47	-	k Ω

Schematic of a simple switch connected at the user end



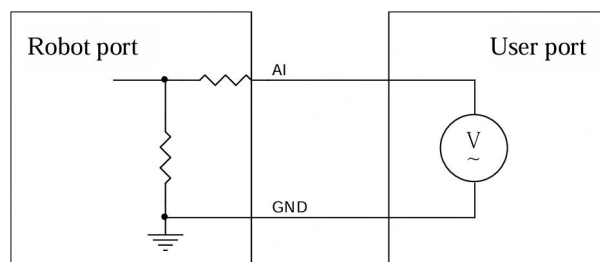
6.2.5 Tool analog input

The tool analog input supports voltage mode and current mode, and can be configured on the HMI.

The analog voltage input parameters are as follows:

Item	Min.	Typ.	Max.	Unit
Input voltage in voltage mode	0	-	26	V
Input resistance in voltage mode	-	22.4	-	k Ω
Resolution	-	12	-	bit

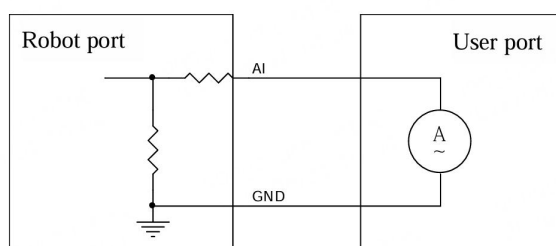
Analog voltage input interface connection schematic



The analog current input parameters are as follows:

Item	Min.	Typ.	Max.	Unit
Input current in current mode	4	-	20	mA
Input voltage in current mode	0	-	6	V
Input resistance in current mode		240		Ω
Resolution	-	12	-	bit

Analog current input interface connection schematic



6.2.6 End tool communication

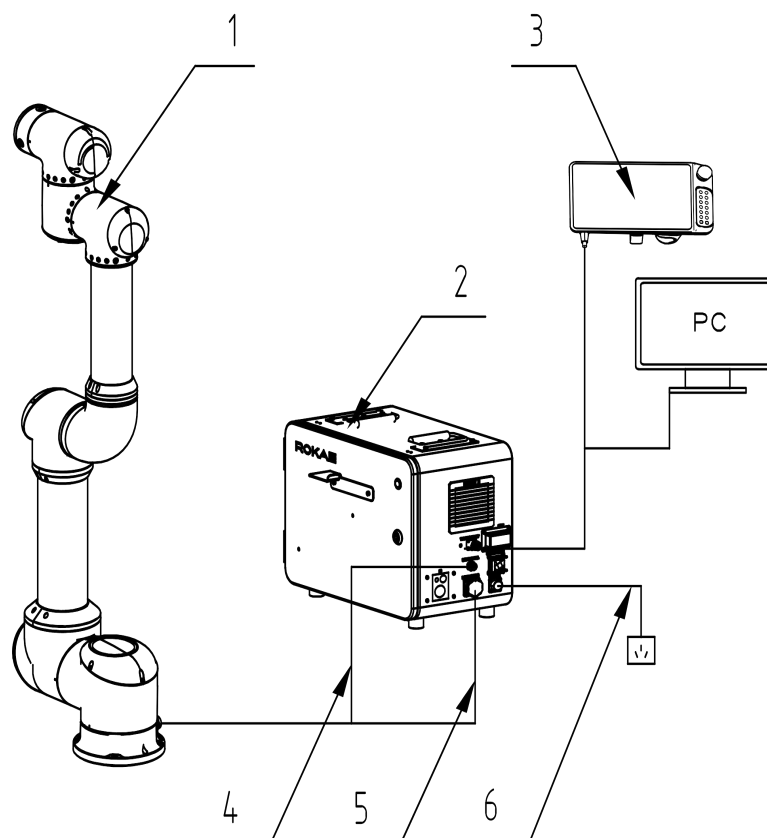
The end tool supports RS485 bus communication, following the Modbus communication protocol.

The communication baud rate supports multiple rates including 9600, 19200, 38400, 57600, and 115200.

The end communication interface supports Modbus pass-through. Communication between the IPC and the end tool uses EtherCAT. When the end tool communicates with the end-effector mounted on the end via RS485, the message transmission delay does not exceed 3 ms.

6.3 Connection system

A complete ZR6-6/0.98C electrical connection system is shown in the figure below ZR6-6/0.98C



Label	Name
①	Manipulator
②	Control cab
③	Teach Pendant
④	Signal relay cable
⑤	Power relay cable
⑥	Control cab power supply cable
⑦*	Computer with network port

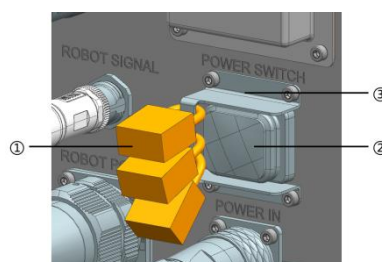
*Note: ⑦ and ③ share the same electrical interface and cannot be connected at the same time. Using a computer with a network port is usually for debugging; in actual applications, connecting the Teach Pendant is the primary method.



Danger

Before wiring, turn off the power to the controller and related devices and erect warning signs (e.g., 'Do not turn on power'). Wiring with power on is extremely dangerous and may cause electric shock or robot system malfunction.

As shown in the figure below, a padlock ① can be installed on the sheet metal ③ above the rocker switch ② to prevent others from turning on the power. Up to 3 padlocks can be installed.

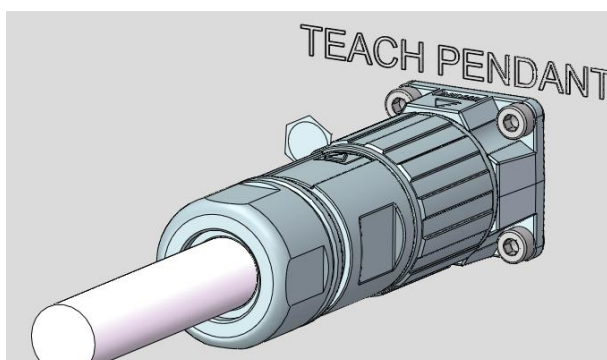


The padlock dimensions are as follows

	Specification	Dimension (mm)
	L	20
	W1	9.5
	W2	19.5
	W3	11
	(H)	11.5
	D	3.2

6.3.1 Connecting the Teach Pendant

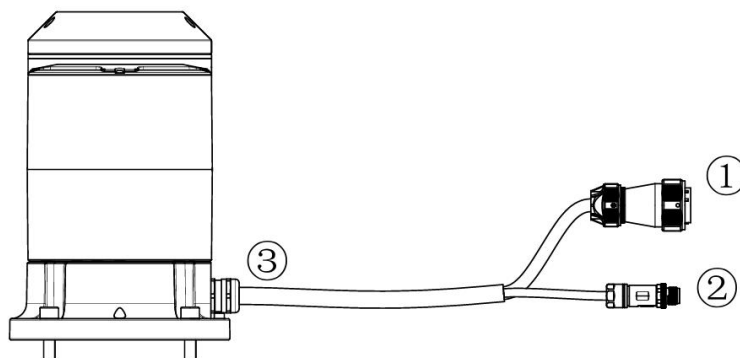
Connect the aviation-plug end of the Teach Pendant cable to the socket on the side of the control cab marked 'TEACH PENDANT'



6.3.2 Connecting the manipulator

There is one connection cable between the control cab and the manipulator, with a standard length of 15 m. The mass of the relay cable is 2.5 kg.

Connect the sockets on the side of the control cab marked 'ROBOT POWER' and 'ROBOT SIGNAL' to the connectors marked ① and ② on the relay cable respectively. Install the connector marked ③ on the relay cable to the local base, and connect the cable to the manipulator.



6.3.3 Connecting the control cab power

The control cab is powered by single-phase AC. See Section 4.3 for the power supply parameters. The user must provide power that meets the control cab's power supply parameter requirements. The robot comes standard with a 6 m flexible power cable; one end has a plug matching the 'POWER IN' socket on the side of the control cab, and the other end is a single-phase grounded 10 A three-pin plug. The AC power cable weighs approximately 1.1 kg.



Warning

Overcurrent protection for the control cab power must be provided by the user. The user must select appropriate overcurrent protection devices based on the rated power of the purchased control cab. The user must ensure that good grounding is provided.



Note

When connecting all connectors, handle gently. If resistance is encountered, check whether the pins inside the connector are skewed. If any abnormality is found, correct it before connecting to avoid damaging the connector.

6.3.4 User-defined wiring

The scope of user-defined wiring includes:

- User-selected I/O signals (including safety I/O and general-purpose digital I/O)

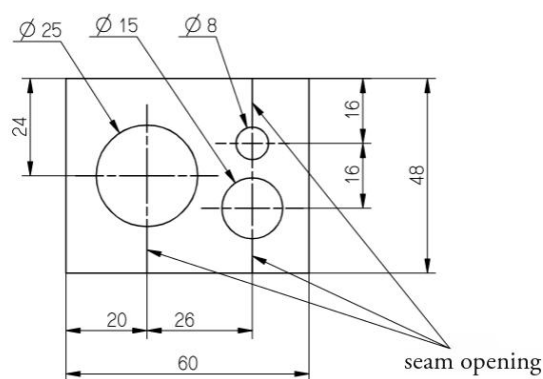
● User-selected network/communication signals



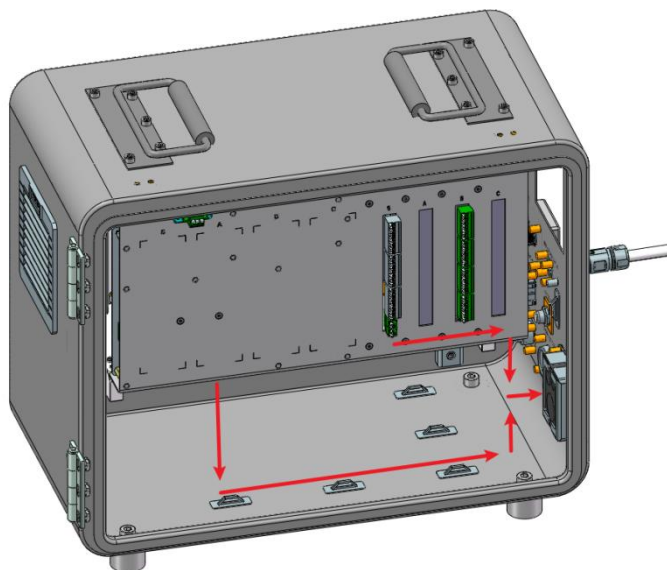
Warning

Wiring work must be carried out by authorized or qualified personnel. Wiring by personnel without the relevant knowledge may result in personal injury or equipment failure.

User-selected I/O signals (including safety I/O and general-purpose digital I/O) and network/communication signal lines must pass out of the cabinet through the foam on the side of the cabinet marked 'I/O'. Pre-cut openings have been made in the foam. Please select an appropriate hole size for the cable entry. After exiting, please protect the corresponding cable entry. The diameter of the pre-cut foam cable entry is shown in the figure below



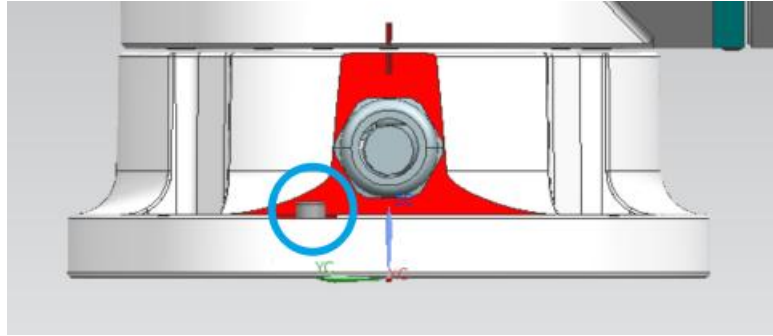
When routing wires inside the cabinet, it is recommended to route along the path indicated by the arrows in the figure below. Cable tie brackets are provided along the path; secure the cables with cable ties. Please keep the cables inside the cabinet tidy.



6.3.5 Grounding instructions

The robot system must be grounded by the user. The user must use terminals to properly

ground the manipulator and control cab based on actual site conditions, spatial location, and other factors, meeting Class D grounding (grounding resistance value $100\ \Omega$ or less). The control cab can be grounded through the ground terminal of the control cab power cable. The grounding location for the manipulator is shown in the figure below



7 Quick operation

7.1 Power-on startup

After completing the cable connection work described above, before powering on, please check again:

- Whether the control cab power connector is properly connected.
- Whether the control cab and robot are properly connected.
- Whether the control cab and Teach Pendant are properly connected.
- The control cab power switch is in the off state when power is not connected.
- The Teach Pendant emergency stop switch is in the released state.
- The control cab power supply provided by the user meets the requirements and is supplied normally.
- The user ensures that the robot will not hit nearby personnel or equipment.
- The control cab is securely fixed.
- The manipulator is securely fixed.

After confirming again that everything is correct, press the self-reset button marked 'POWER' on the control cab panel. The white power indicator on the control cab door lights up and the system powers on normally.

If everything is normal, wait a few seconds. The system finishes booting and the welcome screen is displayed on the Teach Pendant. If an alarm occurs after startup is finished, or if the system cannot start at all:

- Turn off the power switch and recheck the wiring;
- Contact technical support.

7.2 Emergency stop function check

After the system starts, try pressing the Teach Pendant emergency stop button to confirm

whether the control system triggers an emergency stop alarm. After releasing the emergency stop button, confirm whether the emergency stop alarm can be successfully cleared and the system returns to normal.

After confirming the emergency stop function is normal, the robot can be configured or programmed.

7.3 Programming and use

For more information about the detailed use, programming, and parameter setting of the robot operating system, please refer to the xCore Robot Control System Operation Manual.

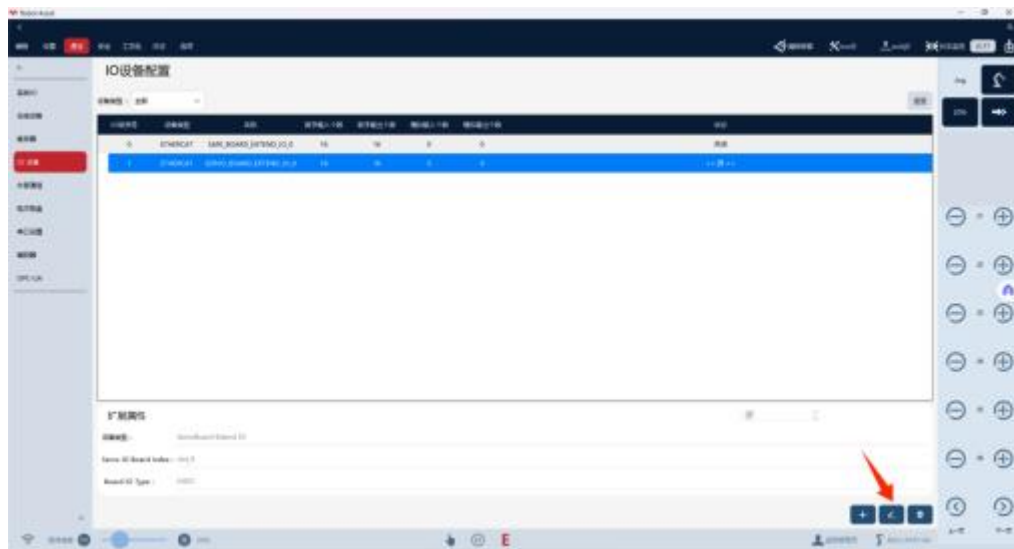
7.4 General-purpose digital I/O configuration

Configuring the general-purpose digital I/O requires the Teach Pendant. The prerequisite is that the Teach Pendant and the control cab are properly connected and communication is normal.

On the Teach Pendant interface, tap 'Communication' to enter the communication interface, then tap 'IO Device' to enter the IO device configuration interface.

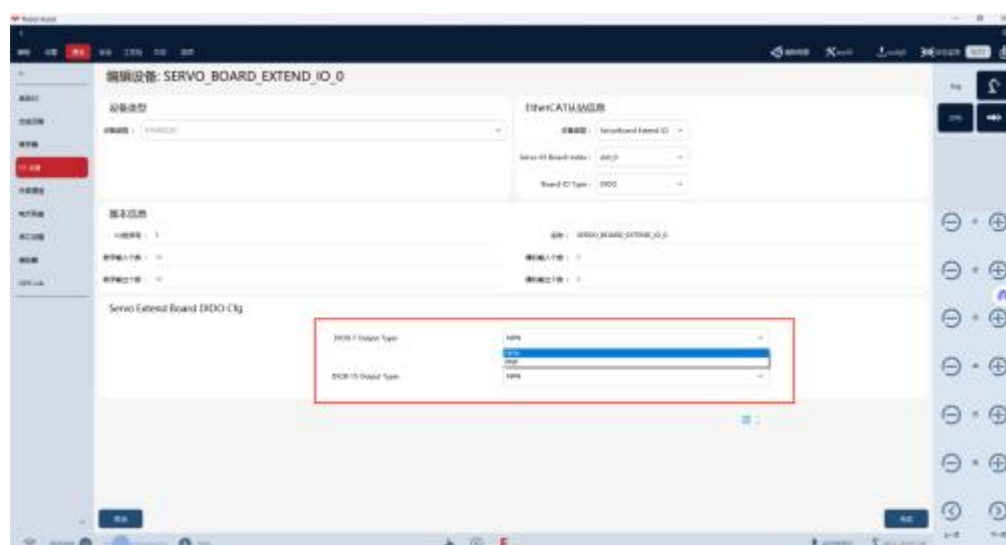
Two IO sequences 0 and 1 are shown on the IO device configuration interface. Select IO sequence number 1. After selecting, click

the icon indicated by the red arrow in the figure below, as shown in the figure below:

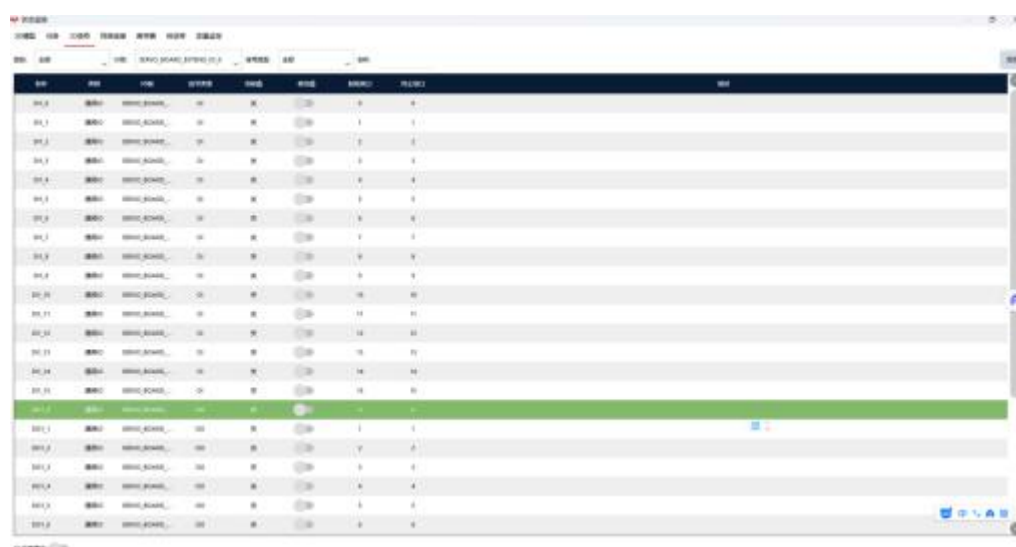


Enter the device editing interface, as shown in the figure below:

The area marked by the red box is where the output I/O type can be configured. Outputting a high-level signal requires PNP configuration, and outputting a low-level signal requires NPN configuration.



Click 'Status Monitoring' at the upper right of the figure above to enter the status monitoring interface, as shown in the figure below:



The 16 inputs and 16 outputs are monitored. When an input signal is received, the input switch automatically turns on. When an output signal is required, the switch must be turned on manually.

8 Maintenance

8.1 Introduction

Before maintenance, please carefully read the 'Maintenance Safety' section, this manual, and related manuals, and carry out maintenance work based on a thorough understanding of safe maintenance methods.

8.2 Maintenance safety



Warning

- Strictly observe the maintenance procedure. Do not disassemble robot components at will.
- Maintenance work must be performed by designated professionals.
- If you have not received training, stay away from the robot while power is on. Also, do not enter the motion area. Even if the robot appears to have stopped, a powered robot may still perform unexpected movements, which could cause serious safety problems.
- Be sure to confirm the robot's motion after parts replacement from outside the safety fence. Otherwise, the robot may perform unexpected movements before the motion confirmation, which could cause serious safety problems.
- Before entering normal operation, confirm that the emergency stop switch and the safety guard switch operate normally. If operation is performed with the switches not operating normally, the safety function will not work in an emergency, which may cause serious injury or significant damage. This is very dangerous.

8.3 Maintenance plan

To keep the robot performing efficiently over the long term, regular maintenance must be performed. Maintenance personnel must develop a maintenance plan and strictly implement it.

8.4 Inspection

No.	Inspection item	Inspection location	Inspection interval				
			Daily	1 month	3 months	6 months	1 year
1	Whether the appearance is damaged	Robot exterior					
		External cables					
2	Whether the control cab and robot connectors are loose	Control cab					
		Manipulator					
3	Encoder battery	When a low battery warning occurs at software startup, or replace the battery every 1.5 years.					

8.5 Cleaning



Warning

Improper use of liquid cleaning agents and failure to properly disconnect equipment power may result in electric shock and endanger life!



Warning

Cleaning may only be performed after the equipment is fully powered off;
Never use liquid cleaning agents to clean the equipment;
Do not turn on the equipment power while it is wet.

The following points should be considered when cleaning robot equipment:

Only instructed users are allowed to perform cleaning;

Do not use any chemical reagents to clean the robot. All equipment may only be cleaned with a thoroughly wrung-out damp cloth;

During cleaning, do not apply excessive force to the manipulator arm, and always support the parts that need to be manually cleaned with your hand to avoid overloading the arm and causing damage;

Do not reconnect power until all surfaces of the cleaned equipment are completely dry.



Warning

Improper cleaning may cause equipment damage.

9 Zero calibration

This chapter provides information about zero calibration. Please use the calibration tools described in this chapter when calibrating.

9.1 What is the mechanical zero

An initial pose is predefined at robot design, in which the angle of each joint is 0. From the mechanical point of view, the zero pose refers to the pose in which adjacent links form a certain specific angle. From the software point of view, since the robot uses encoders to record joint angles, the zero pose refers to the pose of the robot when the servo motor turns to a specific encoder value. Therefore, the mechanical zero can be interpreted in two ways:

- From the observer's perspective, the mechanical zero is the pose of the robot when each joint of the robot moves to a specific position;
- From the control system's perspective, the mechanical zero is the values of several

encoders.

9.2 What is zero calibration

The zero point is the reference for the robot coordinate system. Without the zero point, the robot cannot determine its own position. Therefore, to obtain the highest possible absolute positioning accuracy and to enable the linkage system to correctly respond to control system position and velocity commands, the robot must be zero-calibrated so that the mechanical zero and the algorithmic zero are as close as possible.

In plain language, zero calibration uses certain positioning features pre-designed on the manipulator to rotate each joint of the robot to a specific angle, and notifies the control system to record the encoder values of each joint motor at this time.

9.3 When zero calibration is required

Zero calibration must be performed using the dedicated calibration tool in the following situations:

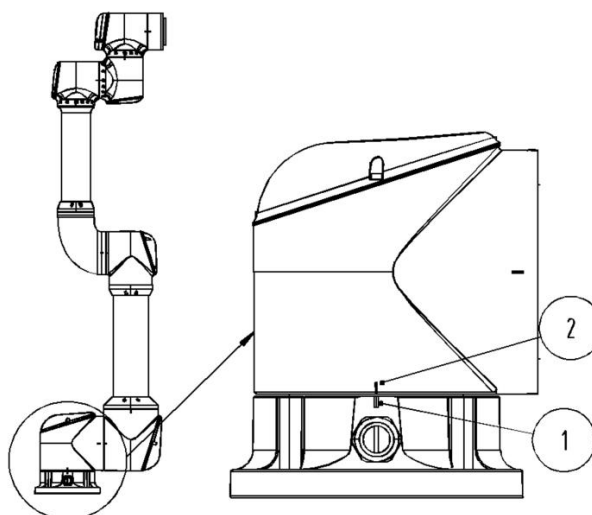
- After replacing mechanical system components such as motors and reducers.
- After a severe collision.
- When external force has moved the robot joints while the system is powered off.

9.4 Zero calibration method

ZR6-6/0.98C

Step 1: Calibrate Axis 1

Slowly rotate Axis 1. When the calibration pin ② is visually aligned with the calibration slot ① from the front, the mechanical zero calibration of that axis is considered complete.



Step 2: Calibrate Axes 2, 3, 4, 5, and 6

Perform calibration in the same manner as Step 1.

Step 3: The final robot zero pose is shown in the figure above.

10 Decommissioning

10.1 Decommissioning the robot

Robot decommissioning, storage, and disposal must comply with the specific national laws, regulations, and standards.

10.2 Recycling

Please contact us for recycling.

11 Revision history

Revision	Date	Revision history
A	2026/6/15	First release

ROKAE



珞石机器人

400-010-8700
www.rokae.com
sales@rokae.com