JAKA 节卡

JAKA ROBOTS

USER MANUAL

JAKA Zu® 7

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USER MANUAL

JAKA Zu® 7 - V1.1

Robot Serial Number: _____

Electrical Cabinet Serial Number: _____

CAUTION

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JAKA reserves the right to regularly revise the contents contained in this manual without prior notice.

JAKA will not be held liable for any mistakes in this manual or for any injury or death resulting from the use of this manual and its product. Please carefully read this manual and other related manuals before installing and using the product.

The pictures in this manual are for reference only, please refer to the actual product.

JAKA will not provide after-sales service for any transformation or disassembly of the product.

Contents

Preface

JAKA Zu 7 is at your service. Think what you think and do what you do.

A creative way is used to connect the robot, using the smart mobile terminal plus the APP, so that one mobile terminal can control several robots. Without the need to master professional programming language, the user only needs to manually guide the robot to complete the programming, which greatly improves production efficiency.

JAKA Zu 7 is an intelligent, light weight, 6-DOF, modularized collaborative robot with a payload of 7kg, and it is one of the JAKA Zu Modularized Collaborative Robots Series.

What Do the Boxes Contain

When you purchase a whole package of JAKA Zu 7, the items you will receive are shown in the table below. (Router, tablet PC, network cables are not included)

Item	Amount
JAKA Zu 7 Robot	1
Electrical cabinet	1
Emergency Stop Button Box	1
Power Supply Cable	1
JAKA Certificate of Quality	1
JAKA Zu 7 User Manual	1
Warranty Card	1

How to Read This Manual

This manual contains two parts: instructions for installation and programming.

Installation: The mechanical and electrical installation of the robot.

Programming: Robot programming.

This manual will be a big help in both installation and operation to the users who have a basic level of mechanical and electrical training.

1 Safety

1.1 Introduction

This chapter contains the safety rules and specifications which should be followed when operating the robot or robot system. Users should carefully read the safety-related content of this manual and strictly observe them. Operators should be fully aware of the complexity and hazards of robot system and should pay special attention to the warning symbols.

1.2 Warning Symbols Descriptions

The hazard level of operating robot system is specified by the following warning symbols. Please strictly observe them.

	DANGER: This indicates an imminently hazardous electrical situation which, if not avoided, could result in serious injury or death.
	DANGER: This indicates an imminently hazardous situation which, if not avoided, could result in serious injury or death.
	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 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 touched, could result in injury.
	CAUTION: This indicates a situation which, if not avoided, could result in damage to the equipment.

1.3 Safety Precautions

This section is mainly for the protection of operators and related matters that need to be paid attention to during the first installation. Users need to carefully read the safety warnings in this manual. We describe various situations as much as possible although the description cannot be exhaustive.

1. Make sure to install the robot and all electrical equipment according to the instructions and warnings in this manual.

2. The power cut-off switch should has a mounting height of 0.6m to 1.9m to ensure that the power can be cut off in a timely and convenient manner in case of emergency.

3. Before using the robot for the first time, the robot's protective system and the integrity of the equipment and system, as well as the safety of the operation should be checked to ensure that there is no damage.

4. A qualified person for robot operation is required to check each safety function and ensure that the parameters and procedures are correct before the robot can be started.

5 . The power plug for the robot must have a grounding jack that is reliably grounded.

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1. Professional commissioning personnel are required to install and debug the robot according to the specifications.

2. The setting and modification of the safety parameters must be carried out by a licensed person. Unauthorized personnel must not change the parameters.

3. Do not switch the power supply system frequently. The JAKA Zu 7 has a brake in each joint to hold position when the power is off.

4. When the robot overload exceeds the default value, the robot will stop moving to prevent damage to the robot or operator injury. This is because JAKA Zu 7 has a collision detection function. If the operator uses controllers not approved by JAKA, the potential risks are to be borne by himself.

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1. Make sure the robot and tool are properly and securely bolted in place.

2. Make sure the robot arm has ample space to operate freely.

3. Do not connect any safety equipment to normal I/O. Use safety-related interfaces only.

4. Make sure to use the correct installation settings (e.g. Robot mounting angle, weight in TCP, TCP offset, safety configuration). Save and load the installations file along with the program.

5. Tools and obstacles shall not have sharp edges or pinch points. Make sure that all people keep their heads and faces outside the reach of the robot.

6. Combining different machines might increase hazards or create new

hazards. Always make an overall risk assessment for the complete installation.

7. Never modify the robot. A modification might create hazards that are unforeseen by the integrator. JAKA DISCLAIMS ANY LIABILITY IF THE PRODUCT IS CHANGED OR MODIFIED IN ANY WAY.

8. When transporting the robot, follow the transportation instructions and handle it carefully to avoid collisions.

1. The robot and electrical cabinet generate heat during operation. Do not handle or touch the robot while in operation or immediately after operation. To cool the robot down, power off the robot and wait one hour.

2. Never stick fingers behind the internal cover of the electrical cabinet.

1. When the robot is combined with or working with machines capable of damaging the robot, it is highly recommended to test all functions and the robot program separately. It is recommended to test the robot program using temporary waypoints outside the workspace of other machines.

2. Do not expose the robot to permanent magnetic fields. Very strong magnetic fields can damage the robot.

1.4 General Warnings and Cautions

1.Do not wear loose clothing or jewellery when working with the robot. Make sure long hair is tied back when working with the robot.

2. During the operation, even if the robot seems to have stopped, it may be because the robot is waiting for the start signal and is about to move. Even in such a state, the robot should be considered to be in motion.

3. During the operation, make sure the power cables of the electrical cabinet and robot are reliably connected. Do not plug or unplug the power cables or terminals in the working mode.

4. A warning line should be drawn on the floor to identify the working range of the robot, so that the operator can understand the working range of the robot with the end effector (gripper, tool, etc.) mounted.

5. Make sure that safety measures and/or robot safety configuration parameters have been set up to protect both programmers, operators and bystanders, as defined in the risk assessment. The lock should be set as needed so that the non-operator cannot access the robot power supply.

6. In emergency situations such as when a person is caught or surrounded by the robot, the robot can be forced to move by pushing or pulling the robot arm. Moving the robot manually without power is for emergency use only, and may damage the robot.

1.5 Responsibilities and Risks

Responsibilities

This manual does not cover all applications for designing, installing and operating robots, nor does it cover all peripheral equipment that may affect the safety of the robot system.

JAKA's integrators are responsible for ensuring compliance with applicable national laws and regulations to ensure that there are no major hazards in the complete robotic application.

All safety information contained in this manual shall not be considered as a guarantee of JAKA. Even if all safety instructions are observed, the injury or damage caused by the operator may still occur.

JAKA constantly strives to improve the performance and reliability of our robots. JAKA is not responsible for any errors or omissions in this manual, and reserves the right of final interpretation of this manual.

Risks

A direct or indirect physical contact relationship exists when there an interaction between the operator and the robot exists. Operators must have sufficient self-protection awareness when contacting, and integrators need to carefully consider the use conditions when using the company's robots. The following are possible dangerous situations:

① Injury caused by the robot dropping during handling;
② Injury caused by the loosening of the robot fixing screw;
③ Finger-pinching and collision injury during the operation;
④ Injury caused by the unrepaired malfunction robot;
⑤ Danger caused by the usage of a sharp end effector or tool connection;
⑥ Injury caused by the operation in a toxic or corrosive environment.

1.6 Usages

JAKA Zu 7 is an industrial collaborative robot suitable for use in industrial environments, for example, for handling tools and fixtures, or for processing or transferring components or products. JAKA Zu 7 is only allowed to be used under specified environmental conditions.

JAKA Zu 7 is equipped with special safety-related features, which are purposely designed for collaborative operation, where the robot operates without fences and/or together with a human. Collaborative operation is only intended for non-hazardous applications, where the complete application, including tool, work piece, obstacles and other machines, is without any significant hazards according to the risk assessment of the specific application.

Any use or application deviating from the intended use is deemed to be impermissible misuse. This includes, but is not limited to the following:

① Use in potentially explosive environments ;
② Use in medical and life critical applications ;

③ Use before performing a risk assessment ;

④ Use where the rated performance levels are insufficient ;

⑤ Operation outside the permissible operating parameters.

1.7 Emergency Stop

When an emergency occurs, press the emergency stop button to stop all movement of the robot immediately. Emergency stop cannot be used as a risk reduction measure, but as a secondary protective device.

1.8 Movement without Drive Power

In the unlikely event of an emergency situation where robot power is either not possible or unwanted, the robot joint can be forced to move in two ways:

1. Forced manual drive: By pushing or pulling the robot arm, it can force the joint to rotate. The brake of each joint has a friction clutch. When the joint is subjected to a torque greater than the friction torque of the friction clutch (about 715 Nm for large joints and 150 Nm for small joints), the joint rotates.

2. Manual brake release: Remove the joint cover by removing the M3 screws (four for big joints and three for small joints) that fix it. Press the plunger on the small electromagnet (shown below) to release the brake.

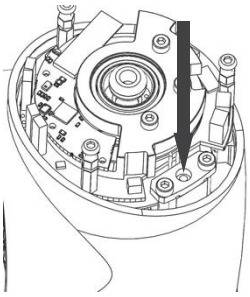


Fig 1-1

WARNING:

1. Moving the robot arm manually is intended for urgent emergencies only and might damage the joints.

2. If the brake is released manually, gravitational pull can cause the robot arm to fall. Always support the robot arm, tool and work item when releasing the brake.

2 Precautions for Transportation and Handling

Transport the robot in the original packaging. Save the packaging material in a dry place; you may need to pack down and move the robot later on.

Lift both tubes of the robot arm at the same time when moving it from the packaging to the installation place. Hold the robot in place until all mounting bolts are securely tightened at the base of the robot.

CAUTIONS:

1. Make sure not to overload your back or other bodyparts when the equipment is lifted. Use proper lifting equipment. All regional and national guidelines for lifting shall be followed. JAKA cannot be held responsible for any damage caused by transportation of the equipment.

2. Make sure to follow the installation instructions when installing the robot.

3 Mechanical Interface

The robot consists mainly of six joints and two aluminum tube arms (as shown in Fig3-1). The base is used to install the robot, and the tool end is used to mount the tool. The tool can perform translational and rotational movements in the robot's working range. The following sections describe the basics to be aware of the installation of various components in the robot system.

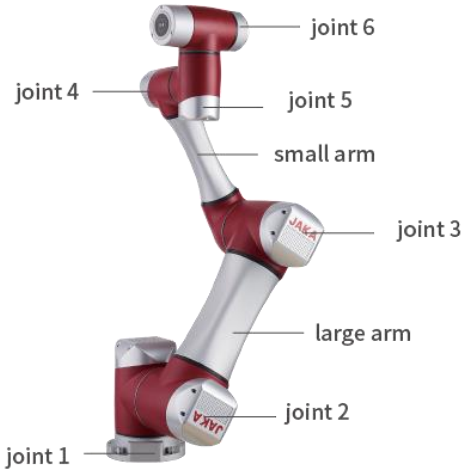


Fig3-1

3.1 Robot Working Range

3.1.1 Robot Dimensions

The photo and dimensions of JAKA Zu 7 robot are shown in Fig 3-2 and Fig3-3. Make sure to take into account the working range of the robot during installation to avoid injury to people or damage to the equipment.

Fig 3-2

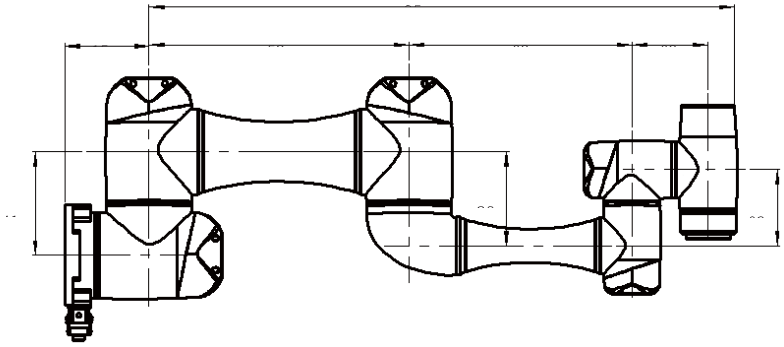


Fig3-3

3.1.2 Robot Working Range

The working range of JAKA Zu 7 is shown in Fig 3-4. When choosing the robot installation position, the cylinder space directly above and below the robot must be considered. Moving the tool close to the cylindrical volume should be avoided if possible, because it causes the joints to move fast even though the tool is moving slowly, causing the robot to work inefficiently and making it difficult to conduct a risk assessment.

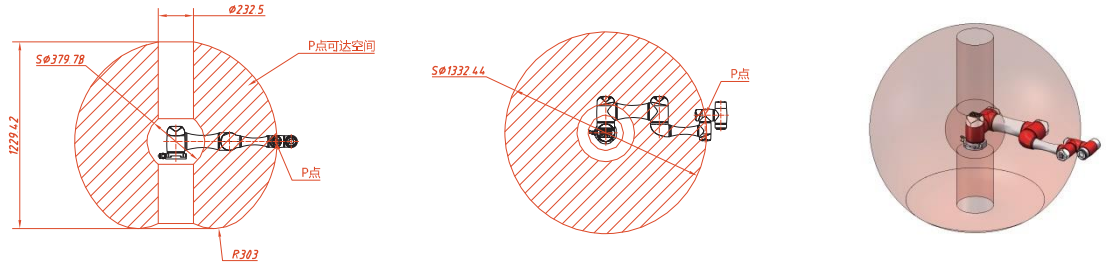


Fig 3-4

3.2 Installation

3.2.1 General installation steps

1. Determine the working range of the robot
2. Mount the robot on the base
3. Install the required tools at the end of the robot

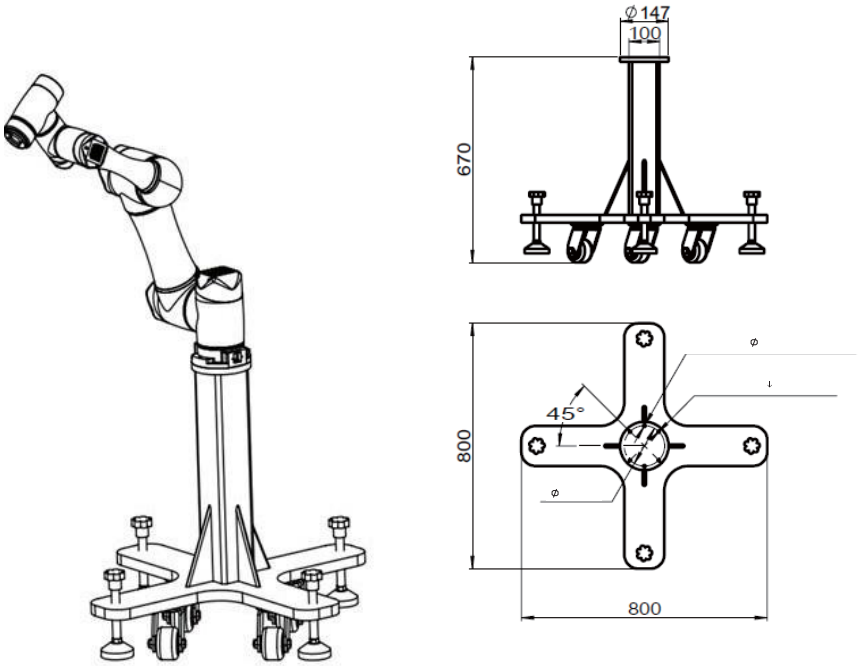


Fig 3-5

3.2.2 Important safety instructions

DANGER: 1. Make sure the robot is properly and securely bolted in place.
2. The mounting surface must be shockproof and sturdy.

DANGER: 1. Make sure the tool is properly and securely bolted in place.
2. Make sure that the tool is constructed such that it cannot create a hazardous situation by dropping a part unexpectedly.

DANGER: 1. Make sure that the electrical cabinet and cables do not come into contact with liquids. A wet electrical cabinet could cause death.
2. The electrical cabinet must not be exposed to dusty or wet environments that exceed IP20 rating. Pay special attention to environments with conductive dust.

CAUTIONS: If the robot is bathed in water over an extended time period it might be damaged. The robot should not be mounted in water or in a wet environment.

3.2.3 Robot Installation Options

The robot has an attitude and position adaptation function. It can be mounted in various ways, such as

ground, wall, and celling mounting. As shown in Fig 3-6:

Fig 3-6

Using four M8 bolts to mount the robot through the four 9mm through holes on the robot base. It is recommended to tighten these bolts with a torque of 40 Nm. If you need to adjust the robot installation position very accurately, you can also drill two φ8 pin holes and fix them with pins. It is also possible to purchase an accurate base counterpart as an accessory. Mount the robot on a sturdy surface that is strong enough to withstand at least ten times the full torque of the base joint and at least five times the weight of the robot arm. Furthermore the surface shall be vibration free. If the robot is mounted on a linear axis or a moving platform then the acceleration of the moving mounting base shall be very low. A high acceleration might cause the robot to stop, thinking it bumped into something. Fig. 3-7 shows the robot mounting holes. All measurements are in mm.

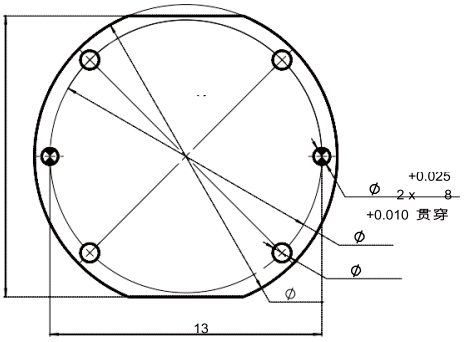


Fig 3-7

3.2.4 End effector Installation

The robot end flange has four M6 tapped holes to mount the end effector. When screws are installed in these threaded holes, the screws need to be tightened with a torque of 15 Nm. If you need to adjust the tool position very accurately, you can also drill a φ6 pin hole and fix it with a pin. Fig. 3-8 shows the drilling position and the screw mounting position. All measurements are in mm.

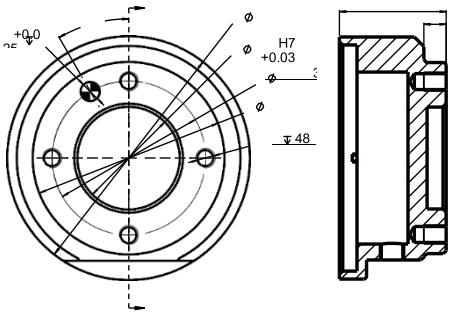


Fig 3-8

4 Electrical Interface

4.1 Introduction

This chapter describes all the electrical interfaces of the robot and electrical cabinet. These interfaces are divided into five categories, each of which has different purposes and properties:

•Controller I/O

• Ethernet

• Emergency stop button box

• Power connection

• Robot connection

The term "I/O" referring to the digital and analog control signals coming in and out of the interface.

These five types of interfaces are described below, and most types of I/O are provided with examples. The warnings and cautions in the next section are related to these five sets of interfaces, so be sure to observe these instructions.

4.2 Warnings and Cautions

Be sure to observe the following warnings and cautions when designing and installing robotic applications. These warnings and cautions are also apply for service work.

4.3 Controller I/O

This chapter describes the I/O interface in the electrical cabinet, which contains 8 DIs (Digital Input), 8 DOs (Digital Output) and 8 AIs (Analog Input). As shown in Fig 4-1：

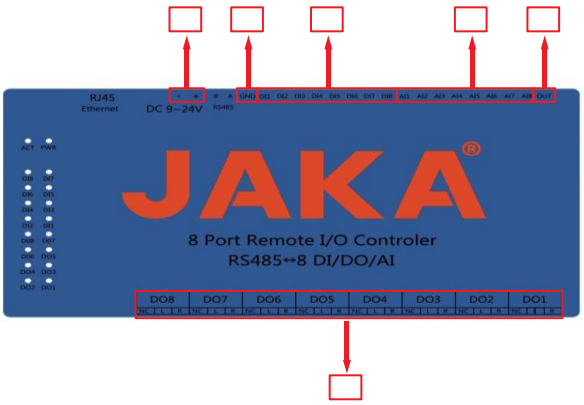


Fig 4-1

Hardware interfaces are shown below.

No. number	Name	Terminals	Functions
1	24V power supply voltage interface	+	Positive terminal of 24V voltage
		-	Negative terminal of 24V voltage
2	Ground terminal	GND	When the dry contact is input, the switch can be collected by connecting this terminal and DI1 to DI8.
3	8 digital inputs (DI1 to DI8)	DI1	1st digital input
		DI2	2nd digital input
		DI3	3rd digital input
		DI4	4th digital input
		DI5	5th digital input
		DI6	6th digital input
		DI7	7th digital input
		DI8	8th digital input
4	8 analog inputs (AI1 to AI8)	AI1	1st way 0~5V voltage input
		AI2	2nd way 0~5V voltage input
		AI3	3rd way 0~5V voltage input
		AI4	4th way 0~5V voltage input
		AI5	1st 4~20mA current input
		AI6	2nd 4~20mA current input
		AI7	3rd 4~20mA current input
		AI8	4th 4~20mA current input
5	Output test point	OUT	Test output point, can output 5V level, used for test purposes of AI1 ~ AI8.
6	8 digital outputs (DO1 ~ DO8)	DO1	The first relay output, R and L represent the 2 contacts of the relay
		DO2	The second relay output, R and L represent the 2 contacts of the relay.
		DO3	The third relay output, R and L represent the 2 contacts of the relay
		DO4	The fourth relay output, R and L represent the 2 contacts of the relay
		DO5	The fifth relay output, R and L represent the 2 contacts of the relay
		DO6	The sixth relay output, R and L represent the 2 contacts of the relay
		DO7	The seventh relay output, R and L represent the 2 contacts of the relay
		DO8	The eighth relay output, R and L respectively represent the two contacts of the relay

4.3.1 Digital Input (DI)

With eight digital inputs (DI1 ~ DI8), configurable: Support: passive switching (dry contact) and active level (wet contact). Active level range:

VCC voltage	Low level	High level
24V	0～17V	17～24V

JAKA uses an active level of 24V, with a high level of 17 to 24V and a low level of 0 to 17V. At present, the DI1 input has been used, and the relays in the DI1 external emergency stop button box (E-STOP) are connected.

4.3.2 Digital Output (DO)

It has eight digital outputs (DO1~DO8): each output has NC/L/R three terminals; R and L respectively represent the two contacts of the relay, which represents the 8-way relay output. The output type is relay output: (The electrical specifications of the relay are as follows)

Relay current	AC voltage (AC)	DC voltage (DC)
≤5A	≦250V	≦30V

JAKA has already used DO1 one-way output, in which the NC end is not connected to the cable, the L end is connected to the relay KA1 in the electrical cabinet, and the R end is connected to the DC24V-. The relay transmission speed (i.e. response time) is less than 30ms. When the relay is not in the pull-in state, the voltage is 24V and the current is less than 12mA.

4.3.3 Analog Input (AI)

With eight analog inputs (AI1 ~ AI8), can be configured:

By default, the first four channels (AI1 to AI4) are 0 to 5V voltage inputs, and the last four channels (AI5 to AI8) are 4 to 20mA current inputs. If you need to customize, you can modify any of these inputs to the following four ways:

1) Current signal input:4～20mA.

2) Voltage signal input:0～5V.

3) Voltage signal input: 0 ~ 10V.

4) Resistance impedance input: such as 0 ~ 10k or resistance type temperature and humidity sensor.

The analog AI interface is a green terminal. This type of interface can be used to set or measure voltage (0 to 5V) or current (4 to 20mA) to and from other devices. JAKA does not currently use an analog input (AI) interface. For high accuracy, the following instructions are recommended:

• Use the AG terminal closest to this AI.

• The equipment and the electrical cabinet use the same ground (0V). The analog AI is not isolated from

the electrical cabinet.

• Use shielded cables or twisted pairs. Connect the shield to the “GND” terminal on the “Power” terminal.

• Use equipment that works in current mode. The current signal is less sensitive than the interface. The input mode can be selected in the GUI, see section II. The electrical specifications are as follows.

Analog input in voltage mode (default):

Terminal (AI1 ~ AI4)	Parameter	Minimum （Min.）	Typical Value(Typ.)	Maximum (Max.)	Units
[AIx - AG]	Voltage	0	—	5	V
[AIx - AG]	Resistance	—	10K	—	Ω
[AIx - AG]	Resolution	—	10	—	bit

Analog input in current mode (default):

Terminal (AI5 ~ AI8)	Parameter	Minimum （Min.）	Typical Value (Typ.)	Maximum (Max.)	Units
[AIx - AG]	Current	4	—	20	mA
[AIx - AG]	Resolution	—	10	—	bit

4.3.4 Status description

There are 18 panel indicators in the upper left part of the controller, which can indicate the current working status of the controller. The indicators are from left to right, from top to bottom:

1. ACT: Communication activity indicator. If it is green, it indicates that the device has received an instruction from RS485, but it does not indicate that the instruction is normally recognized; if blue appears, it indicates that the received command is correctly recognized, and the instruction has been returned to the sender.

2. PWR: Power Indicator

3. DI1～DI8: Green indicates that the DI1~DI8 inputs are low or closed.

4. DO1～DO8: Green indicates that the DO1~DO8 outputs are relay closed.

4.4 Ethernet

The Ethernet interface is at the bottom of the electrical cabinet, please refer to the figure below.

Fig 4-2

The Ethernet interface can be used for the following applications:

• MODBUS I/O expansion module. See section 2 for details.

• Remote access and control. The electrical specifications are as follows.

Parameter	Minimum（Min.）	Typical Value (Typ.)	Maximum(Max.)	Units
Communicating speed	10	—	100	Mb/s

4.5 Emergency Stop Button Box

The electrical cabinet is equipped with an emergency stop button box. The green button on the emergency stop button box is the on/off button (On/Off), which controls the on and off of the electrical cabinet; the red one is the emergency stop button (STOP), which controls the DC48V voltage output from the electrical cabinet to the robot.

After plugged in, press the power-on button, the electrical cabinet is then turned on, and starts working. After pressing the power-on button for 5 seconds, the electrical cabinet is turned off and no longer works. When the electrical cabinet is working normally, the emergency stop button (STOP) is in the pop-up state, and the electrical cabinet normally outputs DC48V voltage to the robot. When an emergency occurs, press the emergency stop button (STOP), the electrical cabinet is in an emergency stop state, and the DC48V power supply of the robot is turned off. After the fault is cleared, the emergency stop button should be reset by rotating it clockwise for about 60 degrees.

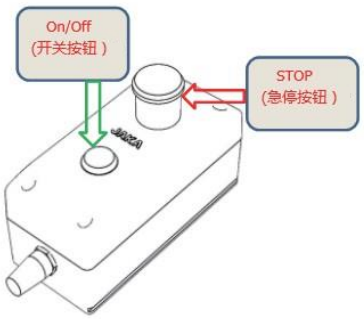


Fig 4-3

4.6 Power Connection

There is a standard plug at the end of the electrical cabinet cable. Connect a local utility power outlet or cable to the plug. To energize the robot, the electrical cabinet must be connected to a power source. This process must be done using the appropriate cable to connect the standard socket on the bottom of the cabinet.

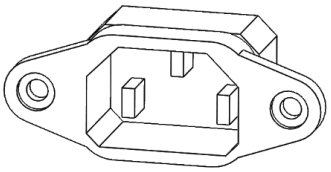


Fig 4-3

The power supply should be equipped with at least the following accessories:

• Connection to earth.

• Main fuse.

• Residual current device.

It is recommended to install a main switch to power off all devices in the robot application in order to lockout and tagout under servicde.

The electrical specifications are shown in the table below.

Parameter	Min	Typ	Max	Unit
Input Voltage	100	-	240	V(AC)
External mains fuse (100-200V)	8	-	16	A
External mains fuse (200-240V)	8	-	16	A
Input Frequency	47	-	63	Hz
Rated Operating Power	120	200	400	W

DANGER: 1. Make sure that the robot is grounded correctly (Electrical connection to earth). Use the unused bolts associated with grounding symbols inside the electrical cabinet to create common grounding of all equipment in the system. The grounding conductor shall have at least the current rating of the highest current in the system.

2. Make sure that the input power to the electrical cabinet is protected with a RCD (Residual Current Device) and a correct fuse.

3. Lockout and tagout all power for the complete robot installation during service. Other equipment shall not supply voltage to the robot I/O when the system is locked out.

4. Make sure that all cables are connected correctly before the electrical canbinet is powered. Always use an original and correct power cord.

4.7 Robot Connection

The cable from the robot must be plugged into the connector at the bottom of the control box, see illustration below. Ensure that the connector is properly locked before turning on the robot. Disconnecting the robot cable may only be done when the robot power is turned off.

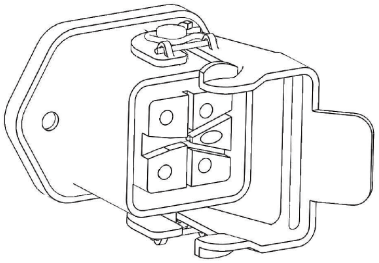


Fig 4-5

CAUTIONS:

1. Do not disconnect the robot cable when the robot is turned on.
2. Do not extend or modify the original cable.

5 Safety-related Functions and Interfaces

5.1 Safety Functions

The robot is equipped with a range of built-in safety-related functions that limit the movement of the robot joint and robot Tool Center Point (TCP). TCP actually refers to the center point of the output flange with the addition of the TCP offset.

The limiting security-related functions are:

Limiting Safety Function	Description
Joint position	Minimum and maximum angular joint position
Joint speed	Maximum angular joint speed
Joint torque	Maximum joint torque
TCPPosition	Planes in Cartesian space limiting the position of the robot TCP
TCPSpeed	Maximum speed of robot TCP

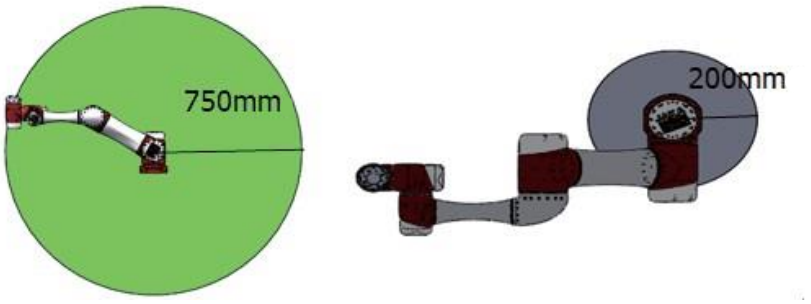


Fig5.1

Fig5-1: Certain areas of the workspace should receive attention regarding pinching hazards, due to the physical properties of the robot arm. One area is defined for radial motions, when the wrist 1 joint is at a distance of at least 750mm from the base of the robot. The other area is within 200mm of the base of the robot, when moving in the tangential direction.

WARNING: There are two exceptions to the force limiting function that are important to notice when designing the work cell for the robot. These are illustrated in Figure 5.1. As the robot stretches out, the knee-joint effect can

give high forces in the radial direction (away from the base), but at the same time, low speeds. Similarly, the short leverage arm, when the tool is close to the base and moving tangential (around) the base, can cause high forces, but also at low speeds. Pinching hazards can be avoided, for instance, by removing obstacles in these areas, placing the robot differently, or by using a combination of safety planes and joint limits to remove the hazard by preventing the robot moving into this region of its workspace.

5.2 Collision Detecting

Collision detecting includes the contents as shown in the following table.

Collision Stop	Collision torque: The maximum of torque when collision happened.
	Collision impulse: The maximum of impulse when collision happened.

Collision is violation that will happen only under abnormal circumstance. The system will automatically shut down to protect the robot and inform the operator to ensure the safety usage when collision is detected.

Collision Stop	Parameter	Detecting Time	Stop Time	Reacting Time
Collision torque	100N·m	200ms	500ms	1000ms
Collision impulse	80N·s	80ms	300ms	500ms

5.3 End Effector Button

If the robot is under the normal stop mode, the operator can press and hold the end effector buttons to activate the free-drive mode. Meanwhile, release the button, it will go back to the normal mode. Four colors of the button standing for four working status, as shown in the following table.

COLOR	WORKING MODE
BLUE	Power-on default mode
GREEN	Enabled, position mode
RED	Fault
ORANGE	Free-drive mode

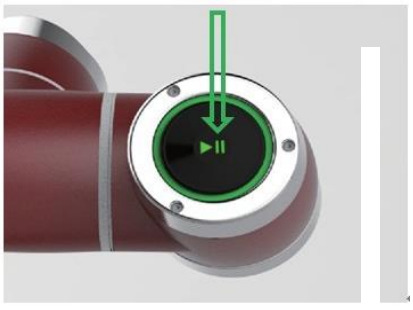


Fig 5-2

6 Maintenance and Repairing

Maintenance and repairing must be performed in compliance with all safety instructions in this manual. Repairing must be performed by an authorized system integrator or JAKA staff. Parts returned to JAKA should be returned as specified in the Service Manual.

6.1 Safety Instructions

After maintenance and repairing, product must be checked to ensure the required safety level. The valid national or regional work safety regulations must be observed for this check. The correct functioning of all safety functions shall also be tested.

The purpose of maintenance and repairing is to ensure that the system is kept operational or, in the event of a fault, to return the system to an operational state. Repairing includes troubleshooting in addition to the actual repair itself.

The following safety procedures and warnings must be observed during the operation of the robot or electrical cabinet:

DANGER:

1. Do not change anything in the safety configuration of the software (e.g. the force limit). If any safety parameter is changed, the complete robot system shall be considered as a new system, which means that the overall safety approval process, including risk assessment, shall be updated accordingly.
2. Replace faulty components using new components with the same article numbers or equivalent components approved by JAKA for this purpose.
3. Reactivate any deactivated safety measures immediately after the work is completed.
4. Document all repairs and save this documentation in the technical file associated with the complete robot system.

DANGER:

1. Remove the main input cable from the bottom of the electrical cabinet to ensure that it is completely unpowered. Deenergize any other source of energy connected to the robot arm or control box. Take necessary precautions to prevent other persons from powering on the system during the repair period.
2. Check the earth connection before re-opening the system.
3. Observe ESD regulations during the disassembly of the parts of the robot or electrical cabinet.
4. Avoid disassembling the power supply inside the electrical cabinet.

High voltages can be present inside these power supplies for several hours after the electrical cabinet has been switched off.

5. Prevent water and dust from entering the robot or electrical cabinet.

6.2 Overhaul Project and Cycle

In order for the robot to maintain high performance for a long time, a maintenance check must be carried out. The person in charge of overhaul must prepare an overhaul plan and carry out an inspection. Please refer to the table below for overhaul items.

In addition, overhauls are required every 20,000 hours of operation time or every 4 years. If you are not clear about the maintenance processes, please contact our service department.

Cycle			Overhaul Items	Overhaul essentials	Part
Daily	Every 3 months	Every Year			
●			Robot body	Confirm whether the taught points are correct	All Parts
	●		Cleaning the robot body	Wipe off dirt, etc., remove accumulated spatter, ash, dust, cutting residue, etc.	All Parts
	●		Main bolts	All the bolts exposed on the outside of the robot need to be tightened and marked (see the specified tightening torque table), including the tool mounting bolts are also implemented.	All Parts
●			Motor	Abnormal heating or sound confirmation	All Axis
●			Brake	Check when the servo power is turned ON/OFF, whether the robot arm or tool will fall.	All Axis
	●		Reducer	Check for abnormal vibration, noise, and oil leakage	All Axis
	●		Tools	Apply force to the tool to make sure it is properly and securely bolted in place.	6th Axis

Bolted tightening torque table

Bolt Size	Hexagon bolt	SUS bolt with hexagon hole
M3	2.4 Nm	1.47 Nm
M4	5.4 Nm	3.4 Nm
M5	9 Nm	6.9 Nm
M6	15.3 Nm	11.8 Nm
M8	37 Nm	28.4 Nm

The tightening torques will vary depending on the type of base metal or bolt. When not specified, please follow the tightening torques above.

Verification number	Inspection cycle			Maintenance			Inspecting Parts	Inspecting Content	Inspection/processing method
	Daily	Every 3 months	Every Year	4 years	5 years	8 years			
1	●						Surfaces	Whether there is splashes, dust, etc.	Visual confirmation, cleaning
2	●						Filters	Whether there is dirt or blockage	Visual confirmation, cleaning, replacement
3		●		●		●	Cables	• Confirm whether there is any damage or fragmentation • Confirm whether the connectors are loosed.	Visual confirmation, tightening. Replace the cable when it is obviously damaged.
4						●	Overhaul		

(P.S.) Use a soft cloth to remove dusts when cleaning. Do not blow off dust with equipment such as air blowers. Wind pressure will cause the dusts to enter the inside of the fan and the blades rotate at a speed exceeding the rated speed, which may cause the fan to malfunction or affect its life. Only use the vacuum cleaner on the blade section. Do not vacuum the rotating part or the main body, which can cause the fan to malfunction or reduction of the fan's service life.

6.3 Parts Replacement and Preservation

When replacing the parts of the robot control unit, please observe the following precautions and work safely.

1. Do not carry out any modification of our products.
2. Fire, malfunction, and wrong movements caused by modification may result in personal injury or damage to the robot.
3. Any loss caused by the user's own modification of JAKA's products is not covered by JAKA's warranty.

To prevent electric shock, when replacing parts, please turn off the circuit breaker, and then turn off the main power supply.

1. Turn off the main power, wait for 5 minutes, and then the parts could be replaced if needed.
2. There is a risk of electric shock, due to residual charge in the electronic components.
3. Do not use wet hands for work.
4. In case of electric shock, it will result in serious injury or death.

1. The replacement must be carried out by the specified operator.
2. Electric shock or being caught by a robot accidentally can result in serious injury or death.

1. There are a large number of connection interfaces between the printed circuit boards. Keep cautious when replacing parts to avoid mis-insertion or omission.
2. If it causes electric shock or fire, it will result in serious injury or death.

1. Do not damage the wiring or pull the connector when it is replaced.
2. Do not touch the electronic components of the printed circuit boards and the contact parts of the wiring or interface when replacing. Hold the edge of the printed circuit board when replacing.
3. If you accidentally touch them, it may cause electric shock, resulting in serious injury or death.

In order to carry out maintenance and inspection work, the power should be turned on once while the electrical cabinet's door is ope. Do not let the inside of the electrical cabinet be exposed to direct sunlight or searchlights, otherwise it will cause malfunction or wrong movements.

1. Before performing maintenance, the operator should discharge static electricity in advance.

2. Antistatic wrist straps are very effective.

3. Failure to take any precautions when touching electrical components directly, electrical components may malfunction.

After the maintenance is completed, check if there is any gap or if any cable is caught. After that, reinstall the case. If there is a gap, it may cause dirt, dust, etc. to enter the inside of the electrical cabinet, which will cause malfunctions.

6.3.1 Filter cleaning and replacement

1. Power off the electrical cabinet.
2. Remove the nut from the filter housing.
3. Clean the dust adhering to the filter by blowing it out. Dust should be blown from the inside of the electrical cabinet during cleaning. When there is dirt, etc., apply warm water or a neutral detergent. And if it still cannot be cleaned, it should be replaced.
4. Installation should be carried out in the reverse order of removal. When cleaning with warm water or a neutral detergent, it should be fully dried before installation.

6.3.2 Joints replacement

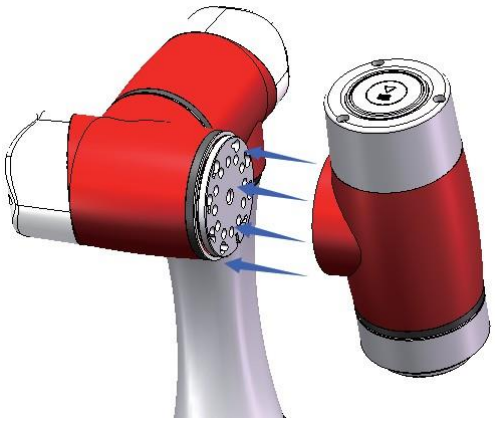


Fig6-1

6.3.3 Part preservation

According to the life and frequency of use of the components, the recommended spare parts are divided into two categories: A and B.

Maintenance parts • A:

Main maintenance parts for daily maintenance and inspection

- A-1: Important backup parts
- A-2: Regular replacement parts / recommended spare parts

Maintenance parts • B:

Maintenance parts prepared when purchasing multiple robots

- B-1: Parts purchased from JAKA

In order to maintain normal operation, the A-1 and A-2 are the minimum necessary important parts. It is recommended to prepare one whole set. In addition, the printed circuit board uses highly reliable components, so please pay attention to the following points during storage.

• Preservation temperature -10℃～+50℃

In order to maintain its reliability during long-term storage, it is recommended to maintain the temperature within 25℃±10℃. Please avoid sharp temperature changes (10℃/ hour or more).

• Preservation humidity 20～85%RH

In order to maintain its reliability during long-term storage, it is recommended to maintain the humidity within 45%-65%. Avoid condensation or mold during storage.

• Antistatic Static

Static electricity is easy to generate in extremely dry conditions, and the shock during electrostatic discharge may damage the semiconductor. Please put it in an anti-static bag.

• Other environmental conditions

Please store it in an environment where no toxic gases, dirt, or dust are generated. Do not place heavy objects on it during storage.

6.4 Service Commitment

JAKA will provide users with the following equipment warranty and maintenance services:

Equipment provided by JAKA: from the day of acceptance of the equipment, the equipment enters the warranty period. The warranty period is 1 year. During the warranty period, if the equipment is faulty, JAKA will be responsible for repairing and maintenance. After receiving the user's equipment failure report, if the fault is caused by JAKA's equipment, JAKA is responsible for providing the warranty and promptly repairing. If the fault is caused by one of the following situations, it is not included in the free warranty, and the user should pay for the cost of equipment. JAKA should assist in troubleshooting as soon as possible to restore the equipment back to normal:

1. User does not operate according to the operating procedures;
2. User damages the equipment on purpose;
3. Other failures caused by force majeure factors (such as lightning strikes, earthquakes, and floods, etc.)

JAKA provides free maintenance services to users during the one-year warranty period. After the warranty expires, JAKA will continue the after-sales service procedures:

1. By negotiating with the user, the content and format of the service application form and the support service implementation report will be determined, and the user and JAKA will designate the related personnel respectively.

2. If the user needs support services, it is required to fill out the service application form and send it to JAKA. If the situation is urgent, user can call directly to request the service.

Range and content of support service

JAKA promises to provide maximum technical services in all dimensions throughout the project, including: hardware maintenance support service and software training support service.

1. Hardware maintenance support service: JAKA promises to be responsible for maintenance of any equipment during the equipment warranty period, and the user does not have to pay any fees (except for mechanical injuries or malfunction caused by incorrect operation of user). After the equipment warranty expires, we will sign the relevant agreement with the user to confirm the charging method, maintenance responsibility, and maintenance method to ensure the fulfillment of maintenance responsibility.

2. Software training support service: JAKA promises to conduct a training for the user during the warranty period of the equipment (the specific times of training can be changed according to the contract), and the user does not have to pay any fees. After the equipment warranty expires, we will sign the relevant agreement with the user to confirm the charging method to ensure the fulfillment of follow-up service responsibility.

Contact information

•Overseas market outside China: info@kunlintech.com

•China market : Support.china@jaka.com

Information required

• Robot serial number

• Software version

• Detailed fault description

• Attached log files

7 Design Criterion

JAKA Zu 7 was designed according to the Chinese national standards of GB11291.1-2011、GB5226.1-2008、GB17799.4-2012、GB17799.2-2003, and GB/T 15706-2012.

8 Warranty

8.1 Product Warranty

Without prejudice to any claim the user (customer) may have in relation to the dealer or retailer, the customer shall be granted a manufacturer's warranty under the conditions set out below:

In the case of new devices and their components exhibiting defects resulting from manufacturing and/or material faults within 12 months of entry into service (maximum of 15 months from shipment), JAKA shall provide the necessary spare parts, while the user (customer) shall provide labor to replace the spare parts, either replace the part with another part reflecting the current state of the art, or repair the said part. This Warranty shall be invalid if the device defect is attributable to improper treatment and/or failure to comply with information contained in this manual. This Warranty shall not apply to or extend to services performed by the authorized dealer or the customer themselves (e.g. installation, configuration, software downloads). The purchase receipt, together with the date of purchase, shall be required as evidence for invoking the Warranty. Claims under the Warranty must be submitted within two months of the Warranty default becoming evident. Ownership of devices or components replaced by and returned to JAKA shall vest in JAKA. Any other claims resulting out of or in connection with the device shall be excluded from this Warranty. Nothing in this Warranty shall attempt to limit or exclude neither a Customer's Statutory Rights nor the manufacturer's liability for death or personal injury resulting from its negligence. The duration of the Warranty shall not be extended by services rendered under the terms of the Warranty. Insofar as no Warranty default exists, JAKA reserves the right to charge the customer for replacement or repair. The above provisions do not imply a change in the burden of proof to the detriment of the customer. In case of a device exhibiting defects, JAKA shall not be liable for any indirect, incidental, special or consequential damages, including but not limited to loss of production or damage to other production equipment.

8.2 Disclaimer

JAKA continues to improve reliability and performance of its products, and therefore reserves the right to upgrade the product without advance warning. JAKA takes every care that the contents of this manual are precise and correct, but takes no responsibility for any errors or missing information.

9 Quick Start Guide

9.1 Introduction

JAKA Zu 7 is made up of aluminum pipes and joints. These joints and their names are shown in fig 9-1. The base is the installation position of the robot, and the other side of the robot (joint 6) is connected to the tool. With the coordination of the movement of each joint, the robot can move the tool freely except for the area directly above and below the base.

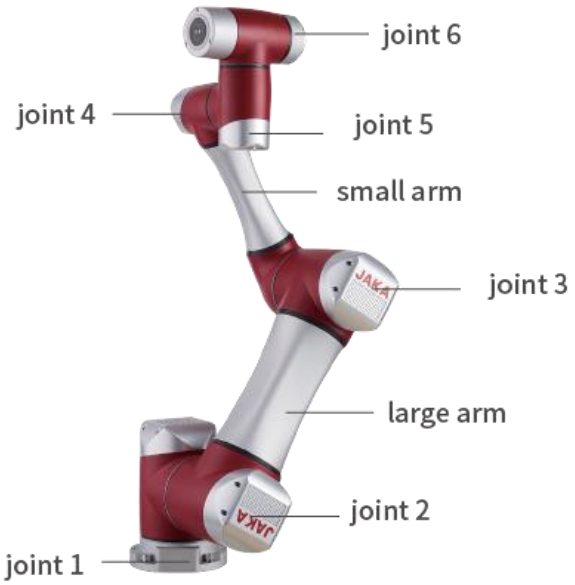


Fig 9-1

P.S.: Before using JAKA Zu (the operation APP), the robot and electrical cabinet must be installed first, and then power on the electrical cabinet.

9.2 Robot and Electrical cabinet Installation

Please install the robot and the electrical cabinet according to the following steps:

1. Open the box and take out the robot and the electrical cabinet.
2. Install the robot on a solid and shockproof surface.
3. Set the electrical cabinet on its pedestal.
4. Connect the cable between the robot and the electrical cabinet.

5. Connect the power plug of the electrical cabinet.

9.3 Turn on/off the Electrical cabinet

After plugged in, turn the emergency stop button clockwise to reset it. Press the power on button to turn on the electrical cabinet, and then start working.

9.4 Turn on/off the Robot

If the electrical cabinet is powered on, and none of the emergency stop buttons is activated, the robot then can be turned on. The way to turn it on is to touch the “Power on” button on the initialized page of the APP (refer to fig 10-1), and then click the “Turn on robot” button. After turning on the robot, all brakes are unlocked. The robot will make some noise and move a little. The robot can be turned off by touching the “Turn off robot” button on the initialized page of the APP, or by turning off the electrical cabinet.

10 JAKA Zu Documentation

1. JAKA Zu 7 use the proprietary APP operating software. Only the tablet PC or phone that installed the designated APP can operate JAKA Zu 7. Any other PC or software cannot operate it.

2. Workers must operate correctly in accordance with the APP usage specification. JAKA is not responsible for the damage caused by operating the robot incorrectly or using software in the way that is not allowed by JAKA.

10.1 Home Page

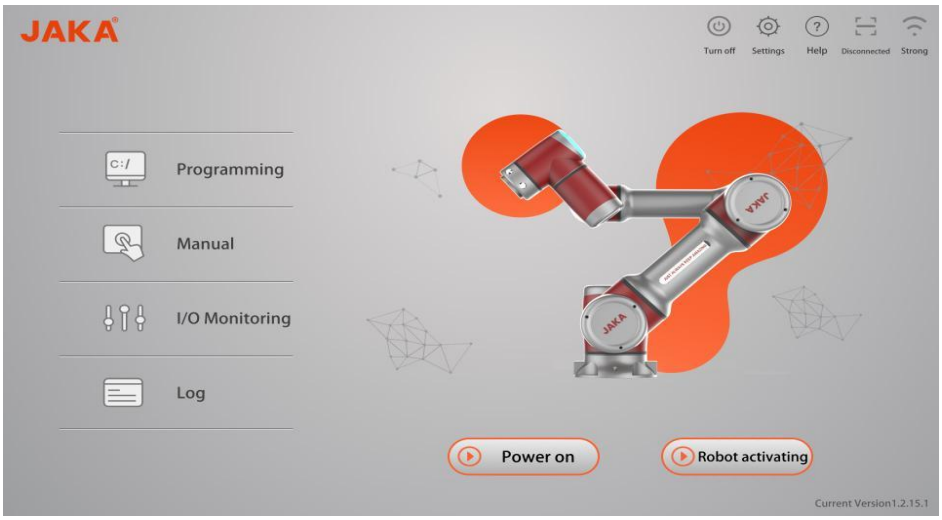
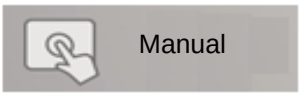
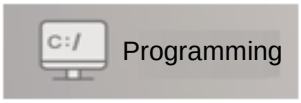


Fig 10-1

Home Page Function Button

Icon	Name	Function
	Manual operation tab	Click to redirect to manual operation page
	Program control tab	Click to redirect to programming page

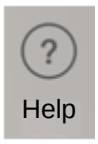
	IO monitoring tab	Click to redirect to IO monitoring
	Power on	Click to power on the robot
	Turn on robot	After turn on the “Power on” button, click the “Turn on robot” to enable the robot.
	Turn off robot	Appear after activating the robot. Click to turn off the robot.
	Robot connection state	When the App is not connected to the robot, the disconnected button displays. Click the QR code scanning frame popped up. The connected button is displayed when the App in the connected state. Click the prompt popped out to disconnect the current robot.
	Settings button	Click to open the page of robot settings
	Help button	Click to open using instructions
	Wi-Fi strength signal	Display the current Wi-Fi signal strength

Fig 10-2

10.2 Manual Operation Page

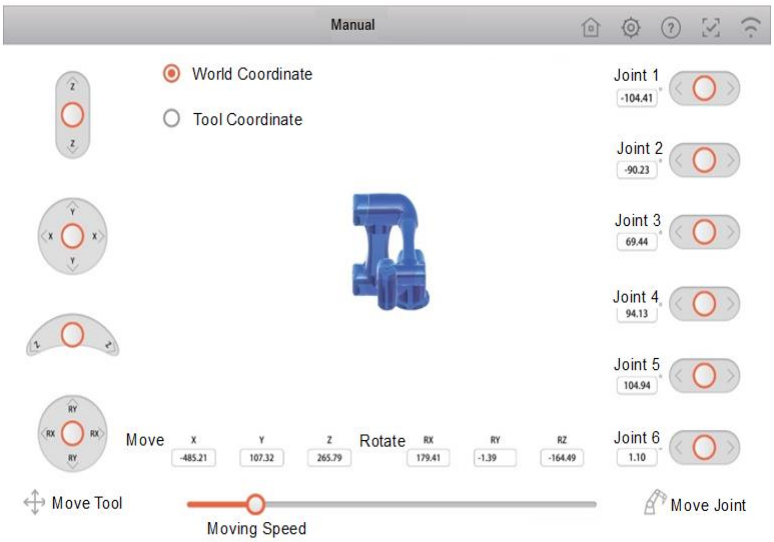


Fig 10-3

10.2.1 Page function instructions

Move tabs

In this interface, the robot can be directly moved by means of using moving tools or moving the joints.

Moving tools

•Free-drive virtual handle (As shown in Fig 10-4). Turn this handle according to the indicated direction. The rotation point is the tool center point (TCP), which is at the end of the robot and provides the feature points of the robot tool.

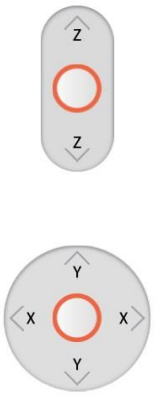


Fig 10-4

•Operation rotary virtual handle (As shown in Fig 10-5). Turn this handle according to the indicated direction. The rotation point is the tool center point (TCP), which is at the end of the robot and provides the feature points of the robot tool.

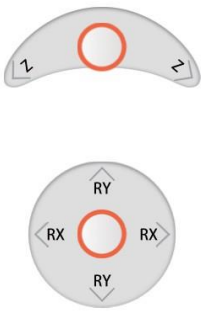


Fig 10-5

Note: It can stop dragging the rocker at any time to make the robot stop moving.

Move the joints

·Direct control of each joint is allowed. Each joint has a joint limit of positive and negative angle. If the joint reaches its limit, the robot cannot be moved.

·Joint data configuration. Click the icon shown in fig 10-6 to open the joint configuration data page as the fig 10-7 shows.

Fig 10-6

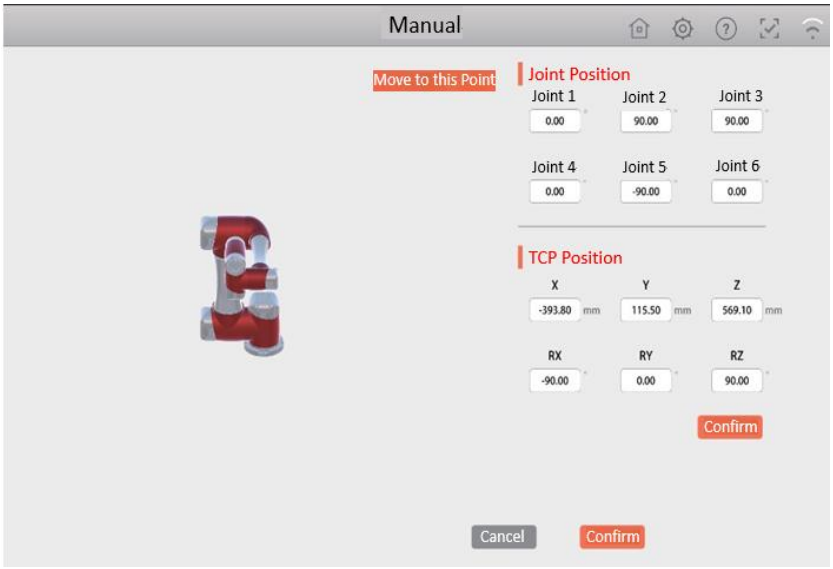


Fig 10-7

10.2.2 Robot Model

Fig 10-8

The current position of the robot is displayed in real time in 3D perspective. Fingers can slide left and right across the model area to check the joint position of the robot more easily. (As shown in Fig 10-8)

10.3 Log Information Page

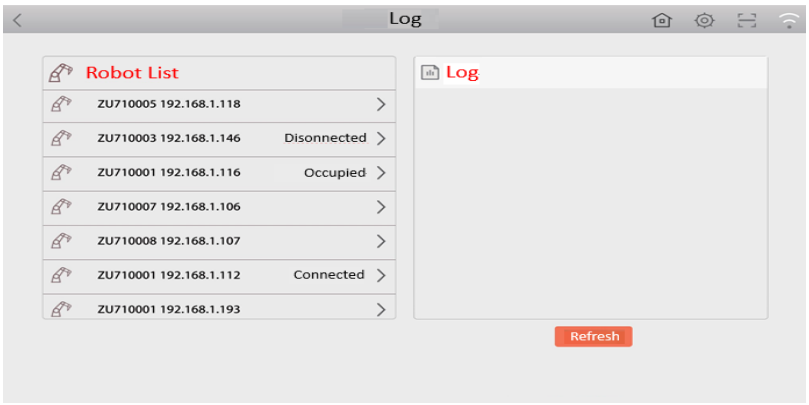


Fig 10-9

This page is divided into two areas: robot list and log information.

10.3.1 Robot list area

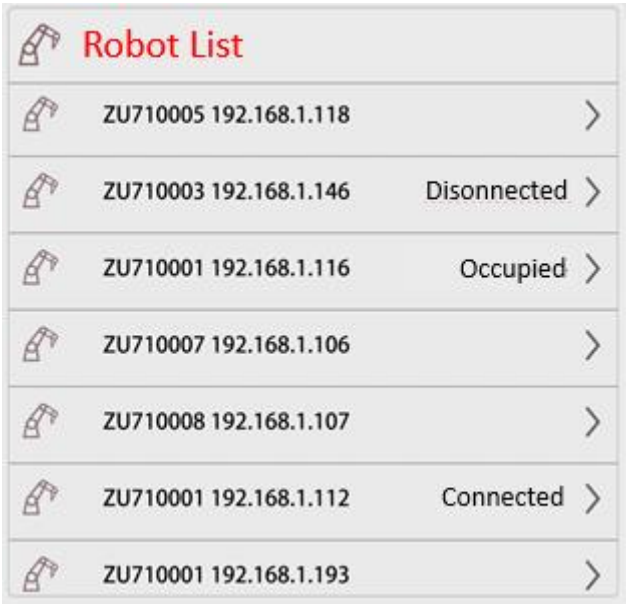


Fig 10-10

- This area shows all the running robots in the current LAN，

- One entry represents one robot.
- When the robot is connected by the app, the word “Connected” will be displayed.
- Every entry is clickable. When you click on the black entry, the following prompt box will pop up. Click “Confirm” to establish a connection with the robot, and then you can control the robot.

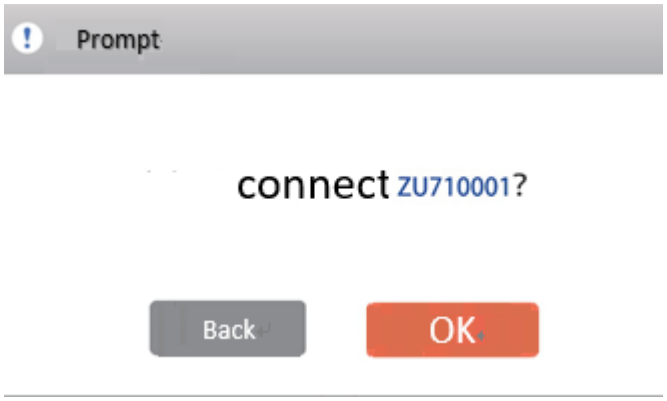


Fig 10-11

10.3.2 Log information area

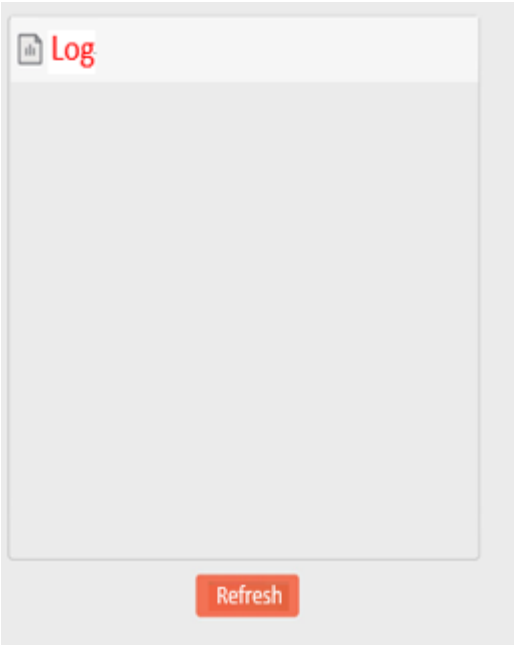


Fig 10-12

This area shows the log information of electronic cabinet of the robot. The information can be filtered by the switch button (correspond with the severity)

10.4 IO Monitoring

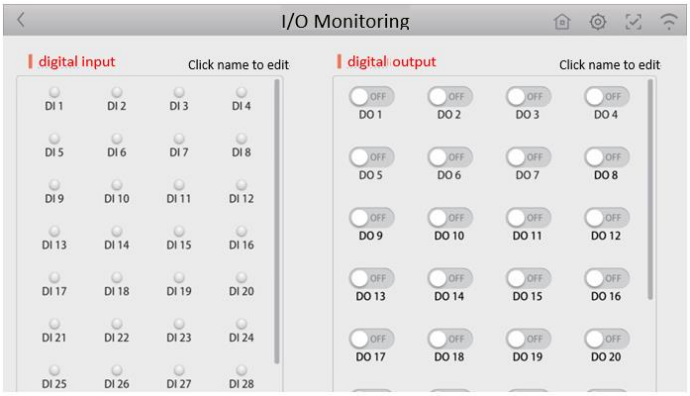


Fig 10-13

This page can display the input and output of each IO port of the electrical cabinet in real time.

· Electrical cabinet input: This area displays the real-time input of the electrical cabinet of the robot connected by the App.

· Electrical cabinet output: In this area, each switch 

can be clicked to switch the on-off state of specified port.

10.5 Programing Control

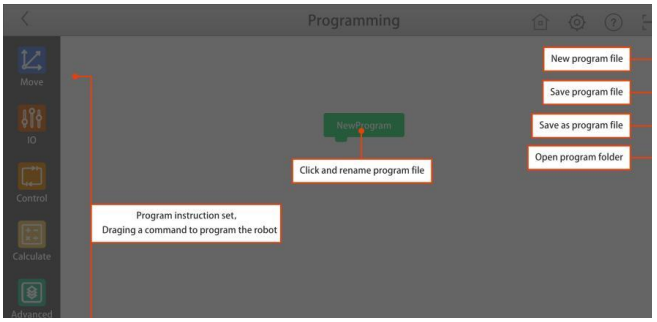


Fig 10-14

10.5.1 Programing commands

As is shown in the figure above (Fig 10-14) in the left, the program commands are classified in six types: move commands, IO commands, control commands, calculate commands, vision commands and submodule commands. Take move commands for an instance, click the move commands, the specified command entry can be opened. As the fig 10-15 shows and others are similar to it.

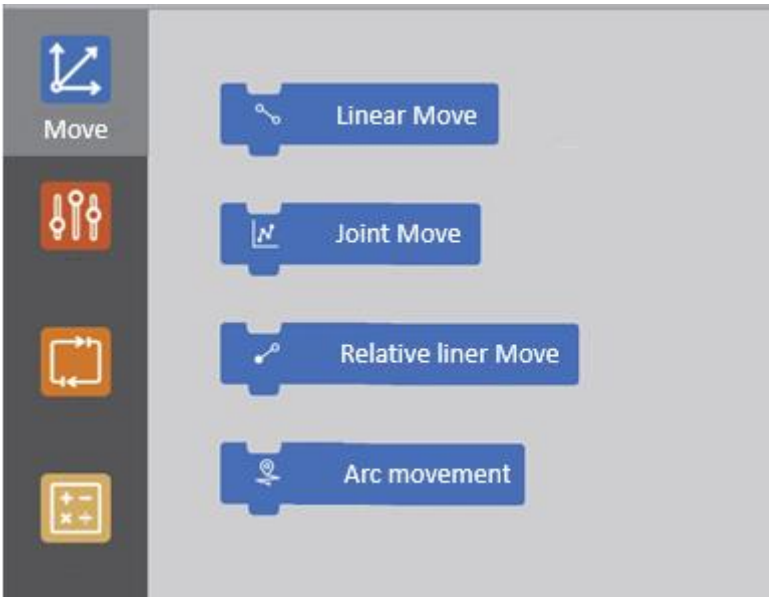


Fig 10-15

10.5.2 Commands instructions

Move Commands

Icon	Industry terminology	Function
Linear Move	MoveL Command	Move the tool linearly among points to keep the tool executing on the strait path
Joint Move	MoveJ command	Execute the calculated movement in the area of robot joints. The system simultaneously control the joints move to the required key position.
Arc movement	Way point	The points on the path of robots. The way point is the core element of robot program to indicate where the robot moves to. It is used with pallet control commands.
Relative liner Move	Relative Linear Movement	Execute offset movement which is relative to the current point

Fig 10-16

IO Commands

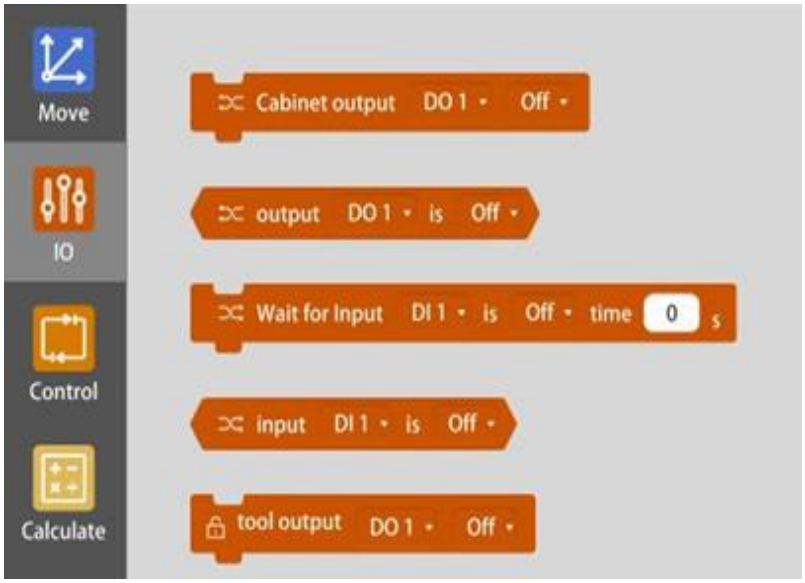


Fig 10-17

This command mainly controls the on/off state of the electrical cabinet output. The specified port can be selected for setting.

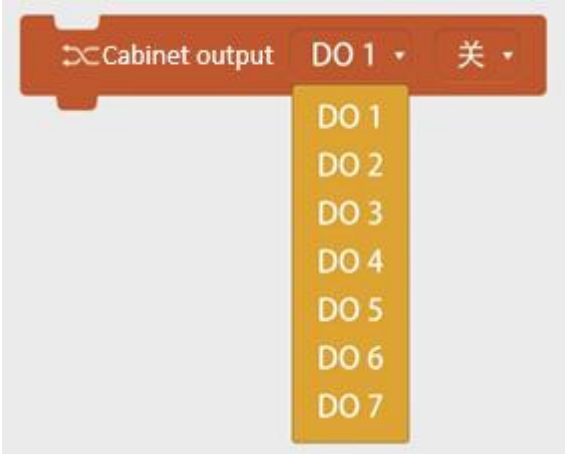


Fig 10-18

Control Commands

Fig 10-19

Loop Commands

Icon	Function
	Establish a Tool Coordinate System.
	Assign the variable in the program.
	Do the loop.

	Loop a specified number of times.
	Execute condition loop until the specific condition is reached.

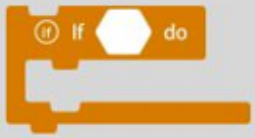
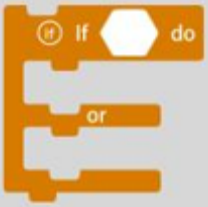
Fig 10-20

Loop through the basic program commands. Basic program commands can operate run an infinite loop or run a specified number of times, or as long as the given condition is true, the loop will stop, specifically relying on the choice made.

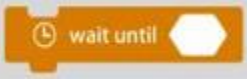
When the program loops a specified number of times, it will create a dedicated loop variable that can be used in an expression inside a loop. The loop variable counts from the beginning until the number of loops is reached.

If the end condition of the loop command is an expression, it is allowed to continue to evaluate this expression. Therefore, the loop can be interrupted at any time of the loop execution instead of stopping after every iteration.

If Commands

Icon	Industry terminology	Function
	If	Execute if the specified expression holds.
	If else	Execute the command in the first white frame if the specified expression holds, otherwise execute the command in the second white frame.

Wait Commands

Icon	Industry terminology	Function
	wait	Wait for the specified time to execute commands
	Wait until	Wait until the specified expression holds, and execute specific command

Pallet Commands

Icon	Industry terminology	Function
	Pallet	Pallet operation enables the robot to execute same movement and movement sequence in various positions. It is useful to execute pallet stacking or other similar operations.
	Initial position of pallet	Set the initial position of the pallet

Pallet operation includes the following features

• The program sequence should be executed in several positions

• The mode provided is in form of list or dot matrix

• Before start sequence can be selected when the operation is executed before the first position

• After end sequence can be selected when the operation is executed after the last position.

Pallet operation can execute movement sequence in a range of position given by mode pattern. In every position of mode, the movement sequence execution is relative to this mode position.

Write pallet operation program:

The programming steps are as follows:

（1）Definition mode: Click the command frame  of the pallet, and open the pallet settings page as the figure followed.

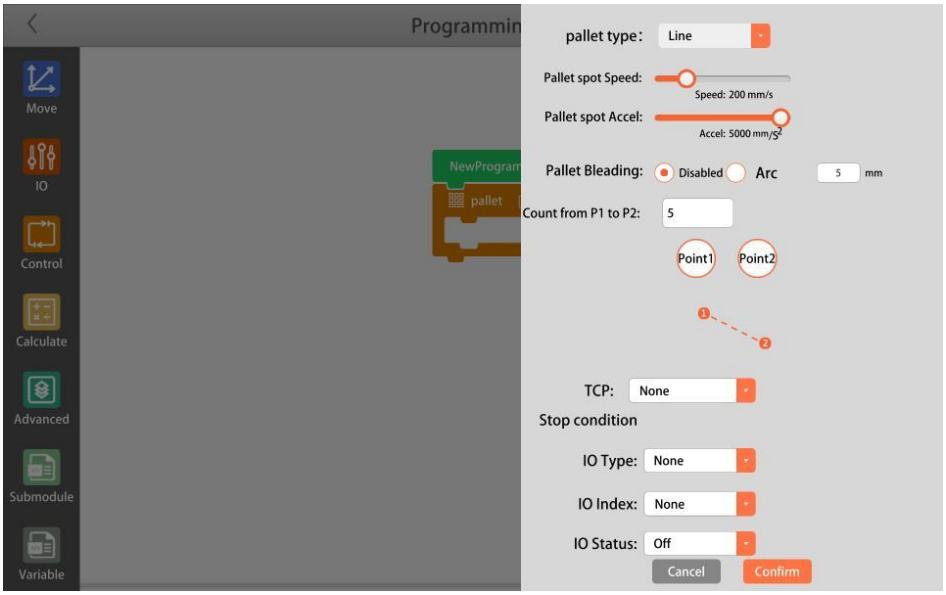


Fig 10-24

There are two pallet types: linear and square.

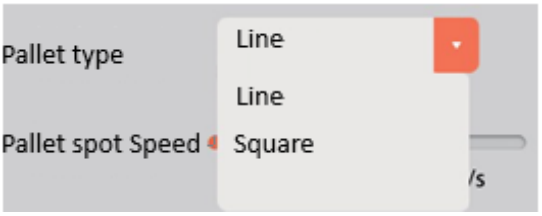


Fig 10-25

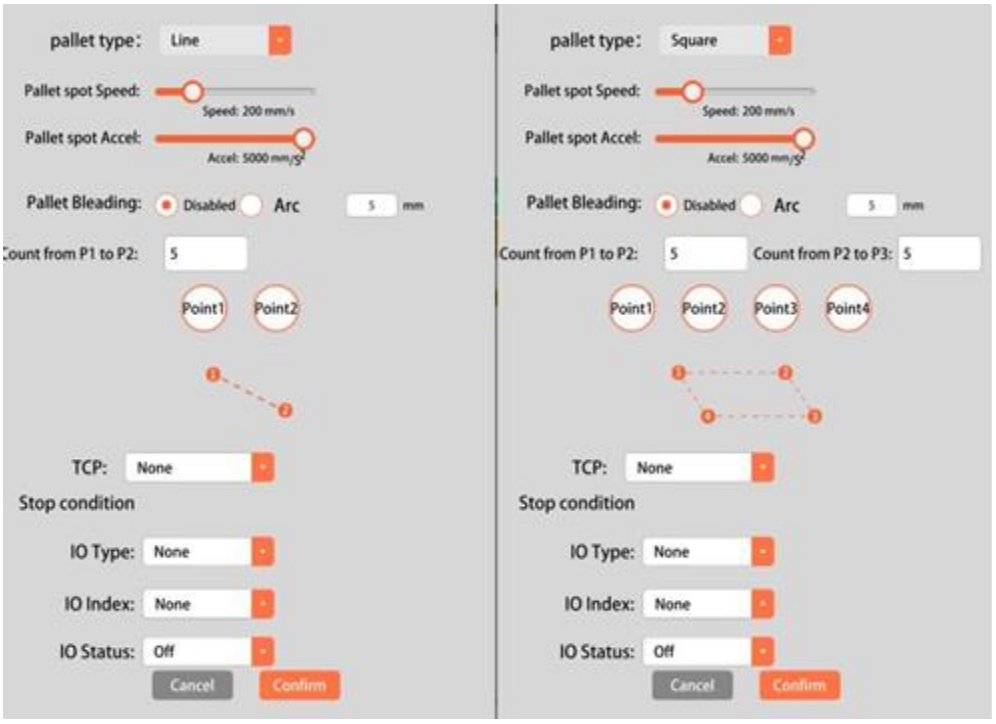


Fig 10-26 Fig 10-27

1. Confirm the “Pallet sequence” used in picking/placement of every point. The sequence describes the operation which should be completed in every mode position.

2. Use the selector on the sequence command screen to define the way point in the sequence which should correspond with the mode position.

Note: In the node of “Pallet sequence”, the movement of robot is relative to the position of pallet, which keeps the robot at the position that the anchor position/mode point given. To satisfy this principle, it will accordingly move to all positions remains. Do not use the move command in sequence because the movement of this command is not relative to anchor position.

Computing Commands

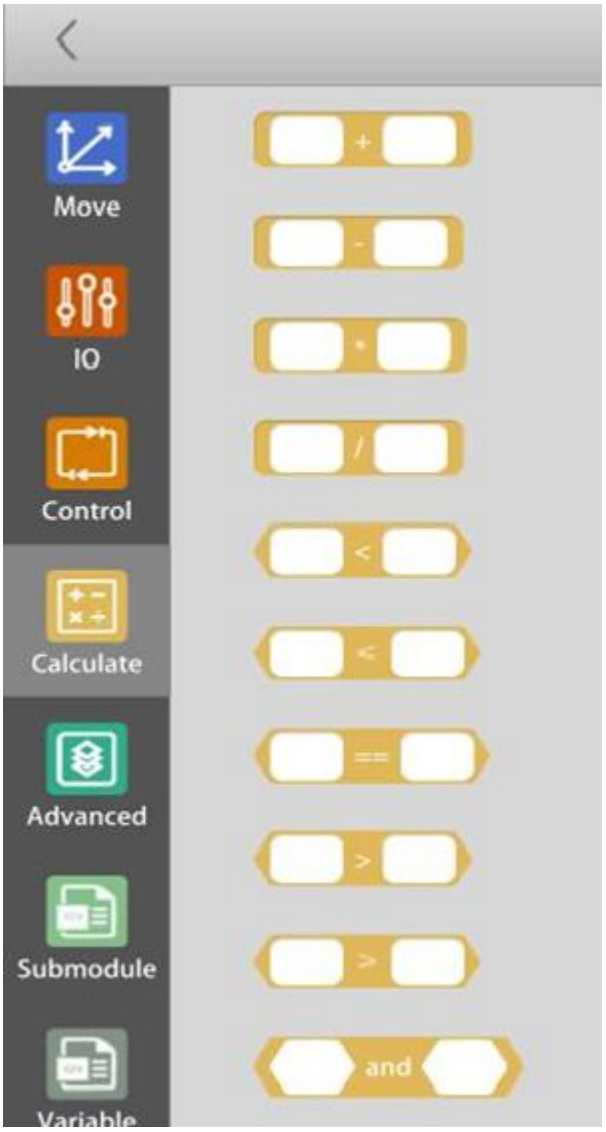


Fig 10-29

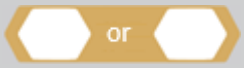
Icon	Industry terminology	Function
	+	
	-	
	*	
	/	
	<	
	=	
	>	
	or	
	and	

Fig 10-30

Vision Commands

Fig 10-31

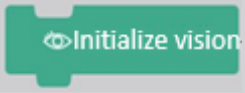
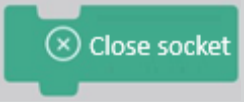
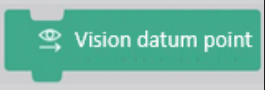
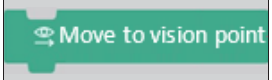
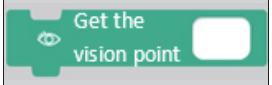
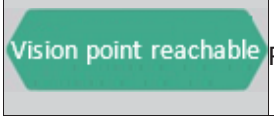
Icon	Name	Function
	Vision initialization	Command to initialize the vision
	Vision shut down	Close the current visual program
	Vision basic point	The reference position where the workpiece is grabbed, with which the camera calculates the offset of the workpiece from the basic point.
	Move to vision point	According to the visual feedback, the fixture at the end calculates and moves to the position of the workpiece.
	Visual photo-taking	Trigger camera to take photos of workpiece and collect data.
	Get the vision point	Get the vision and grab the position of some point.
	Reachable vision position	Judge whether the robot can reach the position the vision reached.

Fig 10-32

Submodule

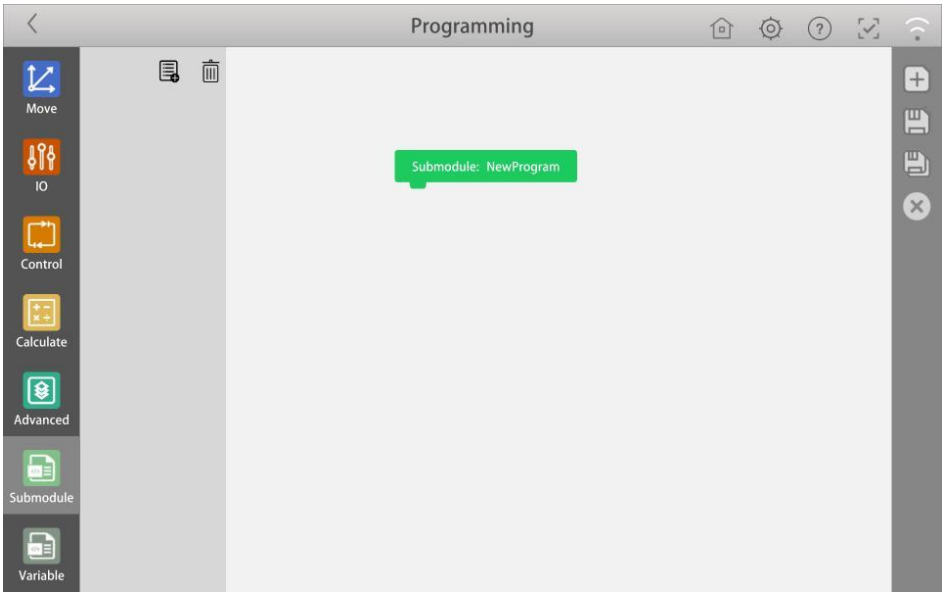


Fig 10-33

“Submodule” command can deposit the program parts needed in various places. The submodule can be

separate file in the disks or be hidden to avoid accidental modifications.

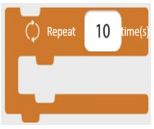
10.5.3 Function buttons area

Icon	Industry terminology	Function
	Start execution button	Click to start program execution. It will switch to “Stop execution button” during operation.
	New program	Click to create a new program.
	Save program	Save the completed program file.
	Open program	Open the saved program file.
	Overall speed	Change the command speed of current program executed.

Fig10-34

10.5.4 Programing demonstration

There is a simple program case to demonstrate the application of specific program commands.

(1)Open the “Control” select tab. Choose the default command 

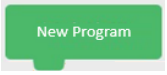
of repeat 10 times, and drag it and align the bottom of 

Fig 10-35

(2)Click the numeric part  in the figure above. Modify the loop execution times in the numeric keypads popped out.

Fig 10-36

(3)Click the “Control” select tab again. Drag the if else command to  the red part and then release it. The result is shown below.

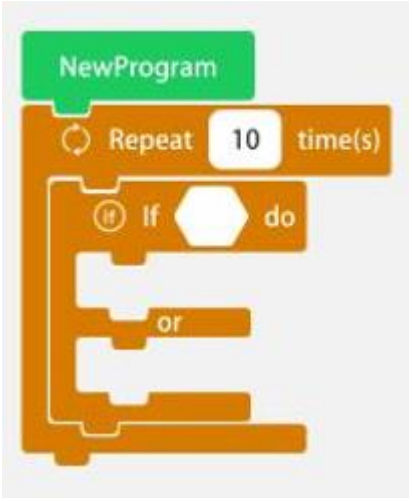
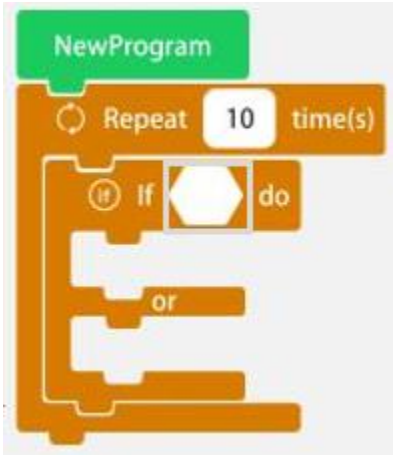


Fig 10-37

(4)Click the “Calculate” select tab. Choose the “&&” command and drag it to the red frame in the following figure.

Fig 10-38



The final result is shown below:

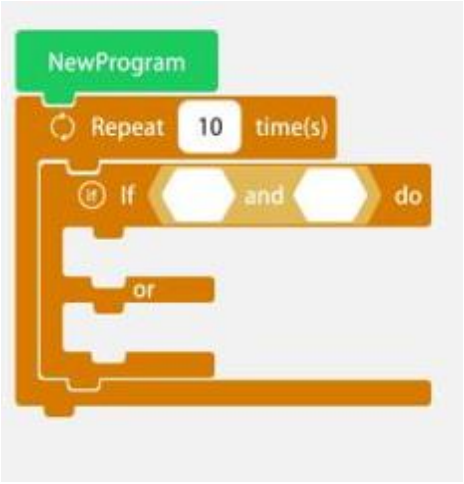


Fig 10-39

(5)Similarly, drag two expression commands in the “Calculate” select tab to the empty area of && command in the figure above. And the result is as follows.

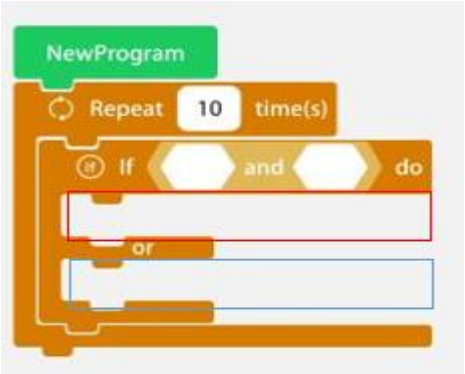


Fig 10-40

(6)Open the “Move” tab and relatively drag the “Linear movement” command and “Joint movement” command to the red area and blue area in the fifth step. The result is as follows:

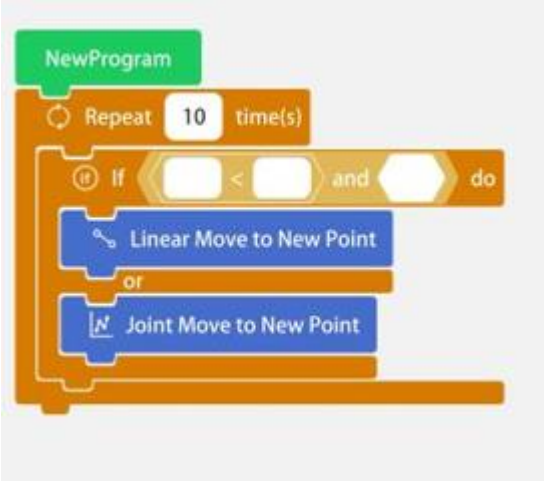


Fig10-41

(7)Click the  command entry in the sixth step, the command editing page will appear in the right of the interface as follows:

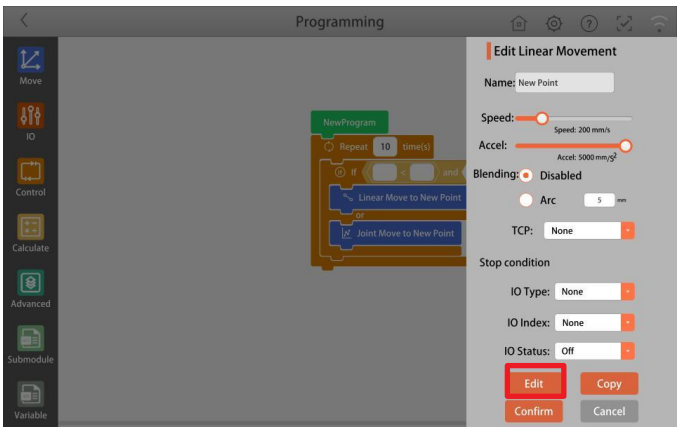


Fig 10-42

(8)Click the “Editing the position” button in the red frame to enter the command editing interface as follows.

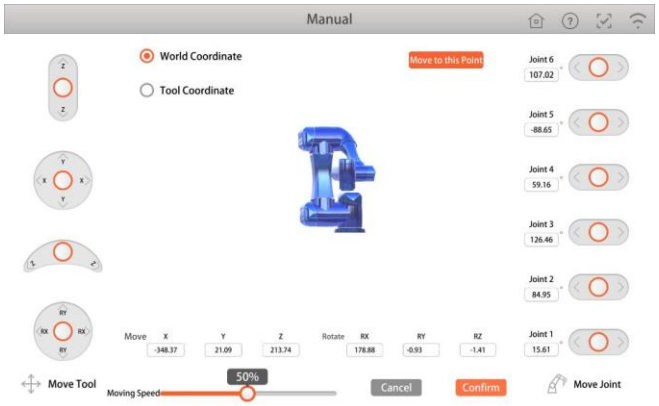
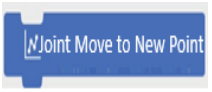


Fig 10-43

The red robot model represents the physical location of the current robot. The blue model represents the virtual initial position of the command edited currently. You can manipulate the left and right virtual handles to move the display position of the model. After saving it, click the orange “Confirm”.

(9)Similarly, click to 

modify the corresponding position of the robot.

(10)At last, click  , and the program starts execution.

(11)Click  the save button to save the current program profile.

(12)Click  to check the program profile saved as follows:

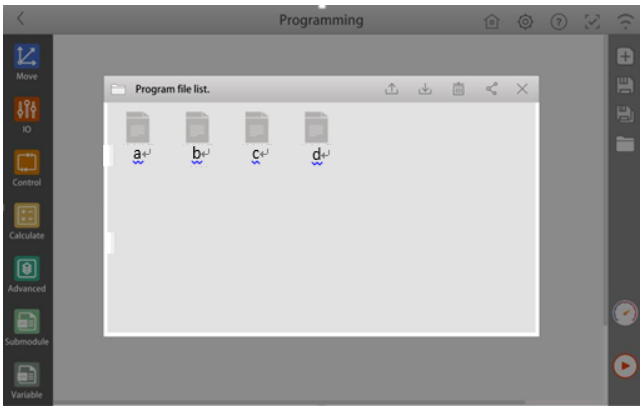


Fig 10-44

10.6 Robot Safety

When the robot detects a collision during operation, the robot will stop moving and enter the pause protection state. At the same time, the corresponding warning prompt will pop up on the APP as follows:

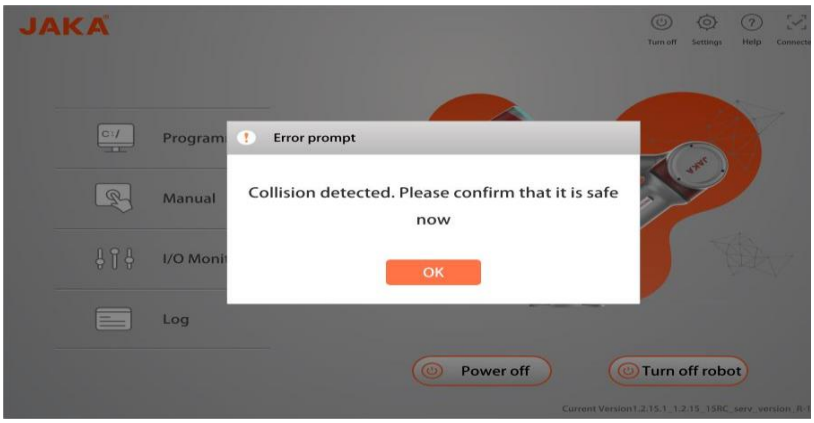


Fig 10-45

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