

MS6MT Robot

User Manual



User Manual

MS6MT Robot

MS6MT-0900-3546

Version V1.0.0

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QKM Technology (Dongguan) Co., Ltd.

Preface

Thank you for purchasing the robot produced by QKM!

This manual describes the matters needing attention for properly use of MS6MT Robot.

Read this manual carefully before using MS6MT Robot.

Keep this manual properly for future reference.

General

This manual describes the safety precautions, product overview, components, mechanical and electrical parameters, electrical interfaces, installation guide, and operation of MS6MT Robot in detail, so that users can systematically understand and correctly use MS6MT Robot.

Target reader

This manual applies to:

Mechanical Engineer	Installation and Debugging Engineer
Electrical Engineer	Technical Support Engineer

Signs & meanings

The signs in this document clearly indicate any dangers, warnings, cautions and notes that may occur while users perform the operations described in this manual. Pay attention to the following signs when they appear in the document.

The signs appearing in this manual are shown in the following table:

Figures	Description
 DANGER	It indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury.
 WARNING	It indicates that a potentially dangerous situation would occur and cause personal injuries or equipment damage if it is not avoided.
 NOTICE	It indicates that an unpredictable situation would occur and cause equipment damage, performance degradation, data loss, etc. if it is not avoided.
 NOTE	It gives the description on key information and operation tips.

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The contents of this document are subject to change any time due to product upgrade or other reasons. QKM reserves the right to change the product, specifications and other documents in this manual without prior notice. To know about the latest information of this product, please visit QKM's website for downloading.

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Version History

The version history contains the information on each update of the document, and the latest version of the document includes the updates in all previous versions of the document.

Version	Release Date	Change Content
V1.0.0	3/7/2022	The first version of the document was released.

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Chapter 1 Safety Precautions

This chapter introduces the safety precautions for use of MS6MT Robot. Read this manual carefully and understand the contents thereof before powering on the robot for the first time.

Personnel who use this product for system design, operation and maintenance must be trained by QKM or relevant institutions or have the same professional skills.

1.1. Precautions for general safety



The safety precautions in this manual only serve as a supplement to safety specifications. Personnel using the robot shall also comply with local safety regulations or specifications.

Personnel who use this series of robots for system design and manufacturing shall observe the following safety rules:

- Please use the robot within the specified operation environment. If it is used beyond its specifications and load conditions, the service life of the robot would be shortened or the robot would even be damaged.
- Users should ensure that the robot operates under safety conditions. There should be no objects around the robot, which may cause damage to it. As the robot may be scratched and bumped due to the motion of its movable mechanical parts, users should carry out risk assessment of the operation environment on site and set up special facilities for protection.
- Detergents with strong corrosion are not suitable for cleaning the robot. Anodized parts should not be cleaned by immersion.
- Non-professionals shall not repair faulty products without permission. Do not disassemble the robot without authorization. If the product fails, please contact Customer Service Center.
- Personnel responsible for installation, operation and maintenance must receive rigorous training to understand all safety precautions and proper methods of operation and maintenance before operating and maintaining the robot.
- Before operating, maintaining and testing the robot, be familiar with the specific location of the workplace where the robot emergency stop device is located, and ensure that the emergency stop switch can be pressed quickly in case of an emergency.

- Do not plug or unplug the power and communication wires and cables or press the emergency stop switch arbitrarily during normal operation of the robot.
- Users shall operate the robot by following the instructions marked on it. Do not enter the dangerous area where the robot operates to avoid personal injuries and robot damage.
- If users request for transport, please adopt the standard packaging required by QKM.

1.2. Precautions for safe operation



Shut off the power when installing and maintaining the robot to prevent accidents. Do not enter the work area of the robot after it is powered on to prevent danger.

Please observe the following safety rules when conducting installation, teaching and programming of the robot:

- Only qualified designated personnel who correctly understand the precautions for safe operation, master the using method and receive specialized training can operate, maintain and repair the robot.
- Do not change the hardware facilities and software configuration of the robot arbitrarily, otherwise damage to the robot or harm to the user would be easily caused.
- Ensure that the entire robot system is in a safe environment before daily check and regular maintenance of the robot.
- Do not plug or unplug the power and communication wires and cables during normal operation of the robot.
- Regularly train operators on operation rules, industrial safety, safety instructions and environmental protection.
- If the robot and its components are to be scrapped, please handle the industrial waste properly in accordance with relevant laws and regulations to protect the environment.

Chapter 2 Product Overview

2.1. Product Overview

MS6MT Robot should be used within a specific range. It consists of robot body, 48V relay module, discharge circuit and controller. The body, 48V relay module, discharge circuit and controller are connected via cables as described in Chapter 5. The appearance of the MS6MT Robot body is shown in Figure 2-1.

 **NOTE** The control cabinet is to be provided by customer. Please refer to Chapter 5 for connection of electrical components.

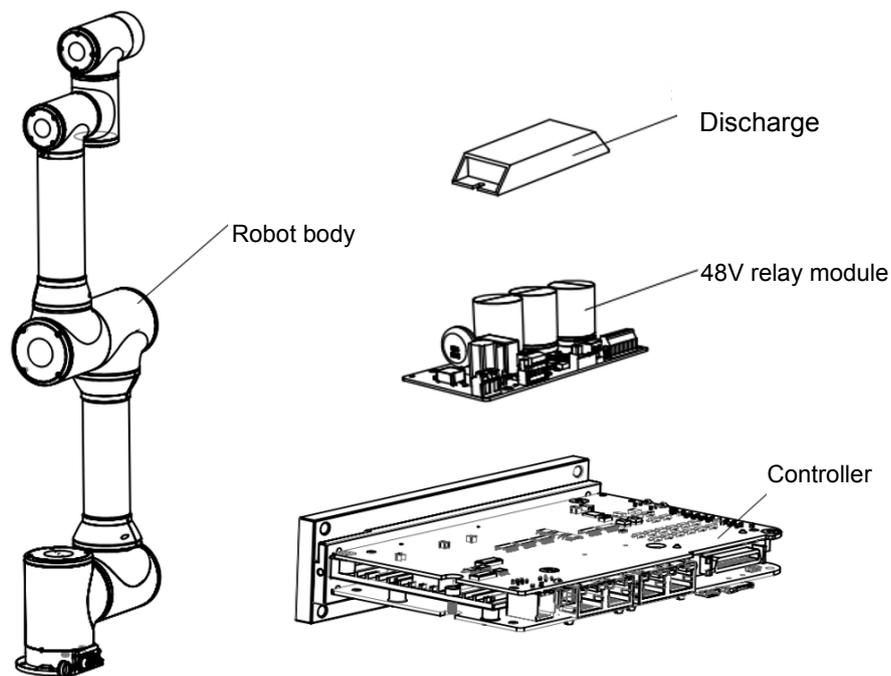


Figure 2-1 Appearance of MS6MT Robot

The MS6MT Robot body is composed of base, Axes J1, J2, J3, J4, J5 and J6.

The controller controls the signal transmission between the robot and upper and lower computers, and the 48V relay module controls the power-on and power-off of the robot.

2.2. Specification and dimension

2.2.1. Overall dimension

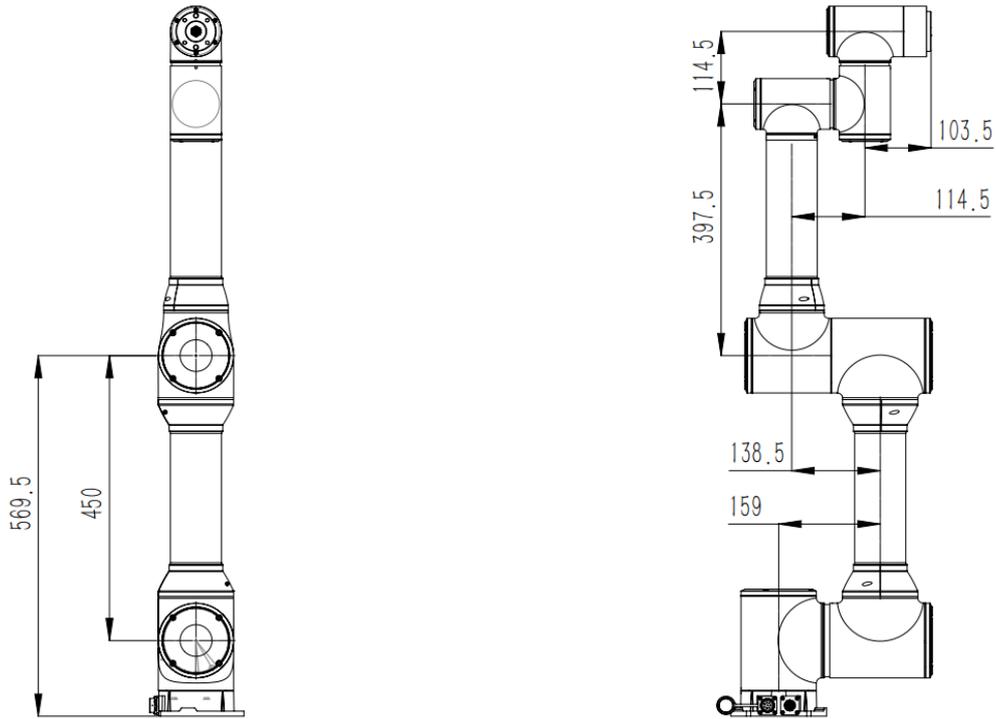


Figure 2-2 Product dimensions (Unit: mm)

2.2.2. Base dimensions

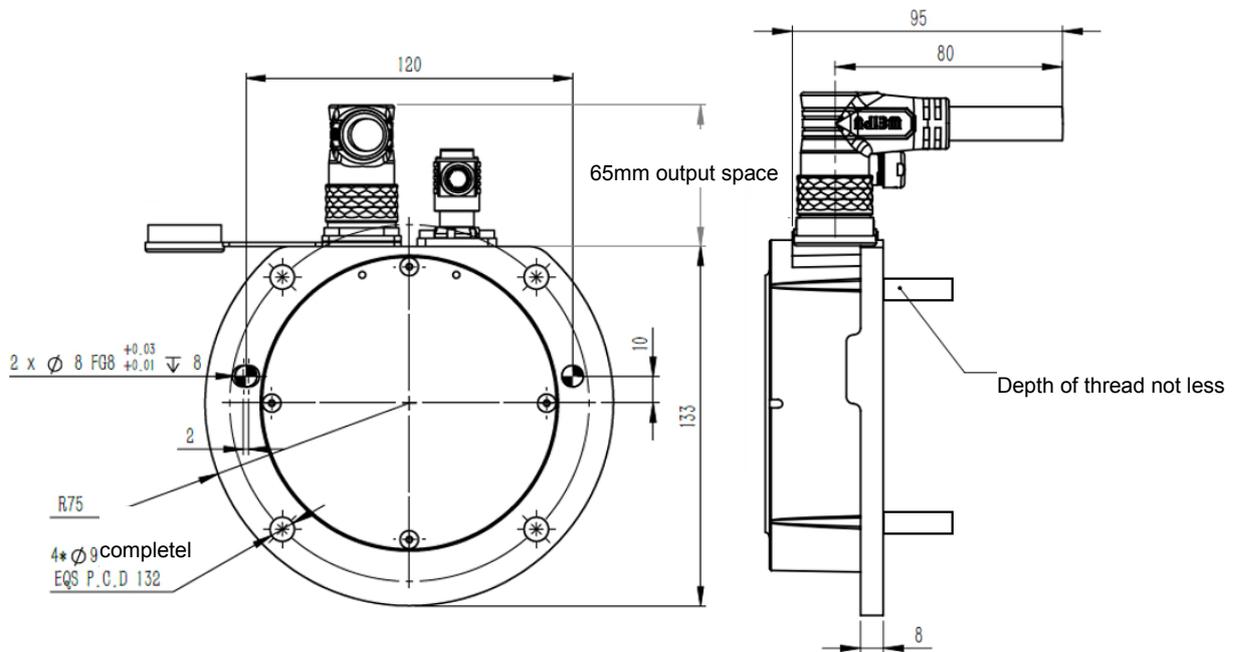


Figure 2-3 Base dimensions (unit: mm)

2.2.3. End flange dimensions

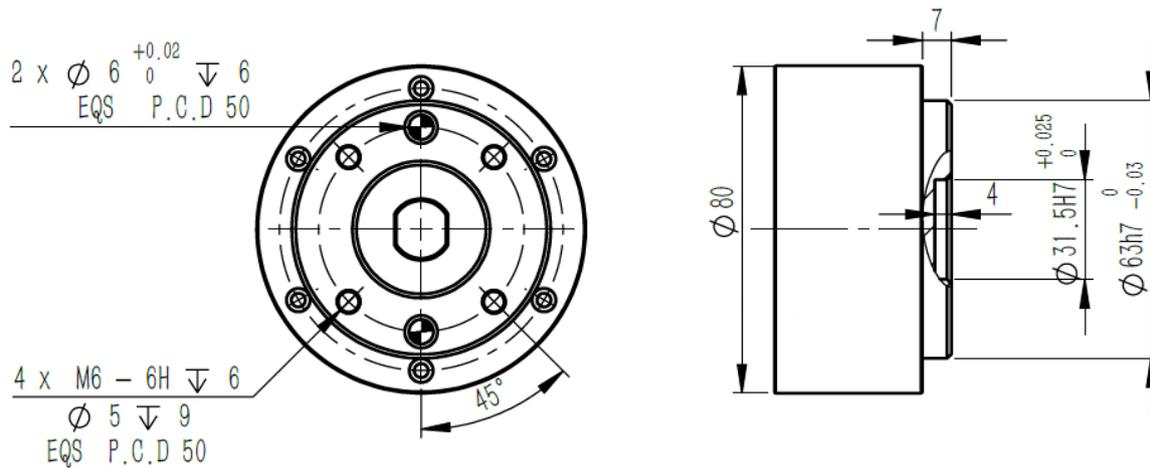


Figure 2-4 End flange installation dimensions (unit: mm)

2.3. Direction of motion

Joint coordinate of robot control system (Joint Coordinate): The posture of the robot is represented by rotation angle of each axis (J1, J2, J3, J4, J5, and J6). As shown in Figure 3-1, Axis 1, 2, 3, 4, 5 and 6 correspond to J1, J2, J3, J4, J5 and J6, respectively; the positive or negative direction of each axis indicates the positive or negative rotation angle.

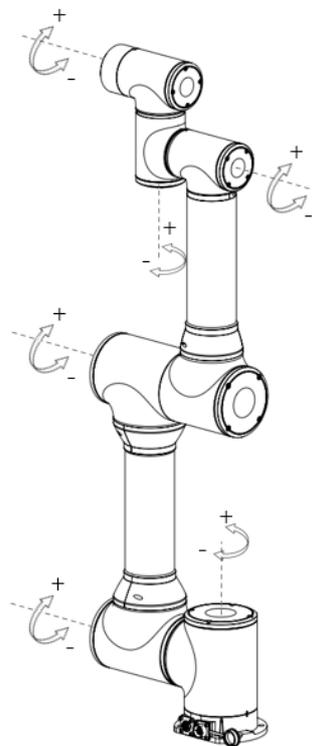


Figure 2-5 Direction of single-axis motion

Table 2-1 Range of single-axis motion

Axis type	Axis name	Range of motion
Primary axis (basic axis)	J1	$\pm 360^\circ$
	J2	$\pm 360^\circ$
	J3	$\pm 360^\circ$
Secondary axis (wrist axis)	J4	$\pm 360^\circ$
	J5	$\pm 360^\circ$
	J6	$\pm 360^\circ$

2.4. Coordinate system

2.4.1. Cartesian coordinate system

The origin (0,0,0) of the Cartesian coordinate system of MS6MT Robot is at the center of its base, as shown in Figure 2-6. MS6MT Robot moves in the Cartesian coordinate system by default.

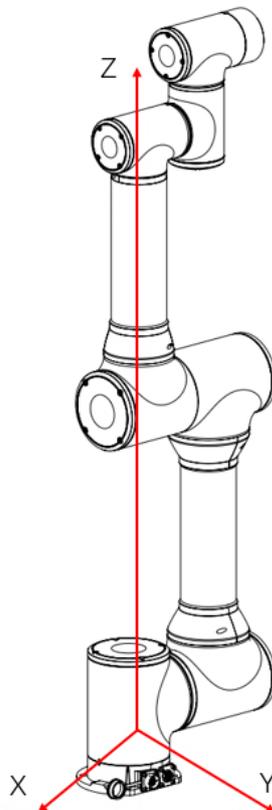


Figure 2-6 Cartesian coordinate system

2.4.2. Tool coordinate system

The tool coordinate system is a coordinate system established with the tool center point (TCP) as the origin, that is, the end coordinate system is offset to the tool center. As shown in Figure 2-7, the original tool coordinate origin (0,0,0) of the robot is set at the center of the flange end. If users want to set a new tool coordinate system, set the center point of the tool end as the coordinate origin. The X, Y, Z coordinates of the tool coordinate system should include the offset from the tool end to the flange center (the direction of Axes X, Y, and Z shown in the figure indicates the positive direction of the tool coordinate system).

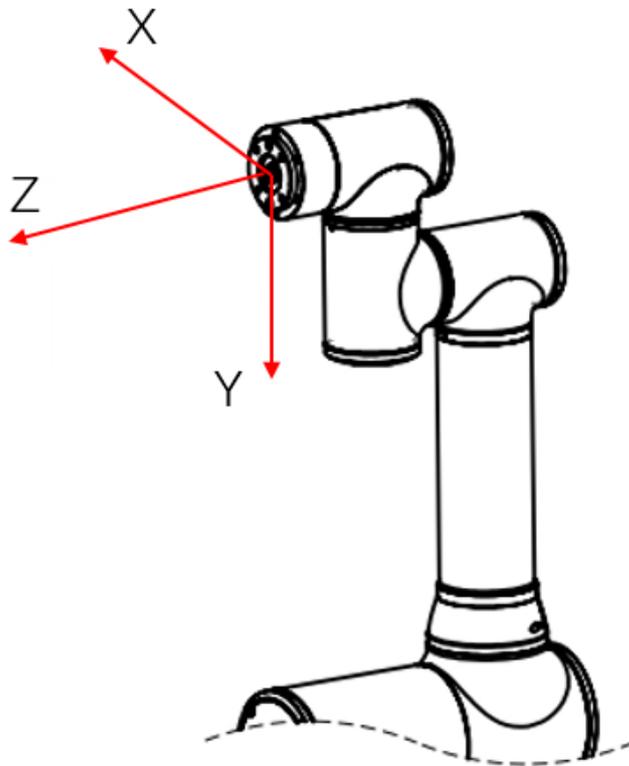


Figure 2-7 Tool coordinate system

Chapter 3 Technical parameters

3.1. Work space

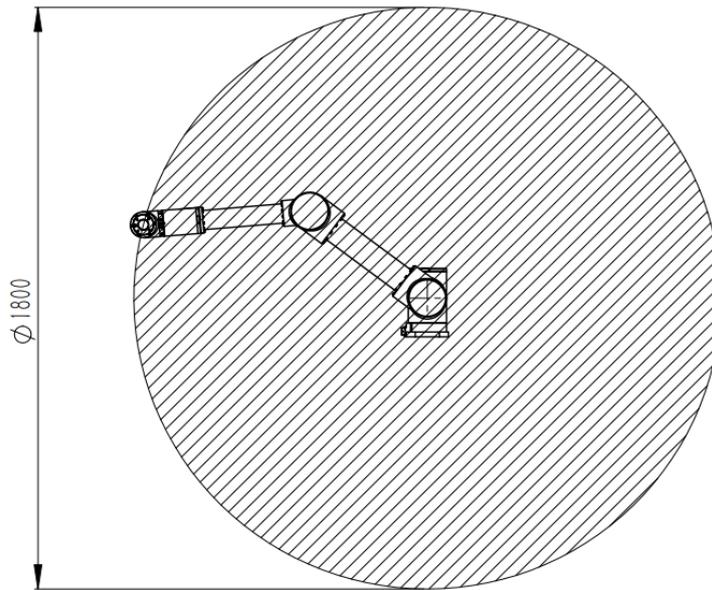


Figure 3-1 Schematic diagram of vertical workspace (unit: mm)

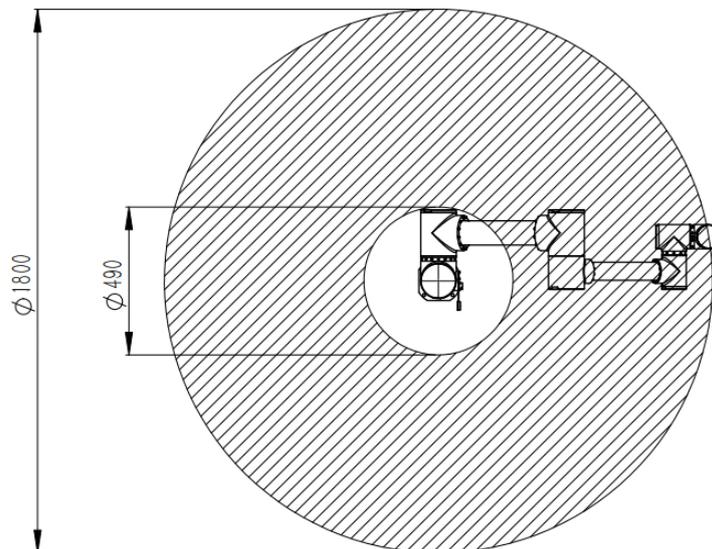


Figure 3-2 Schematic diagram of horizontal workspace (unit: mm)

3.2. Specifications

Table 3-1 Technical parameters of MS6MT Robot

MS6MT Robot		Specifications
Arm length		900 mm
Installation		Upward, side, downward installation
Maximum Load		6 kg
Repeated positioning accuracy		$\pm 0.1\text{mm}$
Absolute positioning accuracy		1mm
End linear velocity		1m/s
IP grade		IP54
Range of robot motion	J1	$\pm 360^\circ$
	J2	$\pm 360^\circ$
	J3	$\pm 360^\circ$
	J4	$\pm 360^\circ$
	J5	$\pm 360^\circ$
	J6	$\pm 360^\circ$
Total weight		21 kg
Noise level		$\leq 70 \text{ dB(A)}$

3.3. Environmental parameters

Install the robot system in an environment that meets the following conditions to

exert the performance of the robot and use it safely.

Table 3-2 Environmental parameters

Item	Technical parameters
Relative humidity	≤ 95%, non-condensing
Ambient environment	No flammable gas, dust or liquid; No corrosive gas or substance;
Vibration	Make sure it's free from strong impact and vibration during operation.
Temperature	-10 ~ 50°C

The robot is not suitable for work in harsh environmental conditions. If used in a place that does not meet the above conditions, please contact QKM for query.



NOTICE

- If used in an environment where temperature and humidity change greatly, fogging may be caused inside the mechanical arm.
- Do not use it in corrosive environments such as acid or alkali environment.

3.4. Electrical parameters

Table 3-3 Electrical parameters

Item	Technical parameters
Controller	24V d.c. input power
48V relay module	48V d.c. input power
Communication interface	Ethernet, EtherCAT, RS-232, CAN

Chapter 4 Introduction to Electrical Interfaces

4.1. Introduction to electrical interfaces of robot body

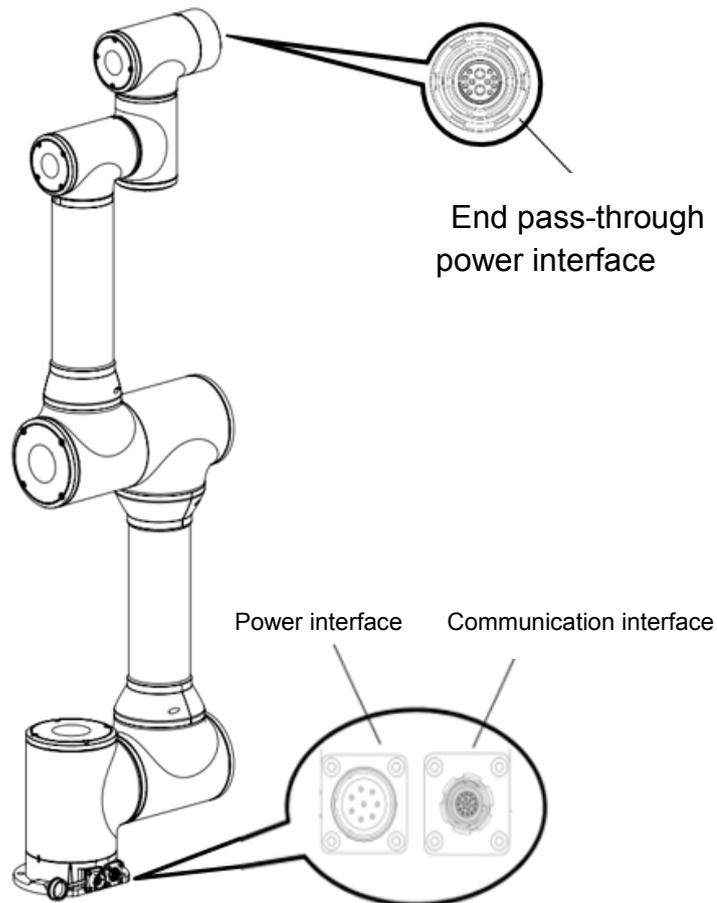


Figure 4-1 Body electrical interface panel

Table 4-1 Introduction of body electrical interface panel

SN	Name	Description
1	End pass-through signal interface	Defined by customer
2	Power interface	Refer to Section 4.5.1 for details.
3	Communication interface	Refer to Section 4.5.2 for details.

4.2. Introduction of controller electrical interfaces

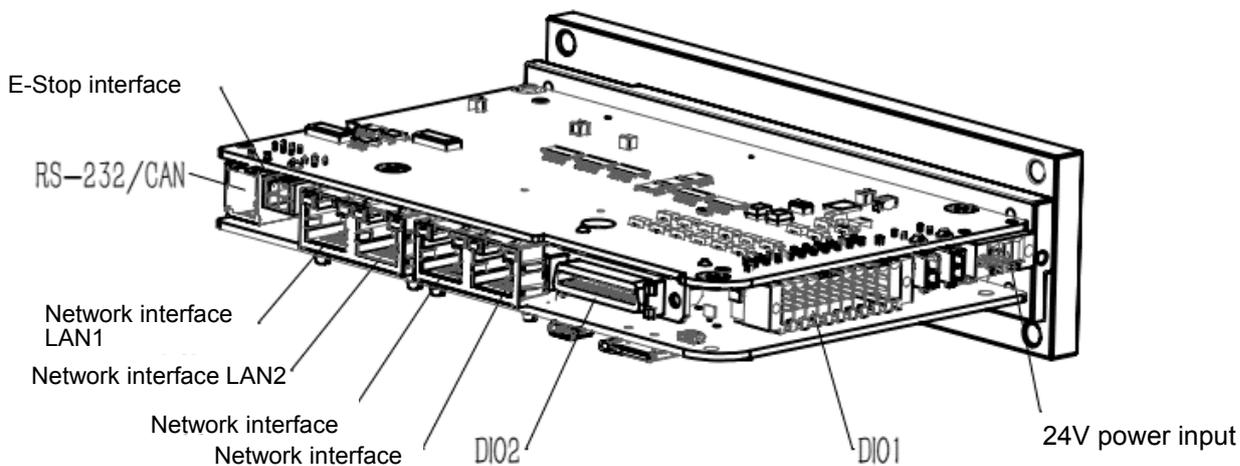


Figure 4-2 Schematic diagram of controller electrical interfaces

Table 4-2 Introduction of controller electrical interfaces

SN	Name	Description
1	24V d.c. power input	Connect to 24V d.c. power supply
2	DIO1	24V d.c. power output (for relay module and fan)
3	DIO2	Reserved port
4	Network interface LAN4	Connect to client IPC (TCP/IP)
5	Network interface LAN3	Reserved port
6	Network interface LAN2	Communicate with MS6MT Robot body (EtherCAT)
7	Network interface LAN1	Reserved port
8	E-Stop interface	Connect to emergency stop switch

9	RS-232/CAN	<p>CAN is used for communication between robot and controller</p> <p>Reserved RS-232 interface</p> <p>(RS-232 and CAN indicate different pins of the same connector)</p>
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4.3. Introduction of 48V Relay Module Interfaces

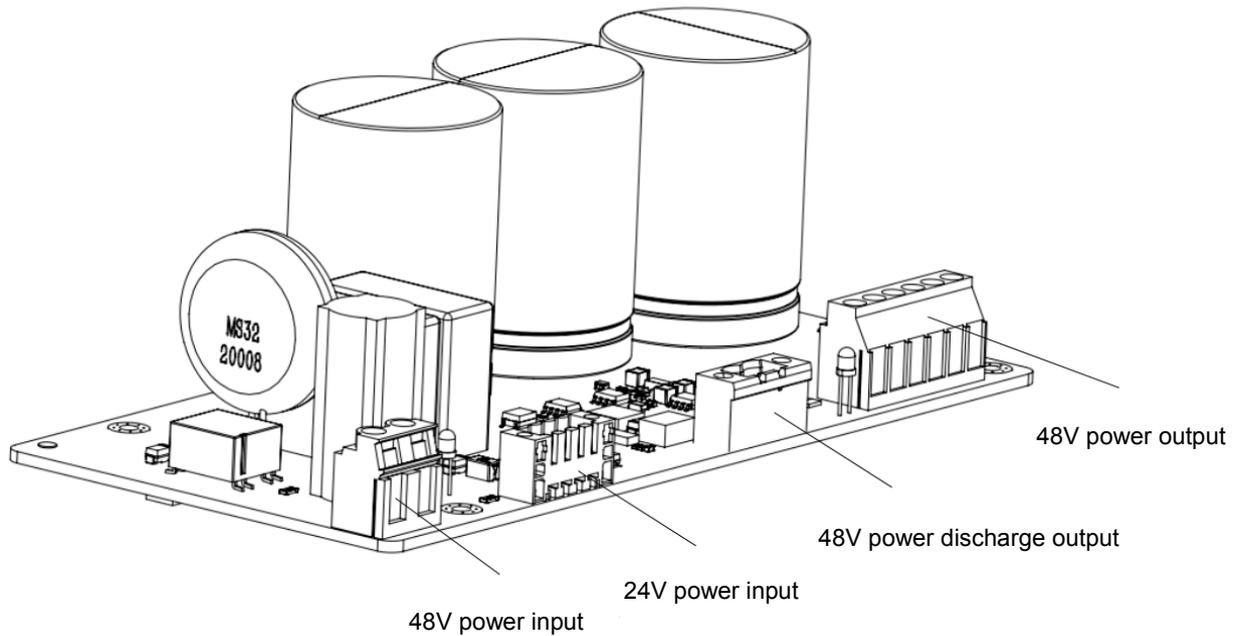


Figure 4-3 Diagram of 48V relay module electrical interfaces

Table 4-3 Introduction of 48V relay module electrical interfaces

SN	Name	Description
1	48V d.c. power input	<p>Robot power source input</p> <p>(To ensure the normal operation of the robot, the input voltage error of the power source shall be within $\pm 0.5V$.)</p>
2	24V d.c. power input	<p>Power input of control circuits, connected to enable signal (POWER-ON) and feedback signal (PWR-FBK).</p>
3	48Vd.c. power discharge output	<p>48V d.c. power output to discharge resistor</p>

4	48V d.c. power output	48V d.c. power output to robot
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4.4. Schematic diagram of electrical connection

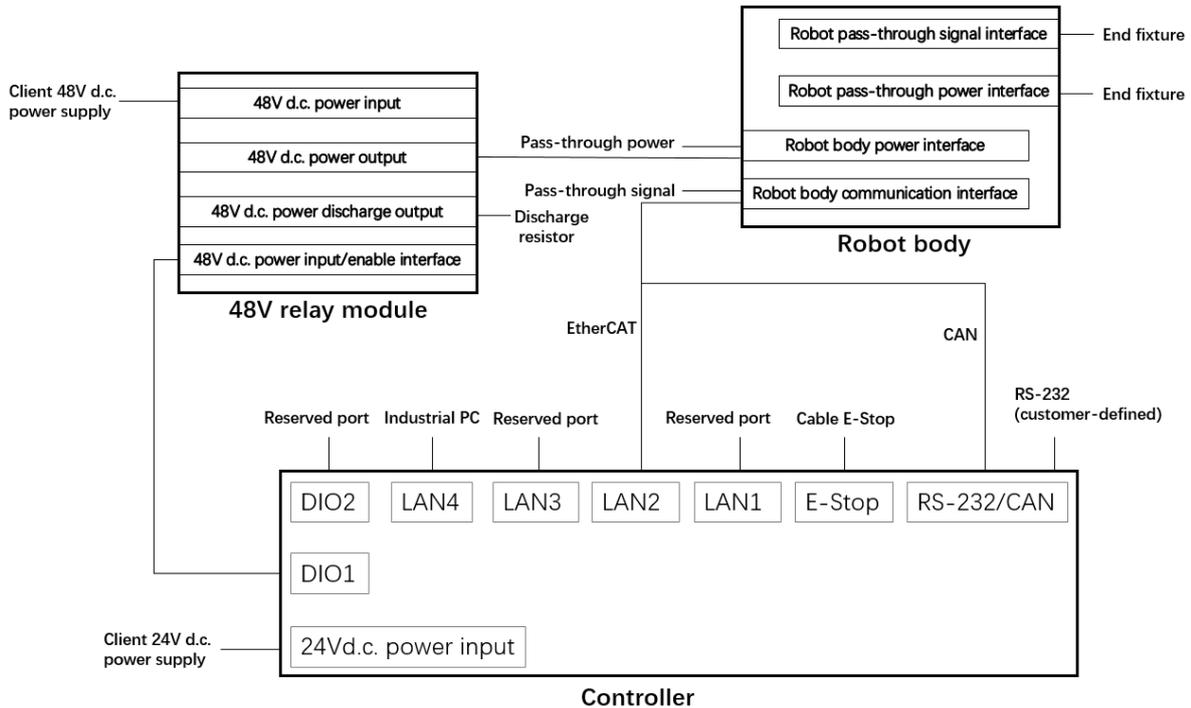


Figure 4-4 Schematic diagram of electrical connection



The control cabinet is to be provided by customer, to connect the 48V relay module, robot controller and discharge resistor according to the schematic diagram of electrical connection.

4.5. Functions of interface pins

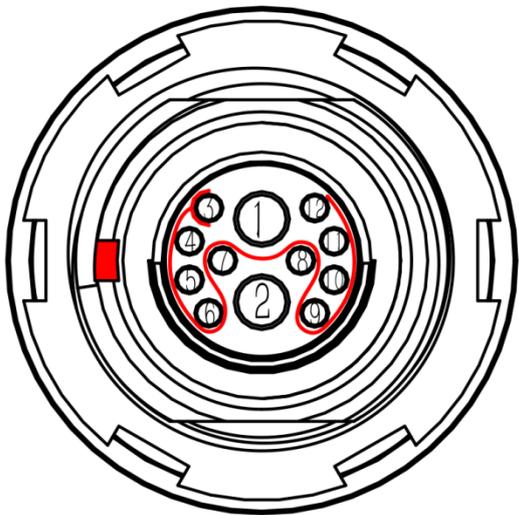
4.5.1. End pass-through cable interface



The end pass-through cable interface is directly connected with 10 pins in the body communication interface on the base panel and 2 pins in the body power interface. The functions of the pins in this part are defined by customer.

The model of the aviation plug connected to the end pass-through cable interface is `_ZLN.1031F.812.CLLW` (Yunyi).

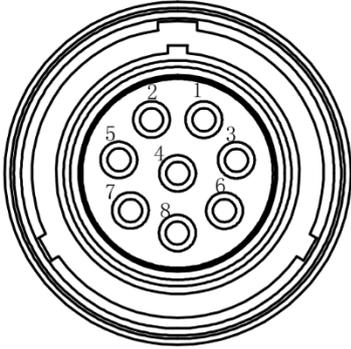
Table 4-4 Description of pins in the end pass-through cable interface

Pin	Function	Description	End pass-through cable interface
1	<i>Pass-through power +</i>	Self-defined	 <p>2 + 10-pin female interface (The twisted pairs for pass-through signal are as follows: 1&2, 3&4, 5&6, 7&8, 9&10; Connected to Yunyi 90° elbow aviation plug _TWN.1031F.812.CLAD82)</p>
2	Pass-through power -	Self-defined	
3	Pass-through signal 1	Self-defined	
4	Pass-through signal 2	Self-defined	
5	Pass-through signal 3	Self-defined	
6	Pass-through signal 4	Self-defined	
7	Pass-through signal 5	Self-defined	
8	Pass-through signal 6	Self-defined	
9	Pass-through signal 7	Self-defined	
10	Pass-through signal 8	Self-defined	
11	Pass-through signal 9	Self-defined	

12	Pass-through signal 10	Self-defined	
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4.5.2. Body power interface (POWER)

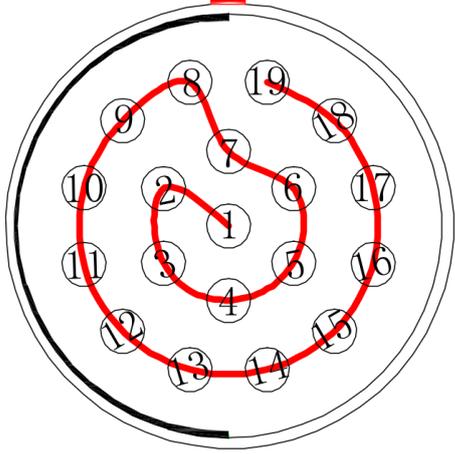
Table 4-5 Definition of body power interface pins

Cable definition	Pin	Function	Description	Power interface
Axis J1	1	+48V d.c input	48V input power	 <p>8-pin male interface (Connected to Weipu 90° elbow aviation plug_SF2024-S8)</p>
	2	GND	Common ground	
Axis J2	3	+48V d.c input	48V input power	
	4	GND	Common ground	
Axis J3	5	+48V d.c input	48V input power	
	6	GND	Common ground	
Pass-through power cable	7	Pass-through power +	Self-defined	
	8	Pass-through power -	Self-defined	

4.5.3. Communication interface

Table 4-6 Definition of body communication interface pins

Definition of body communication interface pins		
Pin	Function	Description
01	/	/
02	Pass-through signal #1	Self-defined
03	Pass-through signal #2	Self-defined
04	Pass-through signal #3	Self-defined

05	Pass-through signal #4	Self-defined	
06	Pass-through signal #5	Self-defined	
07	Pass-through signal #6	Self-defined	
08	Pass-through signal #7	Self-defined	
09	Pass-through signal #8	Self-defined	
10	Pass-through signal #9	Self-defined	
11	Pass-through signal #10	Self-defined	
12	/	/	
13	CAN-H	CAN interface +	
14	CAN-L	CAN interface +	
15	CAN-GND	CAN interface -	
16	TX+	Transmit data	19-pin female interface
17	TX-	Transmit data	(Connected to Yunyi aviation plug_
18	RX+	Receive data	TWN.1031F.319.CLAD65
19	RX-	Receive data	

4.5.4.48V power input and output of 48V relay module

Table 4-7 Definition of 48v d.c. power input pins

Pin	Function	Description	48 V d.c. power interface
1	Input +48V d.c.	Power input +	

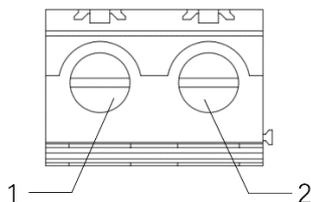
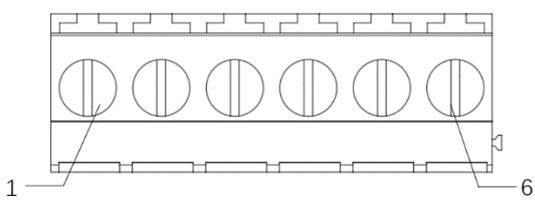
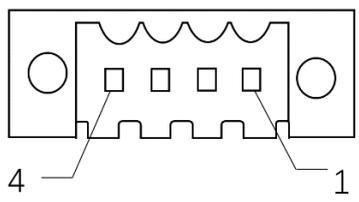
2	GND	Power input -	 <p>2-pin terminal block (Connected to Weidmuller connector_1594460000) (Tube terminal_E1508)</p>
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Table 4-8 Definition of 48V d.c. power output pins

Pin	Function	Description	48 V d.c. power interface
1	Output +48V d.c.	Power output +	 <p>6-pin terminal block (Connected to Weidmuller connector_1001870000) (Tube terminal_E1508)</p>
2	Output +48V d.c.	Power output +	
3	Output +48V d.c.	Power output +	
4	GND	Power output -	
5	GND	Power output -	
6	GND	Power output -	

4.5.5.24V power input interface of 48V relay module

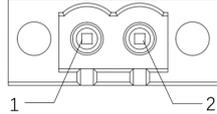
Table 4-1 Definition of 24V d.c. power interface pins

Pin	Function	Description	24 V d.c. power interface
1	PWR_FBK	Enable feedback signal	
2	Power on	Body power enable signal	

3	Input +24V d.c.	Power input +	4-pin male interface (Connected to Weidmuller connector_1615800000) (Tube terminal_E0508)
4	GND	Power input -	

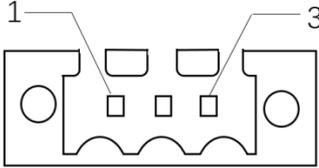
4.5.6.48V power discharge output interface of 48V relay module

Table 4-9 Definition of 48V d.c. power discharge output interface pins

Pin	Function	Description	48V d.c. power interface
1	Input +48V d.c.	Power discharge output +	 2-pin male interface (Connected to TE connector_796859-2) (Tube terminal_E1508)
2	GND	Power discharge output -	

4.5.7.Controller 24V power input interface

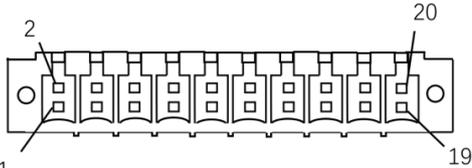
Table 4-10 Definition of 24V d.c. power interface pins

Pin	Function	Description	24 V d.c. power interface
1	PE.	Grounded input	 3-pin male interface (Connected to Weidmuller connector_1615790000) (Tube terminal_E7508)
2	GND	Power input -	
3	Input +24V d.c.	Power input +	

4.5.8.Controller digital input/output interface DIO1

Table 4-11 Definition of controller DIO1 pins

Definition of controller DIO1 pins			
Pin	Function	Description	
01	Output +24 V d.c.	Supply power for relay module	

02	Output +24V d.c.	Supply power for fan	 <p style="text-align: center;">20-pin interface (Connected to Weidmuller connector_1278310000) (Tube terminal_E0512)</p>
03	E-D0-1	Controller indicator (no external connection)	
04	E-D0-2	Controller indicator (no external connection)	
05	E-D0-3	Reserved	
06	E-D0-4	Reserved	
07	GND	Connect to relay module GND	
08	GND	Connect to exhaust fan GND	
09	E-DI-1	Exhaust fan signal	
10	E-DI-2	Enable feedback signal	
11	E-DI-3	Reserved for MCP	
12	E-DI-4	Reserved for MCP	
13	GND	Reserved	
14	Power on	Servo enable signal	
15	GND	Connect to inlet fan-1 GND	
16	GND	Connect to inlet fan-2 GND	
17	HDI-1	Inlet fan-1 signal	
18	HDI-2	Inlet fan-2 signal	
19	HDI-3	Reserved	
20	HDI-4	Reserved	

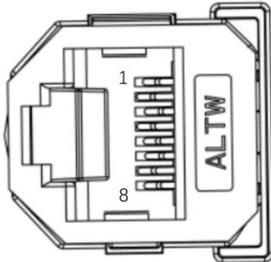
4.5.9. Controller digital input/output interface DIO2



The controller digital input/output interface DIO2 is reserved for MS6MT Robot. For the definition of related interface pins, please refer to the introduction of the controller interfaces.

4.5.10. Controller Ethernet interface (LAN)

Table 4-12 Definition of LAN interface pins

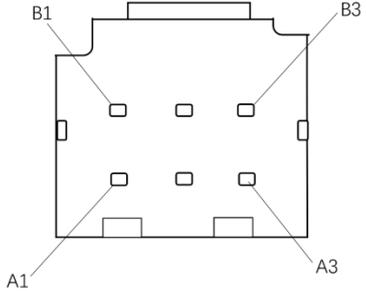
LAN interface			
Pin	Signal name	Description	 <p>8-pin front interface (Connected to connector: registered jack_RJ45)</p>
01	TX_D1+	Transmit data	
02	TX_D1-	Transmit data -	
03	RX_D2+	Receive data +	
04	BI_D3+	Two-way data	
05	BI_D3-	Two-way data	
06	RX_D2-	Receive data -	
07	BI_D4+	Two-way data	
08	BI_D4-	Two-way data	

4.5.11. Controller communication interface (RS-232/CAN)

The definition of RS-232 interface pins and signal distribution are shown in Table 4-13.

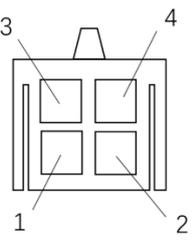
Table 4-13 Definition of RS-232/CAN interface pins

Definition of RS-232/CAN interface pins			
Pin	Function	Description	
A1	RXD	Receive data (RS-232)	
A2	TXD	Transmit data (RS-232)	

A3	GND	RS-232 ground terminal	 <p>6-pin interface (Connected to TE connector_1-1827864-3) (Terminal_1827570-2 TE)</p>
B1	CAN-H	CAN interface +	
B2	CAN-L	CAN interface +	
B3	CAN-GND	CAN interface -	

4.5.12.Controller E-Stop interface

Table 4-14 Definition of E-Stop pins

Definition of E-Stop pins		 <p>4-pin socket (Connected to TE connector_794617-4) (Terminal_1827570-2 TE)</p>
Pin	Function	
01	E-Stop -0	
02	GND	
03	E-Stop -2	
04	GND	

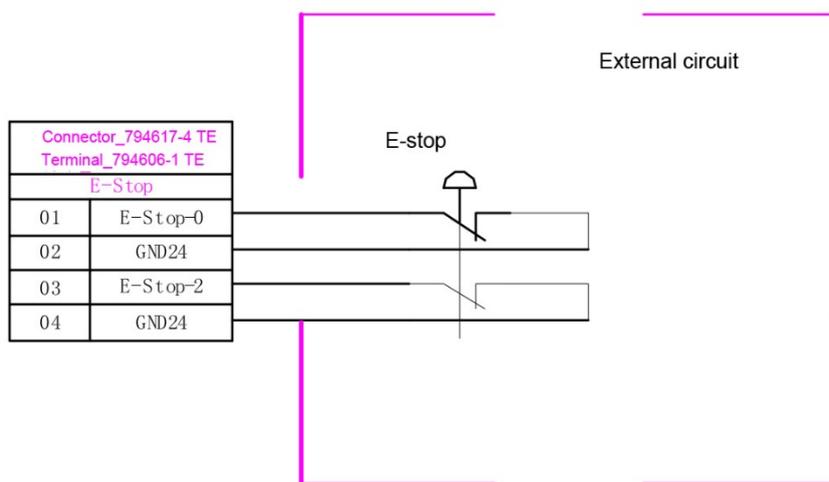


Figure 4-5 MCP aviation plug cabling diagram



NOTE

- Comm-E JP52 E-stop socket needs to be connected to double-circuit normally closed contacts.
 - The client can short connect one of the normally closed circuits and connect the other to the normally closed contacts for use according to the needs.
 - Comm-E supports both two external E-Stop input interfaces and switch access mode (i.e. a switch or NPN/NMOS semiconductor switch is connected between E-Stop and gnd24 before work).
-

Chapter 5 Product Installation

The installation of the robot is critical to its function. Special attention should be paid to the fixing of the base and the foundation needs to be able to withstand the impact load generated from the acceleration of the robot. Install this robot according to the following requirements.



MS6MT Robot weighs 21 kg, so its disassembly and handling must be carried out in strict accordance with the requirements to avoid personal and equipment losses.

5.1. Installation requirements

Users should design and produce the rack for fixing the robot by themselves. The shape and size of the rack may vary depending on the purpose of the robot system.

The rack must withstand the weight of the robot and the dynamic force produced when the robot acts at the maximum acceleration. More crosspieces should be installed to provide sufficient strength. The requirements for installing the rack are as follows.

- The base of the robot is perpendicular to the installation surface.
- Fix the rack externally (on the ground) and ensure that it will not move.
- The mechanical arms are installed through M8 threaded holes on the rack; when installing the mechanical arms, use bolts with a strength equivalent to ISO 898-1-2013 Property class 12.9.



- The poor accuracy of the installation surface would degrade the positioning accuracy of the robot.
 - If the stiffness or stability of the rack is insufficient, or sheet metal is mounted on the rack, the robot would vibrate (resonate) during operation, which may adversely affect the operation.
 - When the robot is powered on for the first time, check the rotation angle of the fourth axis. Return to zero before
-

installing the tool to prevent the fourth axis from exceeding the soft limit position after power-on.

Install the robot base through the four mounting holes, as shown in Figure 5-1. When installing the robot, use M8 hexagon socket head bolts, spring washers and M8 flat washers to fix the robot base. For the installation method, please refer to Section 5.5.

Reserve at least 65 mm space on the side of the robot base for plugging and unplugging power aviation plug cables.

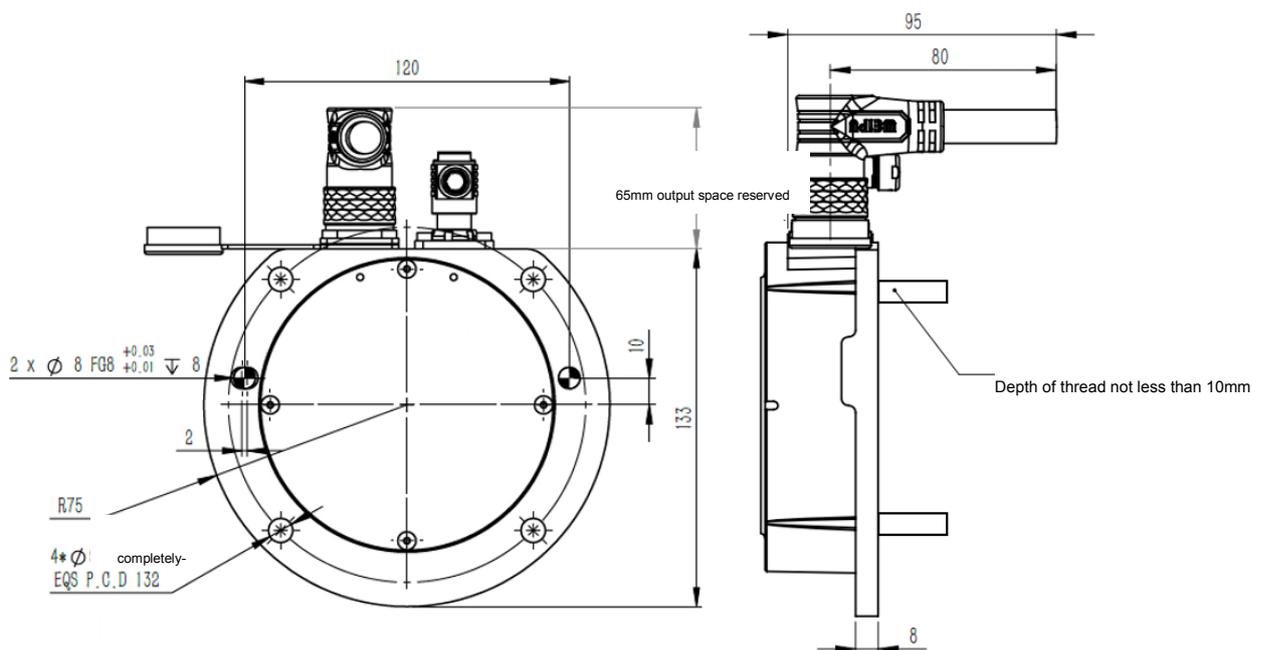


Figure 5-1 Base dimensions

5.2. Product confirmation

After unpacking, confirm the product components and status according to the packing list.

The standard packing list should contain:

- MS6MT Robot body + controller + 48V relay module + discharge resistor
- Accessory box

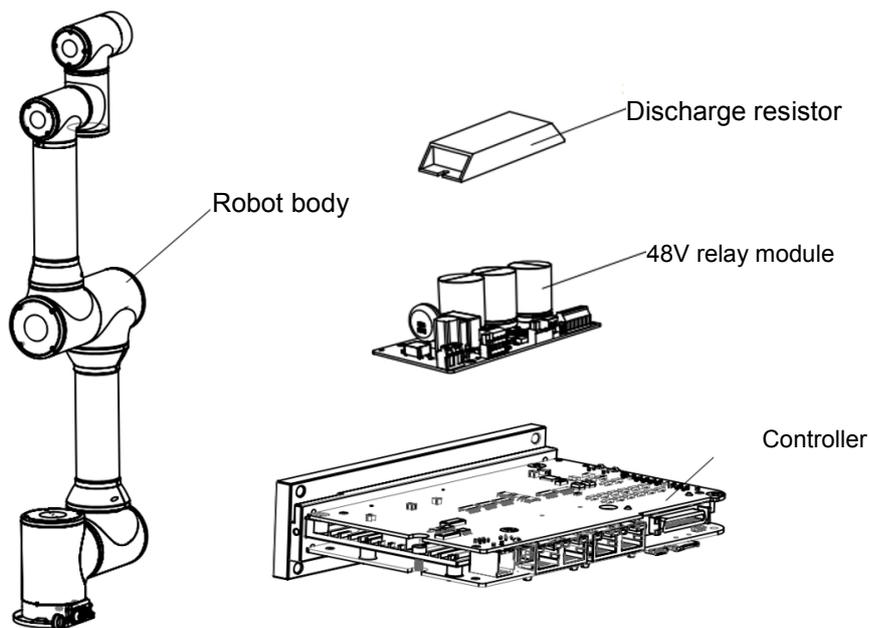


Figure 5-2 Robot

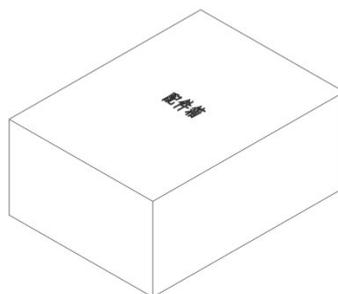


Figure 5-3 Accessory box



If damage or component missing is found after unpacking, please contact the Customer Service Center. For details of the materials, refer to the packing list.

5.3. Installation site and environment

The installation of MS6MT Robot shall meet the following conditions.

Environmental conditions:

- The place should be dry, with low humidity. $\leq 95\%$ relative humidity, non-condensing.
- Free from strong impact and vibration during operation.
- The robot must be installed away from flammable or corrosive liquids or gases.

5.4. Product handling

The robot must be installed and operated by qualified personnel. Follow the following requirements to handle the robot;



- The robot must be handled with forklift by professionals. Serious injuries or damage would be caused if the operation is performed by non-professionals.
 - The robot must be held by at least one person with hands when handling it with a forklift since the robot body is heavy.
-

The handling method with a forklift is as shown in Figure 5-4.

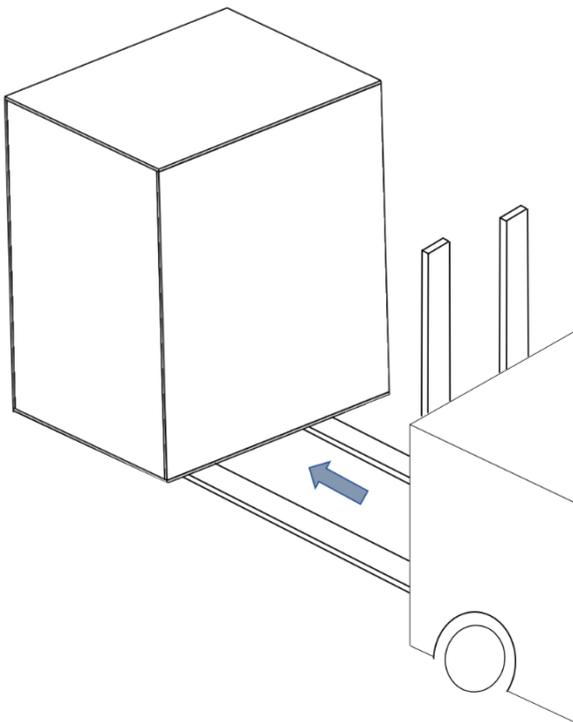


Figure 5-4 Handling Method

Disassemble the outer cover of packing box, then remove it upwards and store it properly for packing and moving the robot in the future.



- Prevent the packing box from tilting or moving during the handling.
 - Do not lift the packing box too high, and avoid excessive vibration and impact when handling.
-

When moving the robot from the packing box to the installation site, two professionals are required to lift and hold the robot until all the mounting screws are fixed on the robot base.

5.5. Installation mode

MS6MT Robot can be installed in an upright or upside-down manner or on a wall. When moving the robot from the packing box to the installation site, two professionals are required to lift and hold the robot until all the mounting screws are fixed on the robot base. The installation diagram is shown in FIGURE 55-.



- Ensure that related parts of the body of professionals do not carry excessive loads when handling. If handling equipment is used, be sure to strictly follow the relevant operating instructions.
- To install the robot on the wall or upside down, two professionals are required to work together to lift the robot and hold it until all the mounting screws are fixed on the robot base.
- To install the robot upside down, the user needs to design and install an anti-fall device to prevent the robot from falling.

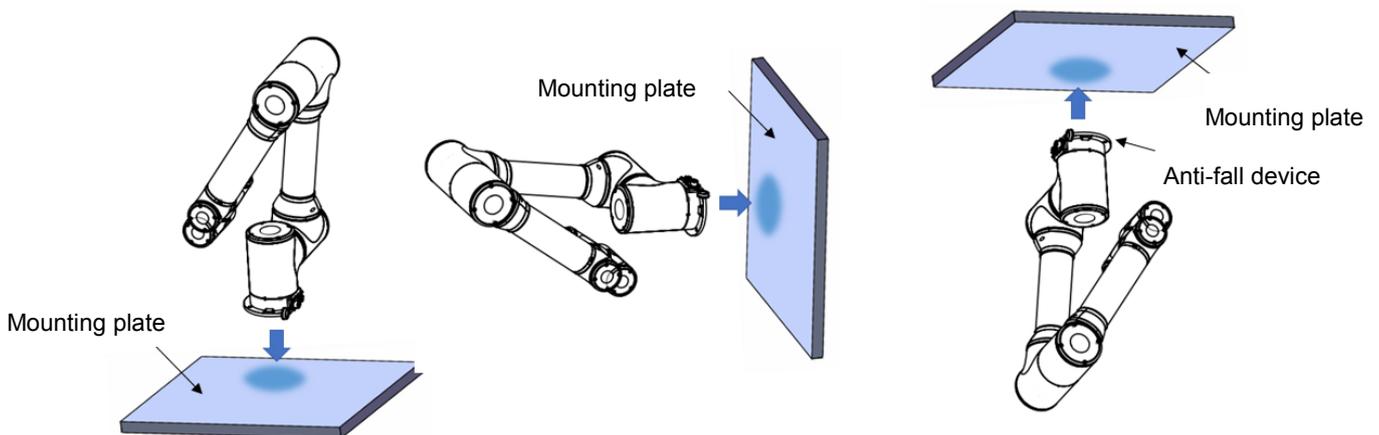


Figure 5-5 Installation diagram

The installation steps are as follows:

Step 1 Refer to Section 2.2.2 Base Dimensions to prepare a mounting rack or plate.

Step 2 Move the robot to the installation site by forklift according to Section 5.4 Product handling.

Step 3 Two or more professionals are required to lift the robot, fix the robot base through the mounting holes on the mounting plate, and install the robot with Allen wrench according to the installation mode.



- Two or more professionals are required to install the robot base. During the installation, be sure to hold the mechanical arms to avoid damage or pinching of hands or feet due to the tilt of the mechanical arms.
 - Fix the robot onto the bottom plate or rack with specified number of bolts meeting the requirement of tightening torque. The robot would tilt if failing to observe the rules.
 - Fix the robot before powering on or operating it. Failure to do so may result in serious injury or major damage to the robot due to rollover.
-

5.6. Installation of robot cable

- The wiring should be carried out by designated operators or qualified personnel. Wiring conducted by personnel without relevant knowledge may cause injury or malfunction.
- Install and replace wires and cables after turning off the power and unplugging the power plug.
- Plugging and unplugging cable connectors while the power is on may cause malfunction or electric shock.
- The bending or breaking of cable connector pins and cable damage may cause anomalies when connecting to the robot. Check whether the above situation exists before connecting.
- Do not interfere with the work area of the robot when wiring the robot. The area where the robot cable is located and load is applied at the front end of the robot are interference area. Do not regard it as the work area to avoid damage to the cable of the robot.
- Some cables are not provided. Users should prepare them as needed. For the interfaces of MS6MT Robot control cabinet, please refer to CHAPTER 4.

5.6.1. Installation of emergency stop switch cable

MS6MT Robot is equipped with an emergency stop switch without cable at delivery. Users should prepare emergency stop switch cable and components personally.

Preparation for operation: Emergency stop switch cables, emergency stop switch components

The wiring steps are shown below.

Step 1 Users should prepare emergency stop switch components and cables, and connect the cables to the E-Stop interface of the controller. The interface position is shown in the figure.

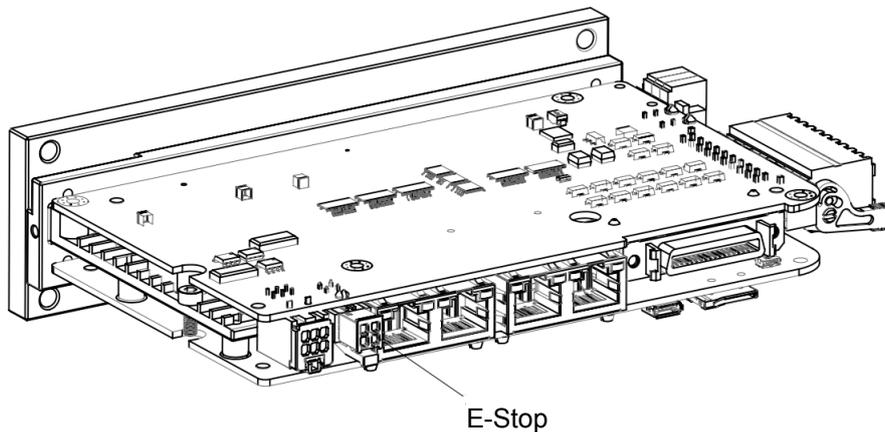


Figure 5-6 E-Stop interface of controller

Step 2 The emergency stop switch box should be placed in a position convenient for easy operation by users.

- For details on the interfaces of MS6MT Robot control cabinet, please refer to CHAPTER 4.
- The emergency stop device needs to be installed before the robot is normally servoed on. If the robot can not be servoed on, check whether the emergency stop switch is installed.



5.6.2. Installation of communication cable

The MS6MT Robot body is connected to the controller through signal cables, and the controller is connected to the IPC through the Ethernet to achieve communication.

Cable: communication

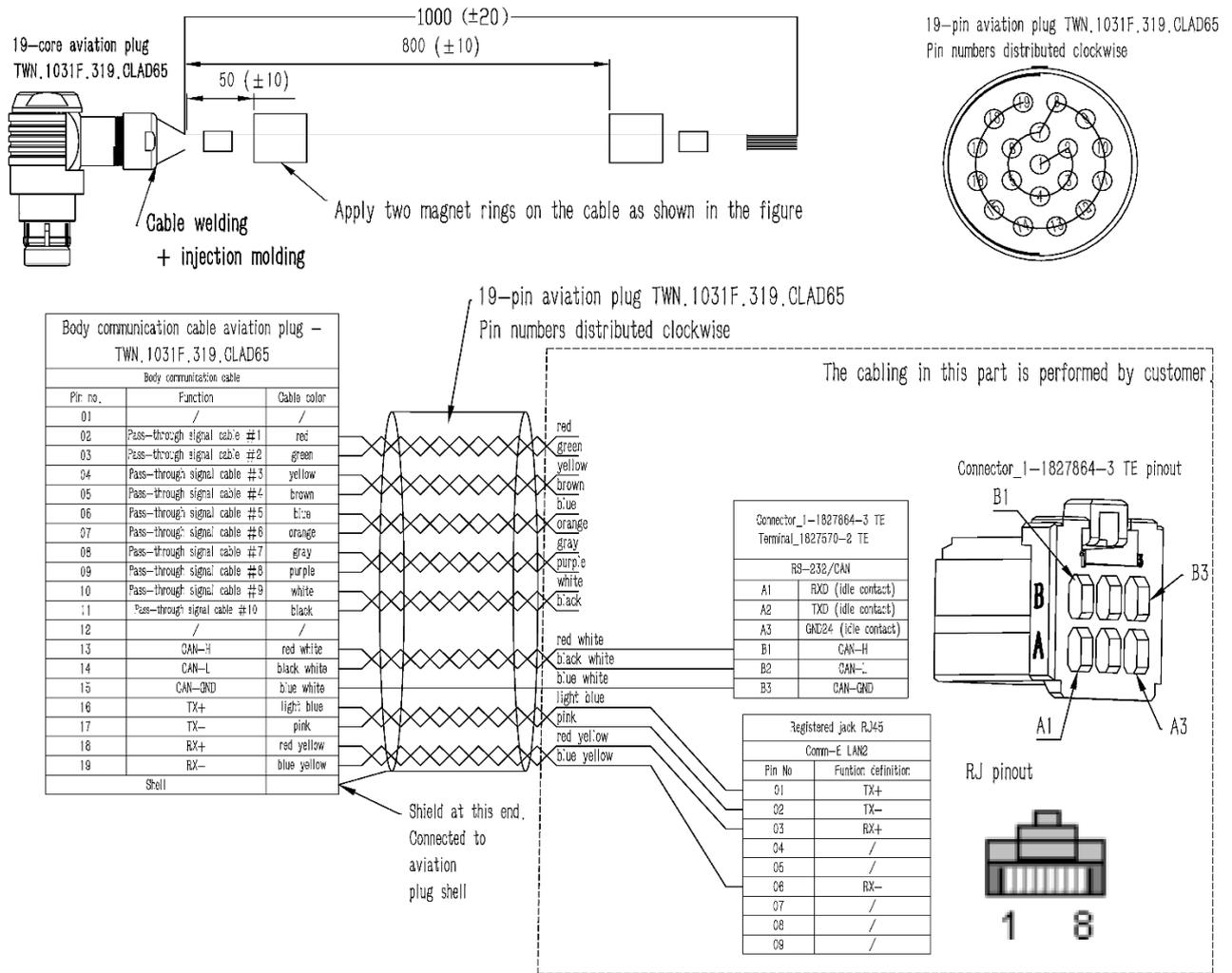


Figure 5-7 Body communication cabling diagram

The wiring steps are shown below.

- Step 1** Take the "communication cable" out of the accessory box, and process one of its ends that is connected to the electric control cabinet as needed on site.
- Step 2** Insert one end of the "communication cable" aviation plug into the communication interface on the robot. The aviation plug is quick-plug type. To connect the aviation plug, align the red point on the aviation plug shell with that on the aviation socket of the communication interface. Hold the aviation plug and insert it to the end until a "click" sound is heard from the metal shrapnel, which indicates that it has been inserted in place, as shown in Figure 5-8.

Note: To unplug the communication cable, hold the metal ring at the front end of the aviation plug and pull back to one end of the cable to unplug the aviation plug.



Figure 5-8 Communication cable plugging diagram

Step 3 Plug the other end of "EtherCAT" into the "LAN2" interface of the robot controller, and the "CAN" into the "RS-232/CAN" interface of the robot controller, as shown in Figure 5-9.

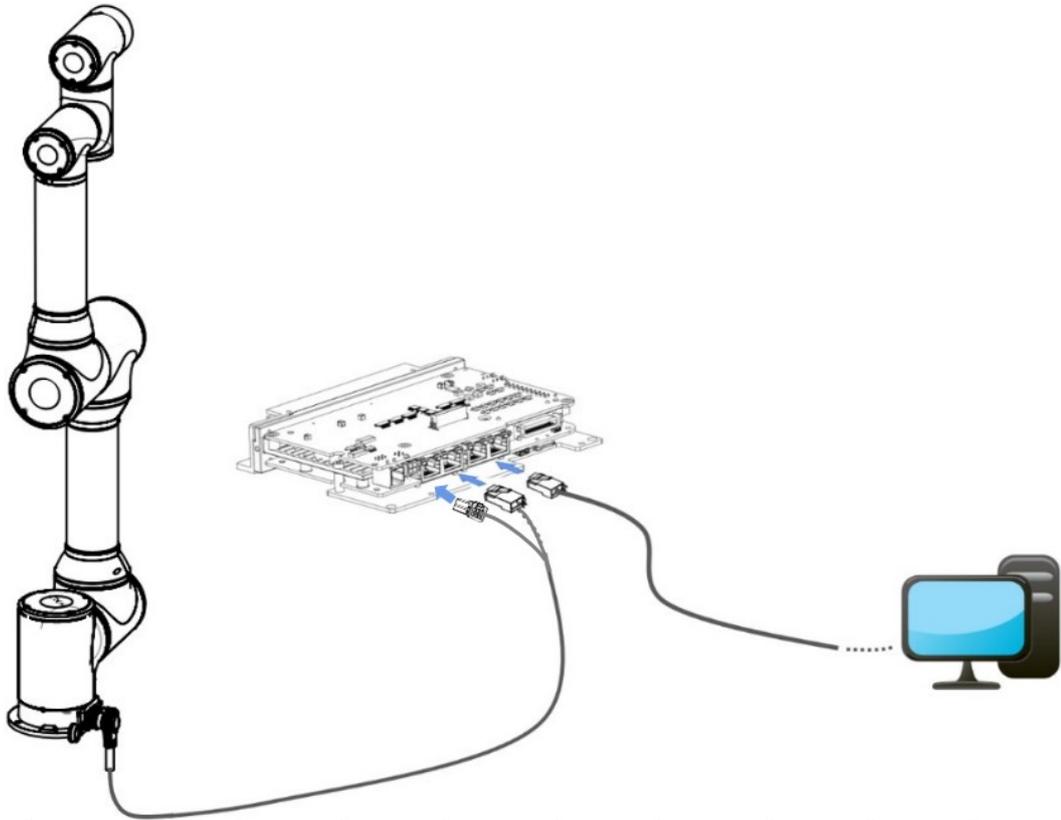


Figure 5-9 Communication cable installation diagram

Step 4 Prepare another network cable, connect one end of the network cable to the LAN4 interface of the controller, and the other end to the network interface of the PC or IPC, as shown in Figure 5-9.



NOTE

For details on the interfaces of MS6MT Robot control cabinet, please refer to Chapter 4.

5.6.3. Installation of power cable

The MS6MT Robot body comprises a 48V power interface, through which power is supplied by the equipment that works together when cabling.

Cable: Power cable

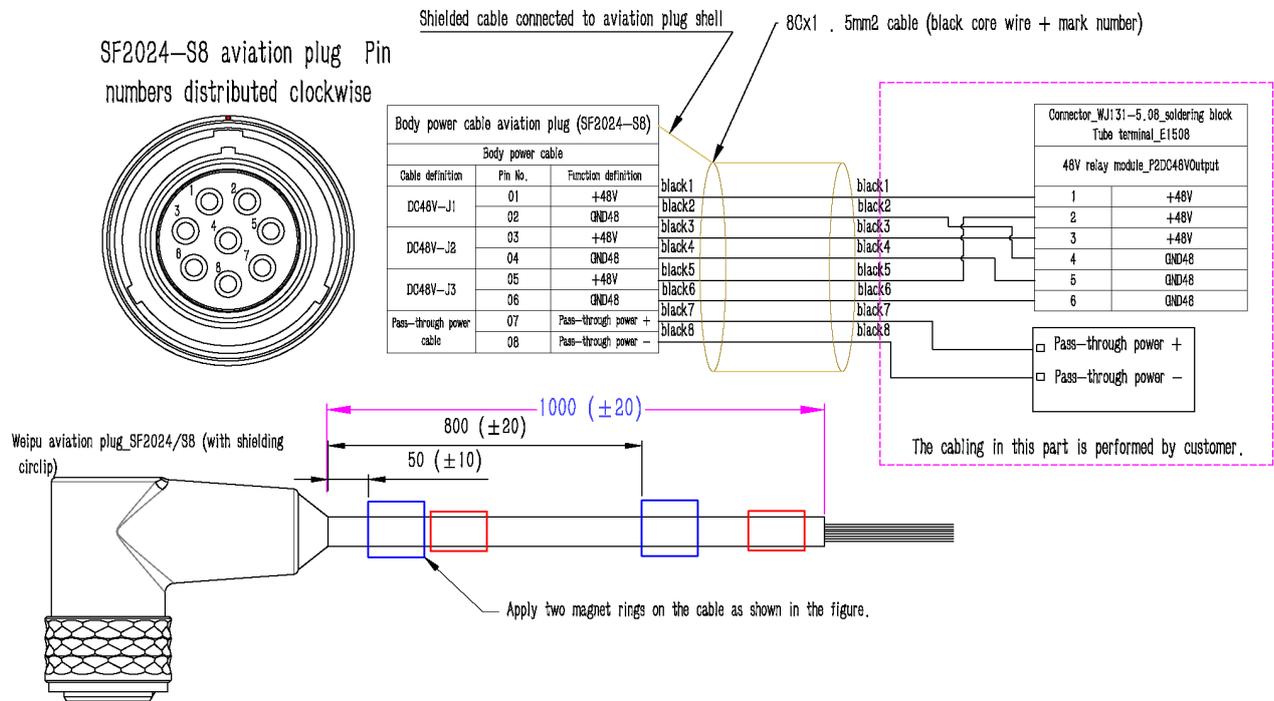


Figure 5-10 Power supply cabling diagram

The wiring steps are shown below.

Step 1 Take the "power cable" out of the accessory box, and process one of its ends that is connected to the electric control cabinet as needed on site.

Step 2 Insert one end of the "power cable" aviation plug into the 48V d.c. power interface of the robot body. The aviation plug is quick-plug type. To connect the aviation plug, align the red point on the aviation plug shell with that on the aviation socket of the 48V d.c. power interface. Hold the aviation plug and insert it to the end until a "click" sound is heard from the metal shrapnel, which indicates that it has been inserted in place. The proper insertion of the aviation plug is shown in Figure 5-11.

Step 3 Insert the other end of the power cable into the 48V d.c. output interface of the control cabinet, as shown in Figure 5-12.

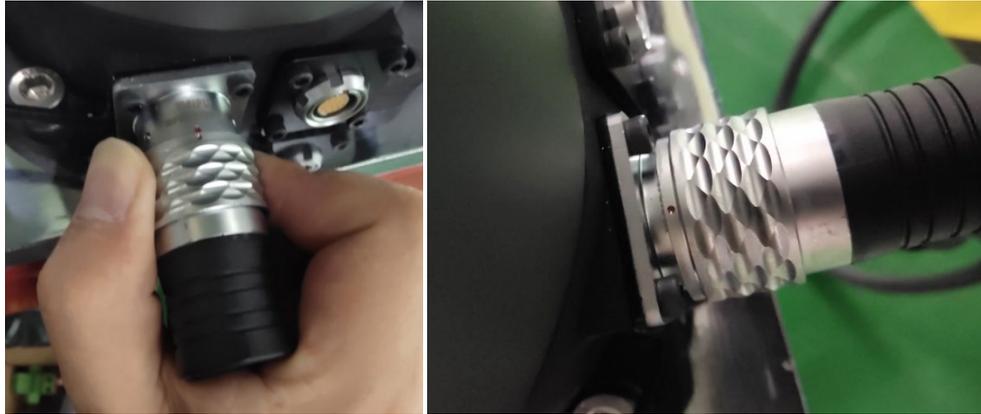


Figure 5-11 Power cable plugging diagram

Note: To unplug the power cable, hold the metal ring at the front end of the aviation plug and pull back to one end of the cable to unplug the aviation plug.



- It is dangerous to perform cable wiring while the robot is powered on. Before wiring, turn off the relevant equipment that provides power and mark with warning signs, e.g "Do not turn on the power".
- Avoid poor contact and ensure that the aviation plug is inserted properly without loosening.

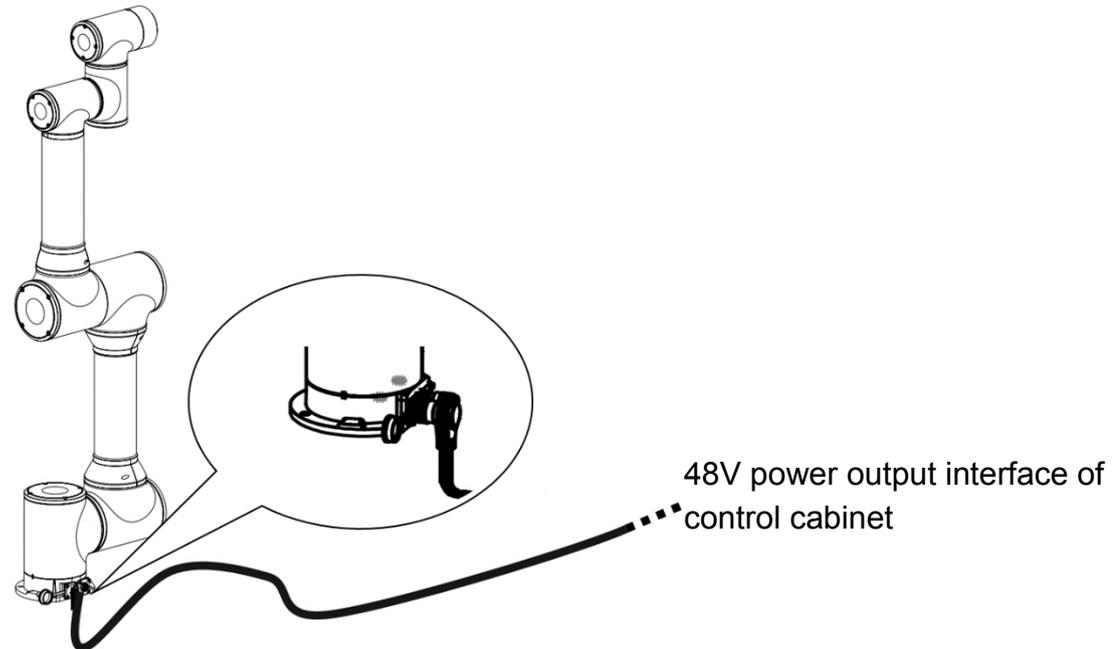


Figure 5-12 48V d.c. power connection diagram

5.6.4. Installation of end pass-through cable

A pass-through cable interface is arranged on the end flange of the MS6MT Robot body, which is customized by user and used to supply power for tool

equipment and transmit signals.

Cable: End pass-through cable

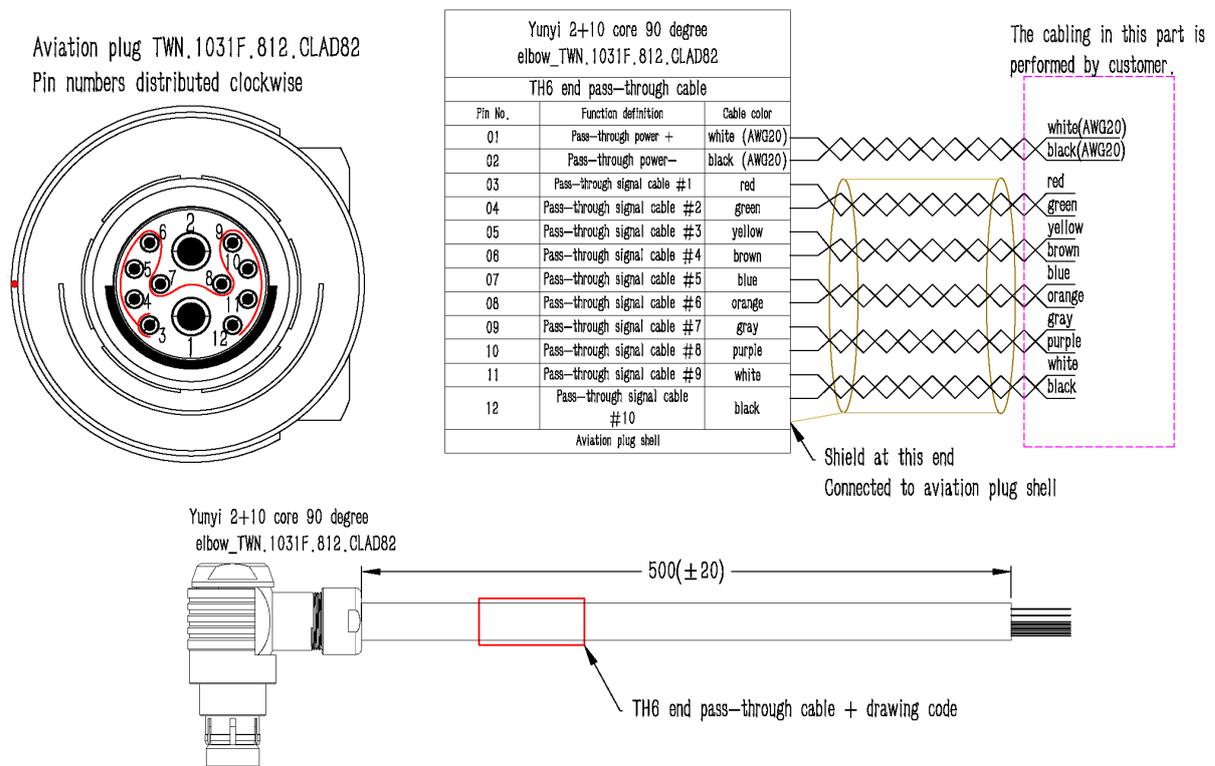


Figure 5-13 End pass-through cable cabling diagram

The wiring steps are shown below.

- Step 1** Take the "end pass-through cable" out of the accessory box, and process one of its ends that is connected to the end tool circuit board as needed on site.
- Step 2** Insert one end of the "end pass-through cable" aviation plug into the "end pass-through cable" interface of the end flange of the robot body. The aviation plug is quick-plug type. To connect the aviation plug, align the red point on the aviation plug shell with that on the aviation socket of the robot body. Hold the aviation plug and insert it to the end until a "click" sound is heard from the metal shrapnel, which indicates that it has been inserted in place. The proper insertion of the aviation plug is shown in Figure 5-14.
- Step 3** Plug the other end of the "end pass-through cable" into the corresponding interface according to the tool circuit board designed by customer.

Note: To unplug the aviation plug, hold the metal ring at the front end of the aviation plug and pull back to one end of the cable to unplug the aviation plug.



Figure 5-14 End pass-through cable cabling diagram

5.6.5. Check after installation

Users need to check whether the robot is in an operable state after installing the cables. The checks are as follows:

- Check whether the plugs at all cable interfaces are loose or not.
- Make sure that the robot is in a safe work space and nobody is within the movable range of the robot.

5.7. Robot movement and storage

Pay attention to the following points when moving, storing and transporting the robot.



Two professionals are required to work together to transport the robot to prevent it from rolling over and clamping hands or feet.

To reassemble the robot after long-term storage and reinstall its system for use, conduct a test run and then start normal operation after confirming that there is no abnormality.

Transport and store the robot according to the robot installation site and environmental requirements.

If fog forms in the robot during transportation and storage, eliminate the fogging before turning on the power.

Chapter 6 Robot Operation

AH6 Series Robot needs to be used in the ARM (Automation Resource Manager) programming environment. ARM is the software programming environment suitable for robots produced by QKM. Users can write programs based on the software and send instructions to control the robot. This chapter mainly introduces the prerequisites and installation of ARM, the functions and usage of macro language development interface, the functions of jog teach interface, servo power-on, speed adjustment, emergency stop and recovery, and robot power-off operation.

**NOTE**

If an error is reported during the use of the robot, refer to the "QKM Robot Error Code Manual" for information on the abnormality. Users can download the latest version of the manual at our official website.

6.1. Prerequisites

- 1) Familiar with macro instructions.

QKM macro instructions indicate the robot secondary development language independently developed and defined by QKM based on the QKM motion control system, which is called Macro instruction set. Macro instructions can be used to automatically execute defined commands and perform functions such as complex operations, string processing, interactions between users and projects, etc.

- 2) Familiar with the mode of motion of the robot.

6.2. Programming environment installation

**NOTE**

You can download QKMLink using the two methods as follows:

- Download the QKMLink installation package at the official website of QKM and install QKMLink.
 - The ARM installation package has integrated QKMLink,
-

so QKMLink will be installed automatically when ARM is installed.

In the application development of robots, the interactions of Windows with QKM robots or equipment system are required. QKMLink provides the interface for such interactions.

QKMLink is designed according to the QKM Protocol. The format of data from the interactions conforms to the protocol. Currently, QKMLink supports TCP communication and can be installed on Windows of different devices. Its interface supports C#, VB, C++ call and development.

QKMLink is an application software development component under Windows. Users use this component for software development to complete data interactions with Robot and other devices.

Requirements for download environment and memory:

- 1) Win7, Win8, Win10 systems;
- 2) Memory: 2G or more.

6.2.1. Installation steps

Step 1 Download an ARM installation package at the official website of QKM.

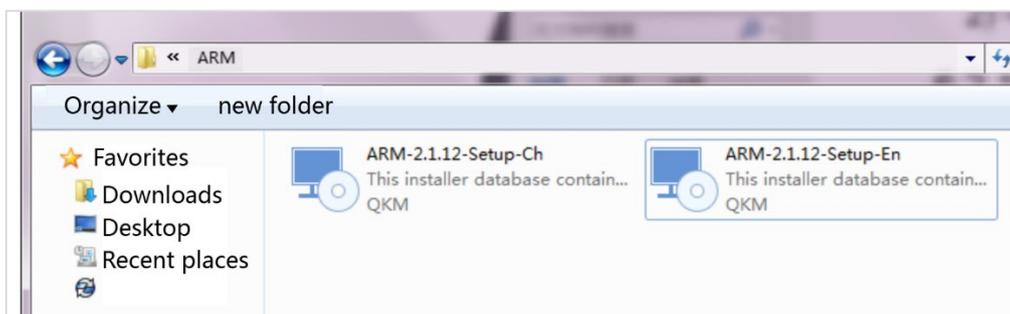


Figure 6-1 Installation package

Step 2 Double-click the left button to install the software.

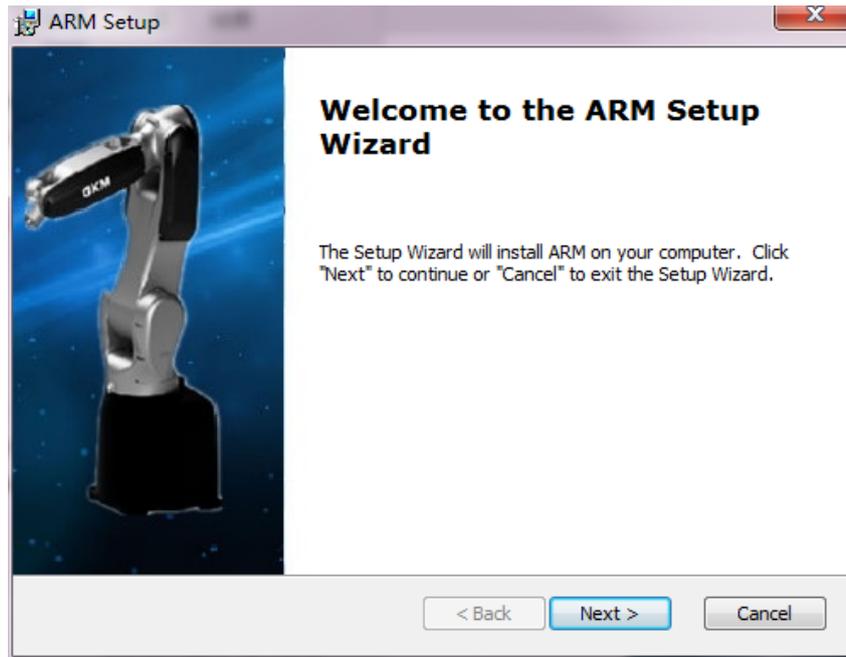


Figure 6-2 Start installation

Step 3 Click on "Next", as shown in Figure 6-3.

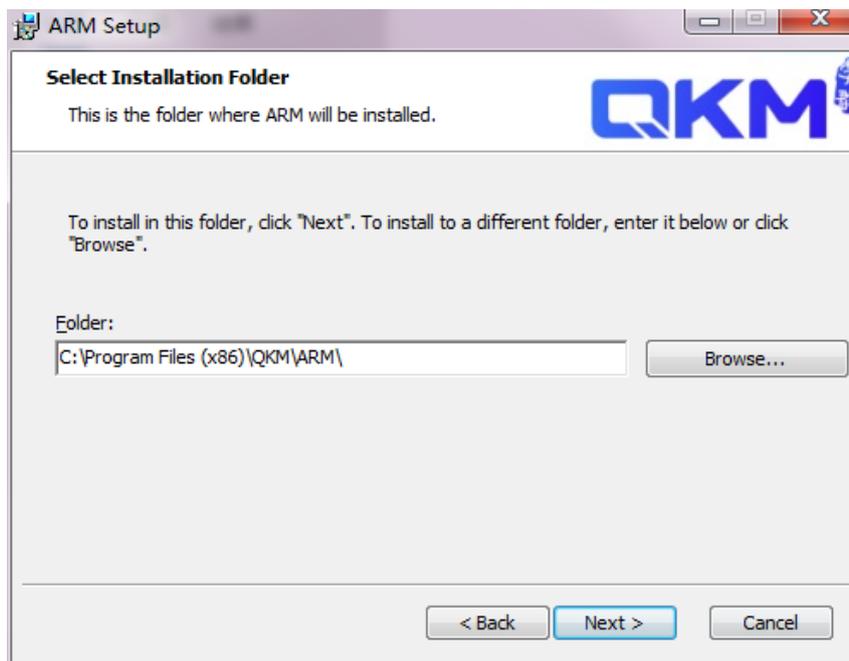


Figure 6-3 Choose installation path

Step 4 Choose the installation path and click on "Next".



Figure 6-4 Successful installation

Step 5 Click on "Install" to complete the installation.

6.3. Open macro language development interface

Step 1 Double-click the installed ARM to open the ARM interface, and then click <Mode> on the menu bar to switch to <Pallas> mode, as shown in Figure 6-5.

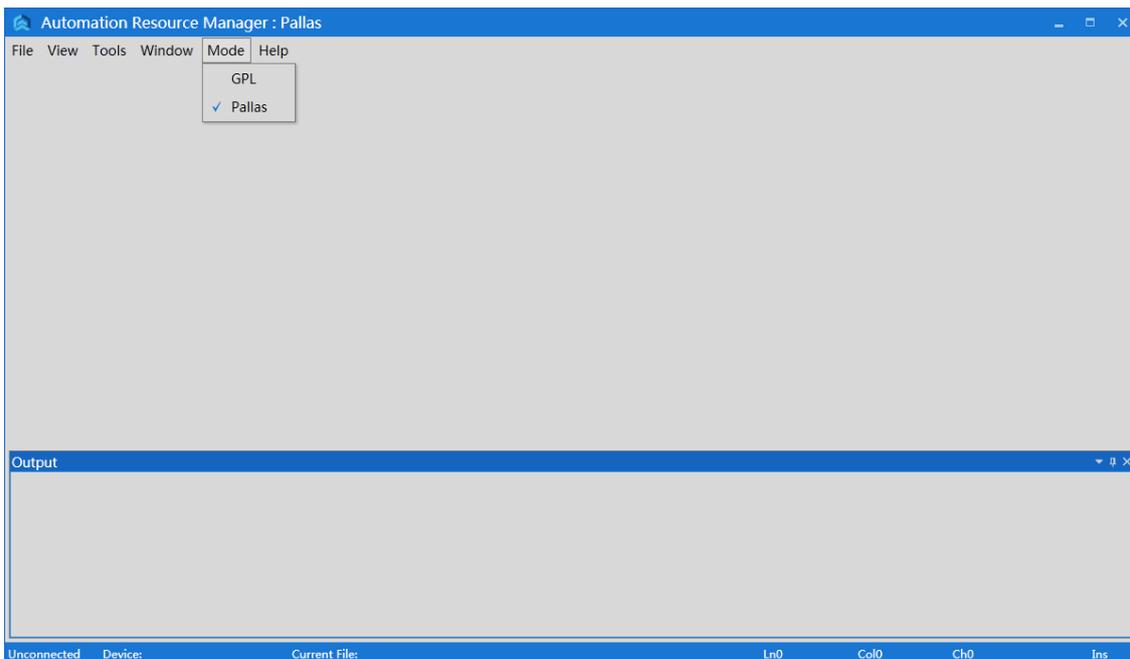


Figure 6-5 ARM interface

Step 2 On the interface of ARM in Pallas mode, click <Tools> on the menu bar and select <Macro language development interface>, as shown in Figure 6-6.

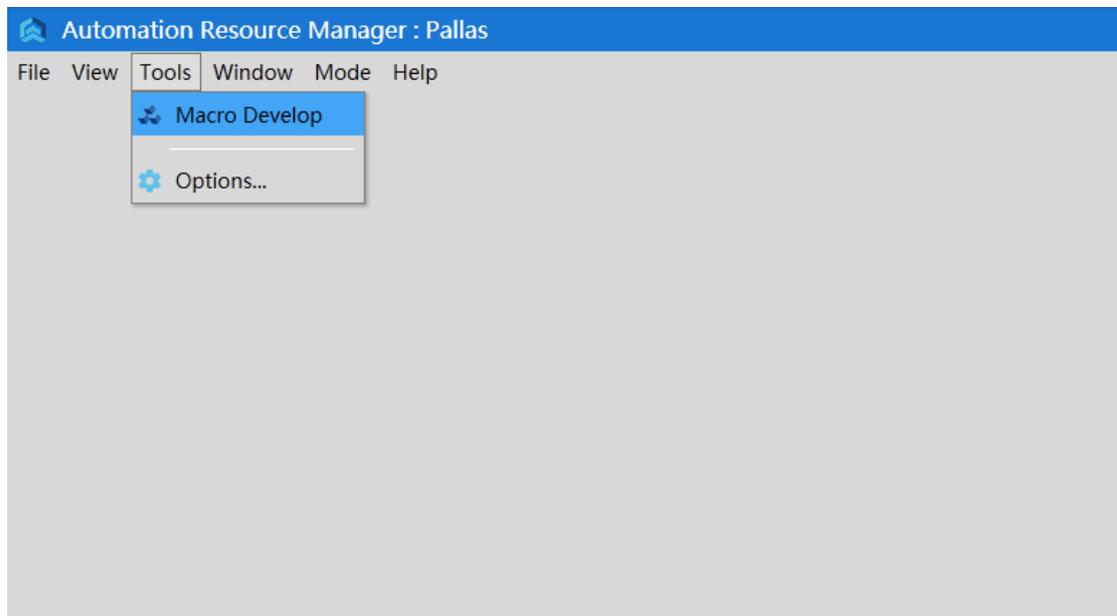


Figure 6-6 ARM interface

Step 3 The macro language development interface is shown in Figure 6-7

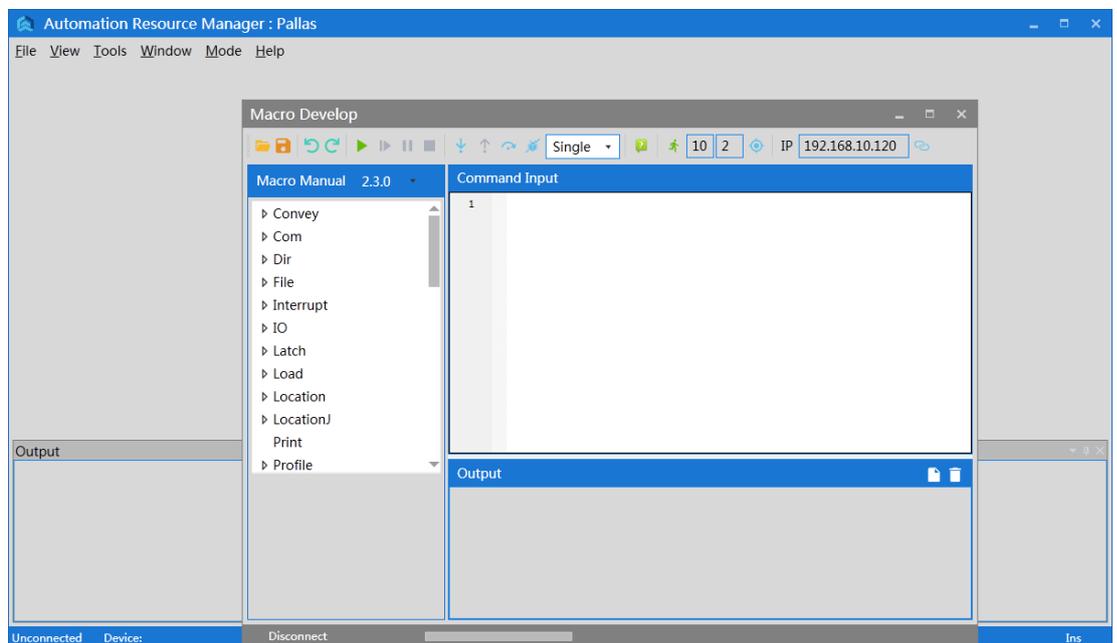


Figure 6-7 Macro language development interface

6.4. Functions of macro language development interface



NOTE

The macro language development interface is used in the installed ARM programming environment.

6.4.1. Interface

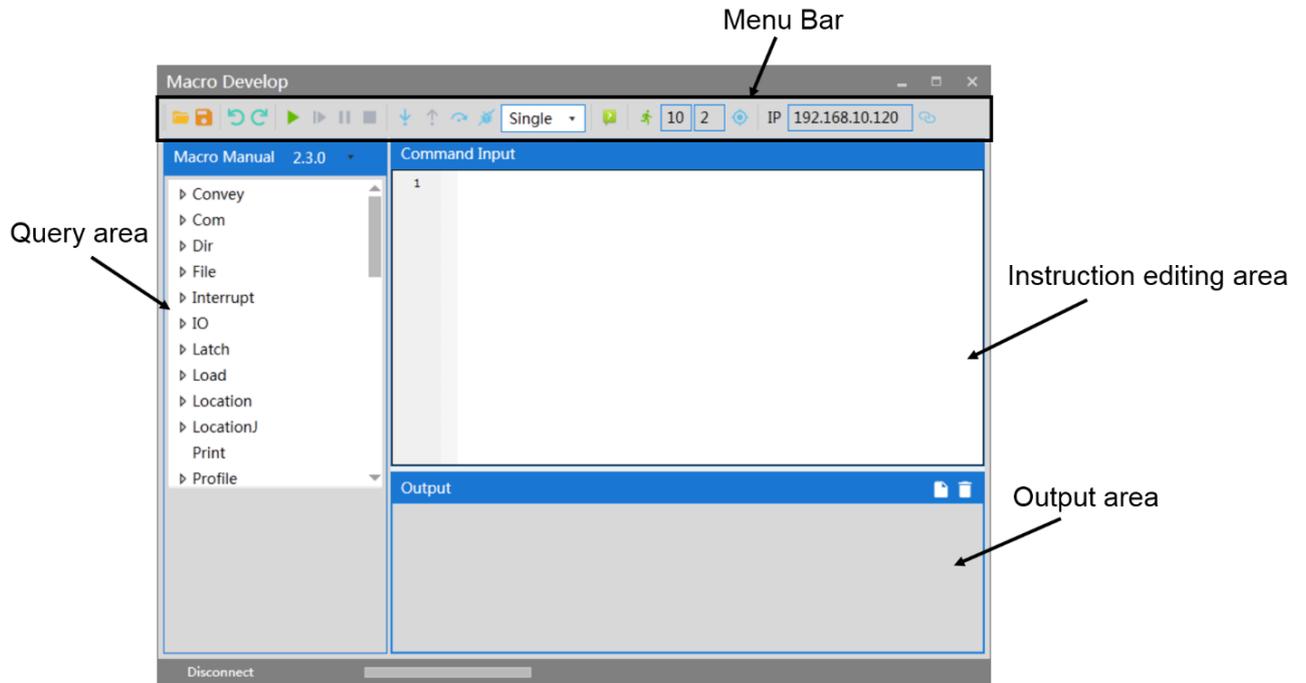


Figure 6-8 Macro language development interface

6.4.2. Menu bar



Figure 6-9 Menu bar of macro language development interface (ARM)

Table 6-1 Functions of tools on the macro language development interface

Introduction to menu bar on the macro language development interface (ARM)			
	Open		Save
	Undo		Resume

	Start (Note: Run all instructions in order.)		Continue
	Pause		Stop
	Single step		Previous
	Jump		Clear
	There are two options, i.e. "Single" and "Cycle". Click on the inverted triangle to select.		Hide and show
	A = Send A instructions for each batch; B = When the remaining B instructions in the previous batch are to be sent, the A instructions of the next batch starts to be sent. Purpose: To improve the speed of continuously sending instructions. Where, A and B are the numbers that need to be set by the user.		Send multiple: After the numbers of A and B are set, click here to start execution.
	Jog teach		Connect to robot: After entering the IP of the robot, click on this button to connect the robot.
IP <input data-bbox="240 1912 440 1980" type="text"/>	Enter the IP of the robot and establish communication		

	with the robot.		
--	-----------------	--	--

6.4.3. Establish IP communication

Step 1 Click the ARM debugging environment, then click <Tools> → <Macro language development interface> to enter the debugging interface.

Step 2 Click the IP address input field in the upper right corner, enter the default IP address (192.168.10.120) of the robot, and then click the <Connect> button on the right, as shown in Figure 6-10.



NOTE

- The IP addresses of the robot and the host computer must remain on the same network segment.
- The IP of the robot is 192.168.10.120, then that of the host computer can be set to 192.168.10.1, that is, the IP addresses of the two must be the same in the first three digits and different in the last digit. The last digit of the IP of the host computer ranges from 1 to 256.

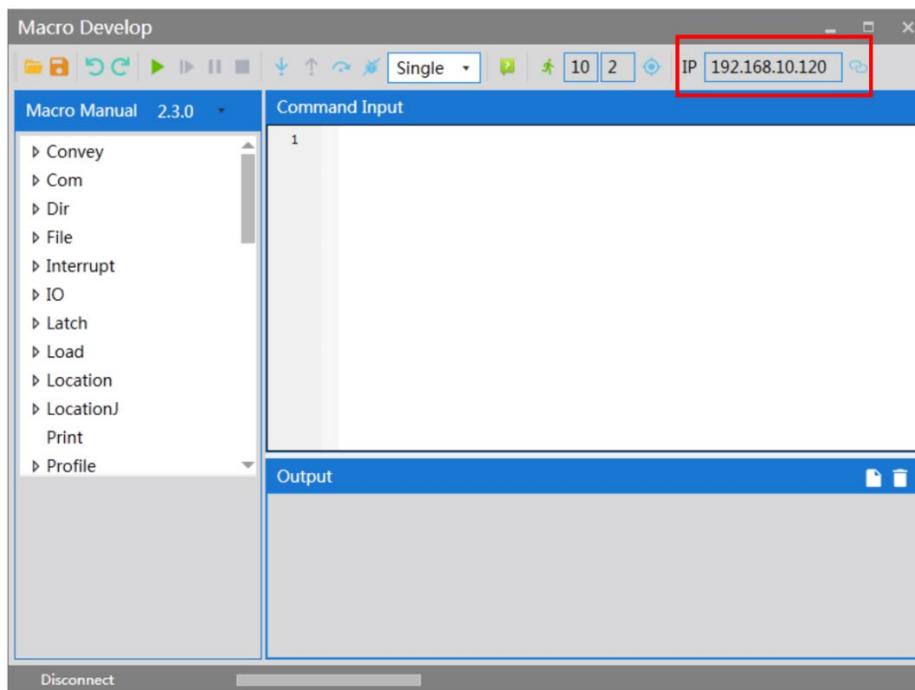


Figure 6-10 IP connection

1.1.1.1 Successful IP connection

The premise of successful IP connection is that the IP addresses of the robot and the host computer are on the same network segment. Upon

successful connection, there is a prompt of "Successful connection: 192.168.10.120" in the lower left corner of the macro language development interface, as shown in Figure 6-11.

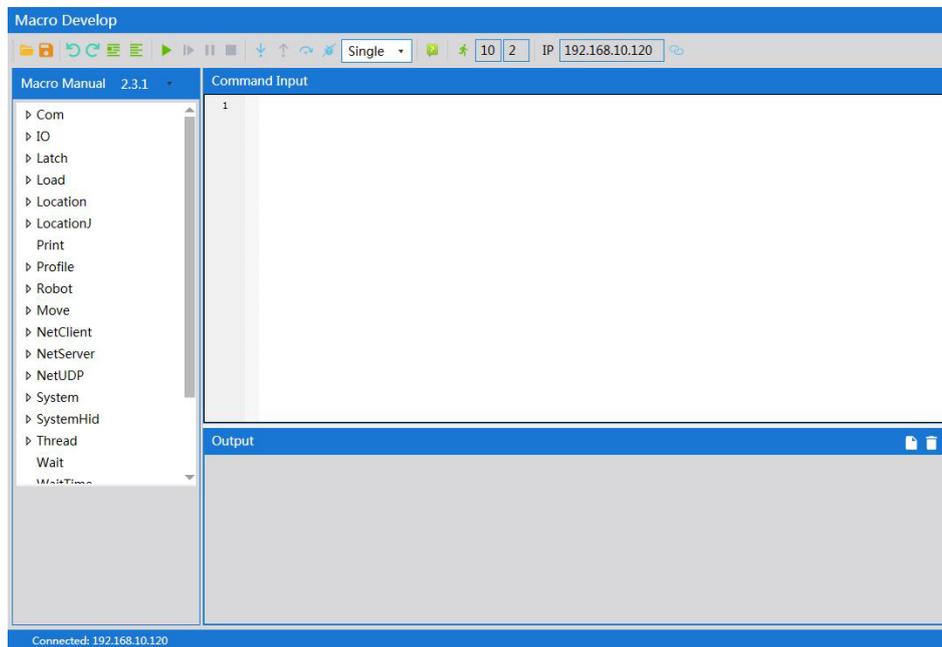


Figure 6-11 Successful connection

1.1.1.2 IP connection failure

The interface of IP connection failure is shown in Figure 6-12

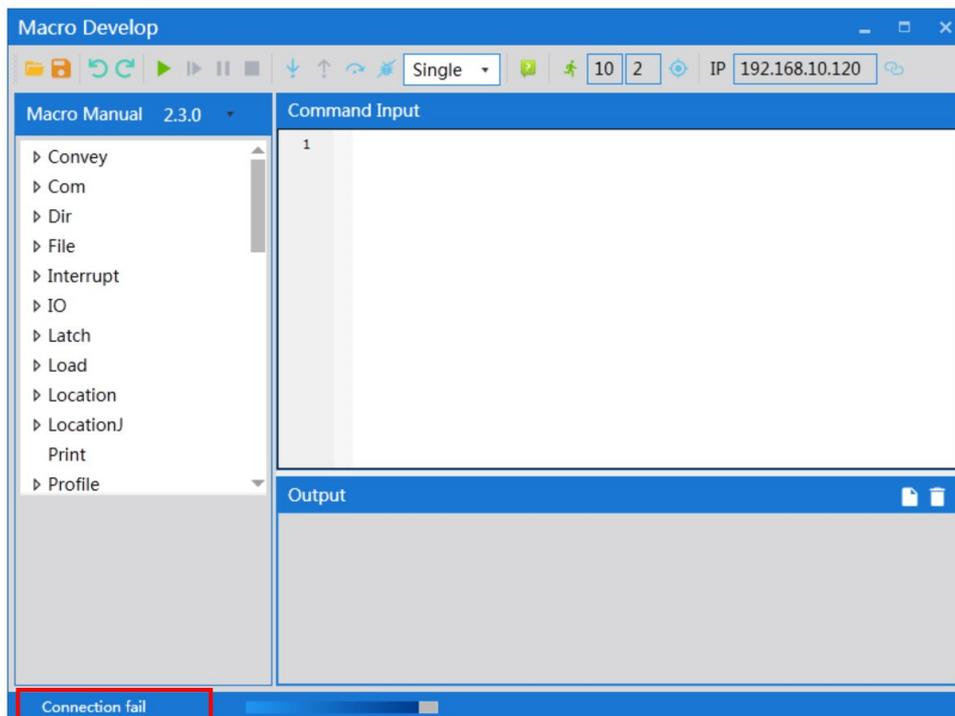
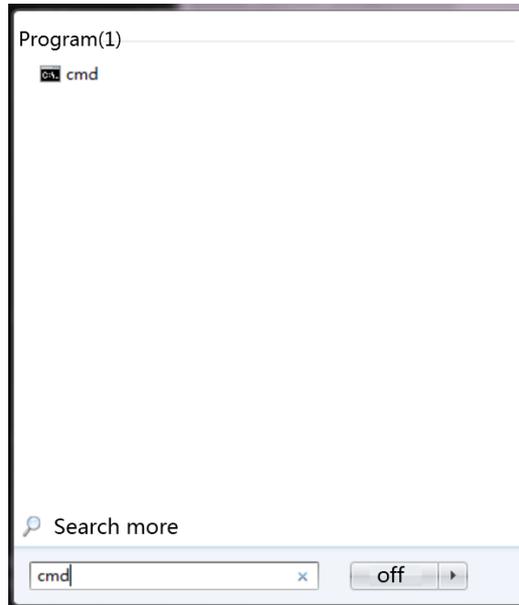


Figure 6-12 Connection failure

Solution to connection failure:

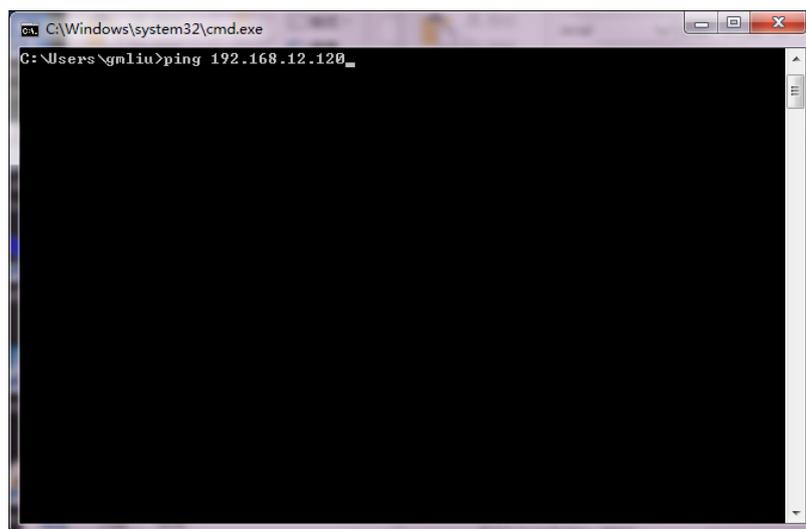
Step 1 Check whether the IP addresses of the host computer and the robot are on the same network segment;

Step 2 Execute system search and run cmd as shown in the figure:



NOTE Step 3 Directly input "ping" + IP after >. If the specific values of the parameters of byte, time and TTL are returned, it indicates that the network is connected as shown in the figure.

(Note: The IP in the figure is just an example. The correct IP is subject to the actual IP of the robot.)



Step 4 Re-enter the IP in the macro language development

interface and connect the robot.

6.4.4. Query on description of macro language instructions

The macro language development interface includes a macro language manual, which lists the macro language instructions that need to be used during robot debugging. For details, please refer to the "QKM Robot Instruction Manual".

When you click a corresponding macro language instruction, the list automatically pops up a description of this instruction set, as shown in Figure 6-13

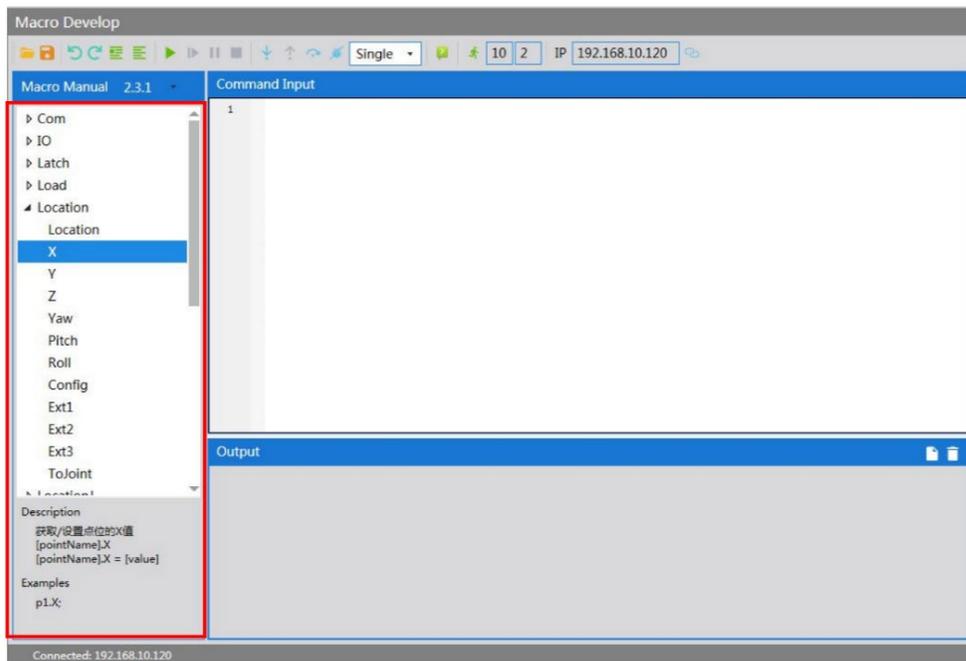


Figure 6-13 Macro language manual

6.4.5. Input instructions

The "instruction editing area" is the area where instructions are input and edited as shown in Figure 6-14.

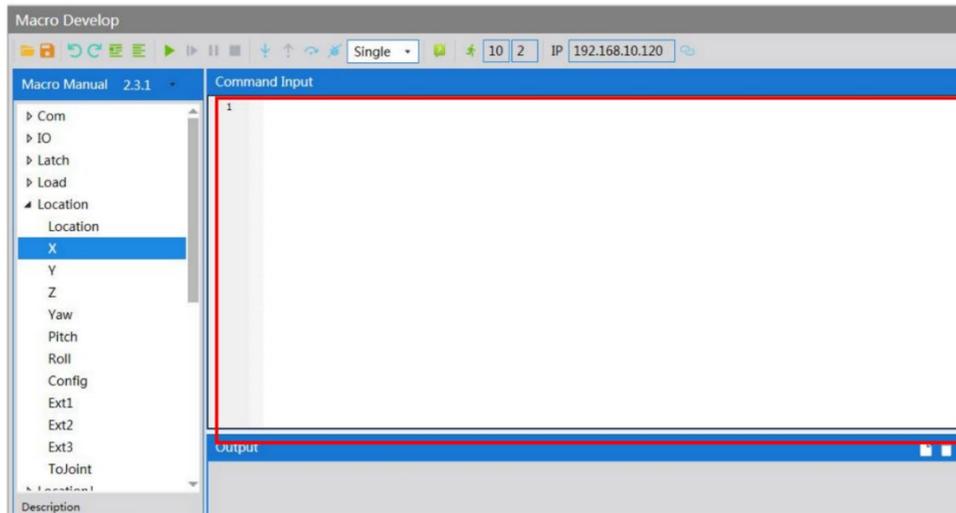


Figure 6-14 Input instructions

When inputting a single instruction, you can enter the first letter of the instruction. If you want to select an instruction, such as System, you can enter the capital letter "S" and the System instruction automatically pops up as shown in Figure 6-15

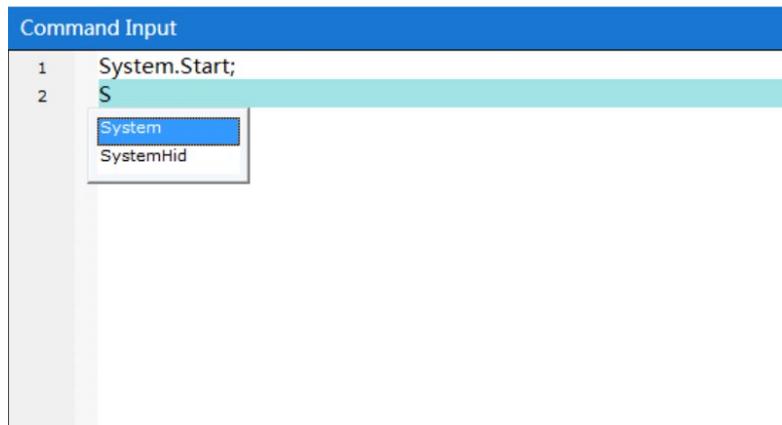


Figure 6-15 Input instructions

All instructions contained under the instruction set can be prompted automatically when you enter ".", as shown in Figure 6-16

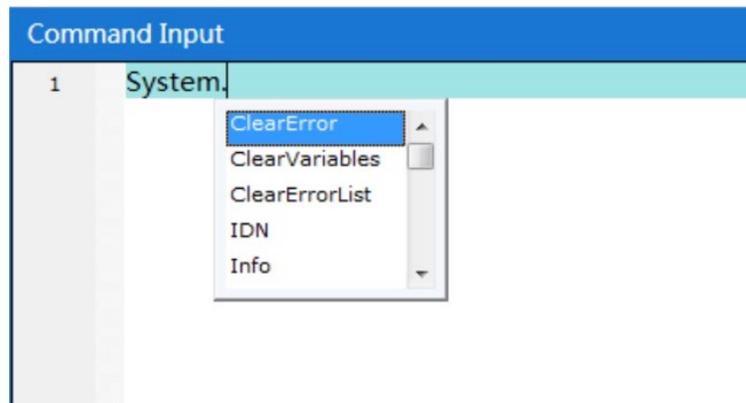


Figure 6-16 Input instructions

6.4.6.Run instructions

After editing the instructions, click on the <Run> button in the menu bar to run all the instructions in the "instruction editing area" one by one in sequence. The results are displayed in the "instruction output area", as shown in Figure 6-17.

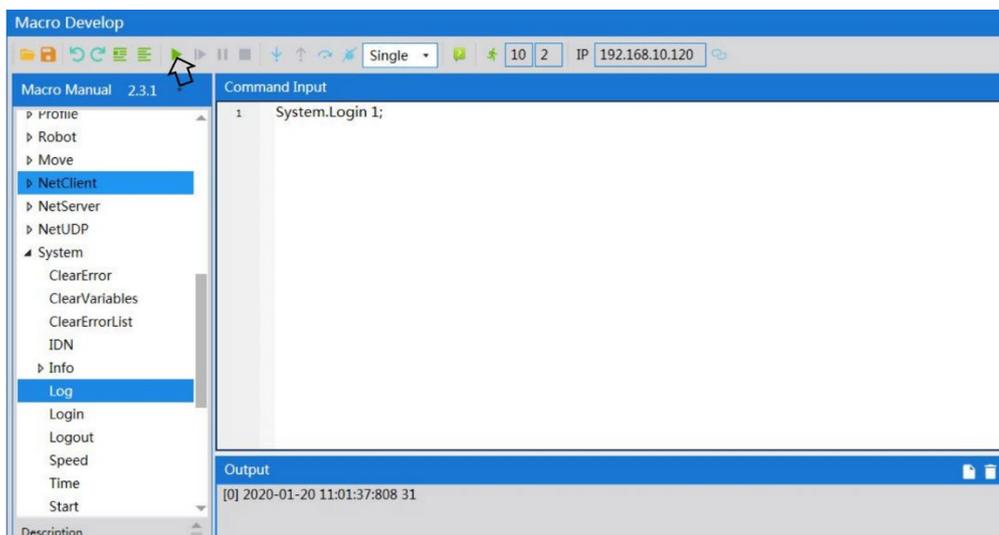


Figure 6-17 Run instructions

6.4.7.Breakpoint debugging

If you need to debug or run an instruction separately, you can locate it by adding a breakpoint before the instruction. Method of adding a breakpoint: Click the left mouse button at the position of instruction number before the instruction to add a breakpoint identifier, as shown in Figure 6-18

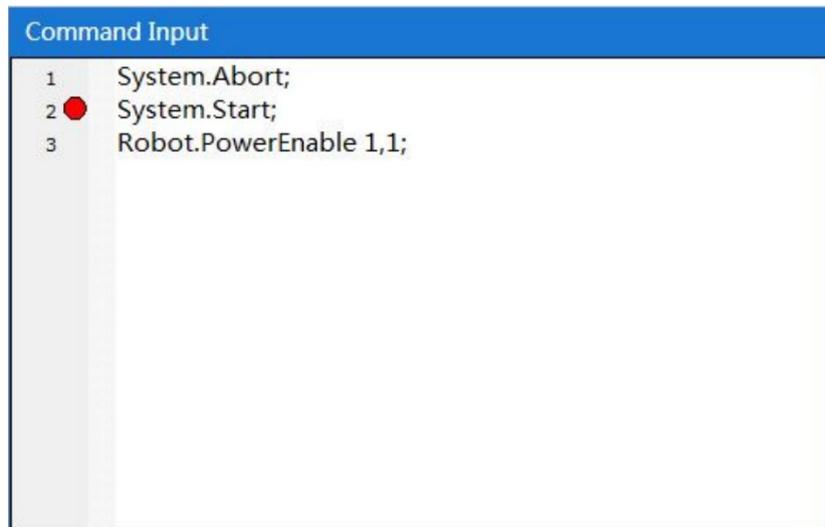


Figure 6-18 Add a breakpoint

6.4.8. Output

The output after running is displayed as shown in Figure 6-19.

**NOTE**

The output interface contains the information of feedback from each instruction. If the instruction is successfully executed, the feedback result is displayed in black. If the instruction fails, the feedback result is displayed in red.

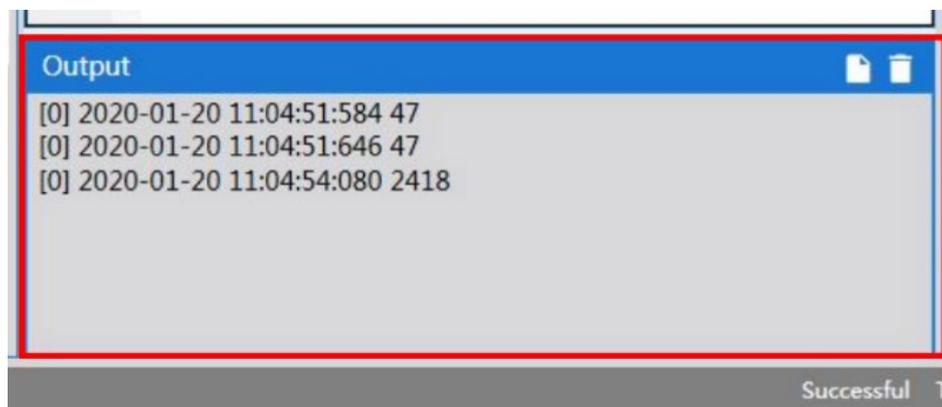


Figure 6-19 Output

6.4.9. Clear output

Click the <Clear> button in the upper right corner of the output area to complete the clear, as shown in Figure 6-20.

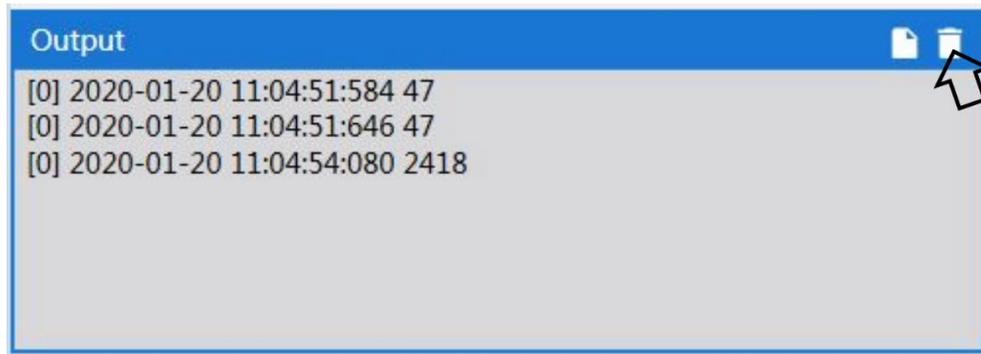


Figure 6-20 Clear output

6.4.10. Save output

If you need to save the output, you can click the <Save> button in the upper right corner of the output box to save it in the *.log format as shown in Figure 6-21

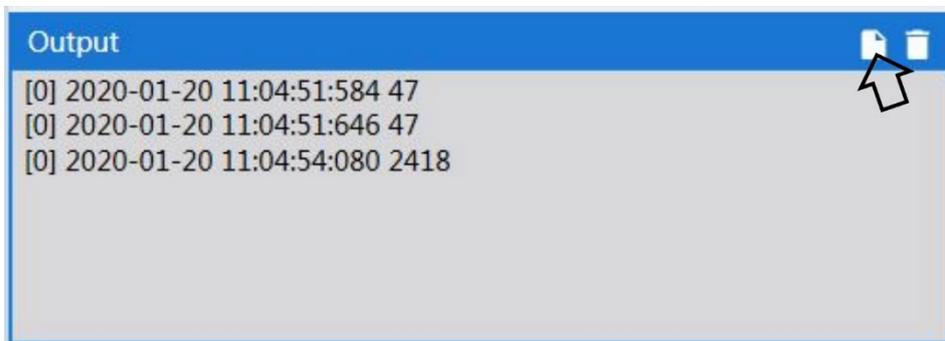


Figure 6-21 Save

6.5. Manual jog teach

On the ARM interface, click  to pop up the jog teach interface as shown in Figure 6-22

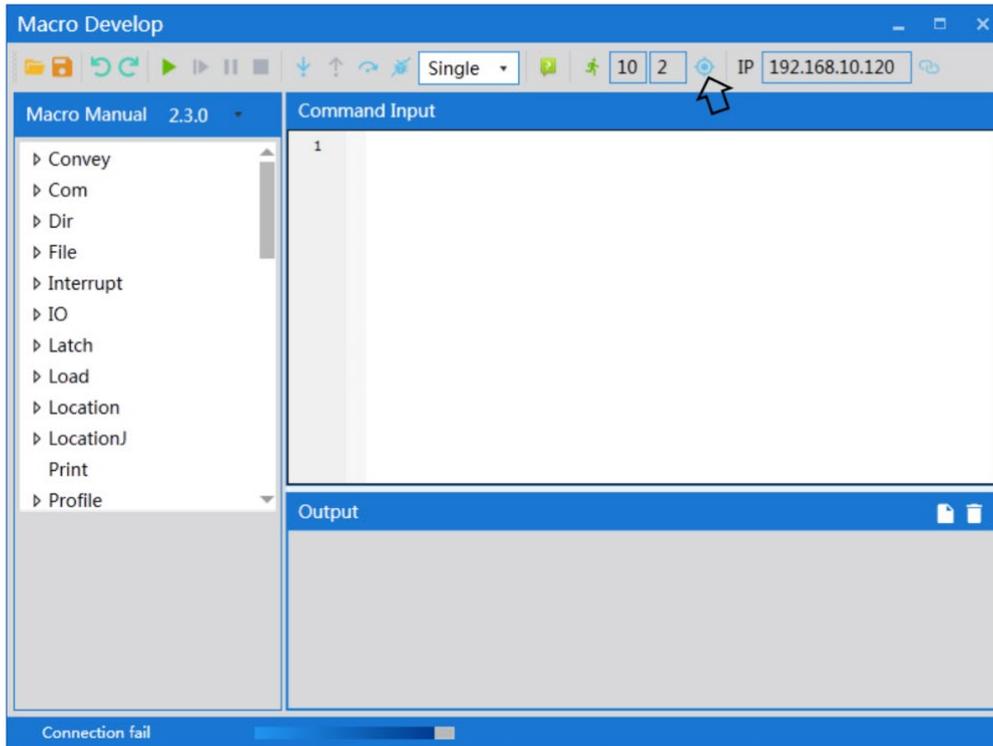


Figure 6-22 Jog teach

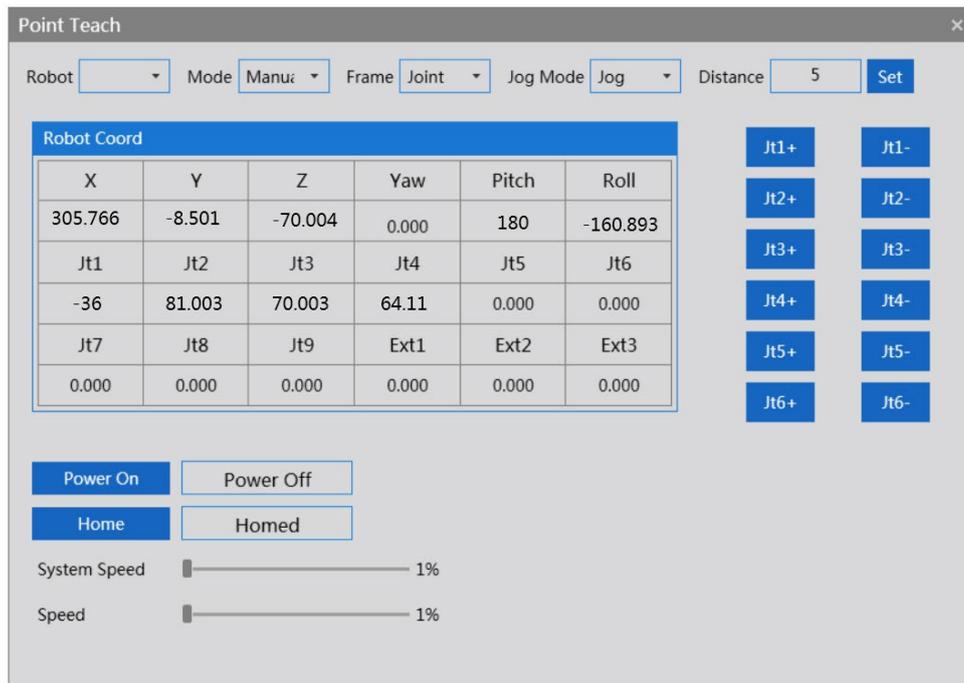
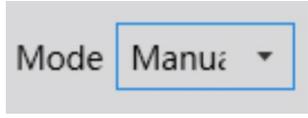
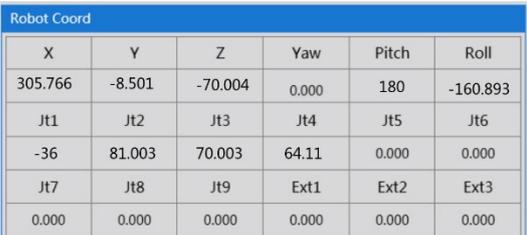
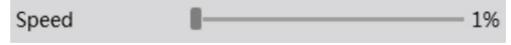


Figure 6-23 Teach interface

Table 6-2 Introduction to tools on the jog teach interface

Function	Diagram	Description
Select Robot		Click the drop-down menu after <Robot> and select the robot with corresponding number, such as Robot 1. For example, 
Select Mode		You can select [Manual] or [Auto].
Coordinate		You can select [Joint] or [World].
Joint Mode		You can select [Jog] or [Inch] in this mode.
Inching distance		Manually enter the distance value for each inching.
Robot coordinate	 Coordinates of the robot when the [Joint] coordinate system is selected	The coordinate values of ends of the current robot in different coordinate systems include X, Y, Z, Yaw, Pitch, Roll; or Jt1, Jt2, Jt3, Jt4
Jog coordinate values		If you need to control the motion of the robot separately, you can click <X +>, <X->, etc. to control the motion of the robot in the

	Parameter values for coordinates of the robot when the [Joint] coordinate system is selected	direction of X, etc.
Robot power-on		Click <Power> to power on the robot.
Home robot		Click <Home> to enable the robot to return to zero.
System Speed		You can adjust the operating speed of the entire system by percentage.
Speed		You can adjust the operating speed of the robot by percentage.

6.6. Servo power-on

When controlling the motion of the robot through the ARM programming environment, you must first power on the robot via servo. The robot can be

After the robot is powered on for the first time or restarted after a power-off, a <Unhome> button appears on the jog teach page, so the robot needs to return to zero after it is powered on via servo.

Method 1 (jog teach):

Click the <Home> button on the jog teach interface to enable the robot to return to zero.



NOTE

Method 2 (send macro instruction):

Enter Robot.Home [robotIndex] in the instruction editing area on the macro language development interface to send a power-on instruction to the robot. (Where robotIndex is the index number of the online robot.)

For example, Robot.Home 1

```
//the current robot at the first node is powered on
```

powered on using the two methods as follows.

Method 1 (jog teach):

Click the <Power> button on the jog teach interface to power on the robot via servo as shown in Figure 6-24

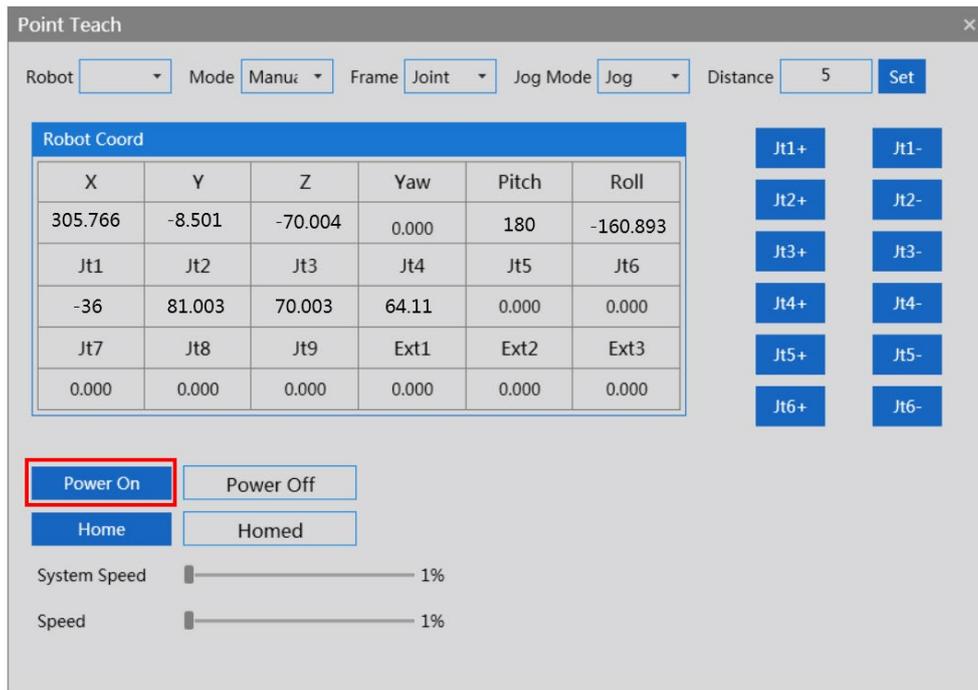


Figure 6-24 Power-on button interface

Method 2 (send macro instruction):

Prerequisites: ① Manual or auto mode; ② The control authority is 0/1 (set authority with System.LogIn).

Enter Robot. PowerEnable [robotIndex],1 in the instruction editing area on the macro language development interface to send a power-on instruction to the robot. (Where robotIndex is the index number of the online robot.)

For example, Robot.PowerEnable 1,1 //the robot at the first node is powered on

6.7. Speed adjustment

There are three speeds:

- System speed;
- Robot speed;
- Speed in robot motion parameters.

6.7.1. Adjustment of system speed

Under the control of the same controller, one or more robots cooperate with each other to complete one or more actions, forming a complete robot operating system including all devices participating in the motion (s). The system operates at

a certain speed which is called system speed. The system speed can be adjusted using two methods:

Method 1 (jog teach):

When the robot is in the servo power-on state, click the <System speed> slider on the "Jog teach" interface and slide it to adjust the motion speed of the robot, as shown in Figure 6-25

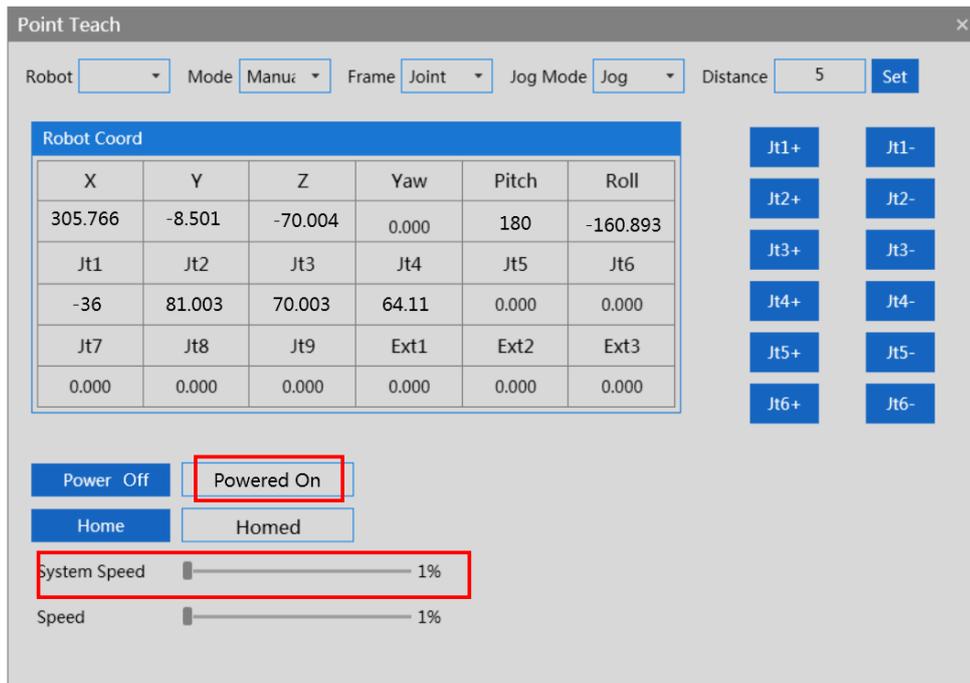


Figure 6-25 Adjustment of system speed

Method 2 (send macro instruction):

Enter System.Speed [value] in the instruction editing area on the macro language interface to send instructions to the robot. (Where value indicates the value of system speed of the robot and its type is double)

For example, System.Speed 50 // The speed of all robots in the node is set to 50.

6.8. Adjustment of robot speed

The speed of a single robot with regard to a complete motion trajectory can be adjusted with the two methods:

Method 1 (jog teach):

When the robot is in the servo power-on state, click the <Speed> slider on the "Jog teach" interface and slide it to adjust the motion speed of the robot, as

shown in Figure 6-26.

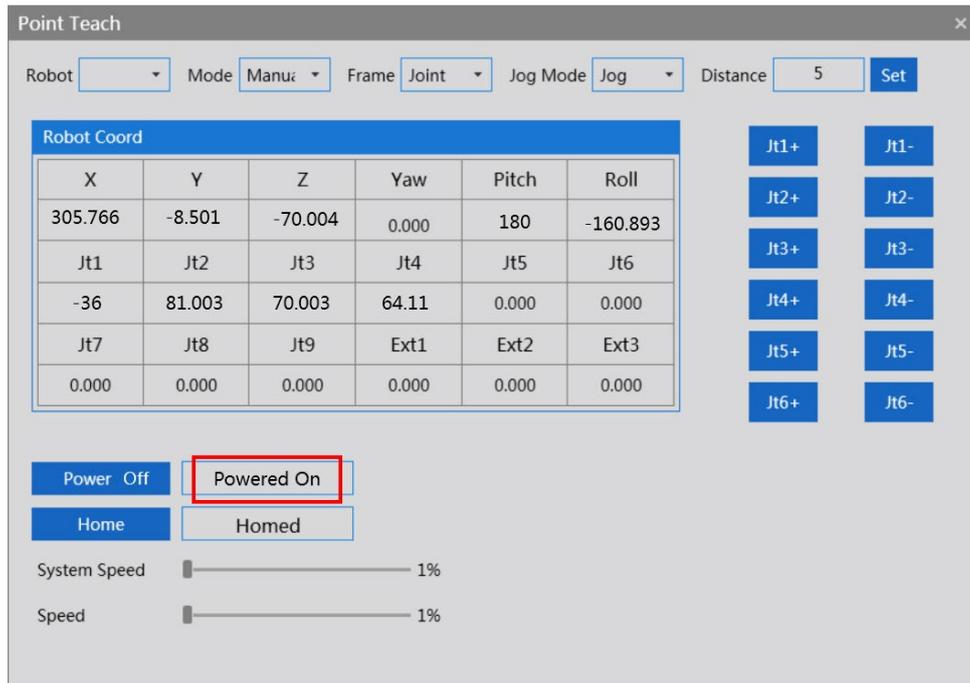


Figure 6-26 Speed adjustment

Method 2 (send macro instruction):

Prerequisites: (1) The robot is stopped; (2) The control authority is 0/1 (set authority with System.LogIn)

Enter `Robot.Speed [robotIndex], [value]` or `Robot.Speed [robotIndex]` in the instruction editing area on the macro language interface. (Where `robotIndex` is the index number of the robot and its type is Integer; `value` is the speed value of the robot system, it is a global variable ranged from 0 to 100, and its type is double.)

Example 1: `Robot.Speed 1,10 // Set the speed of the first robot to 10`

Example 2: `Robot.Speed 1 // Return to [0 10] Note: Set the speed of the first robot to 10`

6.8.1.Speed adjustment during motion

Method of adjusting the speed of a certain point in the process of robot motion (send a macro instruction):

Step 1 Enter `Profile [profileName] = [Speed, Speed2, Accel, Decel, AccelRamp, DecelRamp, InRange, Type]` in the instruction editing area on the macro language interface to create a new name of robot speed and assign

values to its parameters.



profileName is the name of objects for motion parameters. Speed / Speed2 / Accel / Decel / AccelRamp / DecelRamp / InRange / Type respectively represents the information on speed. For details about parameters, please refer to the "QKM Robot Instruction Manual". (If one of the parameters is not assigned a value, it is represented by "0" or a space.)

For example, Profile prof2 = 80,0,80,80,0.1,0.1 // Create an object named prof2 and assign a value to the parameter.

Profile prof3 = 80,80,80,0.1,0.1 // Create an object named prof3 and assign a value to the parameter.

Prerequisite: The control authority is 0/1 (set authority with System.LogIn).

Step 2 Enter Profile.Set [robotIndex], [ProfileName] and send an instruction to the robot. (Where robotIndex is the index of the robot and its type is Integer; ProfileName is the name of the speed (variable) and its type is Profile)

For example, Profile.Set 1, prof2 // The instruction for assigning value to prof2 has been executed before, then set the Profile used during the motion of robot 1 to be prof2.

6.9. Emergency stop and recovery

6.9.1. Emergency stop

During the process of manual operation, an emergency stop needs to be performed when a collision or other unexpected conditions occur due to nonproficiency of the operator. Operation: Press the emergency stop button.

6.9.2. Recovery

After the emergency stop, some manual operations need to be performed to push the robot to a safe position, and then release the emergency stop button to restore the robot to its normal working state for safety.

The manual operations should be adjusted according to different scenarios. The robot may be stopped in an open area or stuck between obstacles. The

handling methods are shown in Table 6-3 Handling methods

Ensure that the robot is in a safe position before releasing the emergency stop button to complete the recovery on it after the emergency stop.

Table 6-3 Handling methods

Robot position	Handling
In an open area	Manually operate the robot and move it to a safe position.
In the case where it is blocked between obstacles but the obstacles are easy to be moved away	Directly move away the obstacles around it, and then manually operate the robot to move it to a safe position.
In the case the obstacles around it are not easy to be moved away and it is difficult to manually operate the robot and move it to a safe position	Release the brake button and manually operate the robot to move it to a safe position.

6.10.Robot power-off

When it is necessary to stop or maintain the robot, it needs to be powered off with the two methods as follows:

Method 1 (jog teach):

Step 1 Click the OFF button on the jog teach interface as shown in Figure 6-27

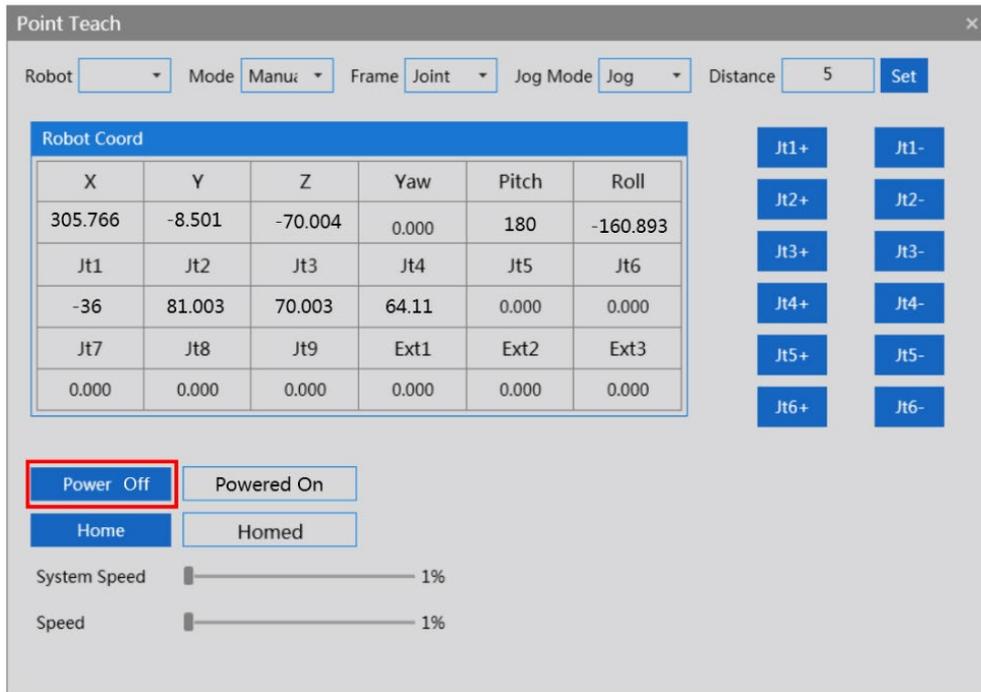


Figure 6-27 Interface of teaching in powered-on state

Step 2 Unplug the power cable from the robot (turn off the power switch before unplugging the power cable if there is a power switch on the robot).

Method 2 (send macro instruction):

Prerequisites: ① Manual or auto mode; ② The control authority is 0/1 (set authority with System.LogIn).

Step 1 Enter Robot.PowerEnable [robotIndex], 0 in the instruction editing area on the macro language development interface. (Where robotIndex is the index number of the online robot.)

For example, Robot.PowerEnable 1,0 // the robot at the first node is powered off

Step 2 Unplug the power cable from the robot (turn off the power switch before unplugging the power cable if there is a power switch on the robot).

Chapter 7 Technical Service

QKM Technology Co., Ltd. is committed to providing you with technical information on machine motion and operation to help you remove faults and reply to your inquiry in detail. If your robot or equipment fails during use, you can contact our service department and provide information below as much as possible:

- Model and serial number of the robot or equipment
- Model and serial number of the control system
- Version number of the control system
- Supporting software feature pack (optional)
- Existing application
- Other additional supporting products (vision, PLC, etc.)
- Problem description, duration and frequency of faults, etc.



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