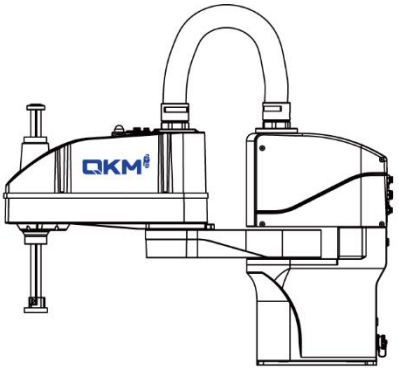
AH6 Robot

User Manual



QKM

User Manual

AH6 Robot

AH6-0500-0204-2000

AH6-0500-0204-3000

AH6-0600-0204-2000

AH6-0600-0204-3000

AH6-0700-0204-2000

AH6-0700-0204-3000

QKM Technology (Dongguan) Co., Ltd.

Version: V1.2.0

Date: 01/06/2023

Preface

Thank you for purchasing the robot produced by QKM!

This manual describes the matters needing attention for properly use of AH6 Robot.

Read this manual carefully before using AH6 Robot.

Keep this manual properly for future reference.

Overview

This manual provides detailed information on product features, main components, installation guide, system debugging and technical specifications of AH6 Robot so that users can fully understand and properly use the robot.

Readers

This manual applies to:

Customer Engineer	Technical Support Engineer
Application Engineer	Installation and Debugging Engineer

Signs and their meanings

The signs in this document clearly indicate any dangers, warnings, attentions and notes that may occur while users perform the operations described in

this manual; be sure to pay attention to the following signs when they appear in this manual.

The signs in this manual are described in the table below:

Sign	Description
	It indicates that a dangerous situation would occur and cause deaths or serious injuries if it is not avoided.
	It indicates that a potentially dangerous situation would occur and cause personal injuries or equipment damage if it is not avoided.
	It indicates that an unpredictable situation would occur and cause equipment damage, performance degradation, data loss, etc. if it is not avoided.
	It indicates the description of key information and tips of operation skills.

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QKM Technology(Dongguan)Co.,Ltd

Tower A, Building 17, Headquarters 1, No.4 Xinzhu Road, Songshan Lake

High-tech Industrial Development Zone, Dongguan , Guangdong,China

Tel: +86 0769-27231381

Fax: +86 0769-27231381-8053

Zip code: 523808

Email: service@qkmtech.com

Website: www.qkmtech.com

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	Issue Date	Revision Content
V1.0.0	04/17/2020	The first version.
V1.1.0	8/26/2020	1. Delete the foreword and back cover address of East China branch; 2. Delete Section 5.7 Removal of fixed plate instructions; 3. Section 4.3.6 corresponding signal code of IO interface pin is added; 4. Modify section 3.7 relative humidity of robot operating environment; 5. Modify Chapter 6 robot operation and arm interface function description;

		5.1 Add reference instructions for robot instructions and access channels for arm installation package; 5.2 Section 6.4.3 functions and operation instructions of user-defined instruction editing area are added; 5.3 Instruction input case description, output failure warning and jog operation mode switching description are added; 5.4 Modify the tool function description of servo power on interface, macro language development interface and jog teaching interface; 5.5 Modify the robot shutdown mode in section 6.9.
V1.1.1	10/26/2020	1. Add the warning instructions of foreign matters falling into the spline screw shaft in the second mechanical arm in section 3.1.4;

		2. Electrical chapter 4.3.2 is added. The plug of robot auxiliary encoder is provided with 5V voltage and does not need to be introduced externally.
V1.1.2	04/20/2021	1. The installation dimension of end flange in Figure 3-17 is modified; 2. Chapter 4.3.6 adds notes on the use of 24V DC output power supply of I / O interface with do, and notes that 24V DC output power supply cannot be connected to external equipment; 3. A detailed description of I / O free allocation is added in chapter 4.3.8.
V1.1.3	07/29/2021	1. Add packaging instructions in Section 1.1; 2. Add inspection instructions when the robot is powered on for the first time in Chapter 5.4.
V1.1.4	12/02/2022	1. Modify Table 4-8 MCP interface picture; 2. Modify Figure 4-6 Wiring diagram of emergency stop device

V1.2.0	01/06/2023	Modify Chapter 6 Robot Operation： 1. Modify Section 6.1,add an overview of the QRL language. 2. Modify the pictures of the ARM installation process in Section 6.2. 3. Modify the interface picture and operation steps of the new version of ARM in Section 6.3. 4. Modify Section 6.4 Macro Command Debugger Function Introduction and Operation Procedures. 5. Added Section 6.5 QRL Mode Description and Operation Content. 6. Modify the manual teaching interface picture and operation steps in Section 6.6. 7. Modify Section 6.7 Servo power-up pictures and content. 8. Modify the picture and content of the robot speed adjustment control in Section 6.8.

		Added 6.10 Robot power-off method 1 and method 2 operation steps, and added method 3.

Contents

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Chapter 1 Safety Precautions

This chapter describes the safety precautions for using AH6 Robot. Please read this manual carefully before using the robot. Improper use of the robot may cause injuries to operators and damage to the system, and even cause personal deaths. Users must strictly follow the safety precautions in this manual. QKM shall not be responsible for any personal and equipment losses caused by illegal operations.

Personnel who use AH6 Robot for system design, operation and maintenance must be trained by QKM or relevant institutions or have the same professional skills. Before robot operation, maintenance, teaching, programming, system development, etc., relevant personnel must read supporting manuals carefully and use AH6 Robot in strict accordance with the safety precautions in this manual.

1.1.1 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:

- Use the robot and its component products in an environment that meets the design specifications, otherwise the robot may fail.
- Please use the robot within the specified operating 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 operating environment on site and set up special facilities for protection.
- To prevent personnel from entering the motion area of the robot by mistake, be sure to install a safety fence to stop personnel from entering the dangerous area.
- When the ambient temperature is close to the freezing point, operate the robot at the speed of 10% or less for more than 10 minutes to preheat it; perform other operations after preheating the robot.

- Detergents with strong corrosion are not suitable for cleaning the robot. Anodized parts should not be cleaned by immersion.
- Non-professionals shall not repair the faulty products or disassemble the electronic control cabinet without permission. If the product fails, please contact QKM Customer Service Department.
- Personnel responsible for installation, operation and maintenance of QKM robots must receive rigorous training to understand all safety precautions and proper methods of operation and maintenance before operating and maintaining the robot.
- Users should carry out regular inspection and maintenance of the robot according to the manual and related requirements and timely replace damaged parts to ensure safe operation and service life of 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 the user needs transshipment,please use the standard packaging shipped 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.
- The robot needs to be connected to the main ground wire of the

factory for proper grounding to prevent static electricity damage; be sure to use special insulated tools for maintenance.

- Confirm that the entire robot system is in a safe environment before performing daily inspection 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.
- Users should carry out regular inspection and maintenance of the robot according to the manual and related requirements and timely replace damaged parts to ensure safe operation and service life of the robot.
- If the robot and its components are scrapped and shall be discarded, please handle the industrial waste properly in accordance with relevant laws and regulations to protect the environment.

1.3 Safety signs

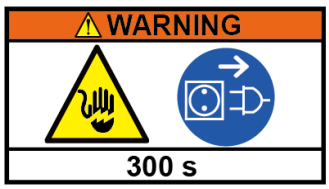
The main body of the robot is labeled with the following warning signs.

There are corresponding dangers and warnings near the location where the signs are labeled, so take sufficient care when operating.

In order to operate and maintain the robot system safely, be sure to

observe the cautions and contents on the warning signs.

Table 1-1 Warning signs

No.	Label	Remark
1		A triangle sign for warning of high voltage
2		A grounding sign
3		Do not disassemble the robot to prevent failures.
4		A sign for protection from residual voltage

Chapter 2 Product Overview

2.1 Introduction

AH6 Robot is a SCARA robot (adopting a new generation of distributed controller) independently developed by QKM Technology (Dongguan) Co., Ltd. (hereinafter referred to as QKM). It is characterized by AIO design, no separate control cabinet, and with compact structure, greatly overthrowing the layout of traditional industrial robots with large control cabinet on equipment and even production lines. Like home appliances, it is plug-and-play, simple and easy to use, suitable for handling, sorting, loading and unloading in mobile

phone, 3C, food and other industries.

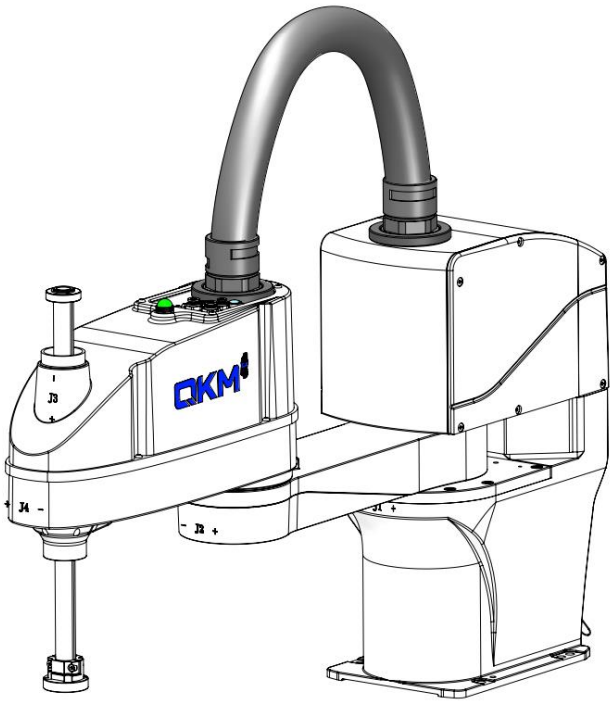


Figure 2-1 AH6 Robot (AH6-0500-0204-2000) appearance

2.2 Model implication

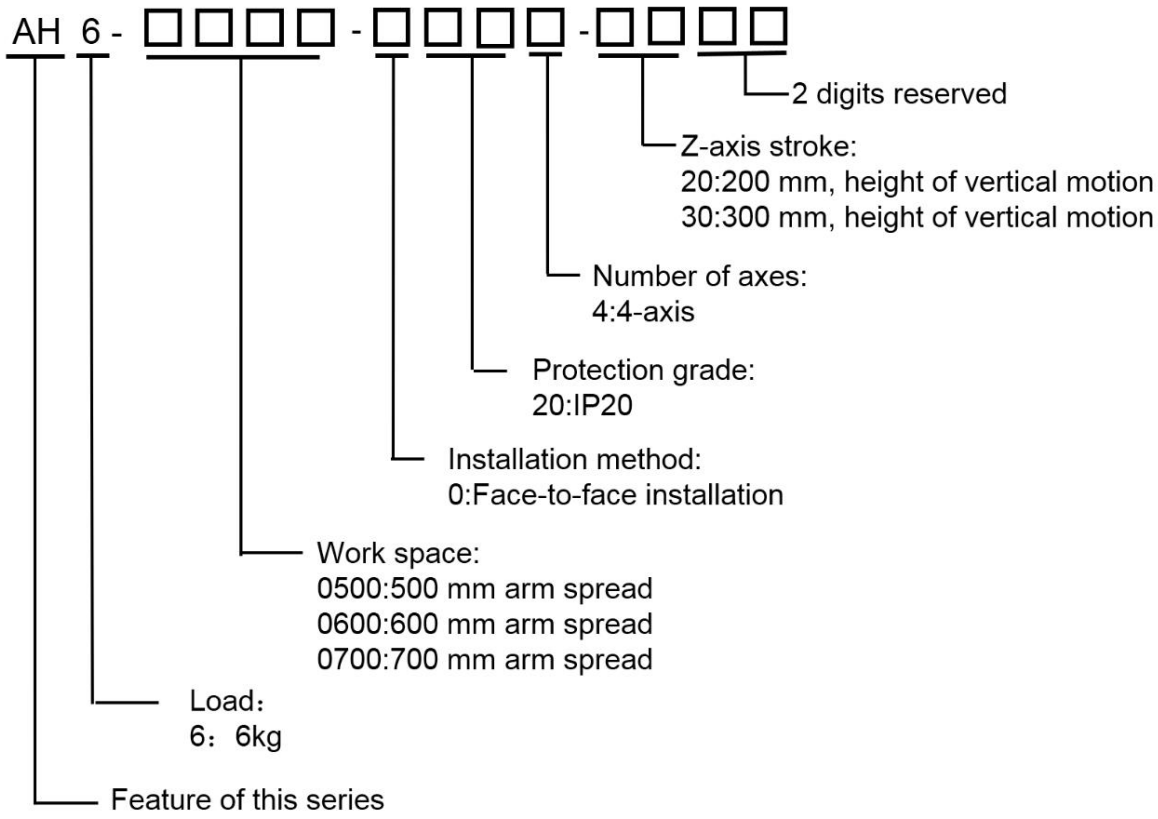


Figure 2-2 Model implication

Table 2-1 Model preview

Model Name	Rated Load (kg)	Maximum Load (kg)	Horizontal Work Space (mm)	Vertical Work Space (mm)	Installation	Protection Grade	Operating Environment
AH6-0500-0204-2000	2	6	500	200	Tabletop mounting	IP 20	Standard
AH6-0500-0204-3000				300			

AH6-0600-0204-2000			600	200			
AH6-0600-0204-3000				300			
AH6-0700-0204-2000			700	200			
AH6-0700-0204-3000				300			

2.3 Product Features

- Available in 500 mm, 600 mm and 700 mm arm lengths for flexible use by customers.
- AIO design without separate control cabinet for less space and easy installation. By adopting a new generation of distributed architecture control system, it is more stable, smoother and easier to use.
- Built-in controller improves electromagnetic compatibility (EMC/EMI) and system stability.
- High precision is perfectly fitting for high-precision laminating and assembly applications.

Chapter 3 Components and Functional Description

3.1 Introduction to main body

AH6 Robot is mainly composed of a base, a mechanical arm 1, a mechanical arm 2, a spline shaft, a terminal flange and a corrugated pipe (including cables). Its appearance and structure are shown in Figure 3-1.

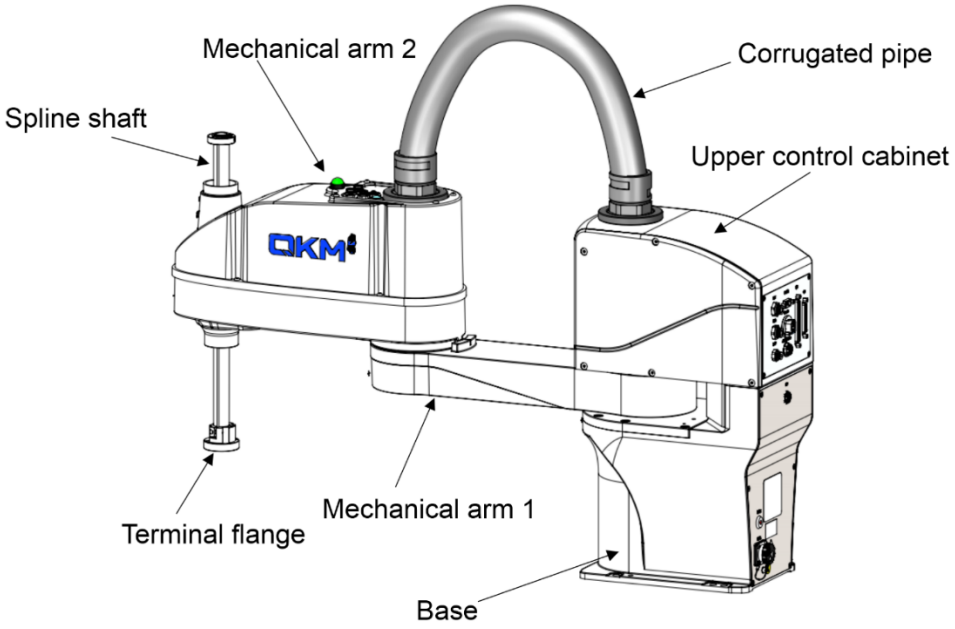


Figure 3-1 Composition of AH6 Robot (AH6-0500-0204-2000)

3.1.1 Upper control cabinet

The control cabinet adopts casting molding process that provides diversified models and beautiful appearance; some electrical components are installed in the upper control cabinet, which greatly reduces the height of the base and increases the space reachable by the screw rod. The controller

independently developed by QKM is installed in the upper control cabinet characterized by integrated drive-control design and compact size.

3.1.2 Base

The interface panel of power supply, communication and satus display is arranged at the back of the AH6 robot base. Six through-holes and two pin holes are provided at the installation location of the base for accurately fixing the robot.

3.1.3 Mechanical arm 1

Casting design with light weight is used for improving the performance of the robot.

3.1.4 Mechanical arm 2

Three groups of motors are built in, with high-precision lifting and rotating shaft. Axis J3 and Axis J4 are driven by synchronous belt with high stability and reliability. Mechanical arm 2 is overall designed with compact structure.

As the spline shaft is exposed, there is a risk of foreign matter falling into the shaft, which will cause damage to the screw. Therefore, foreign matter falling into the spline shaft is strictly prohibited.

3.1.5 Cable

AH6 Robot adopts torsion-resistant and high-flexibility cables which can ensure smooth signal transmission of the robot.

3.2 Trajectory

Joint coordinate of robot control system: The posture of the robot is represented by rotation angle of each axis.

NOTICE The "+" and "-" indicating directions of the axes are applicable to the joint coordinate system.-

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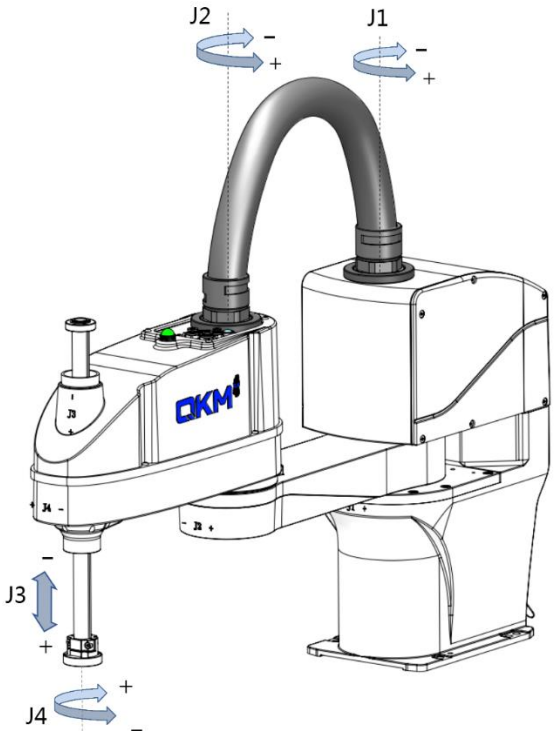


Figure 3-2 Trajectories of each axis

3.3 Work space

3.3.1 Vertical Work Space

- AH6-0500-0204-2000/ AH6-0500-0204-3000

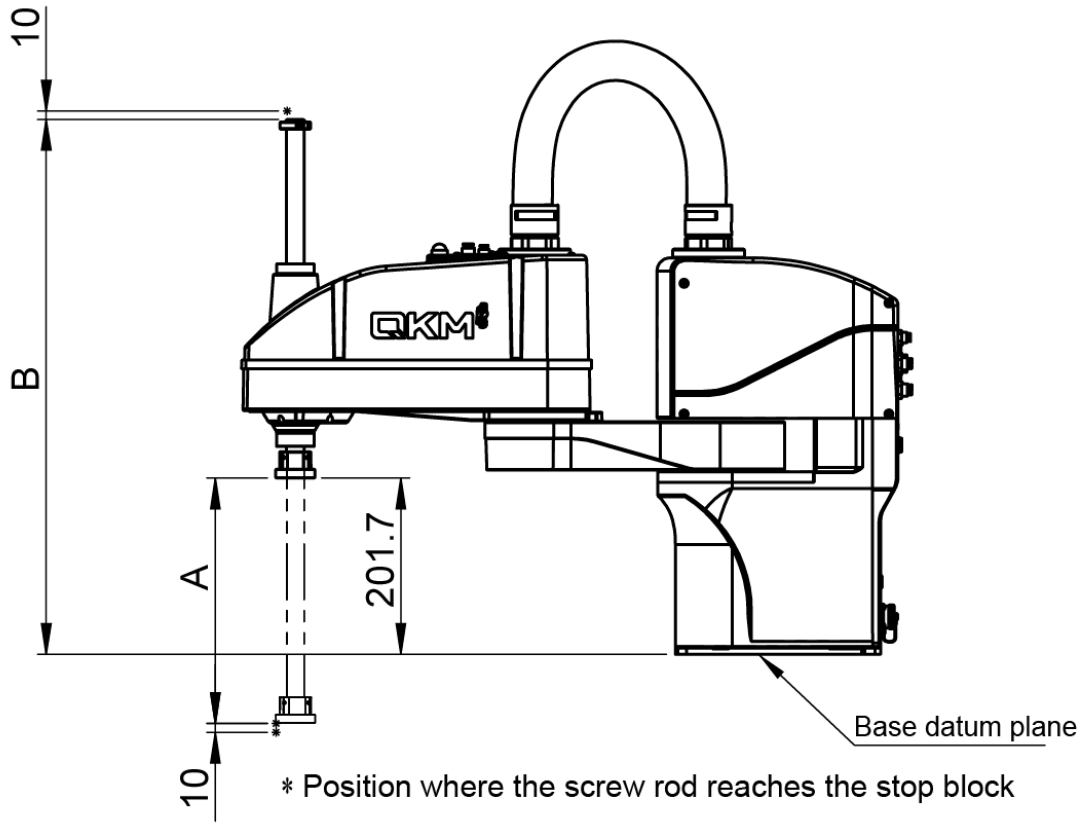


Figure 3-3 Vertical work space of AH6 Robot with an arm length of 500 mm

Table 3-1 Vertical work space of AH6 Robot with an arm length of 500 mm

Model	A	B
AH6-0500-0204-2000	200	610
AH6-0500-0204-3000	300	710

- AH6-0600-0204-2000/ AH6-0600-0204-3000

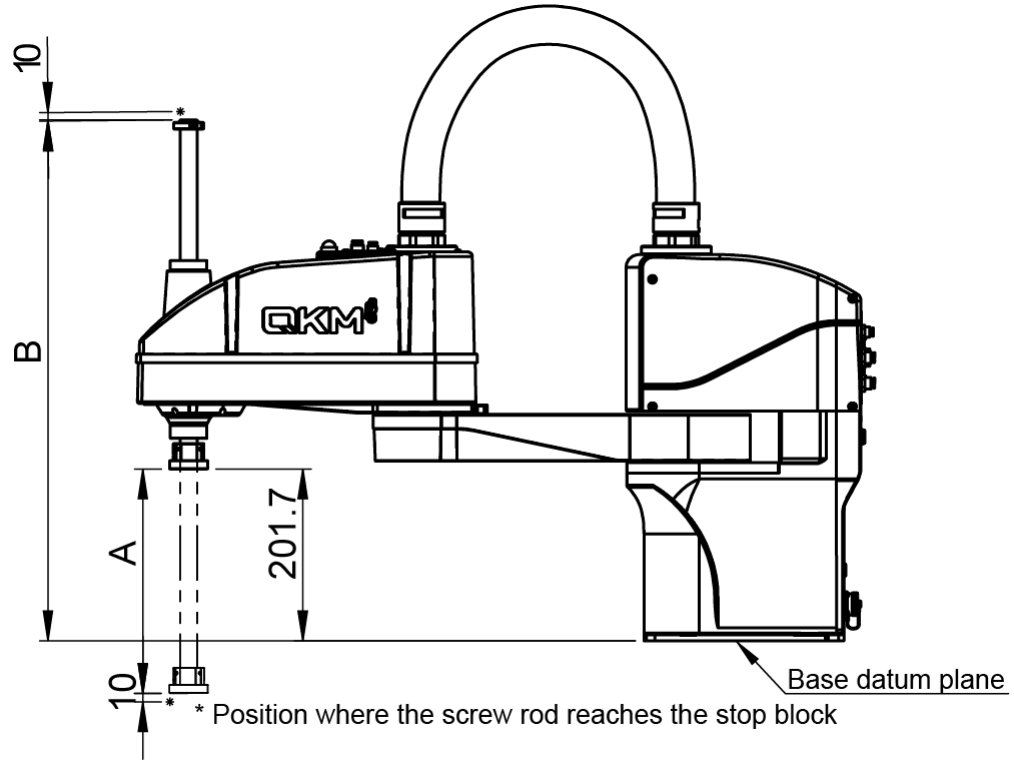


Figure 3-4 Vertical work space of AH6 Robot with an arm length of 600 mm

Table 3-2 Vertical work space of AH6 Robot with an arm length of 600 mm

Model	A	B
AH6-0600-0204-2000	200	610
AH6-0600-0204-3000	300	710

- AH6-0700-0204-2000/ AH6-0700-0204-3000

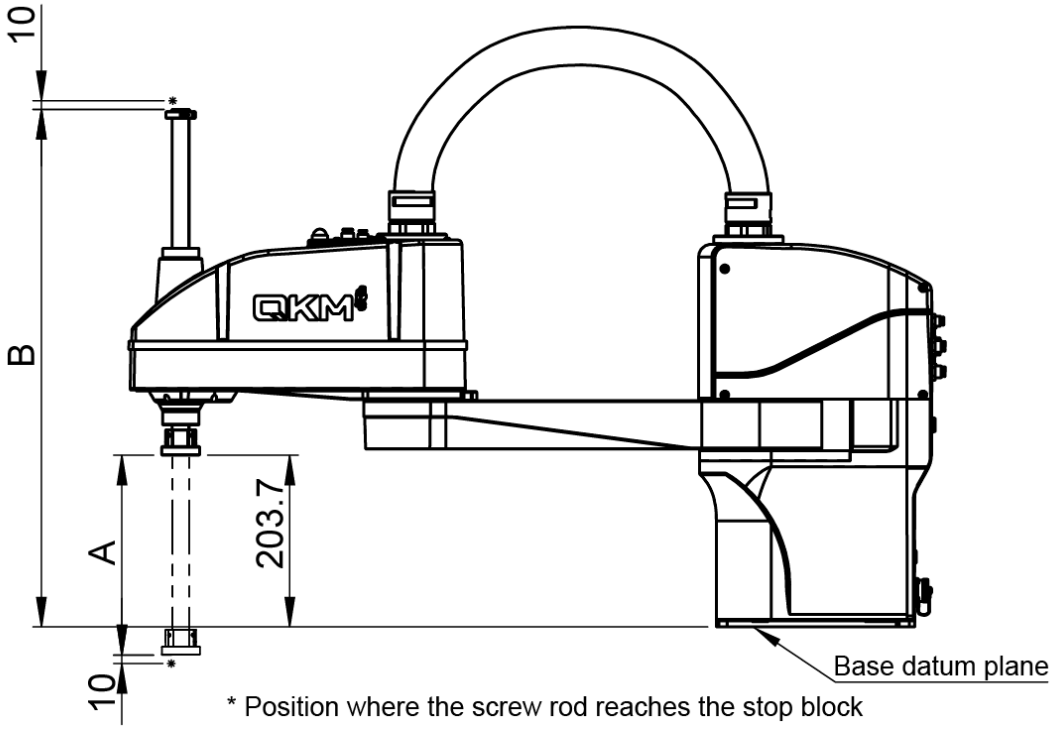


Figure 3-5 Vertical work space of AH6 Robot with an arm length of 700 mm

Table 3-3 Vertical work space of AH6 Robot with an arm length of 700 mm

Model	A	B
AH6-0700-0204-2000	200	612
AH6-0700-0204-3000	300	712

NOTE

B indicates the distance between the highest point at the top of the spline shaft and the base datum plane; A indicates the distance between the highest point at the bottom of the spline shaft and the lowest point at the

bottom of the spline shaft.

3.3.2 Horizontal Work Space

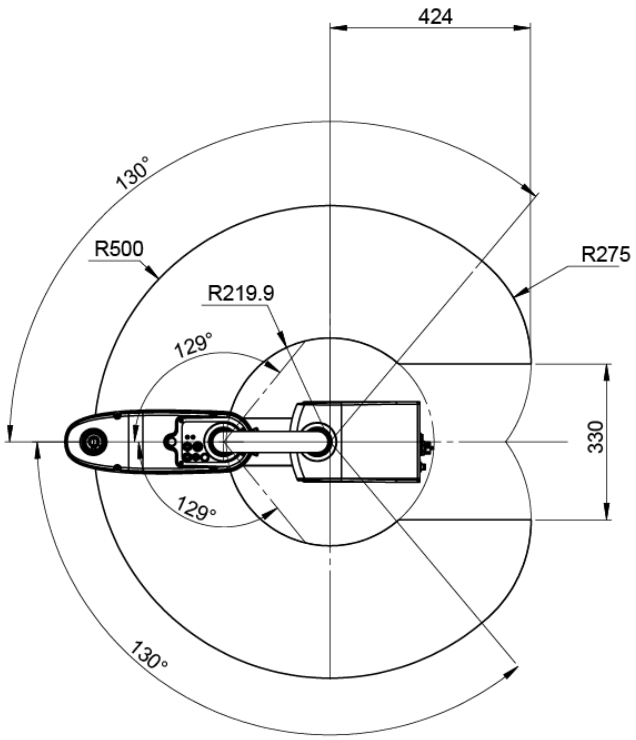


Figure 3-6 AH6-0500-0204-2000/AH6-0500-0204-3000

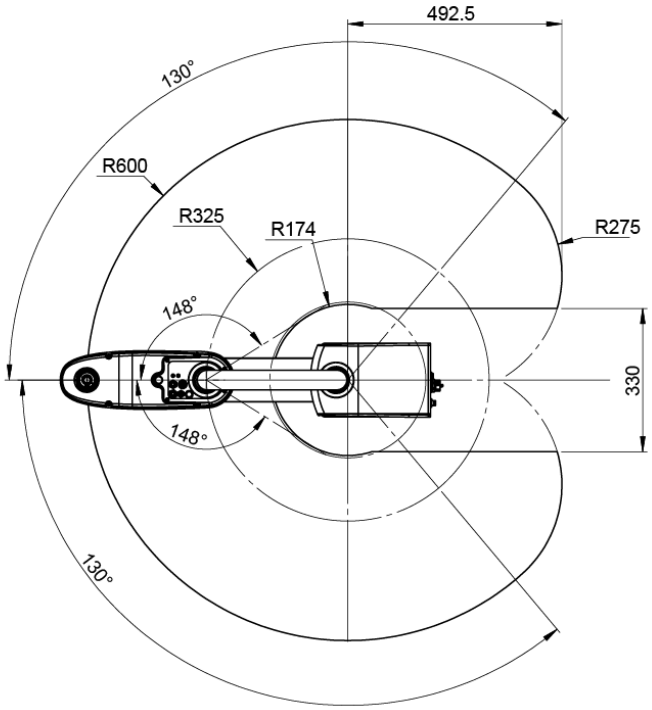


Figure 3-7 AH6-0600-0204-2000/AH6-0600-0204-3000

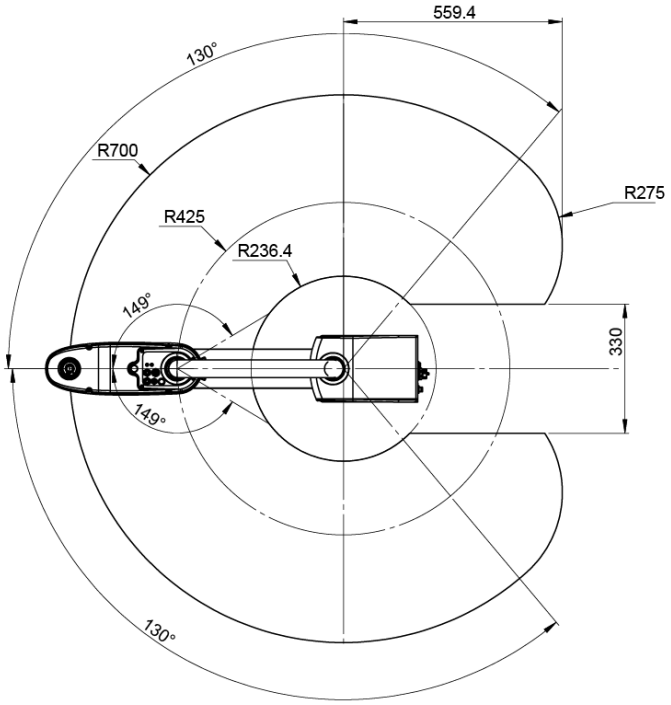


Figure 3-8 AH6-0700-0204-2000/AH6-0700-0204-3000

3.4 Robot coordinate system

NOTICE

The "+" and "-" indicating directions of the axes are applicable to the cartesian coordinate system.

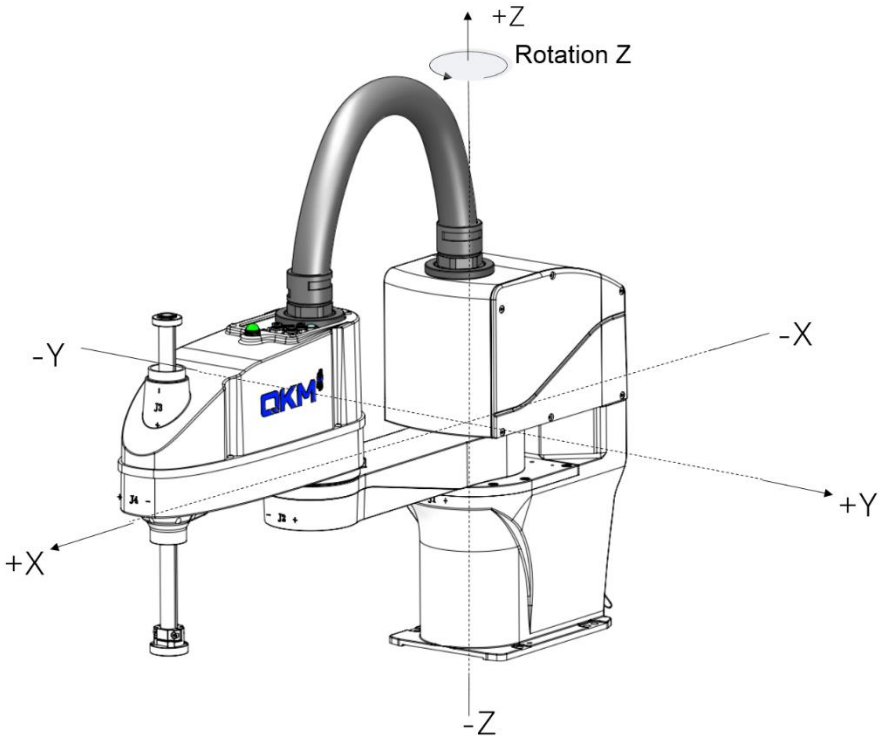


Figure 3-9 World coordinate system

3.5 Specification and dimension

3.5.1 Overall dimension

- AH6-0500-0204-2000/AH6-0500-0204-3000

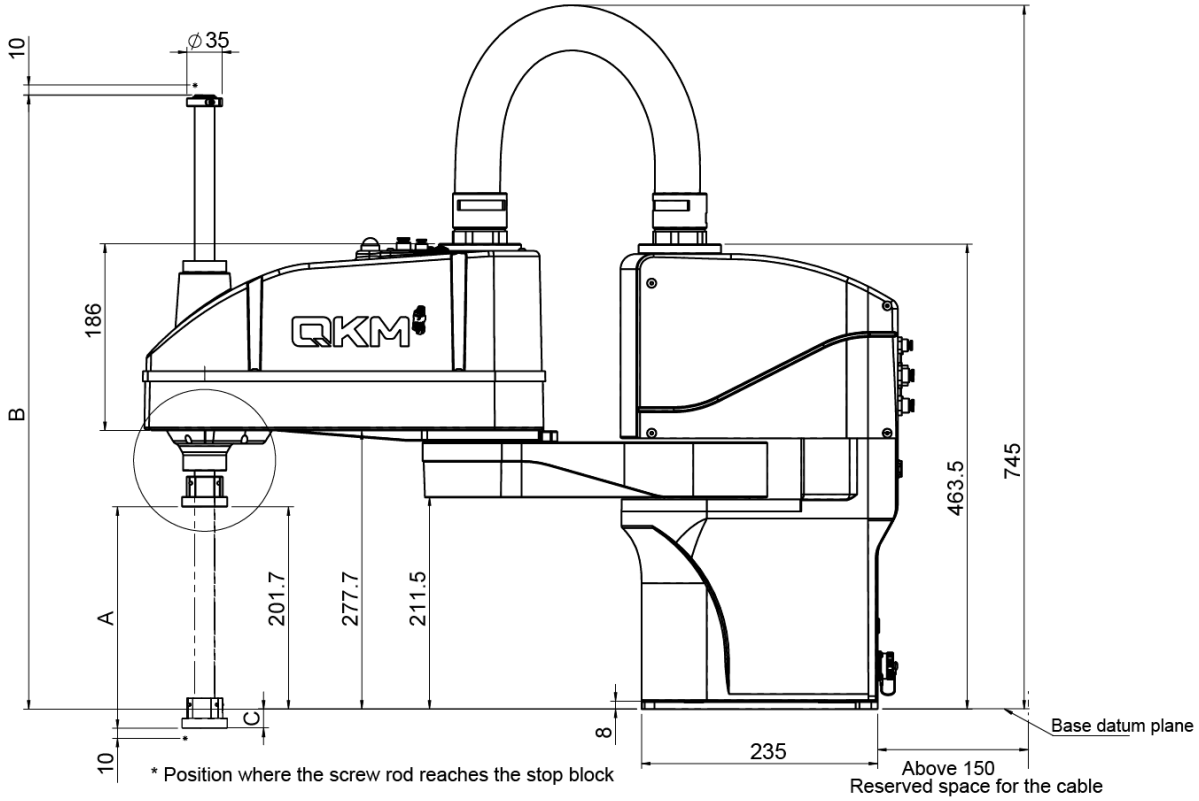


Figure 3-10 Dimensions of AH6 Robot with an arm length of 500 (Unit: mm)

Table 3-4 Dimensions of AH6 Robot with an arm length of 500 (Unit: mm)

Model	A	B	C
AH6-0500-0204-2000	200	610	+1.7
AH6-0500-0204-3000	300	710	-98.3

C: The positive value is above the base datum plane, and the negative value is below the base datum plane.

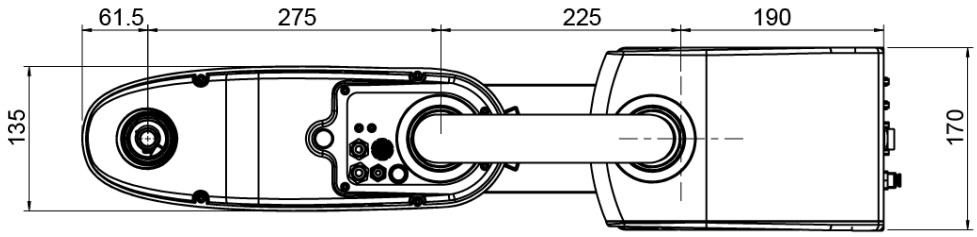


Figure 3-11 Dimensions of AH6 Robot with an arm length of 500 (Unit: mm)

- AH6-0600-0204-2000/AH6-0600-0204-3000

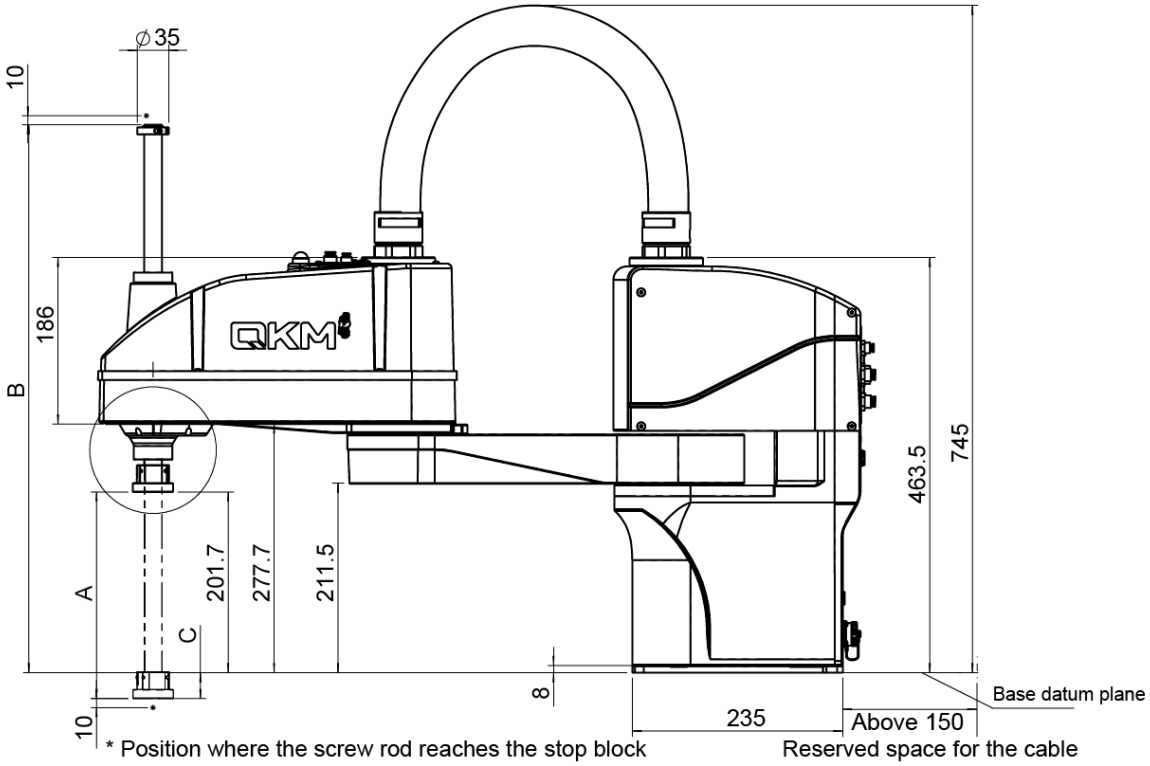


Figure 3-12 Dimensions of AH6 Robot with an arm length of 600 (Unit: mm)

Table 3-5 Dimensions of AH6 Robot with an arm length of 600 (Unit: mm)

Model	A	B	C
AH6-0600-0204-2000	200	610	+1.7
AH6-0600-0204-3000	300	710	-98.3

C: The positive value is above the base datum plane, and the negative value is below the base datum plane.

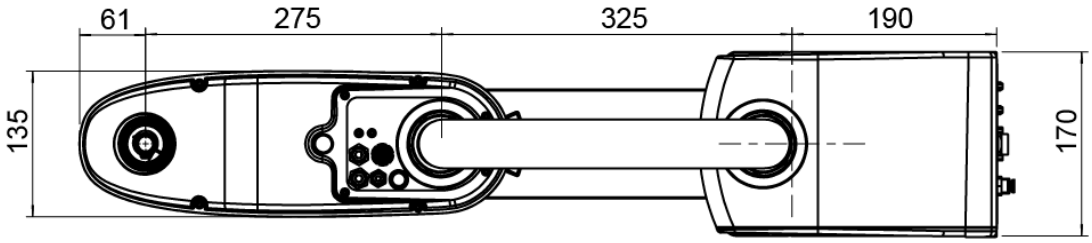


Figure 3-13 Dimensions of AH6 Robot with an arm length of 600 (Unit: mm)

- AH6-0700-0204-2000/AH6-0700-0204-3000

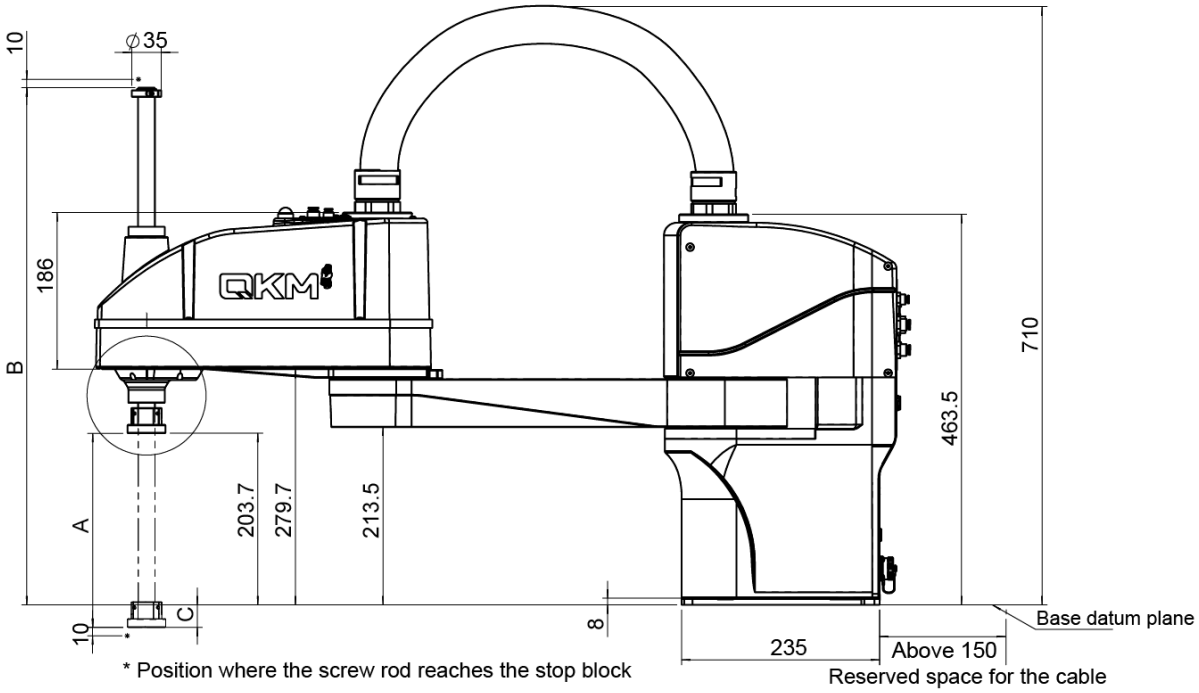


Figure 3-14 Dimensions of AH6 Robot with an arm length of 700 (Unit: mm)

Table 3-6 Dimensions of AH6 Robot with an arm length of 600 (Unit: mm)

Model	A	B	C
AH6-0700-0204-2000	200	612	+3.7
AH6-0700-0204-3000	300	712	-96.3

C indicates the distance between the bottom of the spline shaft and the base datum plane, its positive value is above the base datum plane, and its negative value is below the base datum plane.

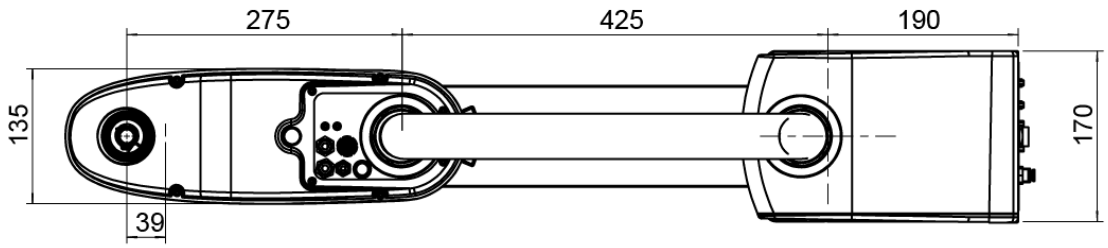


Figure 3-15 Dimensions of AH6 Robot with an arm length of 700 (Unit: mm)

3.5.2 Base dimensions

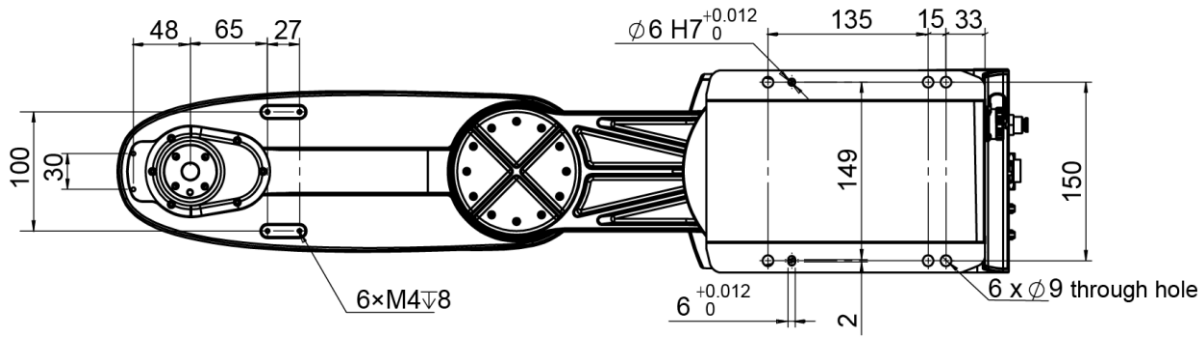


Figure 3-16 Product dimensions (Unit: mm)

3.5.3 Terminal flange dimensions

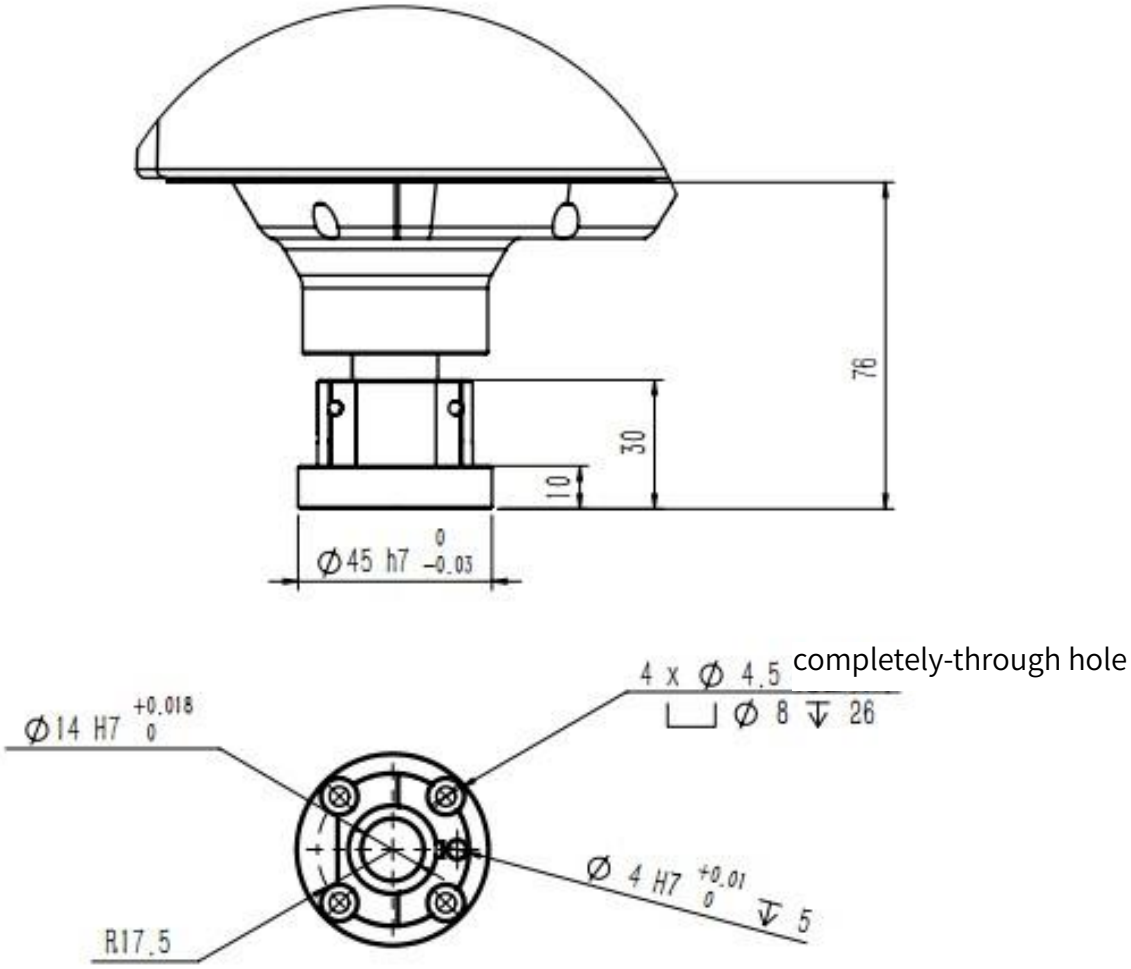


Figure 3-17 Installation dimensions of terminal flange (Unit: mm)

3.6 Technical parameters

Table 3-7 Technical parameters of AH6 Robot

		AH6-0500		AH6-0600		AH6-0700	
Model		AH6-0500-0204-2000	AH6-0500-0204-3000	AH6-0600-0204-2000	AH6-0600-0204-3000	AH6-0700-0204-2000	AH6-0700-0204-3000
Arm length (mm)	Full arm length	500		600		700	
	J1	225		325		425	
	J2	275		275		275	
Maximum speed	J1+J2 (mm/s)	7050		7750		8450	
	J3 (mm/s)	1100		1100		1100	
	J4 (°/s)	2150		2150		2150	
Work space	J1 (°)	±130		±130		±130	
	J2 (°)	±129		±148		±149	
	J3 (mm)	200	300	200	300	200	300
	J4 (°)	±360					
Repeatability	J1+J2 (mm)	±0.02					

	J3 (mm)	±0.01		
	J4 (°)	±0.01		
Rated load (Kg)		2		
Maximum load (Kg)		6		
J4 rated moment of inertia ($kg \cdot m^2$)		0.01		
J4 maximum moment of inertia ($kg \cdot m^2$)		0.12		
Total weight (kg)		27	28	29

3.7 Environmental parameters

Install the robot system in an environment that meets the following conditions to exert/maintain the performance of the robot and to ensure safe use.

Table 3-8 Environmental parameters

Installation Environment	Remark
Ambient temperature	0 ~ 40°C
Ambient relative humidity	10% - 90%, non-condensing
Ambient environment	Located indoors
	No flammable gas, dust or liquid
	No corrosive gas or substance
	Free from electromagnetic interference source, electrostatic discharge, etc. in the vicinity
Vibration	Free from influence by strong impact and vibration

The robot is not suitable for work in harsh environmental conditions. If used in a place that does not meet the above conditions, we welcome your inquiry.

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 acids or alkalis, otherwise the normal use of the robot would be affected.

3.8 Electrical parameters

Table 3-9 Robot electrical parameters

Item	Parameter
Rated voltage	230 V a.c. 50/60 Hz
Rated power	0.9 kW
Motor brake voltage	24 V d.c.
I/O interface	20 universal digital inputs, 6 high-speed inputs, 2 analog inputs, 18 universal digital outputs
Communication interface	Ethernet, RS-232
Noise level	⩽ 70 dB

Chapter 4 Introduction to Electrical Interfaces

4.1 External electrical interface

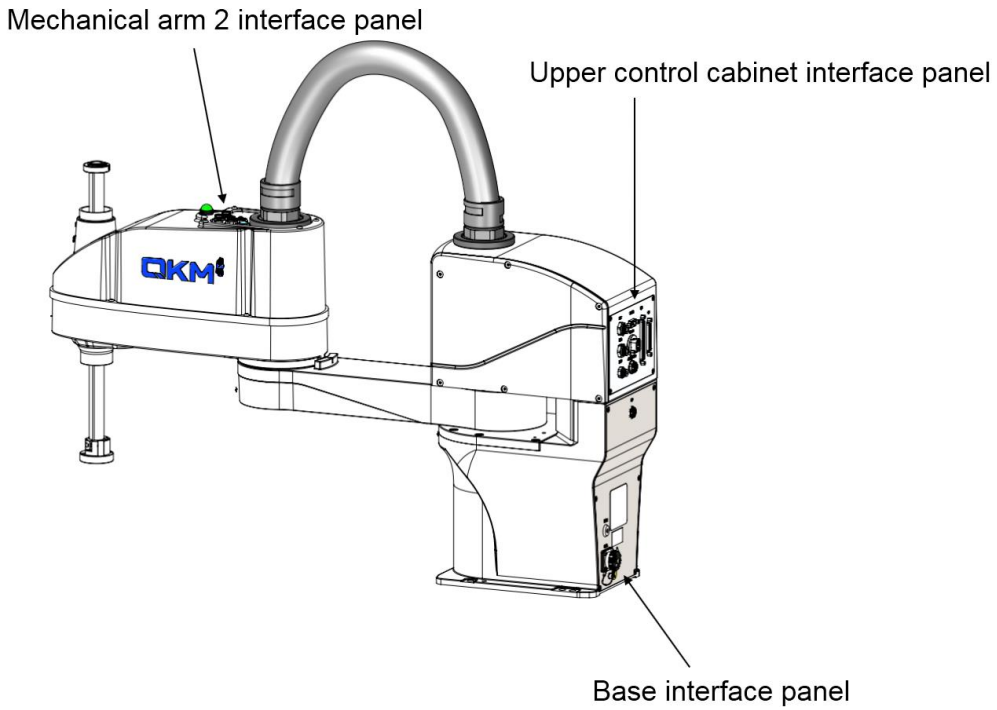


Figure 4-1 External interface panel

4.1.1 Mechanical arm 2 interface panel

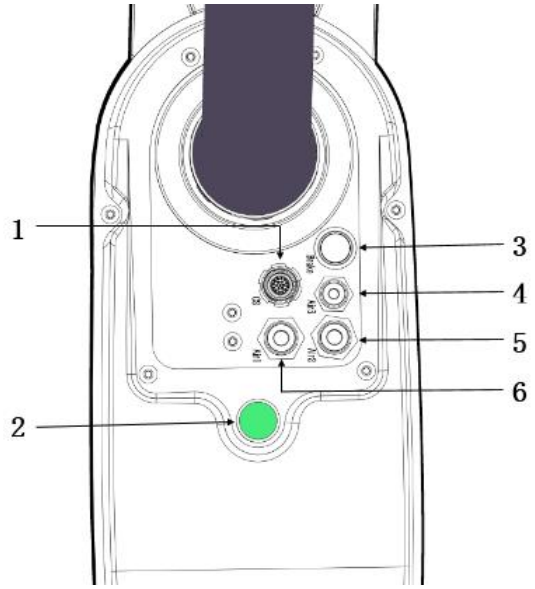


Figure 4-2 Schematic diagram of interface panel

Table 4-1 Interface panel description

No.	Name	Description	No.	Name	Description
1	CS	Customer signal interface (Customer Signal)	4	Air pipe connector	Connected to Φ4 air pipe
2	Indicator	ON (green) indicates that the robot has entered the servo state; OFF indicates that the robot is not in the servo state.	5	Air pipe connector	Connected to Φ6 air pipe

3	Brake	Brake button	6	Air pipe connector	Connected to Φ6 air pipe

4.1.2 Upper control cabinet interface panel

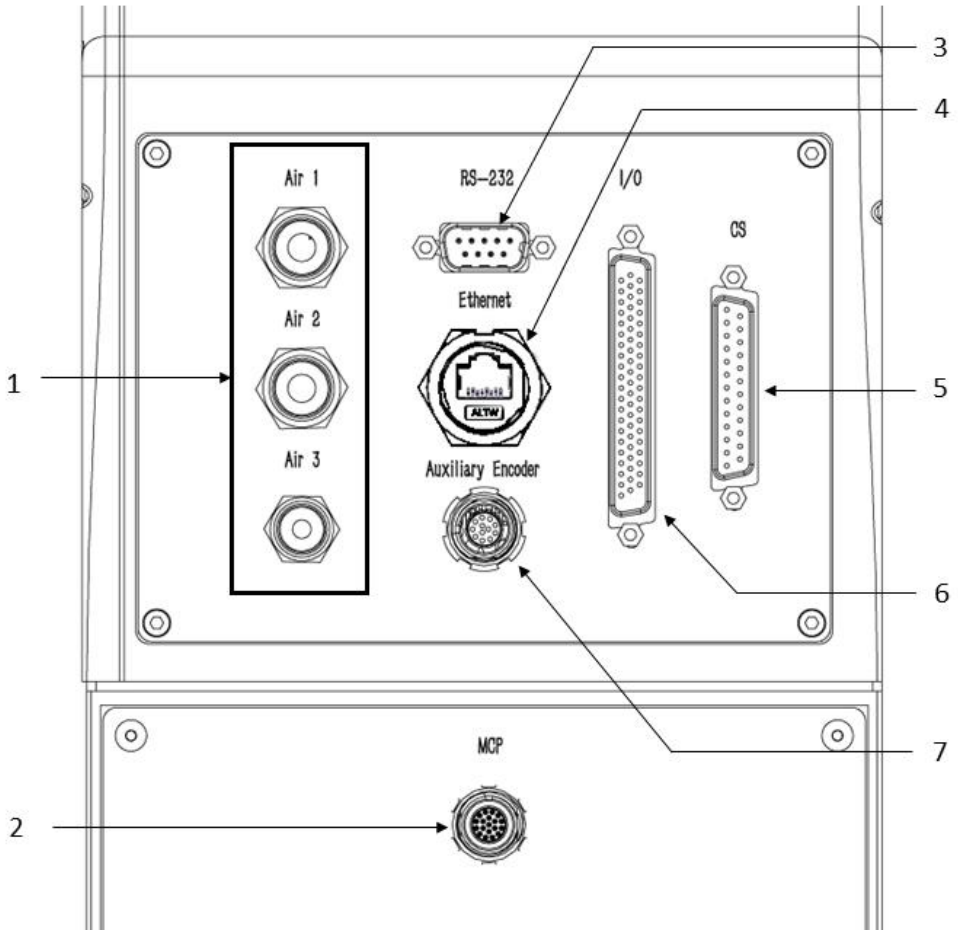


Figure 4-3 Schematic diagram of interface panel

Table 4-2 Interface panel description

No.	Name	Description	No.	Name	Description
1	Air1	Connected to Φ6 air pipe	5	CS	Customer signal interface (Customer Signal)
	Air2	Connected to Φ6 air pipe			
	Air3	Connected to Φ4 air pipe			
2	MCP	Emergency stop component interface/teach pendant interface	6	I/O	Digital input/output interface
3	RS-232	Communication interface	7	Auxiliary Encoder	Auxiliary encoder interface
4	Ethernet	Ethernet interface	/		

4.1.3 Base interface panel

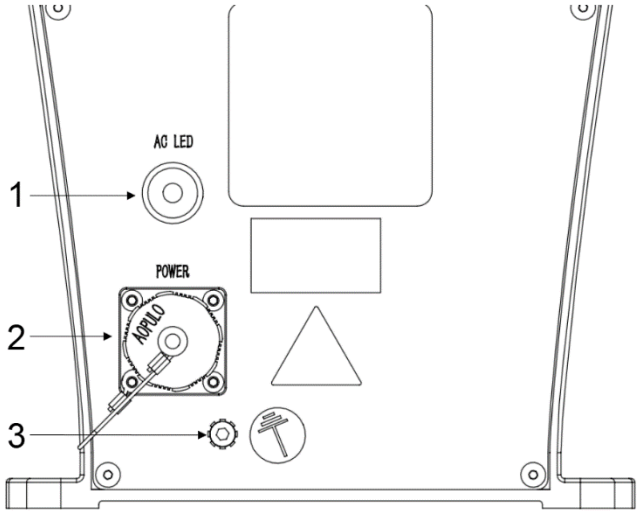


Figure 4-4 Schematic diagram of interface panel

Table 4-3 Interface panel description

No.	Name	Description	No.	Name	Description
1	AC LED	Main power indicator	2	POWER	Power interface
3	Grounding screw hole	For grounding	/		

4.2 Indicator description

AH6 Robot is equipped with AC LED on the base interface panel and system indicator on the mechanical arm 2. The status of the indicators is described below.

4.2.1 Main power indicator

Table 4-4 Description of power indicator status

Status	Description
OFF	Indicates that the robot is not powered on.
ON (red)	Indicates that the robot is powered on.

4.2.2 System indicator (Mechanical arm 2)

The system indicator is located at the top of the second mechanical arm of the robot. It is a circular LED light and it shows different colors when the robot works. The status of the system indicator is described below.

Table 4-5 Description of system indicator status

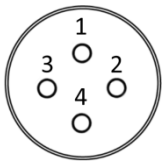
Status	Description
OFF	Indicates that the robot is not in the servo state.
ON (green)	Indicates that the robot has entered the servo state.

4.3 Definition of interface pins

This section provides detailed functions and descriptions of pins on the power interface, each interface of the upper control cabinet and the CS interface on the mechanical arm 2. The operations must be performed in accordance with the descriptions of the pins.

4.3.1 Power interface (POWER)

Table 4-6 Definition of power interface pins

Pin	Function	Description	230 V a.c. Power Interface
1	L	Live wire	 4-pin male front pinout
2	N	Neutral wire	
3	PE	Ground wire	
4	/	Idle	

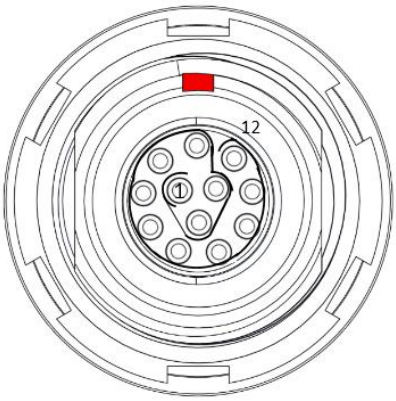
4.3.2 Auxiliary encoder

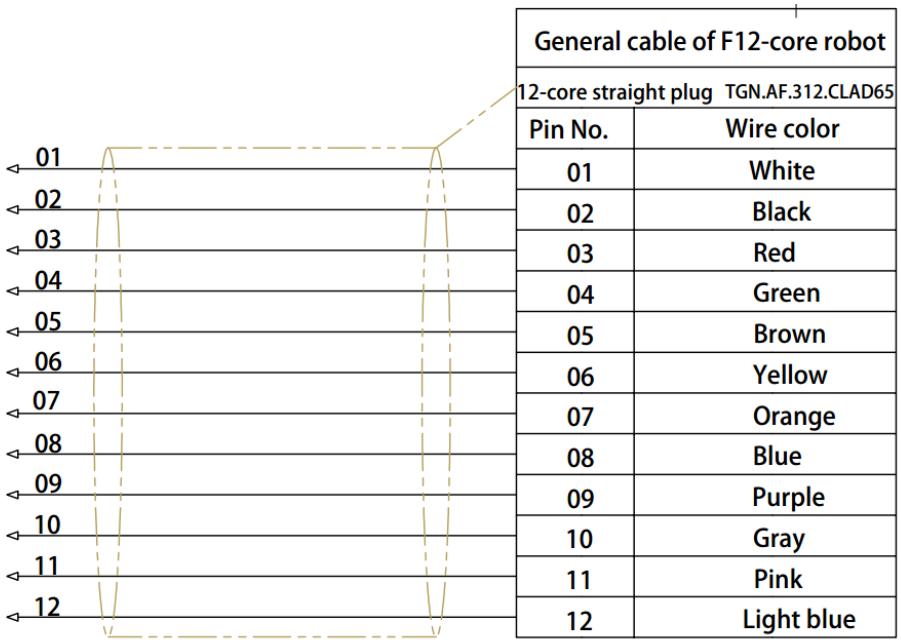
- The 5V pin in the auxiliary encoder interface is the DC output power supply.

- It is forbidden to connect the external power supply at the 5V pin of the auxiliary encoder, otherwise the internal circuit of the robot will be burned.

Table 4-7 Definition of auxiliary encoder pins

Auxiliary Encoder				
Axis No.	Pin	Function	Description	
Axis 1	01	Output 5 V d.c.	5 V d.c. output power	

	02	GND	Common ground	 12-pin female front pinout
	03	1A+	Axis 1 A+	
	04	1B+	Axis 1 B+	
	05	1Z+	Axis 1 Z+	
	06	F.G	Shielded cable	
Axis 2	07	Output 5 V d.c.	5 V d.c. output power	
	08	GND	Common ground	
	09	2A+	Axis 2 A+	
	10	2B+	Axis 2 B+	
	11	2Z+	Axis 2 Z+	
	12	F.G	Shielded cable	

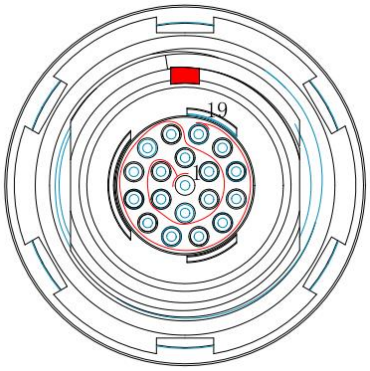


General cable of F12-core robot	
12-core straight plug TGN.AF.312.CLAD65	
Pin No.	Wire color
01	White
02	Black
03	Red
04	Green
05	Brown
06	Yellow
07	Orange
08	Blue
09	Purple
10	Gray
11	Pink
12	Light blue

Figure 4-5 Auxiliary encoder

4.3.3 MCP interface (MCP/E-stop)

Table 4-8 MCP Definition of MCP pins

MCP		
Pin	Function 1 (MCP)	
01	Auto/Manual 2	
02	Output 24 V d.c.	
03	Auto/Manual 1	
04	Output 24 V d.c.	
05	BI_D4+	
06	BI_D4-	
07	E-STOP_0	

08	GND	
09	RXD	
10	TXD	
11	E-STOP_2	
12	GND	
13	GND	
14	BI_D3+	
15	BI_D3-	
16	TX_D1+	
17	TX_D1-	
18	RX_D2+	
19	RX_D2-	

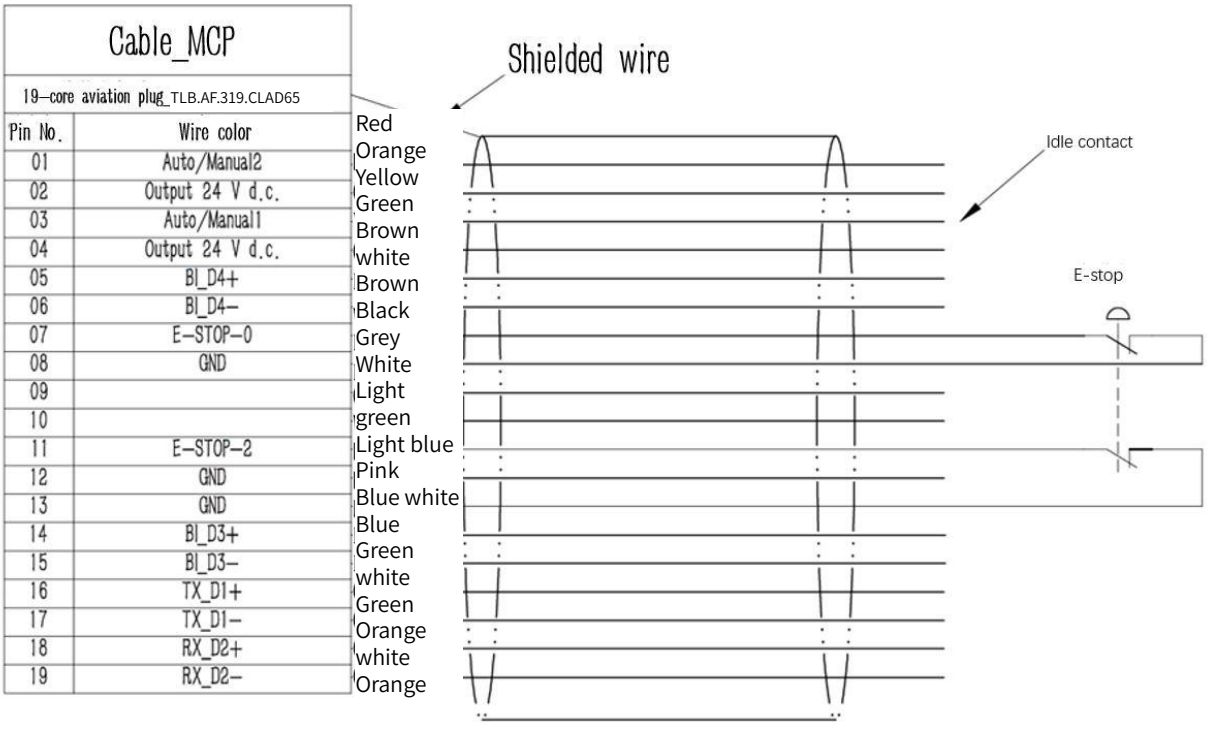
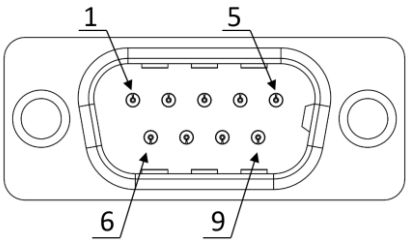


Figure 4-6 Wiring diagram of emergency stop device

4.3.4 Communication interface (RS-232)

Table 4-9 Definition of RS-232 pins

Definition of RS-232 pins			
Pin	Function	Description	
01	/	Unused	
02	RXD	Receive data	
03	TXD	Transmit data	
04	/	Unused	
05	GND	Ground terminal	
06	/	Unused	
07	/	Unused	
08	/	Unused	
09	/	Unused	

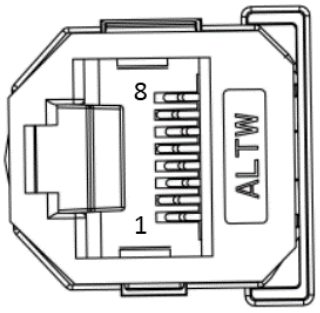


9-pin male front pinout

4.3.5 Ethernet interface (Ethernet)

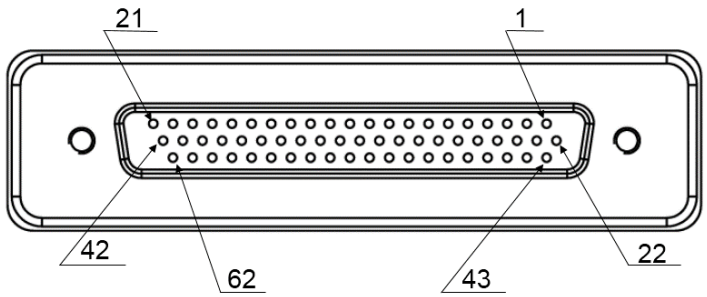
Table 4-10 Definition of Ethernet interface pins

Ethernet interface			
Pin	Signal name	Description	

01	TX_D1+	Tranceivie data +	 8-pin front interface
02	TX_D1-	Tranceivie data -	
03	RX_D2+	Receive data +	
04	BI_D3+	Bi-directional data +	
05	BI_D3-	Bi-directional data -	
06	RX_D2-	Receive data -	
07	BI_D4+	Bi-directional data +	
08	BI_D4-	Bi-directional data -	

4.3.6 Digital input/output interface (I/O)

Table 4-11 Definition of I/O interface pins

Definition of I/O interface pins			
 62-core female front pinout			
Pin	Function	Signal encoding	Description
01	E-DO_1	20101	General purpose output 1
02	E-DO_2	20102	General purpose output 2
03	Output 24 V d.c①	/	24 V d.c. output power
04	GND	/	Common ground
05	E-DO_3	20103	General purpose output 3
06	E-DO_4	20104	General purpose output 4
07	E-DO_5	20105	General purpose output 5
08	E-DO_6	20106	General purpose output 6
09	Output 24 V d.c①	/	24 V d.c. output power
10	GND	/	Common ground

11	E-DO_7	20107	General purpose output 7
12	E-DO_8	20108	General purpose output 8
13	E-DO_9	20109	General purpose output 9
14	E-DO_10	20110	General purpose output 10
15	Output 24 V d.c ①	/	24 V d.c. output power
16	GND	/	Common ground
17	E-DO_11	20111	General purpose output 11
18	E-DO_12	20112	General purpose output 12
19	E-DO_13	20113	General purpose output 13
20	E-DO_14	20114	General purpose output 14
21	Output 24 V d.c ①	/	24 V d.c. output power
22	GND	/	Common ground
23	E-DO_15	20115	General purpose output 15
24	E-DO_16	20116	General purpose output 16
25	E-DO_17	20117	General purpose output 17
26	E-DO_18	20118	General purpose output 18
27	Output 24 V d.c ①	/	24 V d.c. output power

28	GND	/	Common ground
29	E-HDI_1	30101	High speed input 1
30	E-HDI_2	30102	High speed input 2
31	E-HDI_3	30103	High speed input 3
32	E-HDI_4	30104	High speed input 4
33	GND	/	Common ground
34	E-DI_1	10101	General purpose input 1
35	E-DI_2	10102	General purpose input 2
36	E-DI_3	10103	General purpose input 3
37	E-DI_4	10104	General purpose input 4
38	E-DI_5	10105	General purpose input 5
39	E-DI_6	10106	General purpose input 6
40	E-DI_7	10107	General purpose input 7
41	E-DI_8	10108	General purpose input 8
42	GND	/	Common ground
43	E-DI_9	10109	General purpose input 9
44	E-DI_10	10110	General purpose input 10
45	E-DI_11	10111	General purpose input 11
46	E-DI_12	10112	General purpose input 12

47	E-DI_13	10113	General purpose input 13
48	E-DI_14	10114	General purpose input 14
49	E-DI_15	10115	General purpose input 15
50	E-DI_16	10116	General purpose input 16
51	E-DI_17	10117	General purpose input 17
52	E-DI_18	10118	General purpose input 18
53	E-DI_19	10119	General purpose input 19
54	E-DI_20	10120	General purpose input 20
55	GND	/	Common ground
56	E-HDI_5	30105	High speed input 5
57	E-HDI_6	30106	High speed input 6
58	GND	/	Common ground
59	E-AI-1	60101	Analog input 1
60	AGND1	/	Analog input common ground 1
61	E-AI-2	60102	Analog input 2
62	AGND2	/	Analog input common ground 2

Note ①: The rated current of one-way 24 V output power supply is 1 A.

24V DC output power supply can not be used to connect to external equipment, but can only be used for I / O output

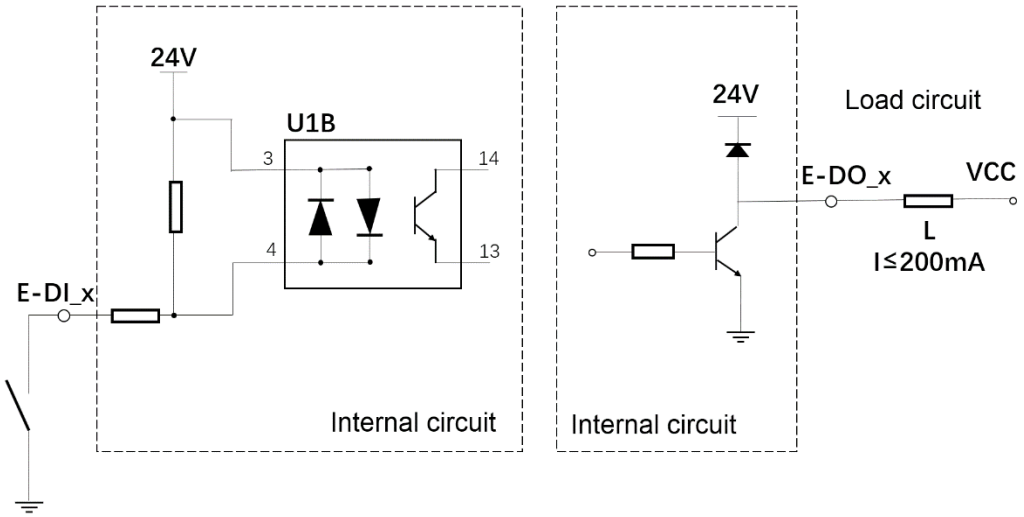
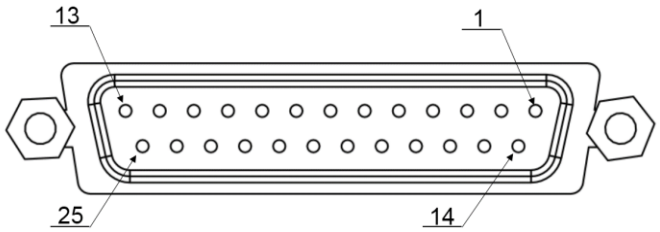
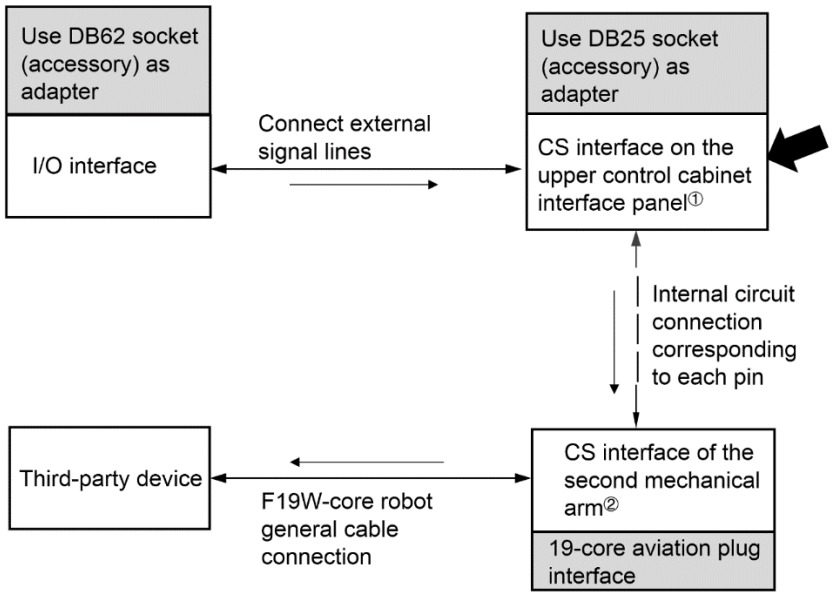


Figure 4-7 Diagram of input circuit (left) and output circuit (right)

4.3.7 Customer signal interface of upper control cabinet (CS)

Table 4-12 Definition of upper control cabinet CS interface pins

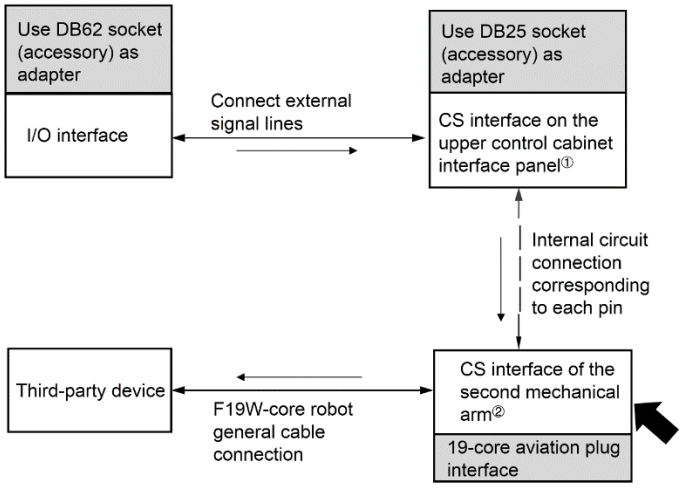
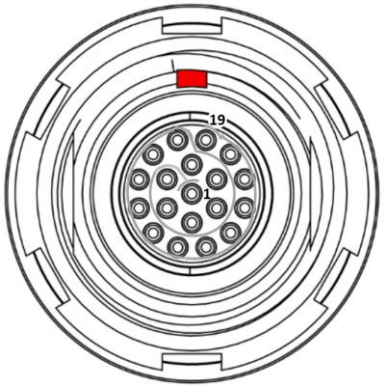
Definition of upper control cabinet CS interface pins	
 25-pin female front pinout	
Pin	Description
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	
11	
12	
13	



14	
15	
16	
17	
18	
19-25	Idle

4.3.8 Customer signal interface of mechanical arm 2 (CS)

Table 4-13 Definition of mechanical arm 2 CS interface pins

Definition of mechanical arm 2 CS interface pins		
Pin	Description	
01		 19-pin female front pinout
02		
03		
04		
05		
06		
07		
08		
09		
10		
11		
12		
13		
14		
15		
16		

17		
18		
19	Idle	

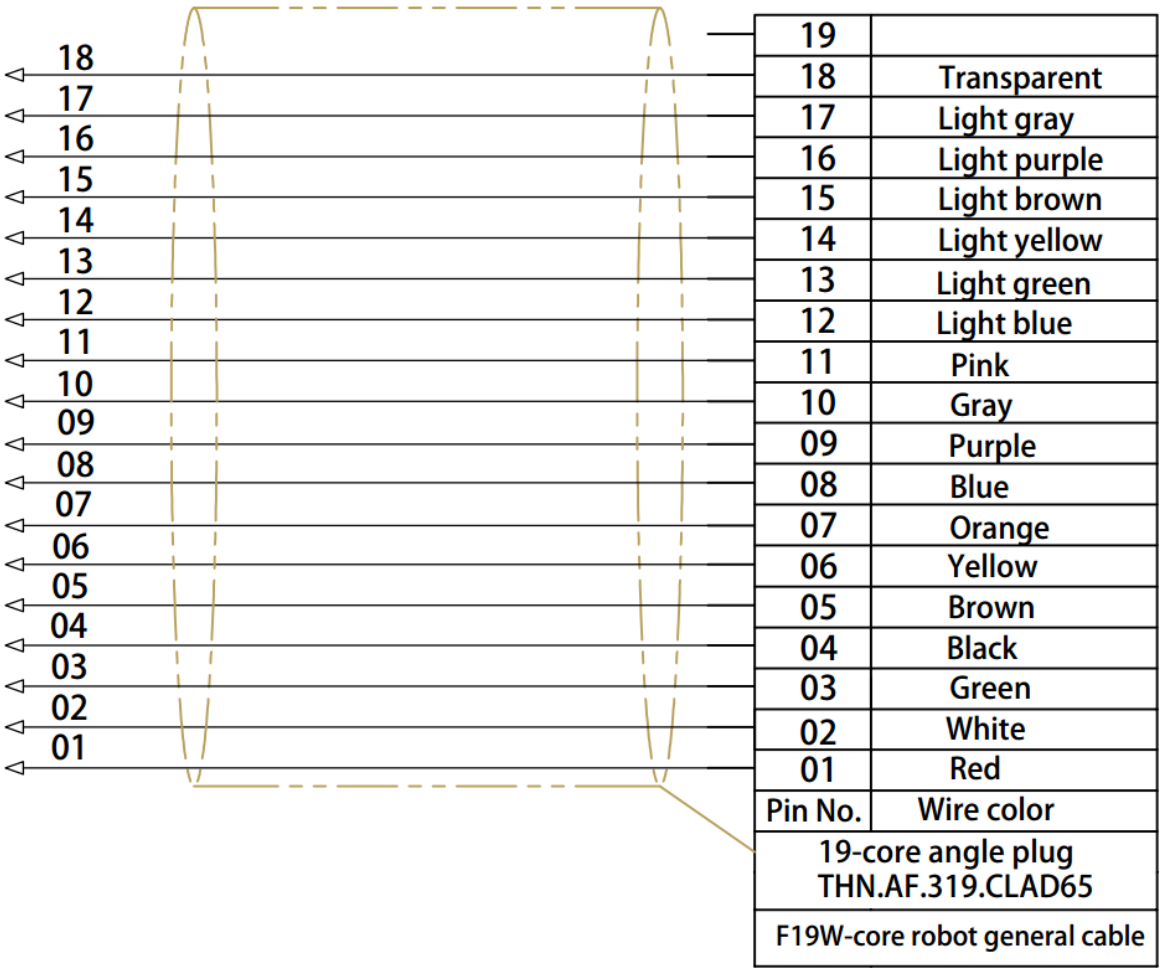


Figure 4-8 Wiring diagram of CS interface of F19W-core robot general cable

1. Take out the DB62, DB25 welding header and plug shell from the accessory box, refer to the I/O interface pin definition table, and weld and make I/O cable and CS cable as needed;

2. Under the premise of turning off the power supply of the robot, plug the I/O cable and CS cable respectively to the socket corresponding to the interface panel of the robot base, and lock the fixing screw on the plug with a Phillips screwdriver;

3. Take out the two-joint universal cable in the accessory box and plug it into the CS aviation socket of the two-joint interface panel, at this time the universal cable and the CS cable have been conducted;

4. Then, short-connect the pin pin that needs to be freely allocated on the I/O cable with the CS cable (must use electrical tape, etc. for protection), you can realize the I/O in the pin corresponding to the general cable to conduct, and complete the free allocation of I/O.

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.

5.1 Installation requirements

Users should design the rack for fixing the robot personally. The shape and size of the rack may vary depending on the purpose of the robot.

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 bottom surface of the robot is parallel to the mounting surface.
- The area of the mounting surface is not less than that of the bottom surface of the robot.
- Fix the rack externally (on the ground) and ensure that it will not move.
- The holes on the rack for installing the mechanical arm should be M8 threaded holes. When installing the mechanical arm, use bolts with a strength meeting ISO898-1 property class 10.9 or 12.9.

NOTICE If 4040 square tube is used for welding, ground screws (not less than M12) should be used for fixing.

In order to suppress vibration, the installation panel of the mechanical arm should be iron plate with a thickness of 20mm or more, a surface roughness of 12.5 μm or less and a flatness of less than 0.5 mm.

- The poor accuracy of the installation surface would degrade the positioning accuracy of the robot.

NOTICE

- 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.

- Installation example

Fix the bottom plate on the ground with anchor bolts (M12 or more). The bottom plate must be sufficiently strong and rigid. The bottom plate with a thickness of 20mm or more is recommended.

Position and install the robot base through four mounting holes and two pin holes. Fix it with M8*25 hexagon bolts, elastic washers and flat washers. In order to prevent the hexagon bolts from loosening during the operation of the robot, sufficiently tighten them following the method described.

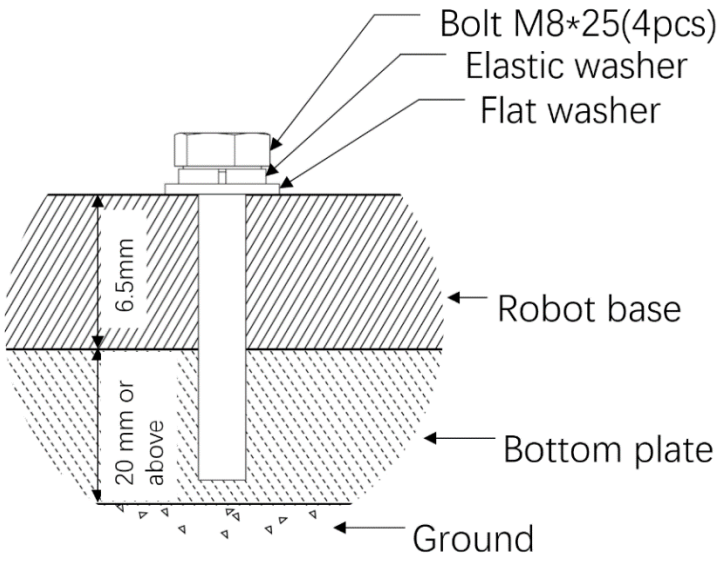


Figure 5-1 Installation diagram

5.2 Product confirmation

After unpacking, confirm the product components and status according to the packing list. The standard shipping list contains the following items:

- AH6 Robot body
- Accessories box (containing user manual)

NOTICE

In case of any damage or component incompletion after unpacking, please contact QKM or local office.

5.3 Installation site and environment

The installation of AH6 Robot shall meet the following conditions.

- The ambient temperature during transportation maintains at 0 ~ 40°C.

- The site is dry, with low moisture, ⩽90% relative humidity, and free from condensation.
- The site causes small vibration and impact to the robot (vibration of less than 0.5G).
- The robot must be installed away from flammable or corrosive liquids or gases and sources of electrical interference.

5.4 Installation of external parts

External equipment, such as vision camera, solenoid valve, etc. can be installed through the holes at the front end of the second mechanical arm of AH6 Robot. You can install external equipment by designing and fixing the bracket depending on the scenarios. The installation dimensions at the fixing position are shown inFigure 5-2.

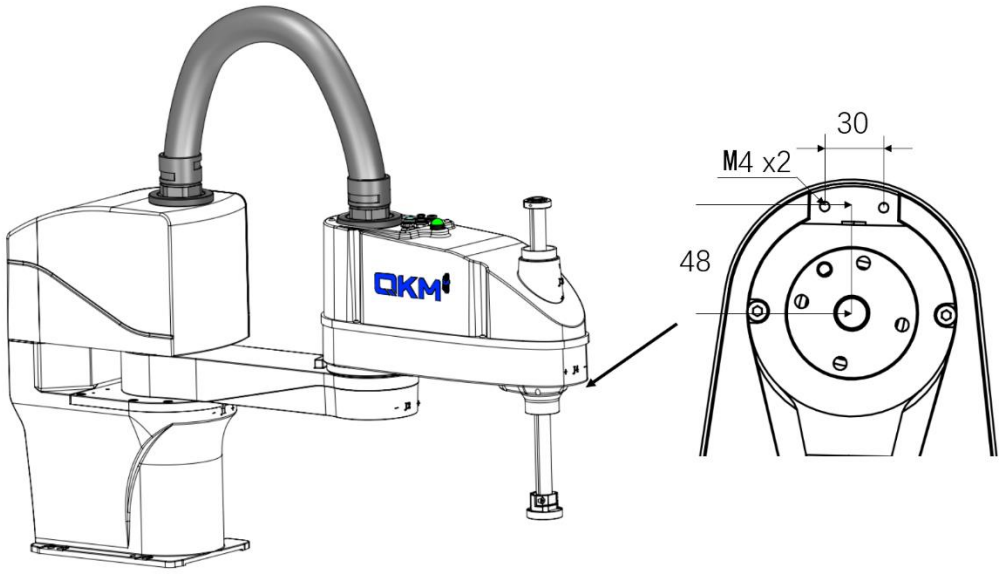


Figure 5-2 external parts mounting position（unit：mm）

NOTICE

When the robot is powered on for the first time, it is necessary to check the rotation angle of the fourth axis, return to zero first, and then install the tool to avoid finding the super soft limit of the fourth axis after the tool is installed.

5.4.1 Installation of camera (optional)

Install the camera as shown in the figure. The figure only shows one installation method. You can install the camera as required. If you use the installation method as shown in the figure, M4 screw holes are used here and you should prepare the screws yourself.

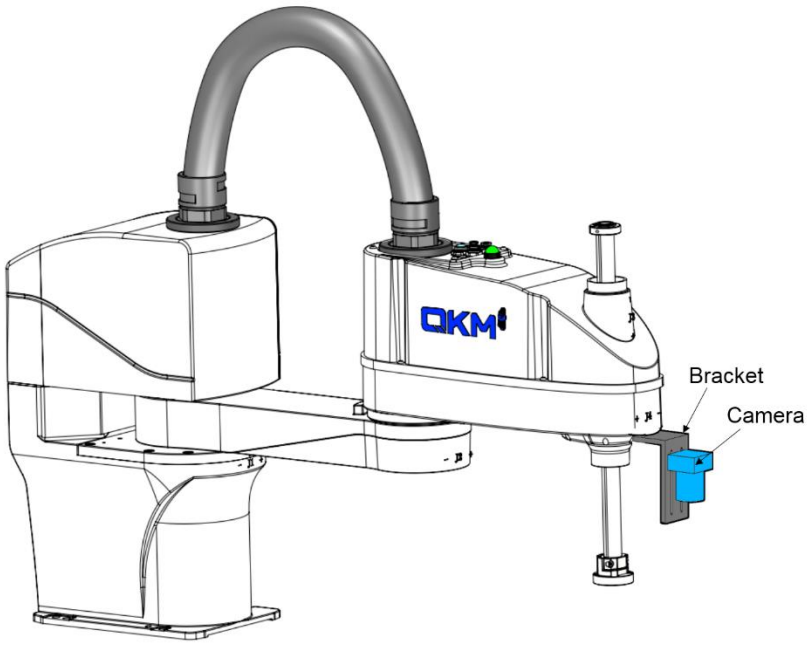


Figure 5-3 Schematic diagram of camera installation

5.5 Handling of robot

Use a forklift or the like to handle the robot in a packed state as far as possible. Comply with the following requirements when handling and unpacking the robot.

The installation should be performed by qualified personnel. Take care not to impact the equipment when unpacking.

- The robot should be lifted with crane or handled with forklift by professionals. Serious injuries or damage would be caused if the operation is performed by non-professionals.
- When lifting the robot, hold it by hand to ensure balance. Unstable lifting may result in serious injuries or damage when the robot falls.
- The packing box of the robot should be placed vertically upwards. Handle it with care and prevent it from damage due to collision.
- Do not remove the fixing bolts, or the robot fixed on the handling tray would roll over. Be careful not to allow your hands or feet to be clamped by the robot.

- The robot must be held by at least two persons with their hands when handling it with a forklift or a crane.

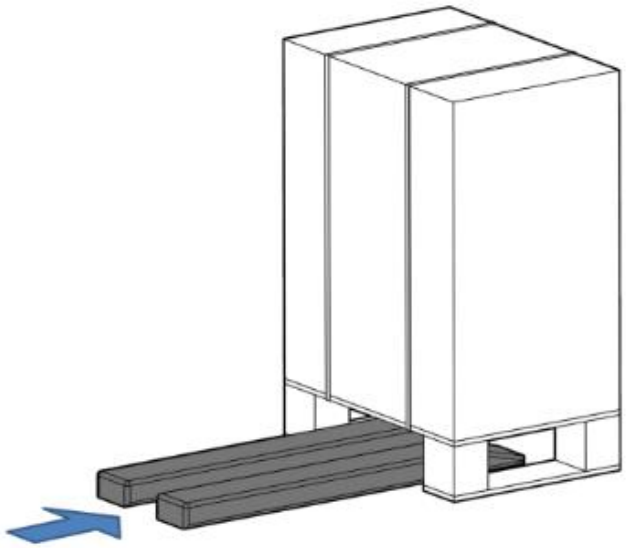


Figure 5-4 Schematic diagram of packaging and transportation

Use scissors to cut the cable ties outside the packing carton, then lift out the carton and store it properly.

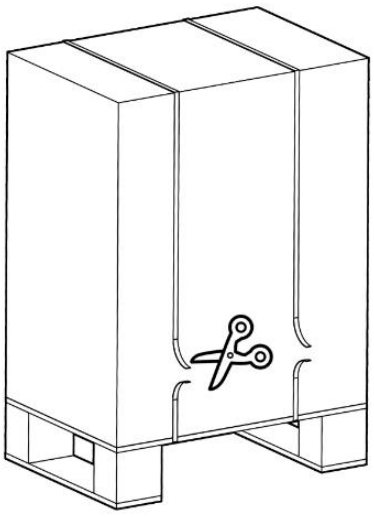


Figure 5-5 Cut the cable ties

NOTE Fold the carton and store it for multiple use.

5.6 Base installation

Table 5-1 Tightening torque

Fixing bolt	Tightening torque
M8*25	35 N·m

Use bolts, elastic washers and flat washers to install the base. The dimensions and installation of the bolts and washers are shown in Figure 5-6.

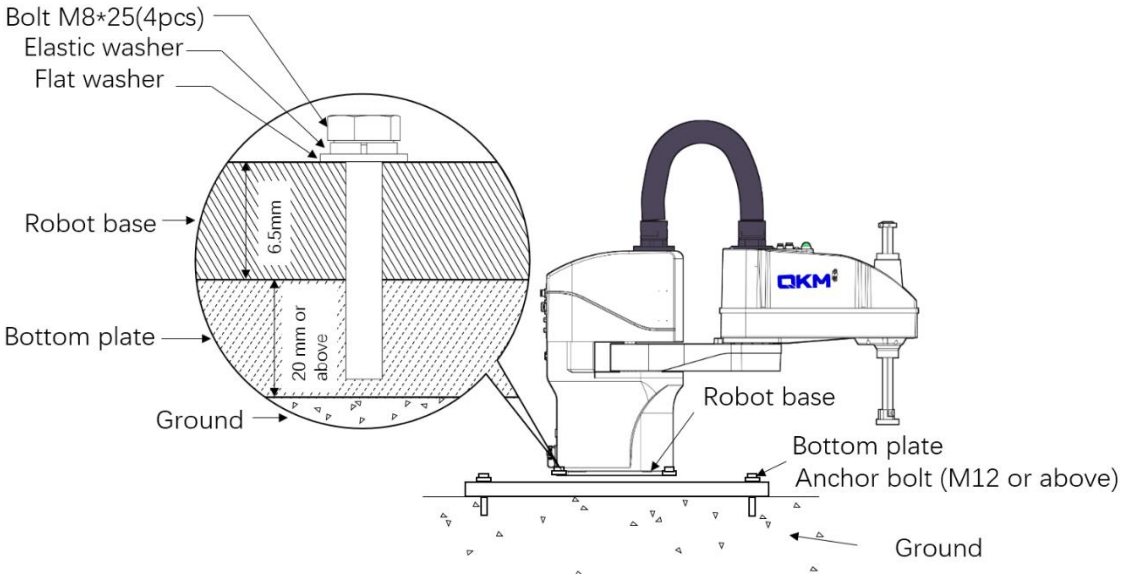


Figure 5-6 Installation of bolts in the base

NOTE

- The base of the robot must be installed by at least two professionals. Pay full attention to avoid damage due to mechanical arm movement or to prevent hands or feet from being clamped.
- Fix the robot onto the rack with specified number of bolts meeting the requirement of tightening torque.

5.7 Ground protection

Each AH6 Robot is labeled with a "Ground Protection" sign and equipped with a ground terminal. Connect the ground terminal of the robot base to the external protective conductor.

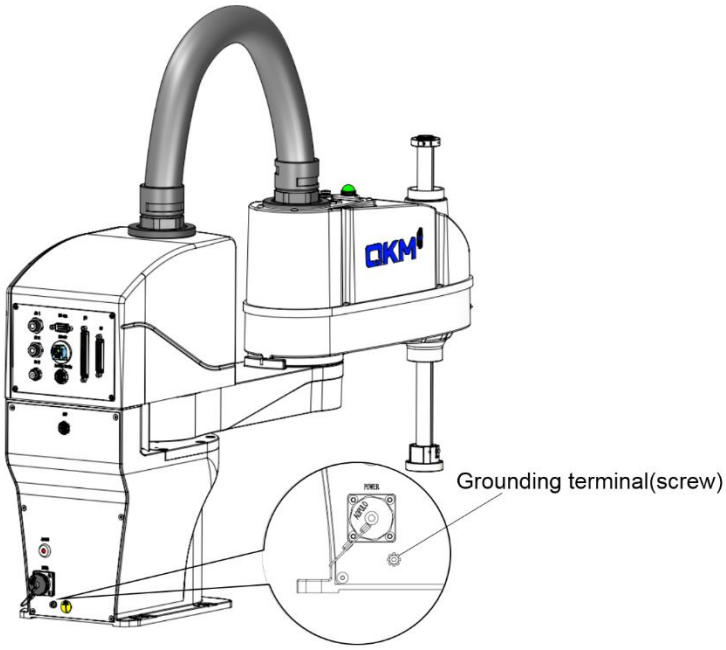


Figure 5-7 Schematic diagram of ground connection

5.8 Installation of robot cable

- Connect the robot to other equipment when the robot is powered off.
- The bending or breaking of cable connector pins and cable damage may cause anomalies when connecting to the robot. Check whether the above conditions exist before connection.

- When cabling the robot, do not interfere with the motion of the robot. The area where load is applied on the cable and the front end of the robot would cause interference. Do not regard it as the work area, to avoid damage to the cable of the robot.

Do not plug or unplug the cable connector when the robot is powered on, or the internal circuit may be burnt out.

5.8.1 Communication connection

AH6 Robot communicates via Ethernet.

Cable to be used: CAT5E network cable

Step 1 Install one end of the network cable to the "Ethernet" interface on the interface panel of the robot back.

Step 2 Insert the other end of the network cable into the PC or IPC port as shown in Figure 5-8

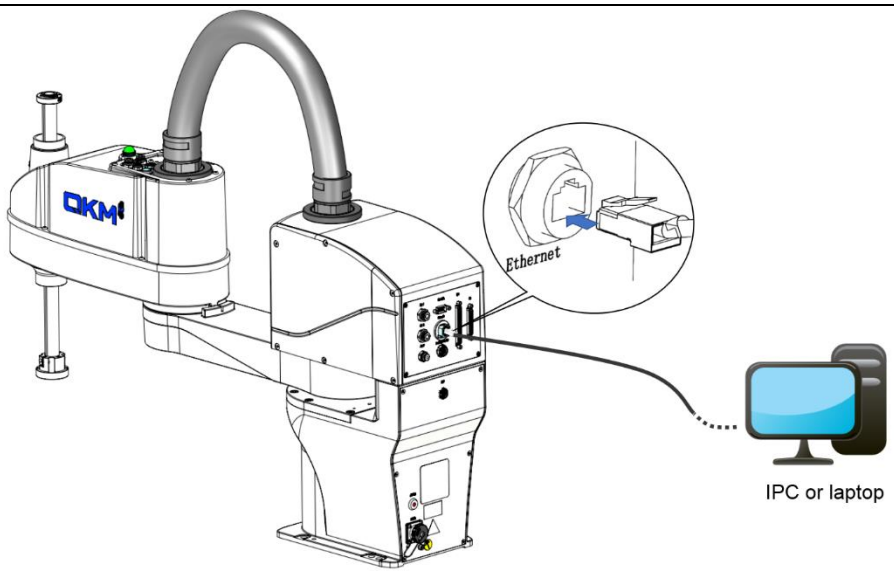


Figure 5-8 Schematic diagram of communication connection

5.8.2 Connection of emergency stop device

AH6 Robot is provided with an emergency stop device with cable at delivery.

Cable to be used: cable for emergency stop device

NOTE If a teach pendant is purchased, you need to prepare the teach pendant, and then install and use the cables according to the teach pendant user manual.

The wiring steps are shown below.

Step 1 Take out the provided emergency stop device and install its aviation plug at the "MCP" interface on the interface panel of the robot.

Step 2 Place the emergency stop button box in a position that will allow easy operation by users.

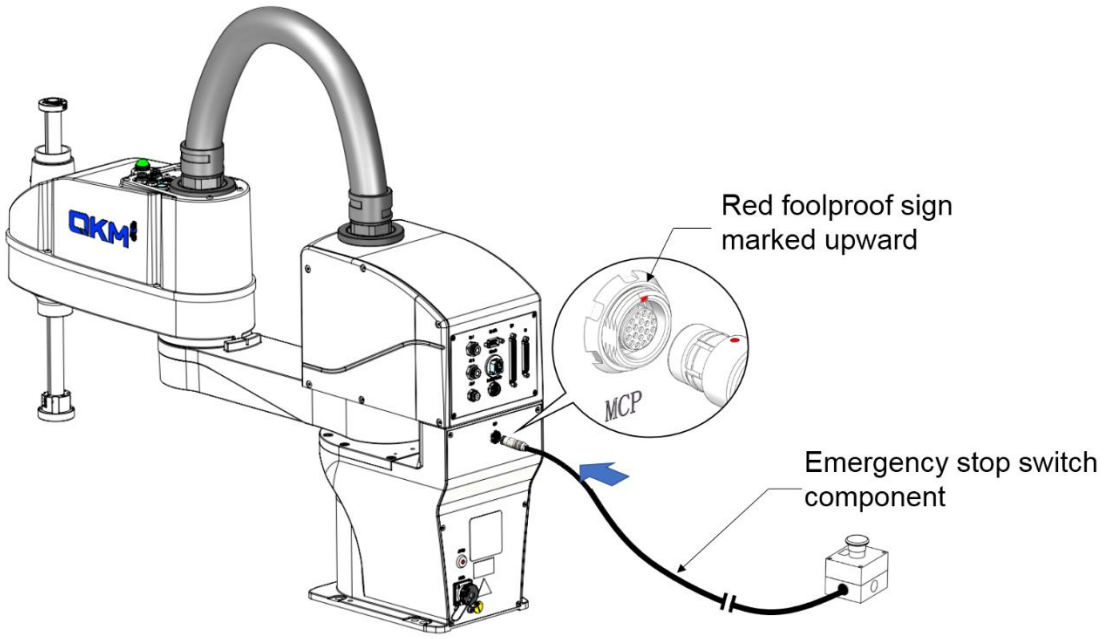


Figure 5-9 Schematic diagram of emergency stop device connection

5.8.3 Power connection

AH6 Robot has achieved integrated design without power supply box for power connection, which is convenient for use.

Cable to be used: Power cable

The wiring steps are shown below.

Step 1 Take the power cable out of the accessories box. Install the aviation plug end of the power cable at the "POWER" interface of the robot.

Step 2 Tighten the screw cap of the aviation plug clockwise.

Step 3 Plug the other end of the power cable into the 230 V a.c. socket.

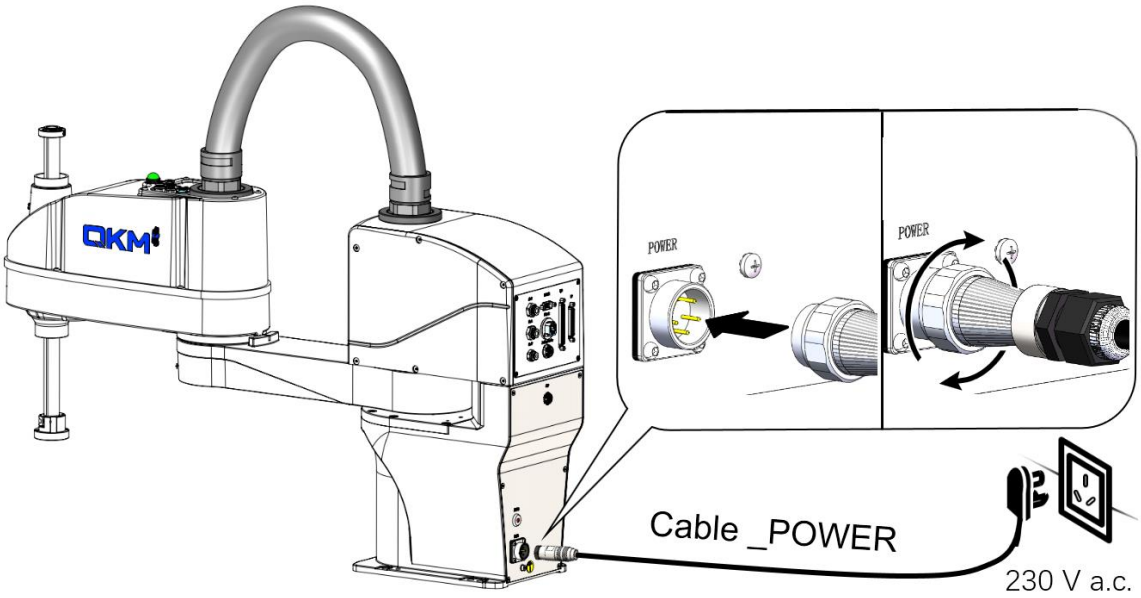


Figure 5-10 Connection of power cable to socket and robot

- 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."

NOTICE

- Avoid poor contact and ensure that the screw cap needs to be rotated to the end without loosening.
- Provide 230 V a.c. power supply as required; do not connect directly to the factory power supply. The connection of a servo plug to the factory power supply would cause failure in the robot system.

5.8.4 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.

5.8.5 Check before power-on

Ensure that:

1) each fastener of the robot is free from loose connection.

2) necessary protective devices have been properly installed and functioned well.

3) the voltage level of the energized electrical equipment is equal to that of the power supplied.

4) the power plug of the equipment is not shorted when checked with a multimeter before power-on.

5) all cable heads are correctly connected to buses and they are securely installed.

Check safety functions to ensure that:

1) the equipment is in a well-insulated environment.

2) the main power cable is grounded and the triangle plug is firmly inserted into the socket to prevent electric shock.

3) the emergency stop button is connected to the robot.

5.9 Robot movement and storage

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

- When transporting the robot, fix it on a handling equipment to prevent it from rolling over as it would clamp hands or feet of the operators.
- When hoisting the robot with a crane, hold it by hand to ensure balance. The loss of balance may cause the robot to fall, resulting in personal injury and robot damage.

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 robots need to be used in the ARM (Automation Rescource Manager) software programming environment. ARM software is suitable for the robot software programming environment produced by QKM. Users can write programs based on the software to 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.

- Users can write programs based on the software and send commands to operate the robot. For specific robot program programming operations, please refer to the “QKM Robot Command Manual” and “QKM Robot (QRL Language) Programming Manual”. Users can download the latest version of the manual through the company's official website.
- If the robot reports an error during use, you can refer to the QKM Robot Error Code Manual for abnormal

information. Users can download the latest version of the manual through the 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) Proficiency in QRL language.

QRL (QKM Robot Language) is a robot secondary development language based on Lua language and independently defined on the Lie group motion control system platform. The QRL language is simple and easy to program, not only supports single statement instruction execution, but also supports mathematical arithmetic operations, logical operations, conditional control, loop statement control, thread control and other functions. It can automatically execute defined commands by performing complex operations, string processing, performing interaction between users and projects, and other functions; Users can easily and conveniently develop robot integration projects by editing and sending command programs.

3) Familiar with the mode of motion of the robot.

6.2 Programming environment installation

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.

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.

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, as shown in Figure 6-1.

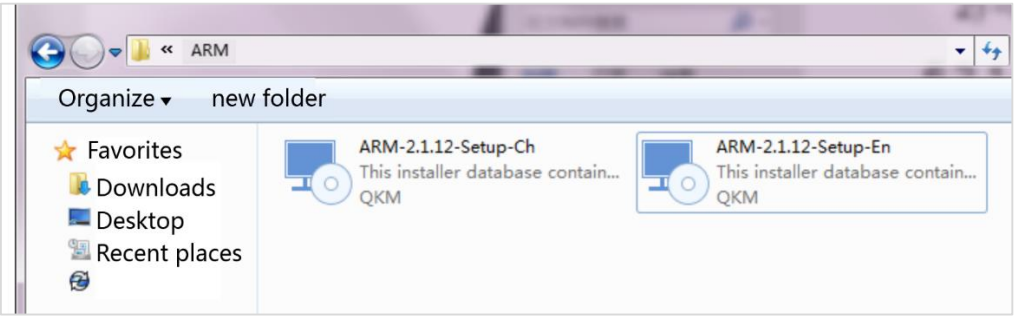


Figure 6-1 Installation package

Step 2 Double-click the left button to install the software, as shown in Figure 6-2.

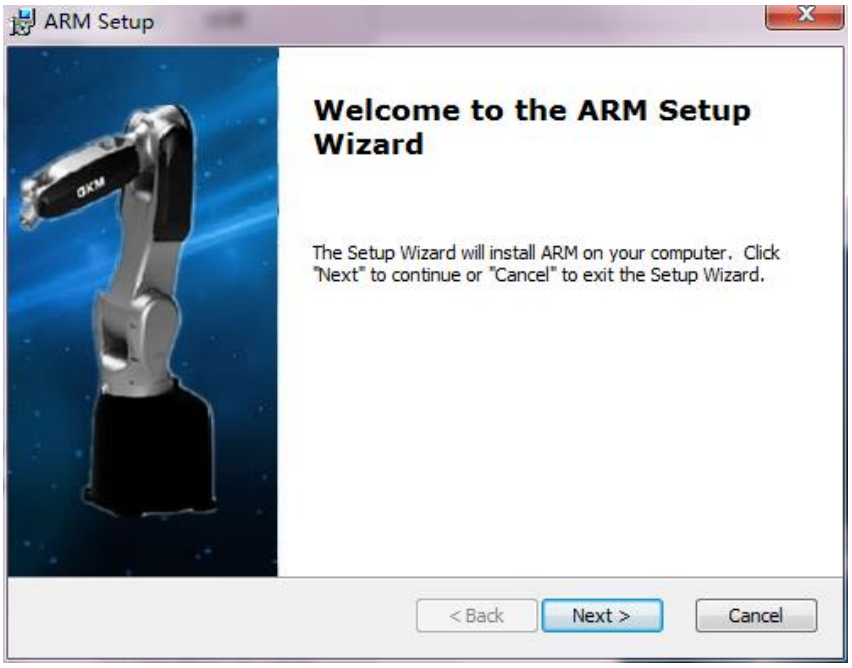


Figure 6-2 Start installation

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

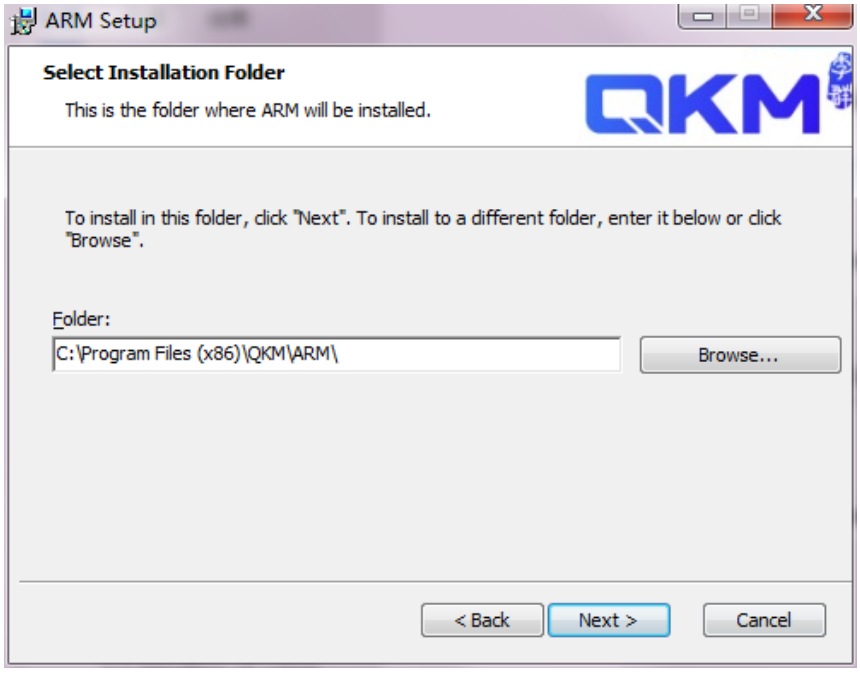


Figure 6-3 Choose installation path

Step 4 Choose the installation path and click on "Next", as shown in Figure 6-4.

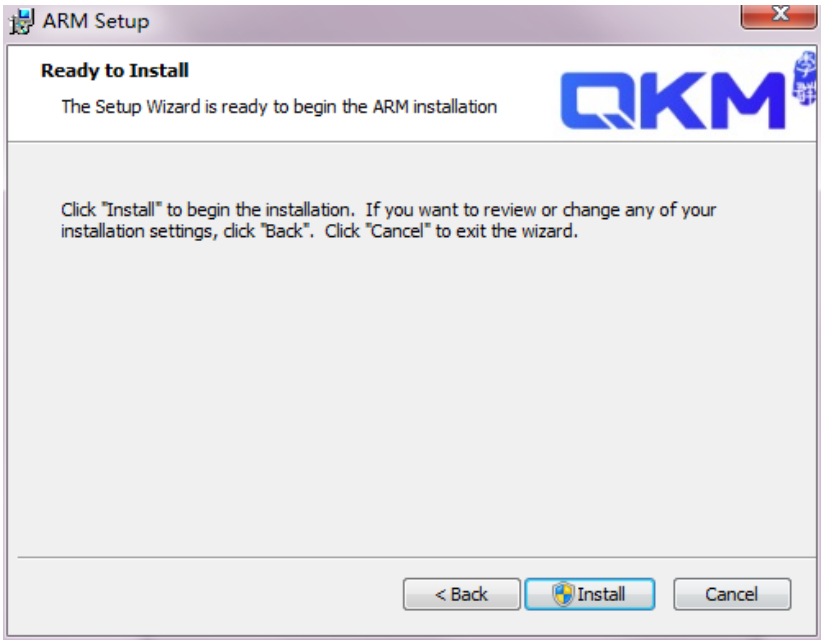


Figure 6-4 Successful installation

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

6.3 Open Macro Command Debugger

Step 1 Double-click the installed ARM to open the ARM interface, and then click < window > on the menu bar to switch to <Pallas> mode,

as shown in Figure 6-5.

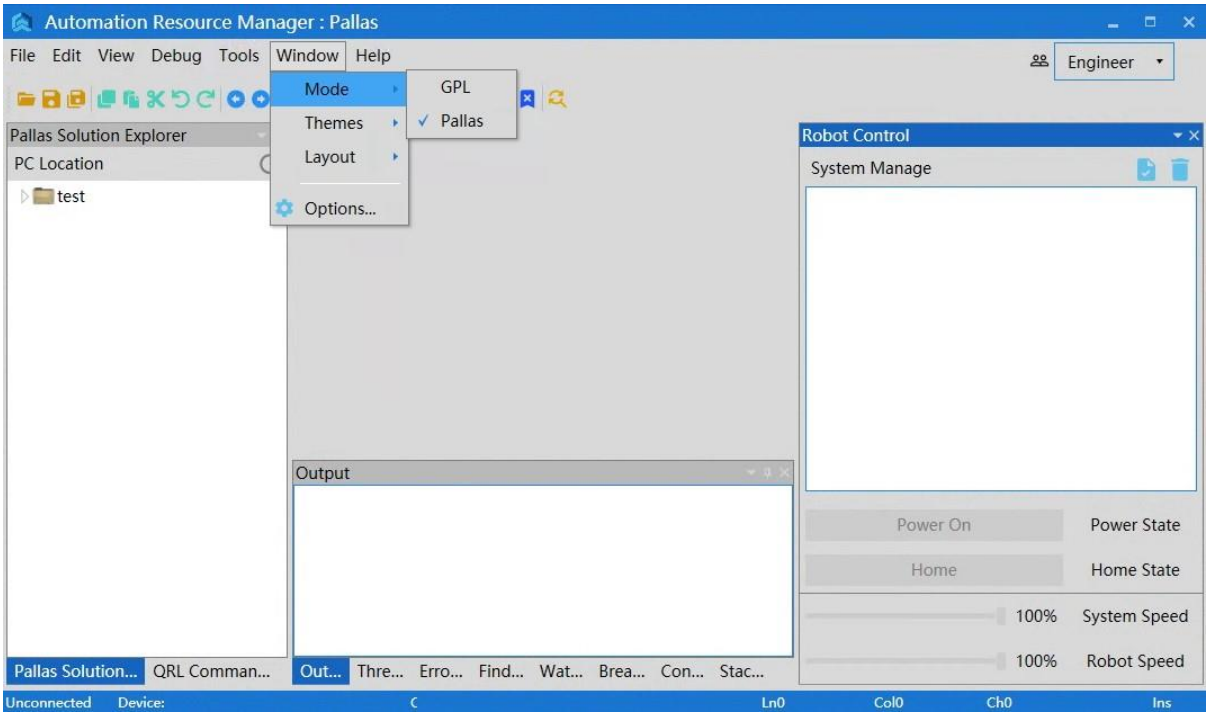


Figure 6-5 ARM interface

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

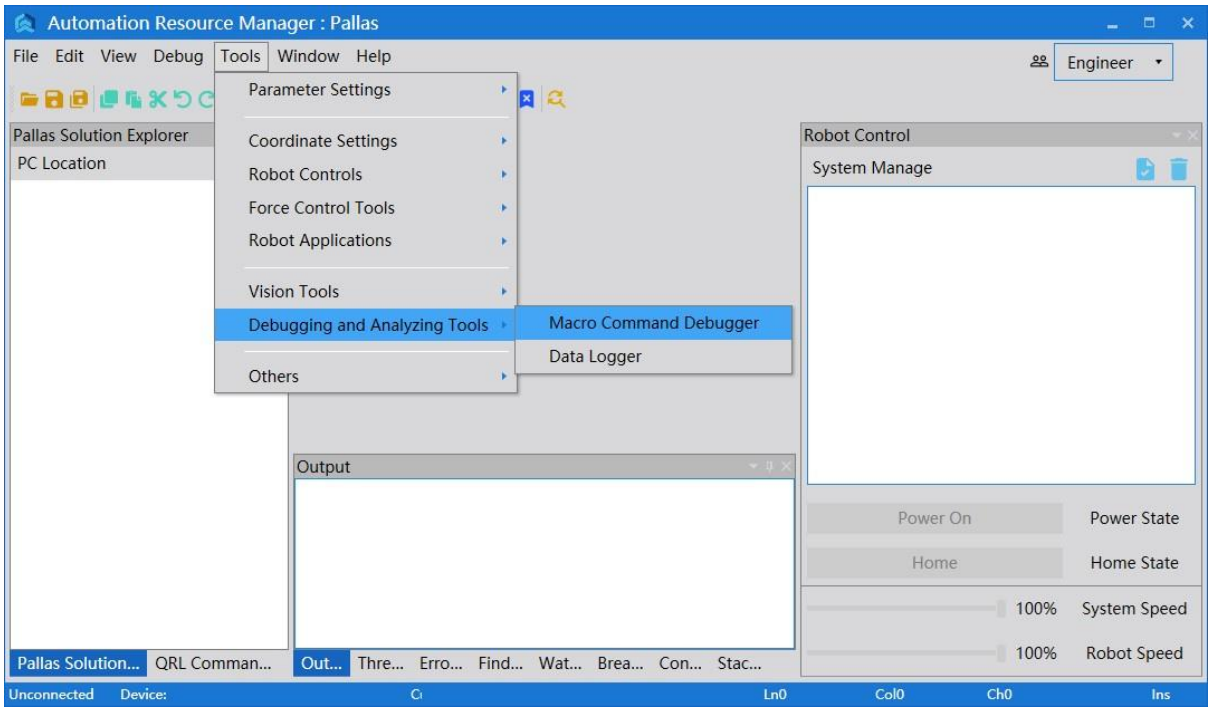


Figure 6-6 ARM interface

Step 3 The macro command debugger is shown in Figure 6-7.

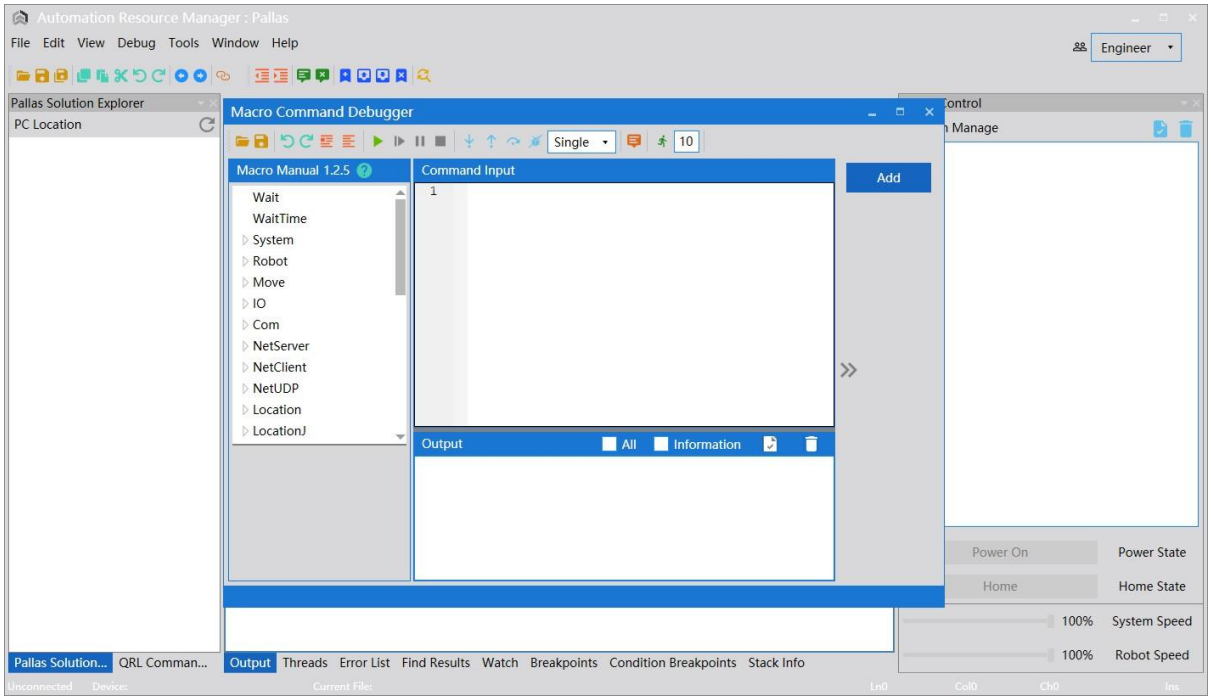


Figure 6-7 Macro Command Debugger

6.4 Functions of macro command debugger

NOTE

The macro command debugger is used in the installed ARM programming environment.

6.4.1 Macro Command Debugger interface

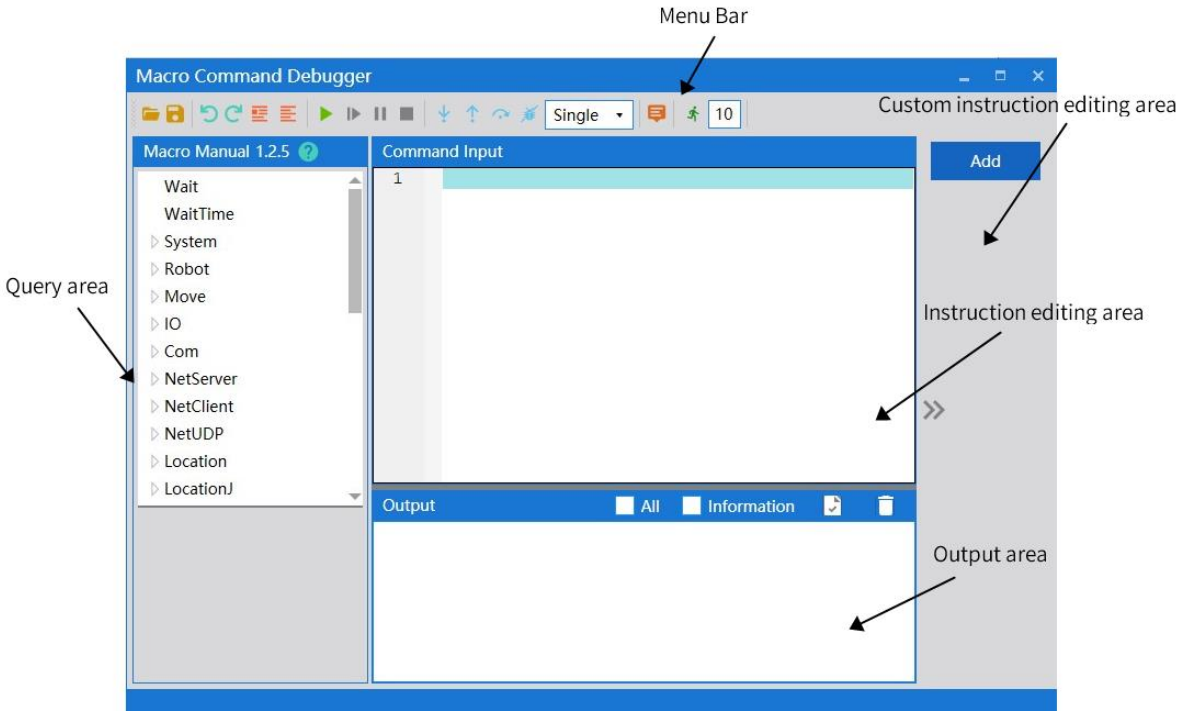


Figure 6-8 Macro Command Debugger

6.4.2 Menu bar

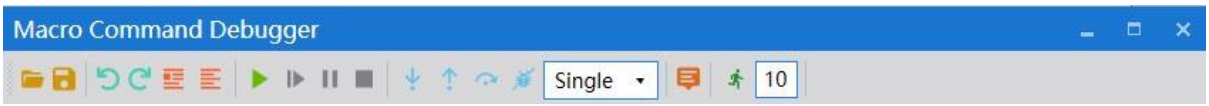
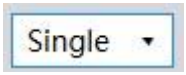


Figure 6-9 Menu bar of macro command debugger (ARM)

Table 6-1 Functions of tools on the macro command debugger

Introduction to menu bar on the macro command debugger (ARM)			
	Open		Save

	Undo		Resume
	Comment out the selected lines		Uncomment out the selected lines
	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
	10 instructions are sent at a time, the purpose is to increase the speed of continuous sending. “10” is the number that		Sending multiple commands at once: After the number 10 is set, click here to start execution

	needs to be set by the user, and can be set to other numbers.		

6.4.3 Introduction to user defined instruction editing area

Users can add common instructions to the < macro command debugger> interface through the user-defined instruction editing function according to their needs. After editing, the required instructions will be added to the right side of the interface for easy access next time.

For example, add the command of "servo power on" in the interface:

Step 1 Click the arm software debugging environment, and then click <Tools>→<Debugging and Analyzing Tools>→<macro command debugger> to enter the debugging interface.

Step 2 Click the < add > button on the right to open the operation instruction dialog box. Type the instruction name "servo power on", the operation instruction content "robot. Powerenable 1,1" and the comment "robot servo motor power on" in the input box of the interface to edit the required instructions, , as shown in Figure 6-10.

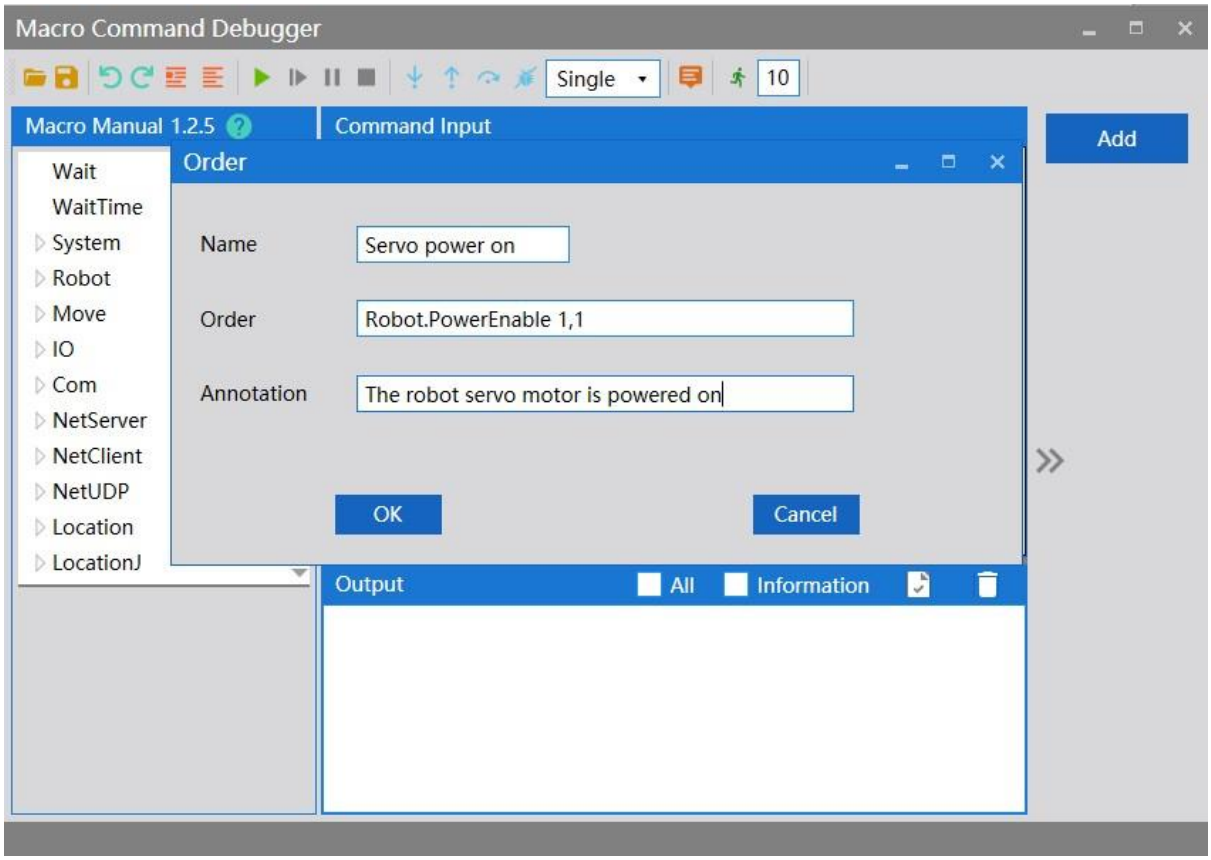


Figure 6-10 Customize the editing interface(ARM)

Step 3 Click < OK >, and the command shortcut key < servo power on >, just added, will appear on the right side of the macro command debugge.

To call the command of "servo power on" again, the user can directly click the shortcut key of < servo power on > on the right side of < macro command debugger>, and the specific content of the command "robot. Powerenable 1,1" will be sent to the robot. The sent command and execution result can be seen in the < output > window, without manual input a,as shown in Figure 6-11.

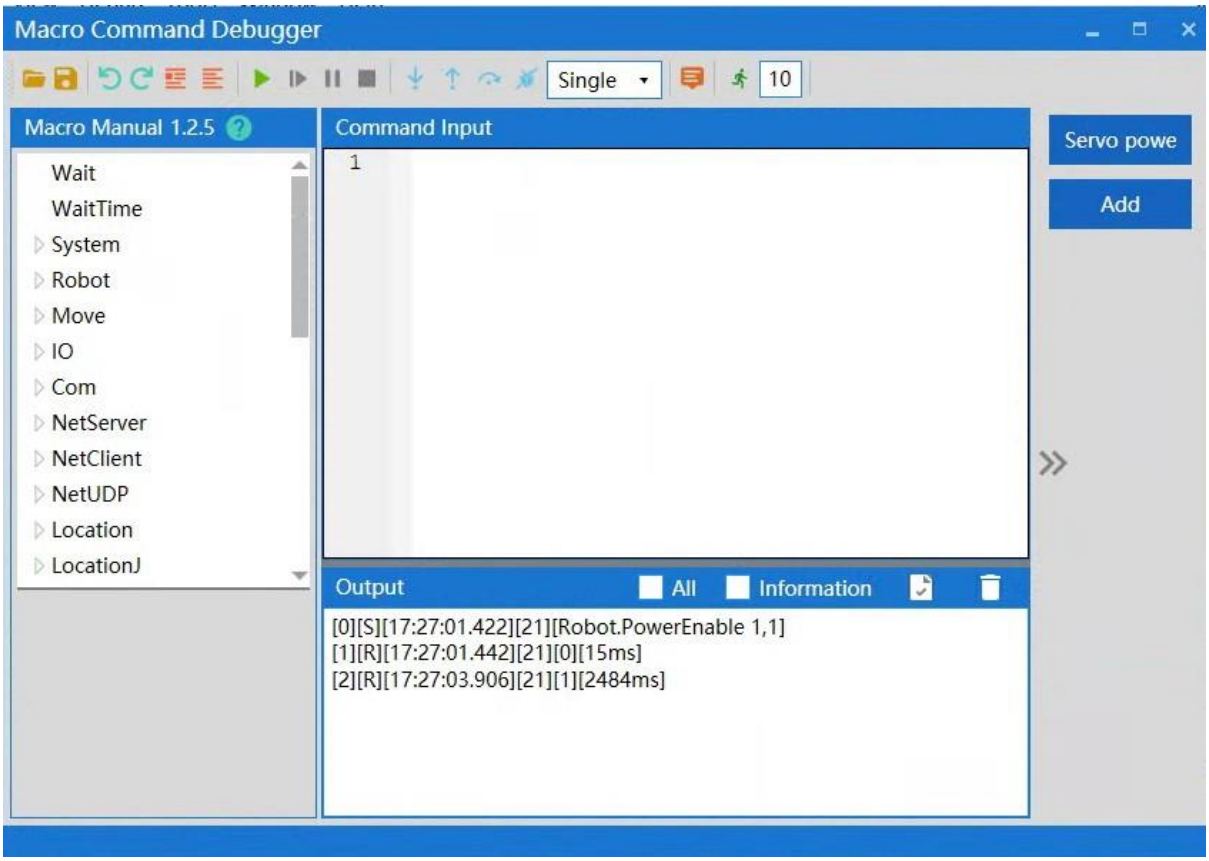


Figure 6-11 call the command shortcut interface(ARM)

6.4.4 Establish IP communication

Step 1 Open the ARM debugging environment, then click the button in the menu bar < Connect or disconnect quickly >to enter the connection interface.

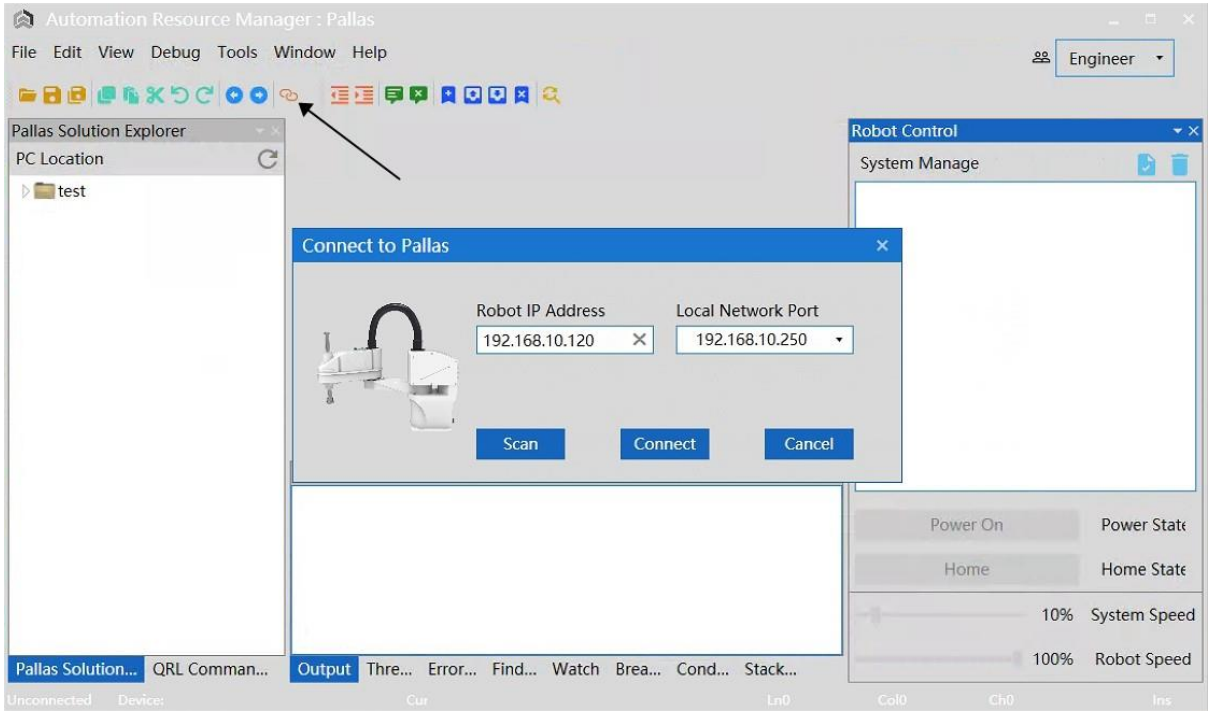


Figure 6-12 connection interface

Step 2 Click the lower left corner to enter the scanning interface, the <Scan>interface will automatically scan the IP address of the robot, click the IP address and click the lower right corner<Select>.

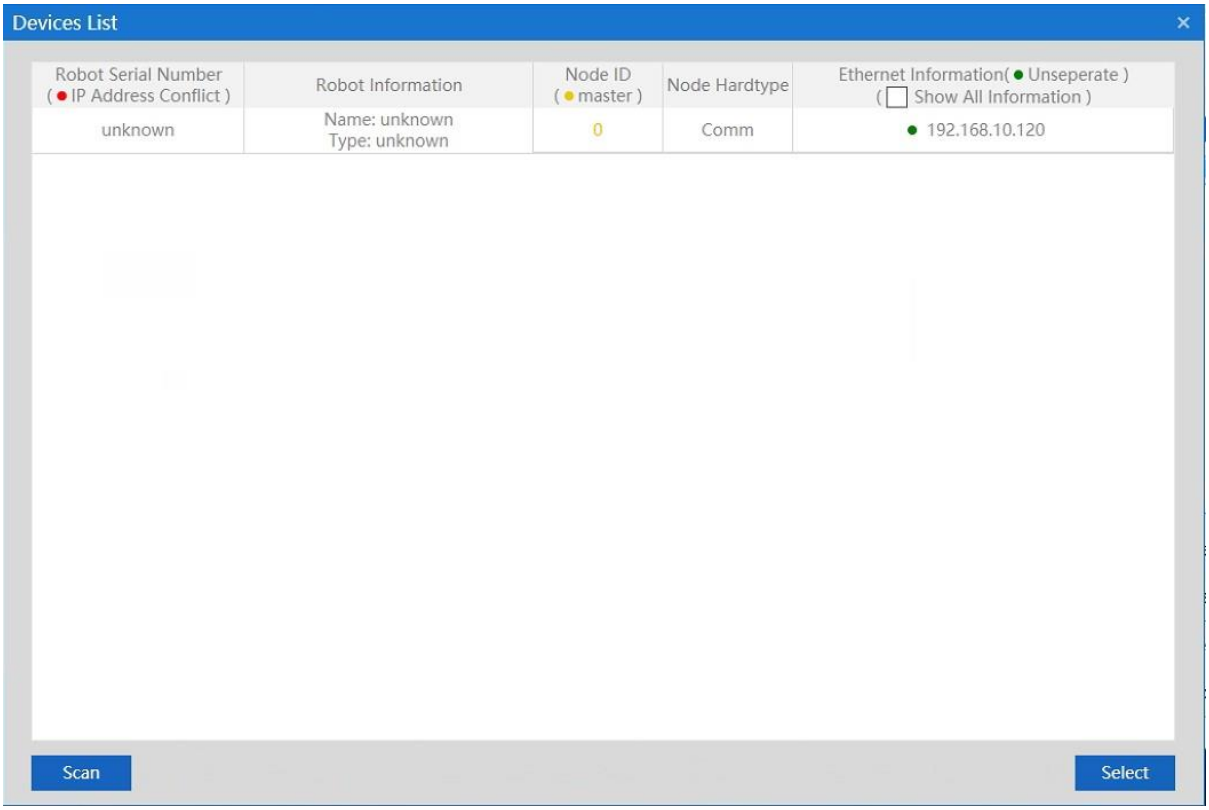


Figure 6-13 scanning interface

Step 3 The IP address of the robot: 192.168.10.120, then click <Connect>the button below,as shown in Figure 6-14.

- The IP addresses of the robot and the host computer must remain on the same network segment.

NOTE

- 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.

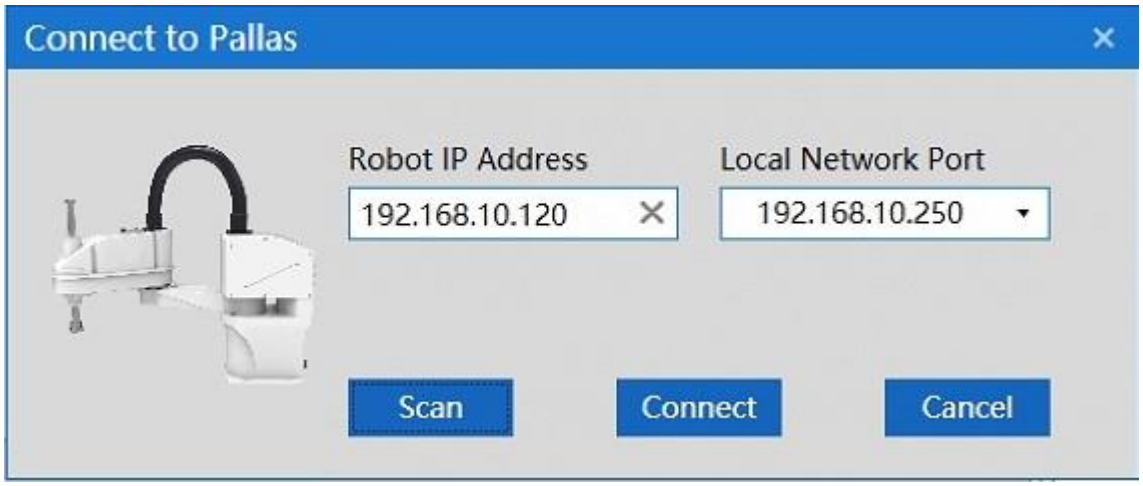


Figure 6-14 IP connection

6.4.4.1 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 " Connected Device: 192.168.10.120" in the lower left corner of ARM interface,as shown in Figure 6-15.

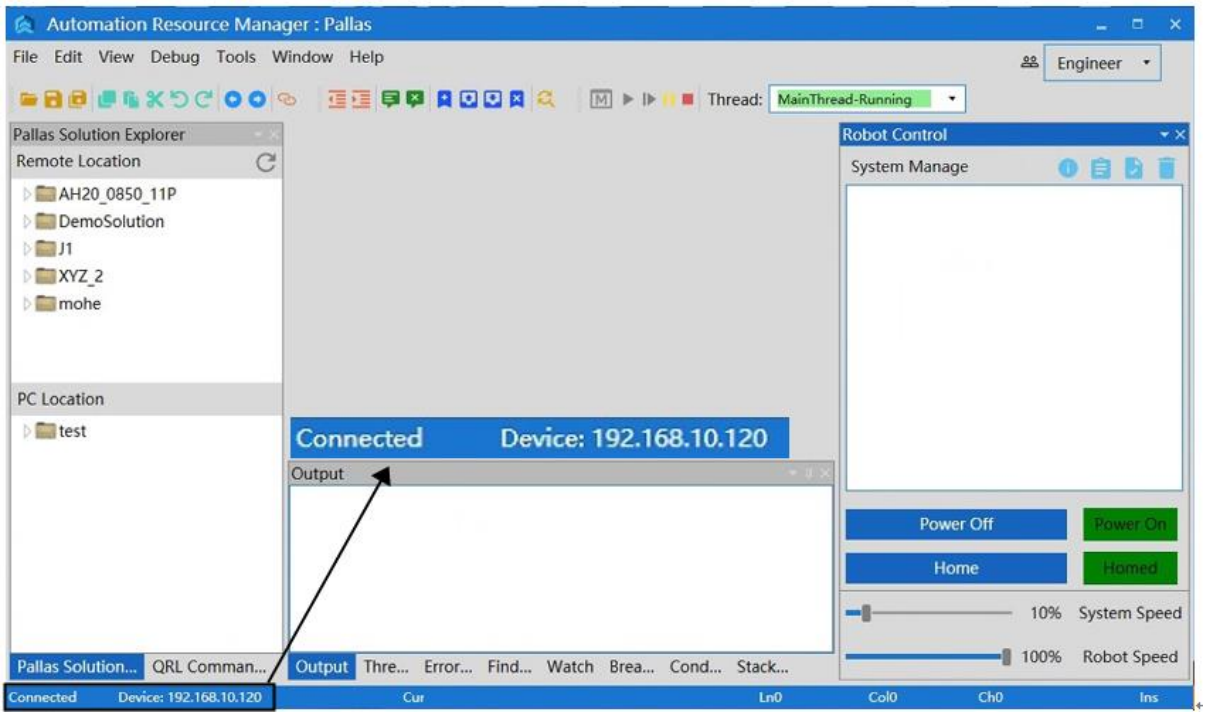


Figure 6-15 Successful connection

6.4.4.2 IP connection failure

When the connection fails, the "Error" prompt dialog box will pop up, as shown in Figure 6-16.

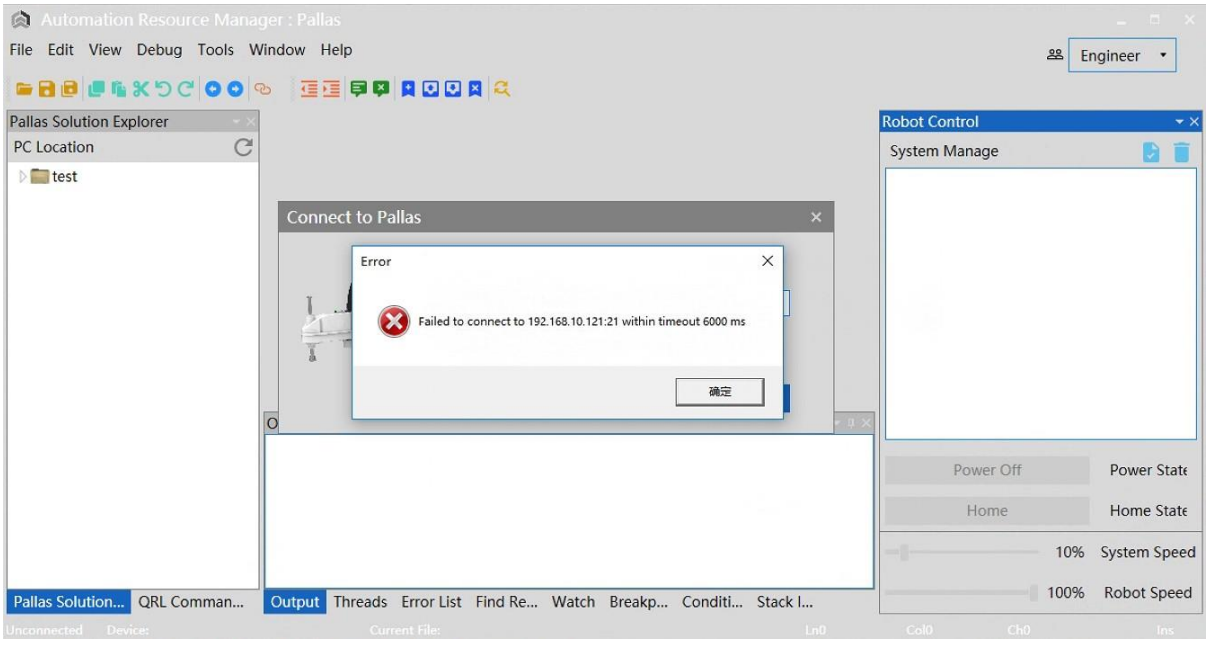


Figure 6-16 Connection failure

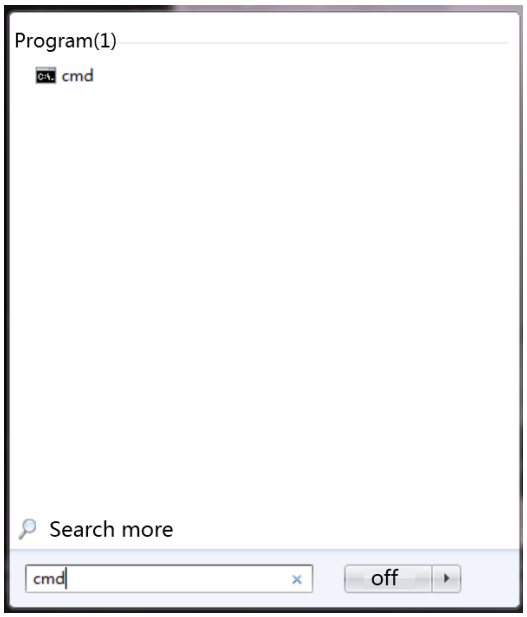
Solution to connection failure:

Step 1 Rescan the robot's IP address; If the IP address of the robot can be scanned, try to reconnect to the robot; If the IP address of the robot cannot be scanned, check whether the network cable between the host computer and the robot is connected normally, or whether the network port connected to the robot is correct, and the network port connected to the robot by the network cable is a LAN port.

NOTE

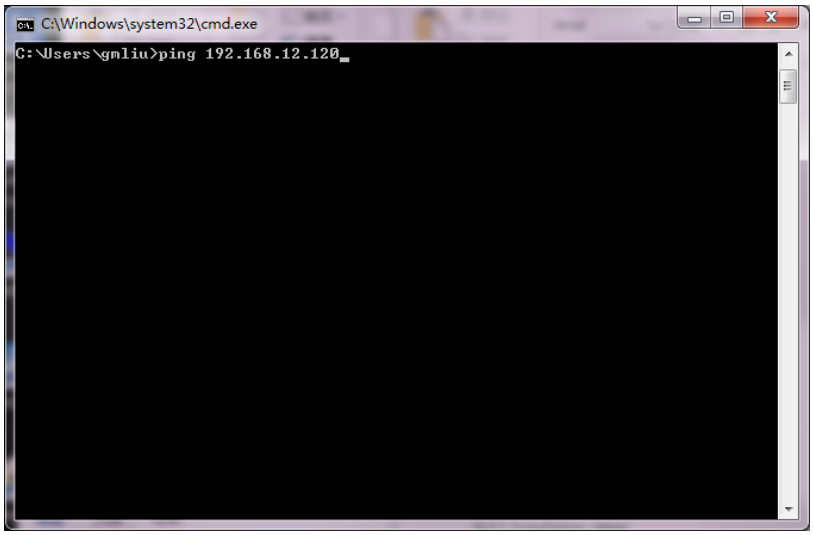
Step 2 If the robot can be scanned in Step 1 but the connection fails, check whether the IP addresses of the host computer and the robot are in the same network segment. Make sure that the IP addresses of the host computer and the robot are in the same network segment.

Step 3 Execute system search and run cmd as shown in the figure:



Step 4 Directly input "ping + Robot IP" after >. If the specific values of the parameters of byte, time and TIL 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 5 Connect the robot again in the ARM interface.

6.4.5 Query on description of macro language instructions

The macro command debugger includes a macro 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".Double-click the button in the interface to open the "QKM Robot Command Manual".

When you click a corresponding macro language instruction, the list automatically pops up a description of this instruction set,as shown in Figure 6-17.

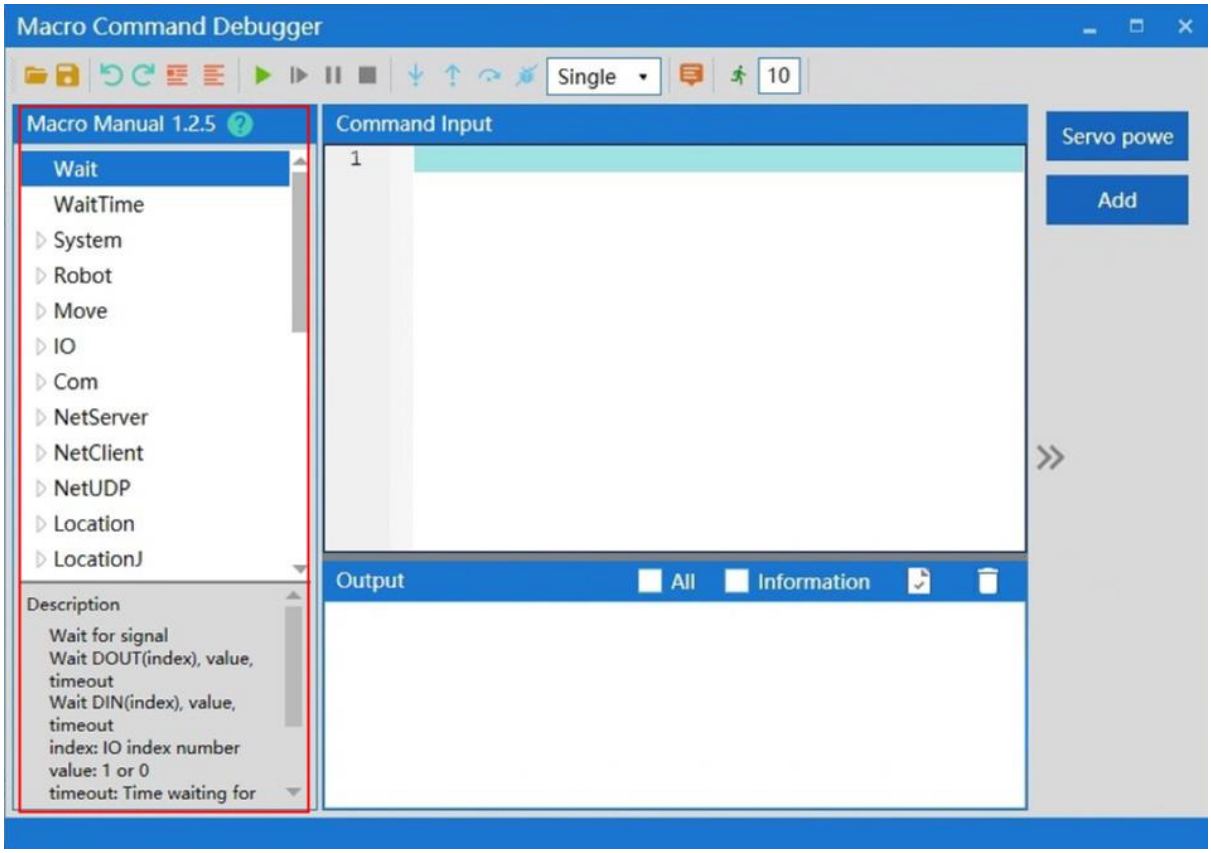


Figure 6-17 Macro manual

6.4.6 Input instructions

The "instruction editing area" is the area where instructions are input and edited as shown in Figure 6-18.

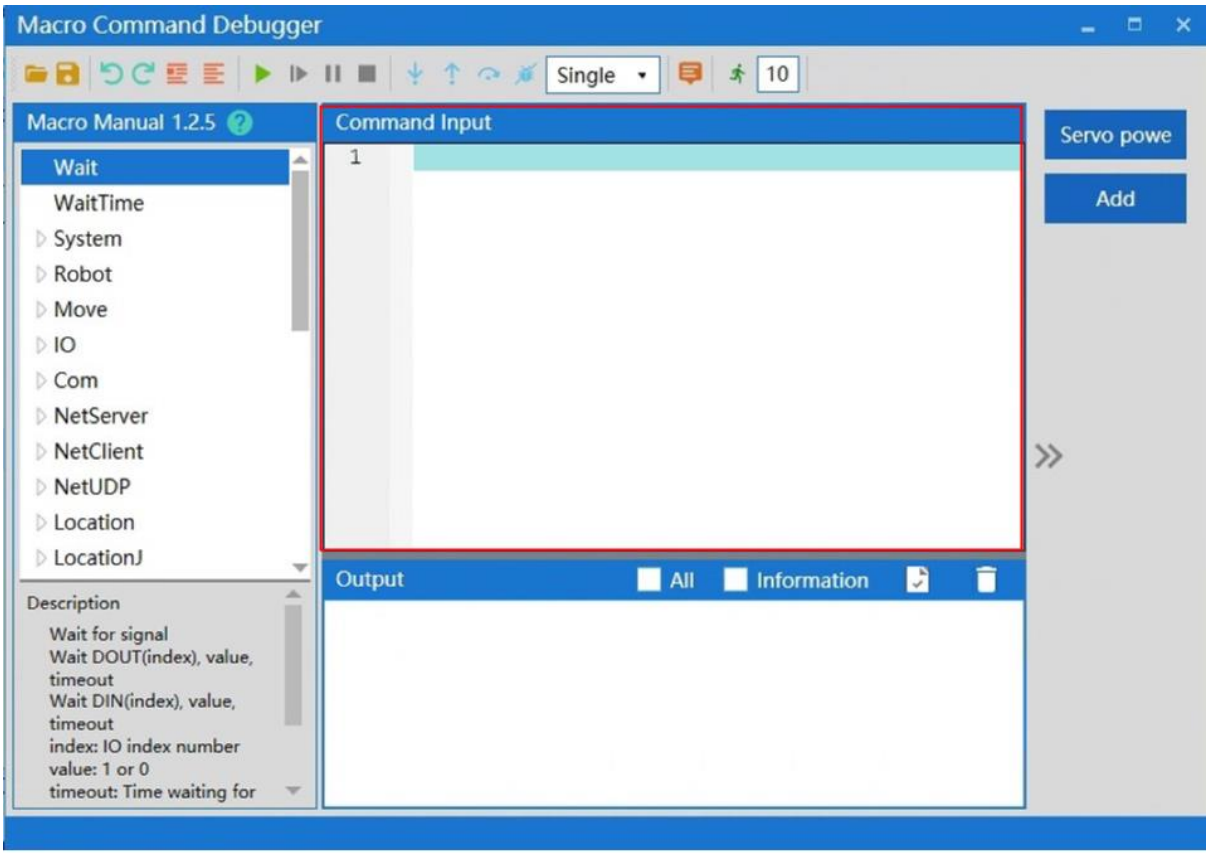


Figure 6-18 Input instructions

NOTE

The system distinguishes between case and instruction, and the default first letter of instruction is uppercase.

When inputting a single instruction, you can enter the first letter of the instruction. If you want to select an instruction, such as Loction, you can enter the capital letter " L " and the initial letter is L-related instructions automatically pops up,as shown in Figure 6-19.

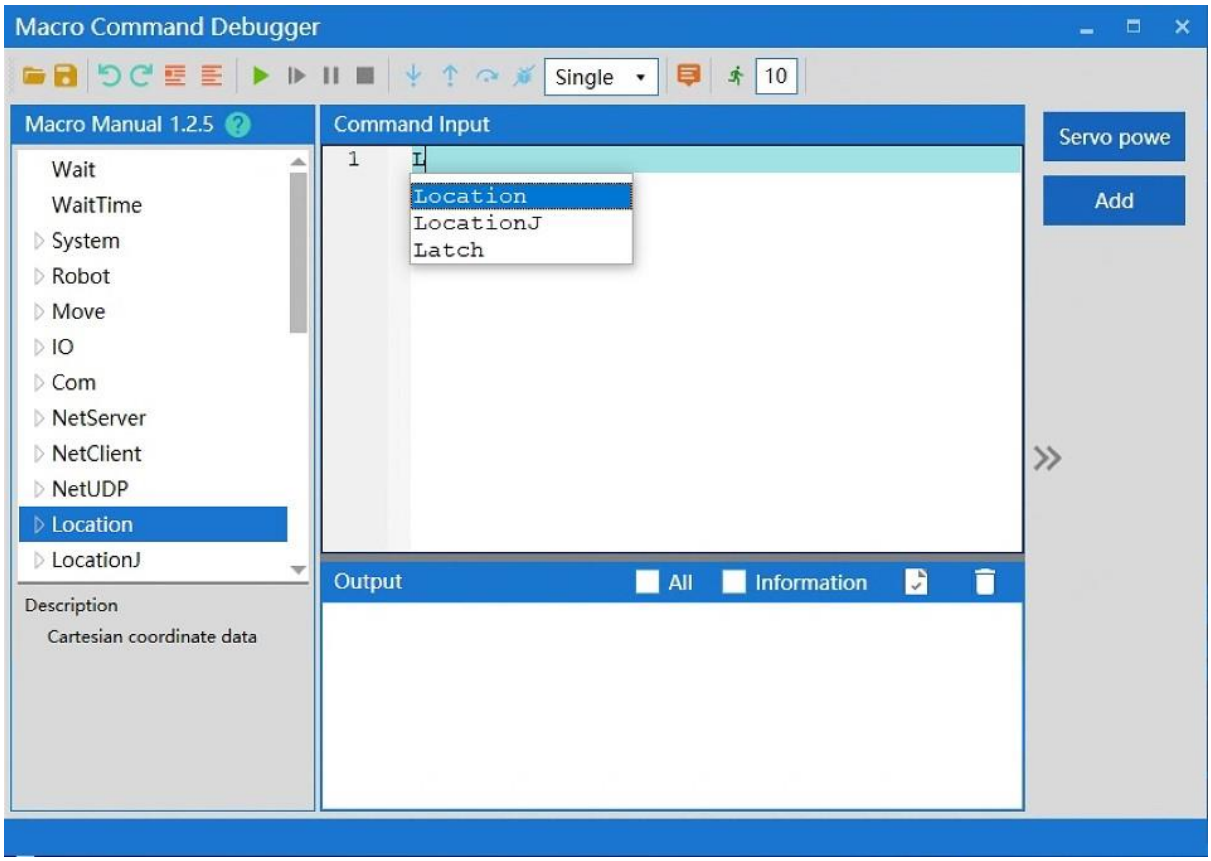


Figure 6-19 Input instructions

All instructions contained under the instruction set can be prompted automatically when you enter ".", as shown in Figure 6-20.

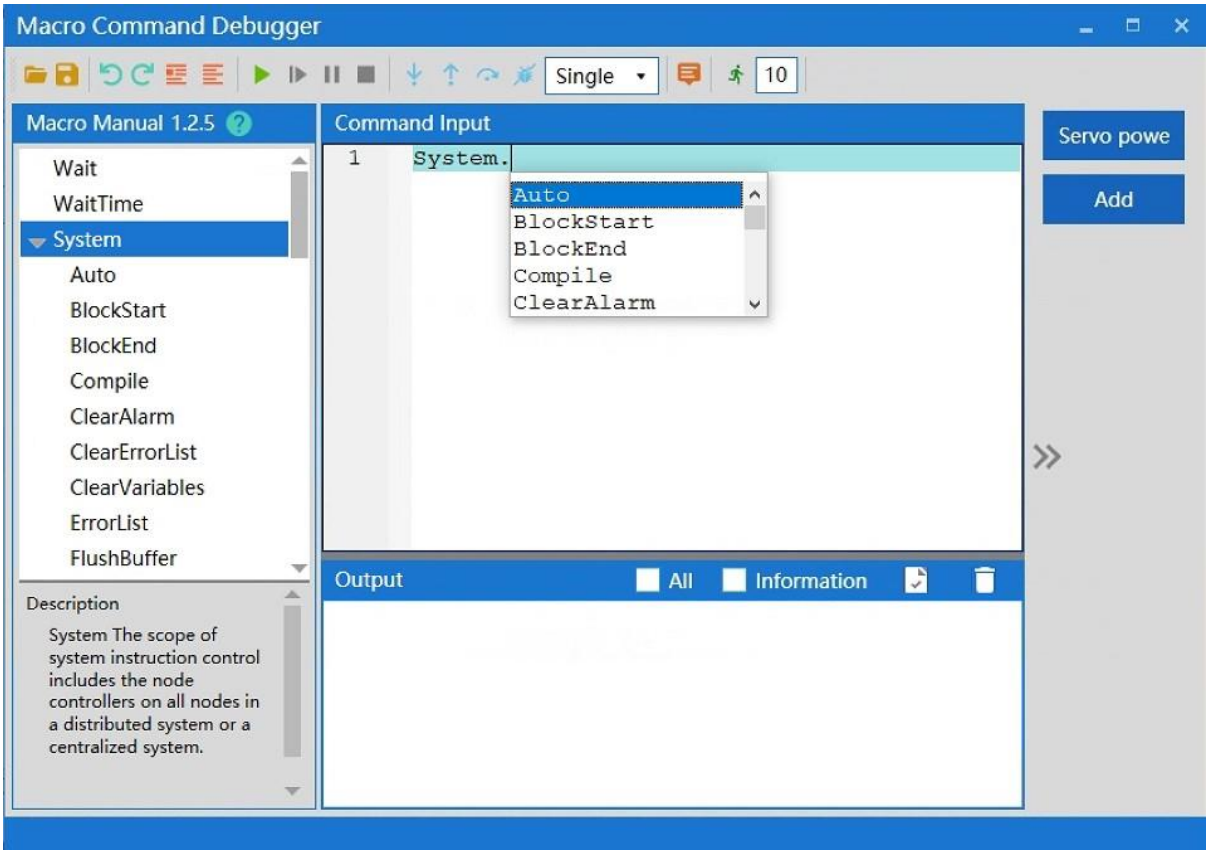


Figure 6-20 Input instructions

6.4.7 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 6-21.

If you select the < All > key on the upper right of the output area, the Macro instruction currently sent and received will be displayed in the "Instruction Output area"; if you select the < Information > key, the Hidden message received will be displayed in the "Instruction Output area".

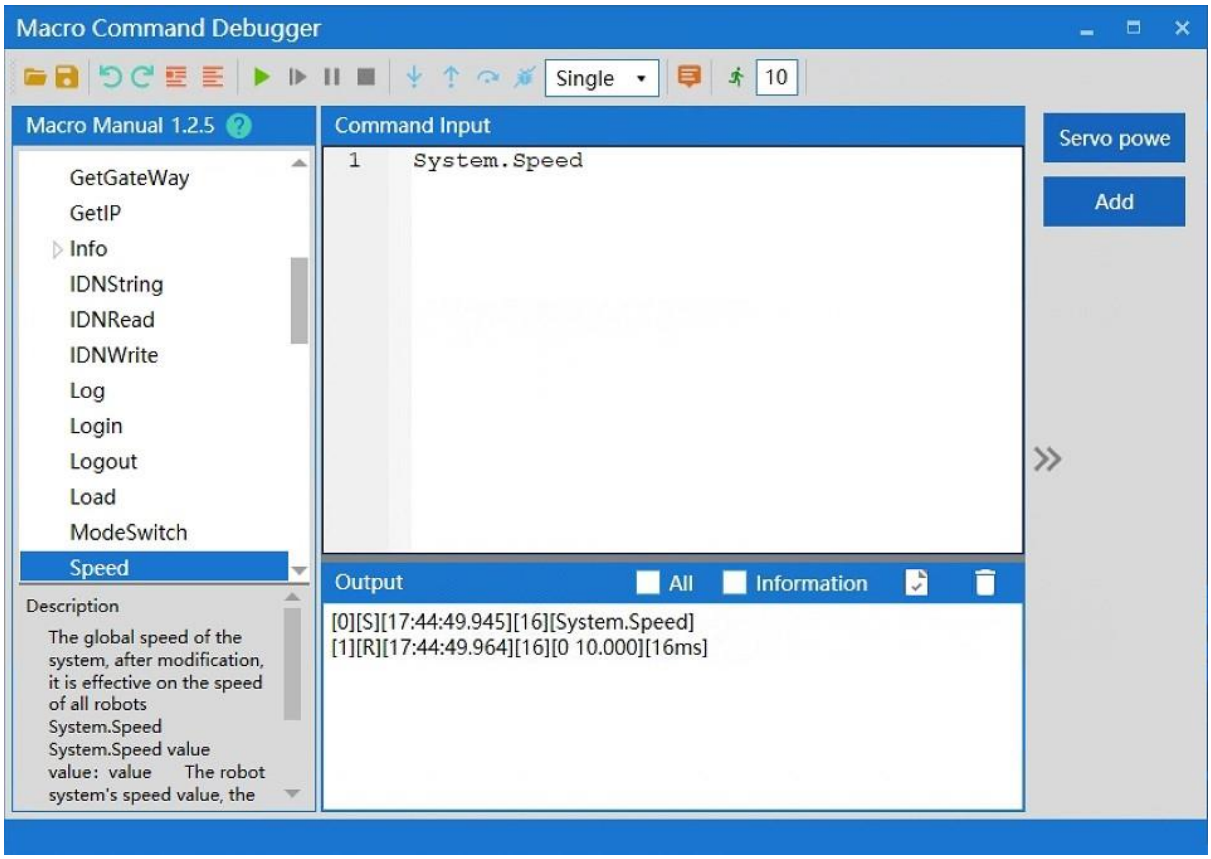


Figure 6-21 Run instructions

6.4.8 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 6-22.

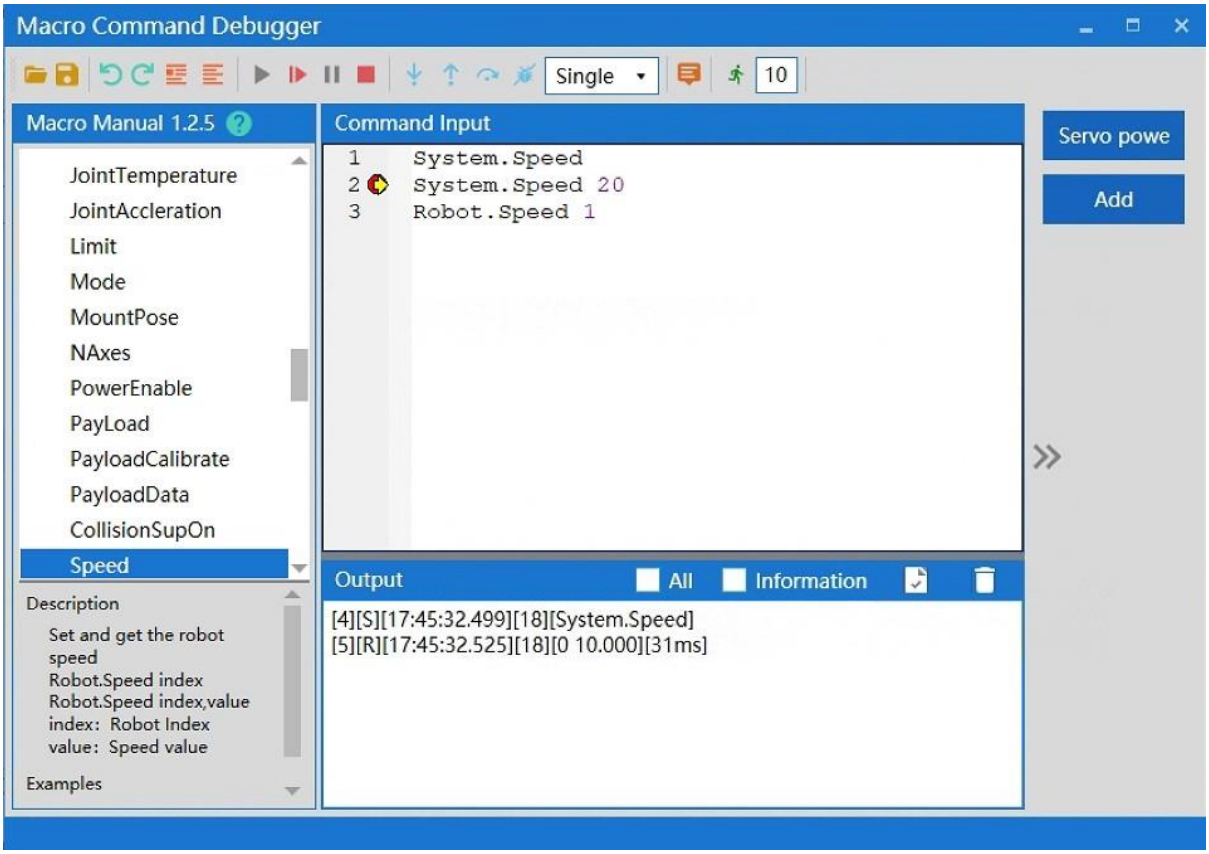


Figure 6-22 Add a breakpoint

6.4.9 Output

The output after running is displayed as shown in Figure 6-23.

NOTE The output interface contains the feedback information of each command. If the command is successfully executed, the feedback result will be displayed in black font. If the command fails to be executed, the system will pop up the "Execution Failure" dialog box to prompt you.

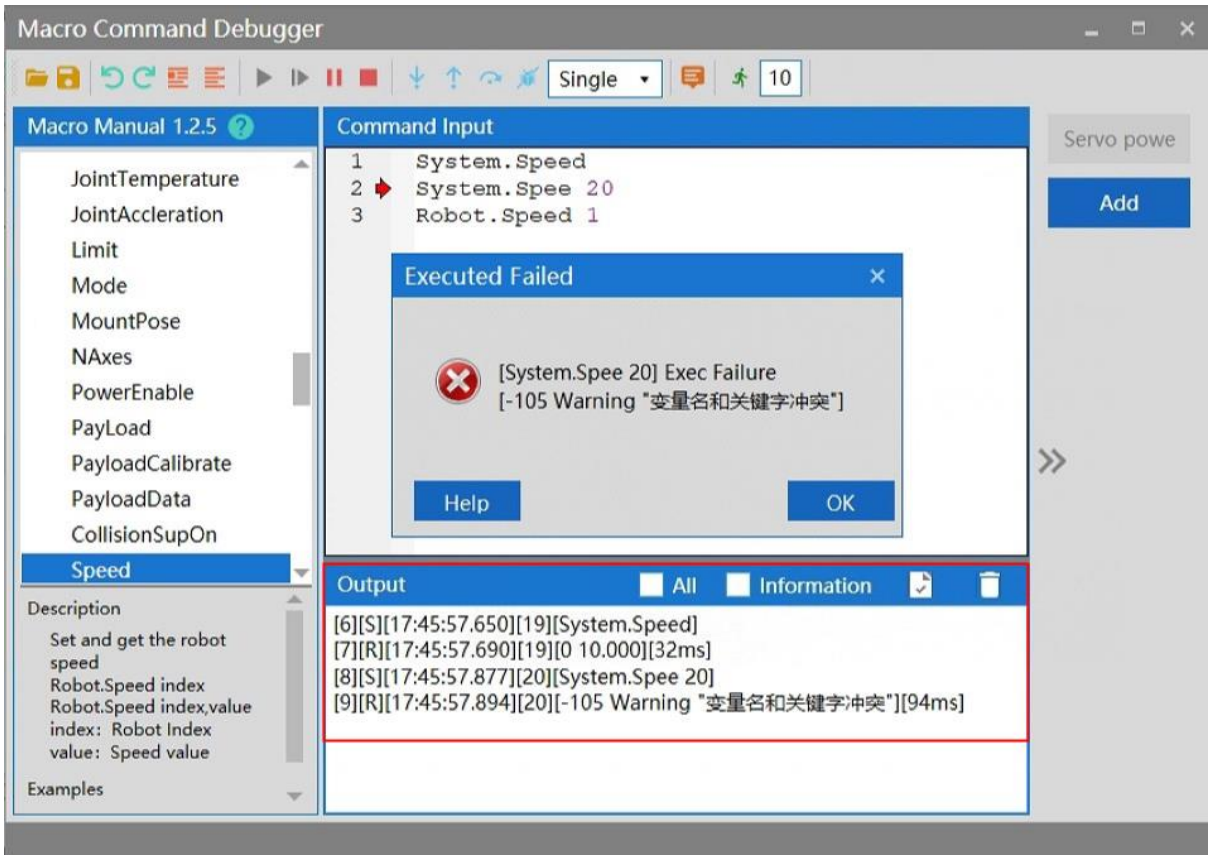


Figure 6-23 Output

6.4.10 Clear output

Click the <Clear> button in the upper right corner of the output area to complete the clear, as shown in Figure 6-24.

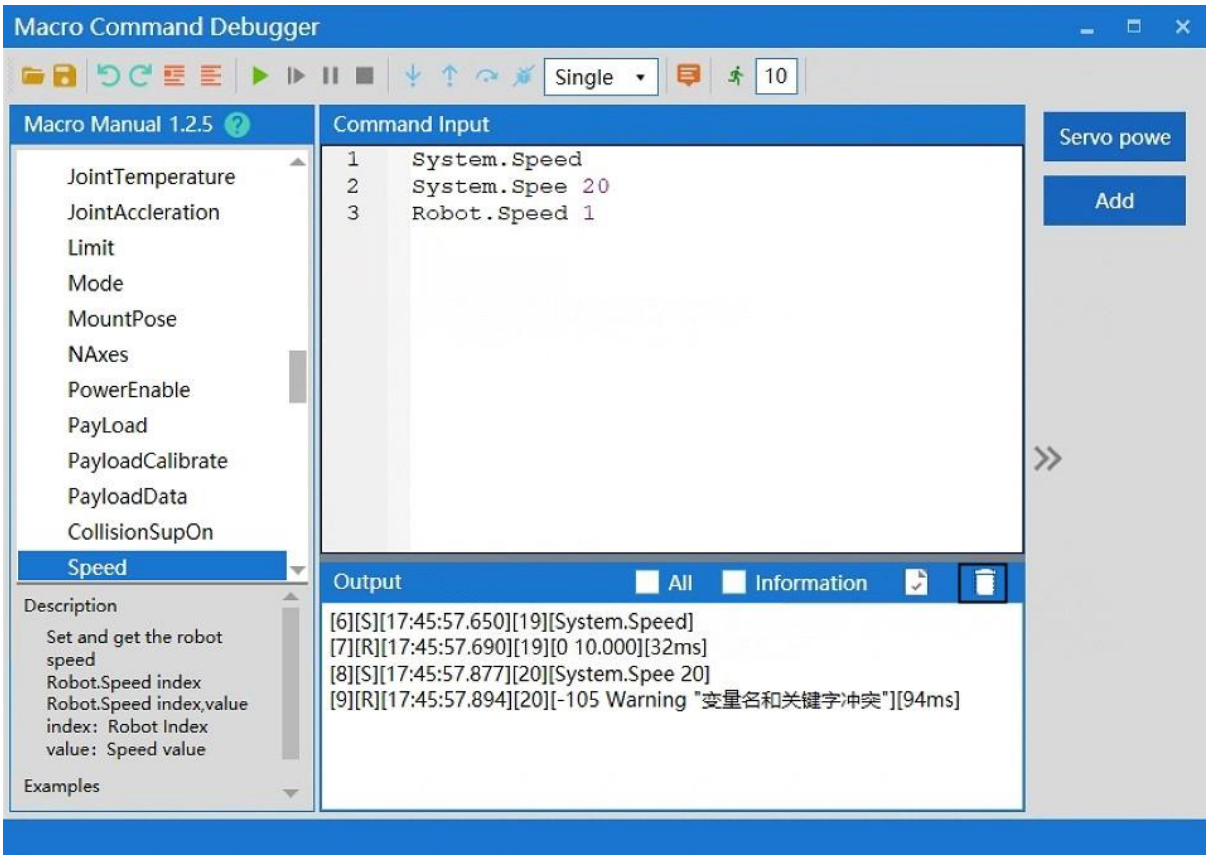


Figure 6-24 Clear output

6.4.11 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 6-25.

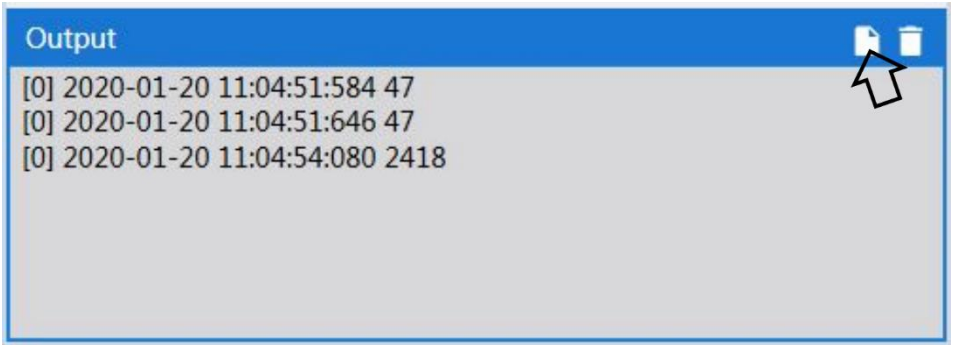


Figure 6-25 Save output

6.5 QRL mode

NOTE

QRL programs are used in ARM-installed programming environment.

6.5.1 Switch to QRL mode

In the ARM debugging interface, click the upper middle button , and then click the lit button on the left to switch to the QRL mode . When clicking the button , a pop-up window will appear to confirm whether you would like to switch to QRL mode. Click OK to switch, as shown in Figure 6-26.

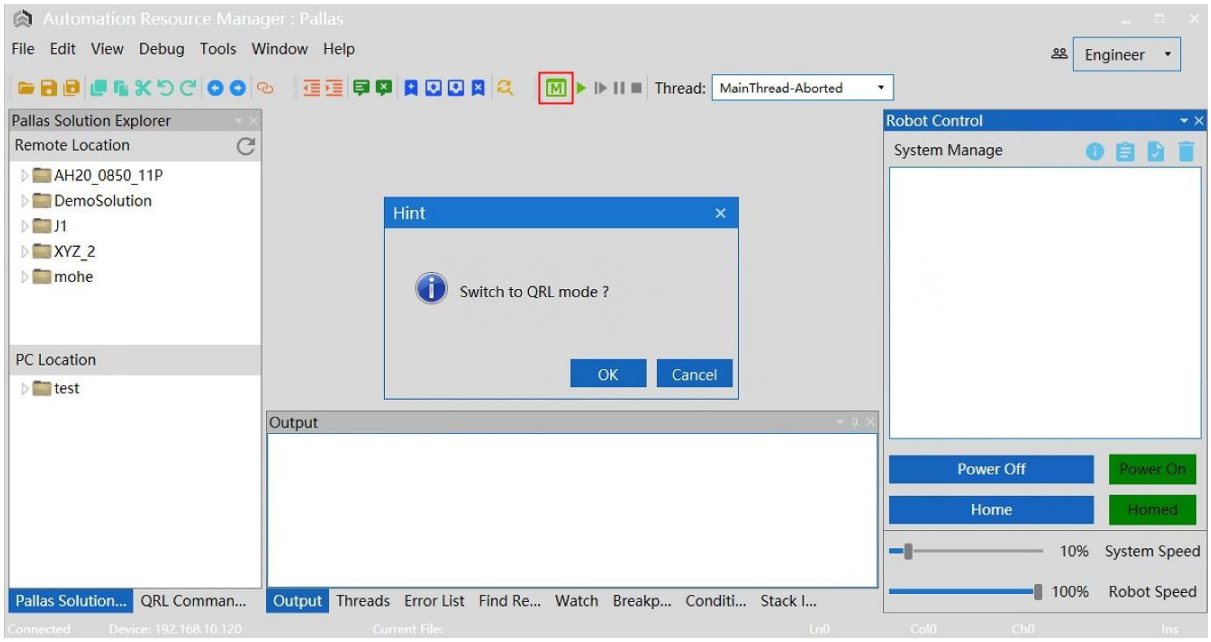


Figure 6-26 Switch to QRL mode

6.5.2 Creating QRL project files

To use QRL programs, you need to create program files. Create a new solution on the left side of the ARM debugging interface. Select "Remote Location" under "Pallas Solution Explorer".

Step 1 Right-click in the space below "Remote Location" and click "New Solution", as shown in Figure 6-27.

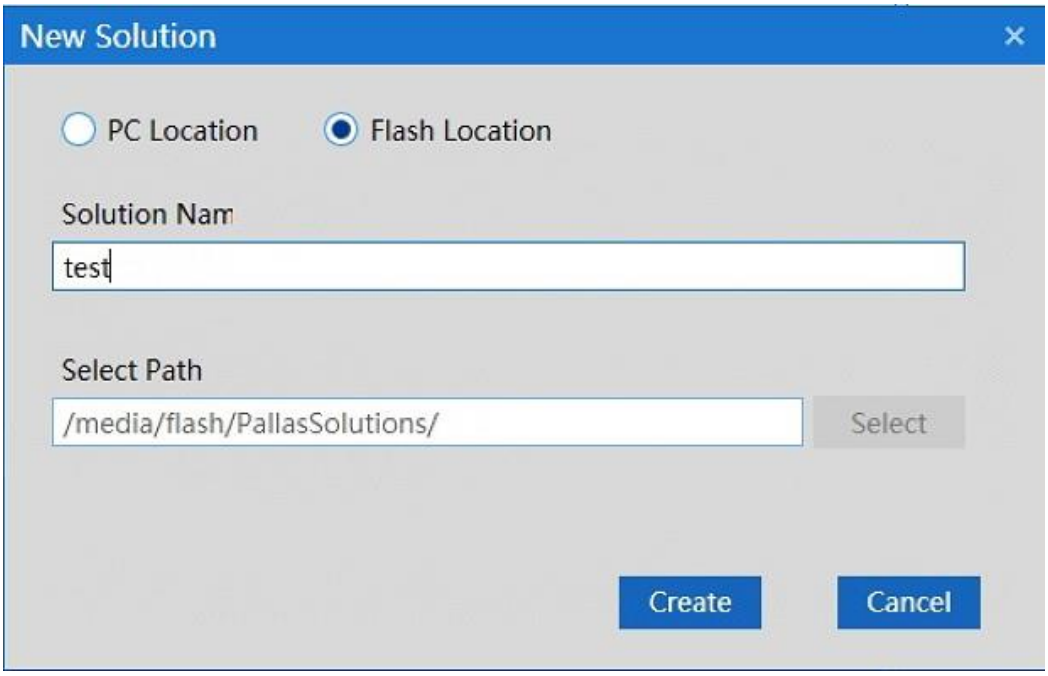


Figure 6-27 New Solution

Step 2 After the New Solution interface pops up, enter a program name, such as "test", and click "Create".

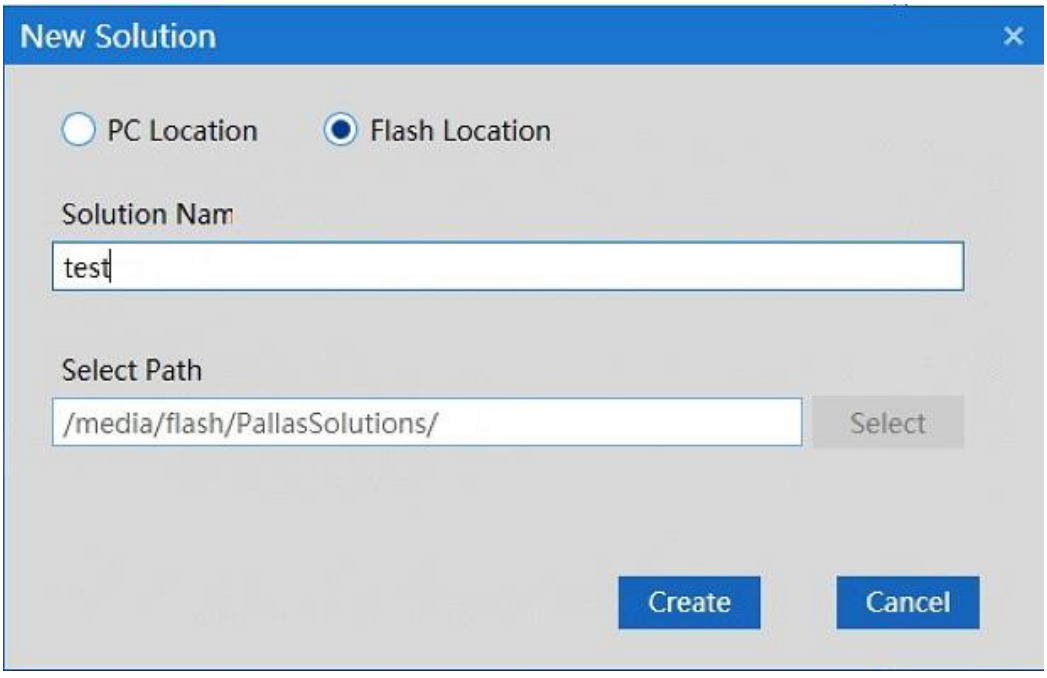


Figure 6-28 Enter a solution name

Step 3 After the creation is completed, the corresponding solution file will appear below "Remote Location". Expand the "test" file, and then the "project" file, which contains the "main.ql" and "data.qlv" program files, as shown in Figure 6-29.

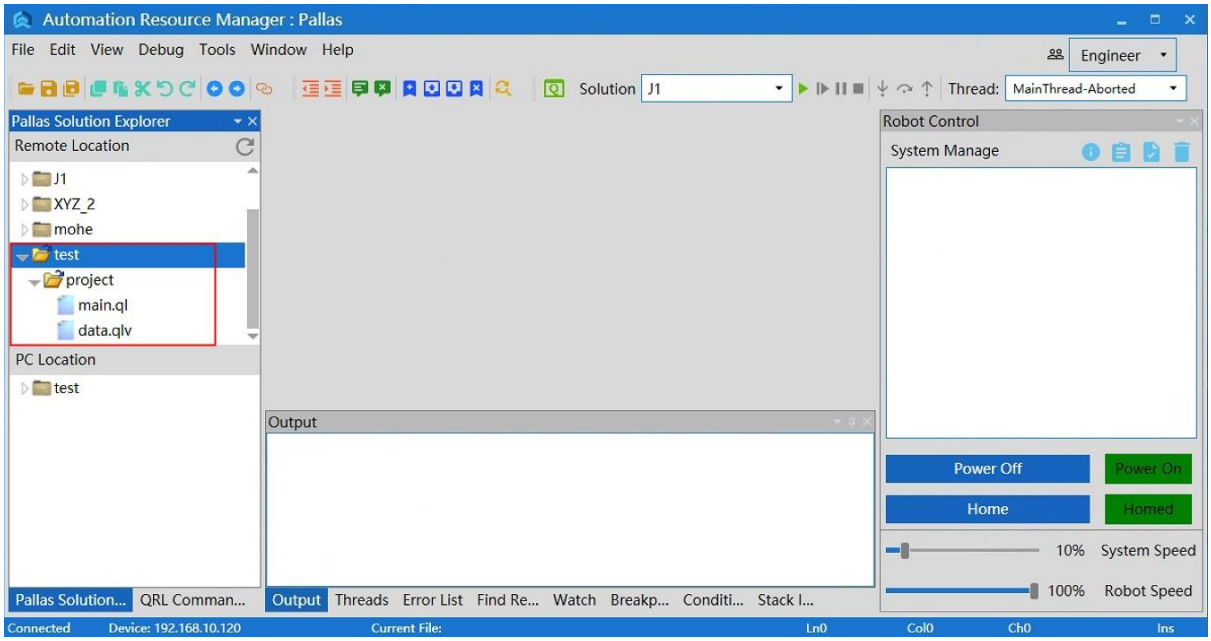


Figure 6-29 "New Solution" file interface

6.5.3 Introduction to "main.ql"

"main.ql" is the main file of the program. Robot motion, logical operation, condition control, loop statement control, thread control, etc. written in the program can be written in this file. Double click to open the "main.ql" file, the corresponding program content will appear in the middle of the ARM debugging interface, as shown in Figure 6-30. The program content in the figure is the default program in the new solution.

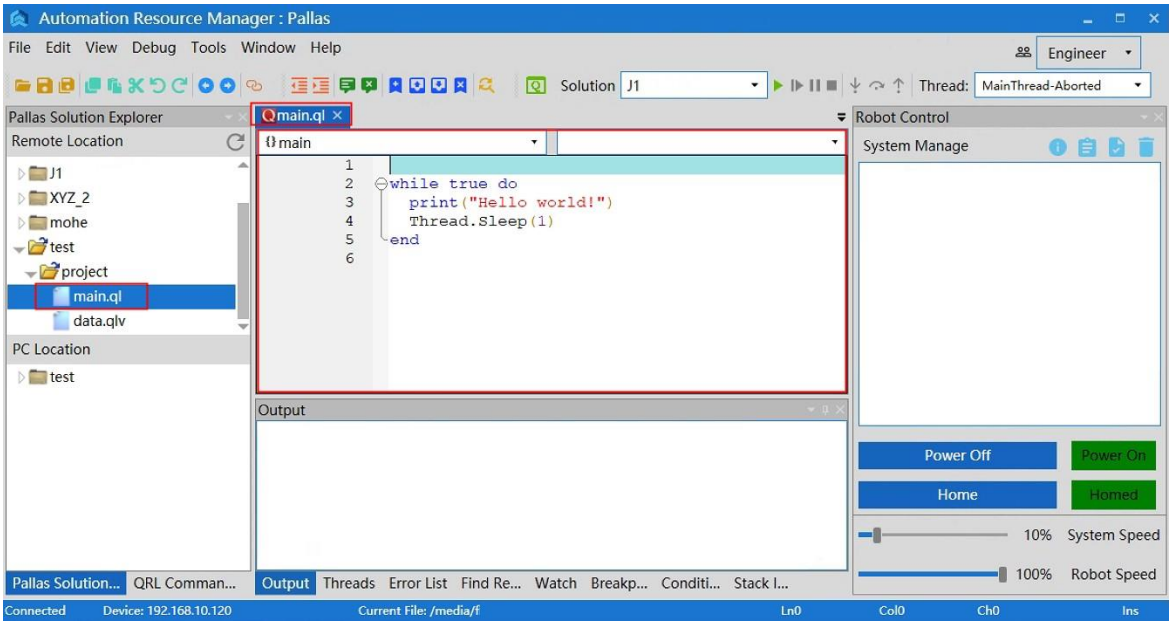
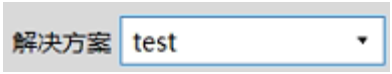


Figure 6-30 "main.ql " interface

Run the "test" solution; Select "test" in 

at the top of the ARM debugging interface and click the button  to run it. At this point, the program will output "Hello world!" below in a circular way, as shown in Figure 6-31.

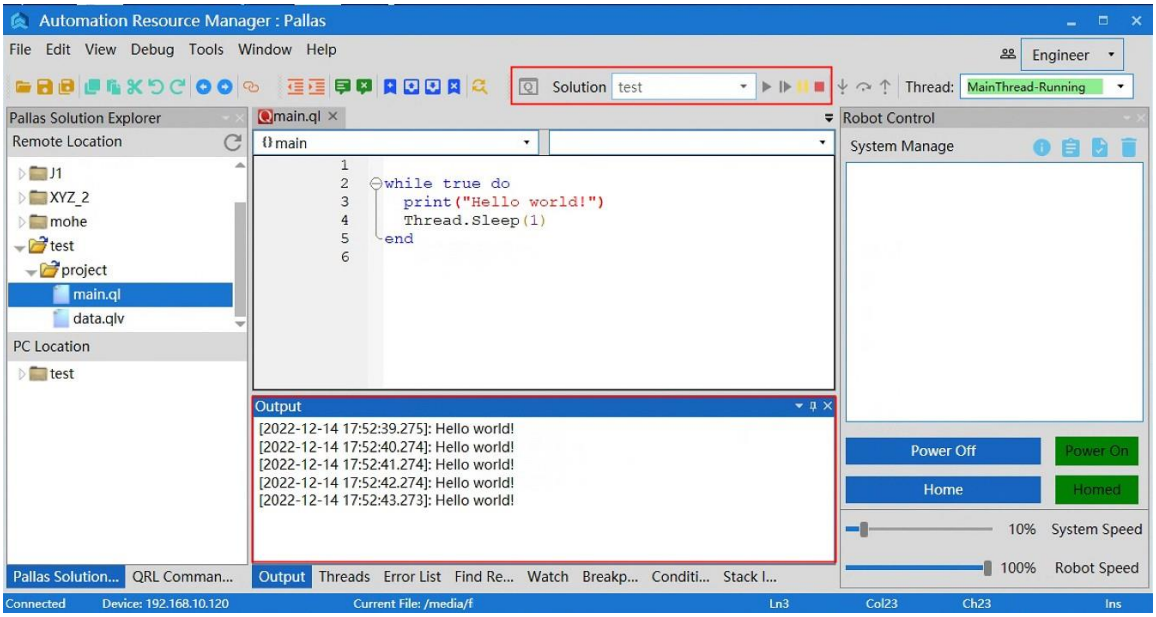


Figure 6-31 Run the solution

NOTE

For details of QRL program content, please refer to the "QKM Robot (QRL Language) Programming Manual".

6.5.4 Introduction to "data.qlv"

"data.qlv" is the robot motion point and motion parameter setting file. Double-click to open the "data.qlv" file, and the "data.qlv" interface will pop up, as shown in Figure 6-32. The interface contains: Location, LocationJ, Profile, Location Array, LocationJ Array, Profile Array. It is an interface of setting robot motion point information and motion parameter information.

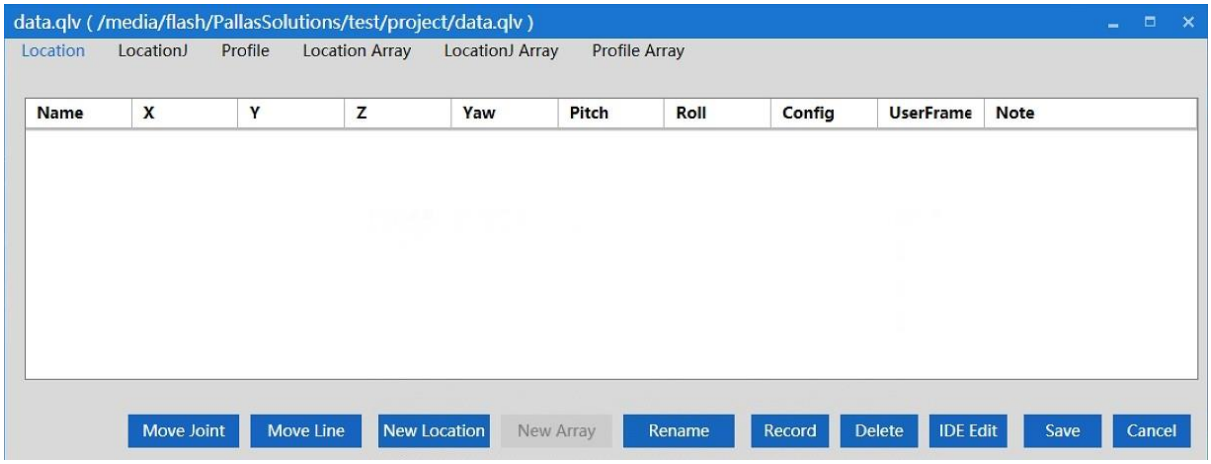


Figure 6-32 "data.qlv" interface

Introduction to Buttons	
Move Joint	Switch to the M pattern to control the joint movement of the robot to the selected point position

Move Line	Switch to the  pattern to control the linear movement of the robot to the selected point position
New Location	Add the point of the robot's current position in the current interface
New Profile	Use in the Motion Parameters interface to add motion parameters
New Array	Only use in Location Array/ LocationJ Array/Profile Array to add point/motion parameters of array type
Rename	Rename the point name
Record	Select a point to record the current robot position as that point information
Delete	Select a point and delete it; or select an array and delete it
IDE Edit	Switch to file programming and manually write coordinate points or motion parameters
Save	Save modified information in "data.qlv"
Cancel	Cancel information modification and close the "data.qlv" interface

Step 1 New Location; Click "New Location" in "Location", and the point information of the current robot's Cartesian position will appear in the interface. The point name is the default name, and you can click Rename to modify it, as shown in Figure 6-33.

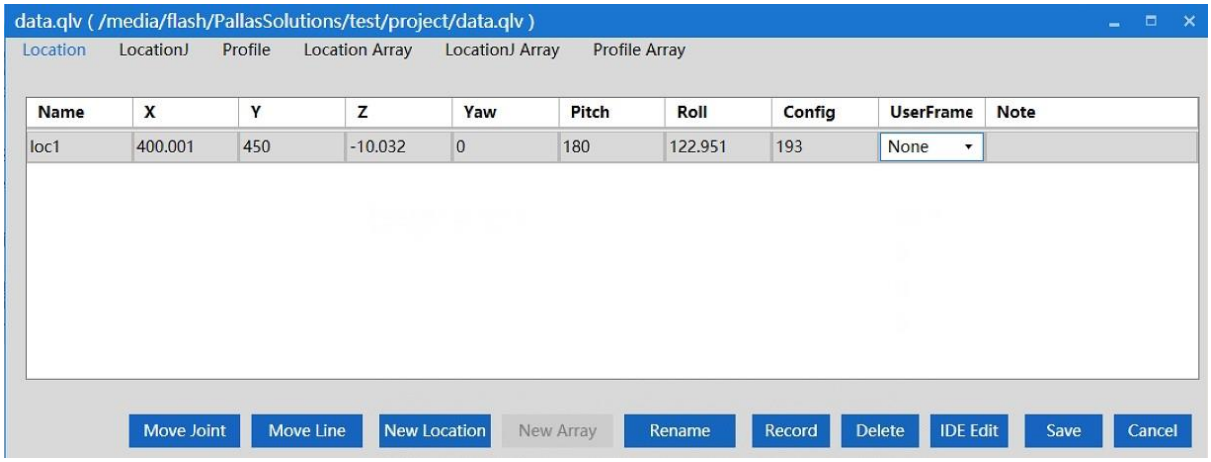


Figure 6-33 New Location

Step 2 New LocationJ; Click "New Location" in "LocationJ", and the point information of the current robot’ s axis coordinate position will appear in the interface. The point name is the default name, and you can click Rename to modify it, as shown in Figure 6-34.

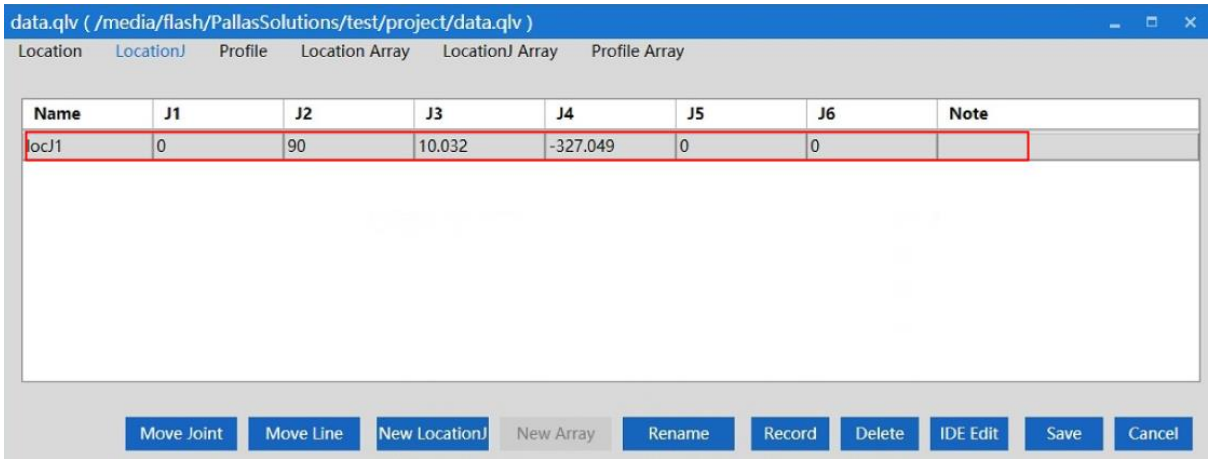


Figure 6-34 New LocationJ

Step 3 New Profile; Click "New Profile" in "Profile", and the default motion parameter information will appear in the interface. The motion parameter name is the default name, and you can click Rename to modify it, as shown in Figure 6-35.

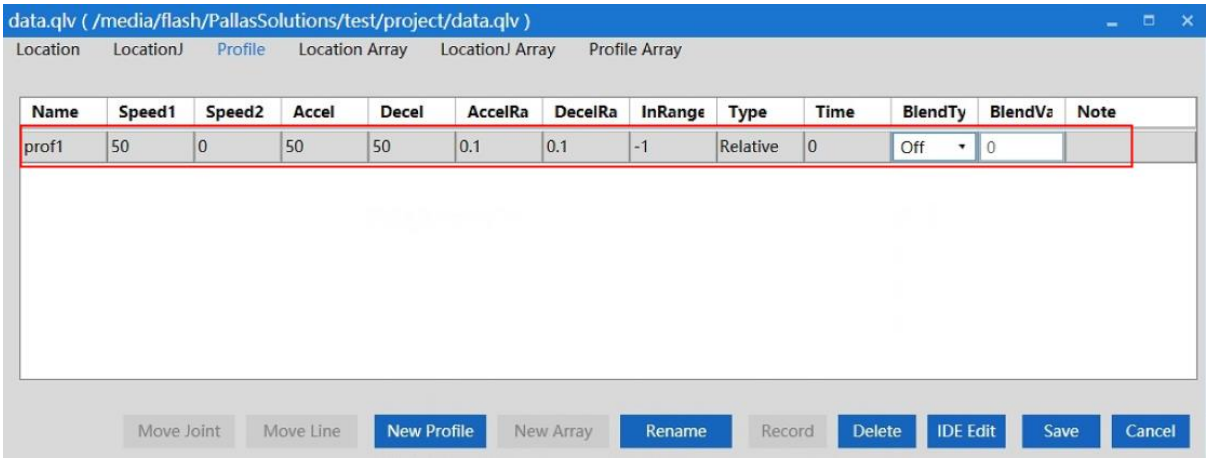


Figure 6-35 New Profile

Step 4 New Location Array; Click "New Array" in "Location Array", and the "New Array" interface will pop up. Enter the array name and array length, and click "OK", as shown in Figure 6-36.

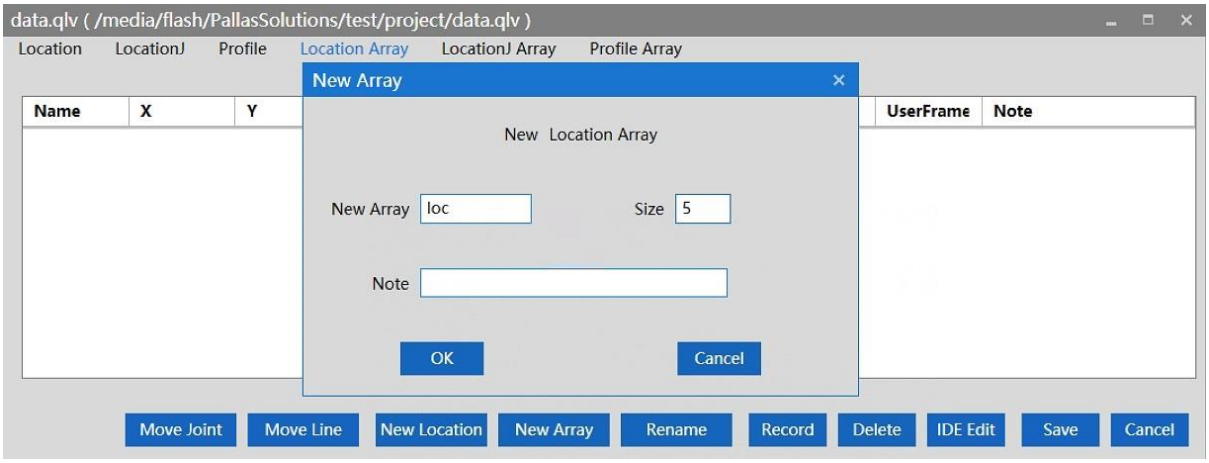


Figure 6-36 New Location Array

After completion, the "Location Array" information will appear, and the point will be recorded as the robot's current Cartesian coordinates, as shown in Figure 6-37.

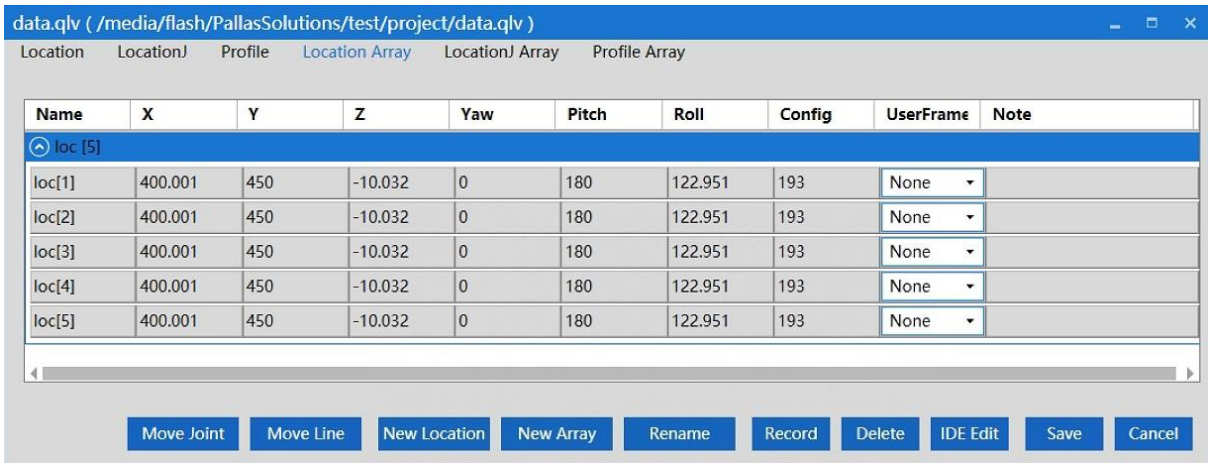


Figure 6-37 "Location Array" information interface

Step 5 New LocationJ Array; Click "New Array" in "LocationJ Array", and the "New Array" interface will pop up. Enter the array name and array length, and click "OK", as shown in Figure 6-38.

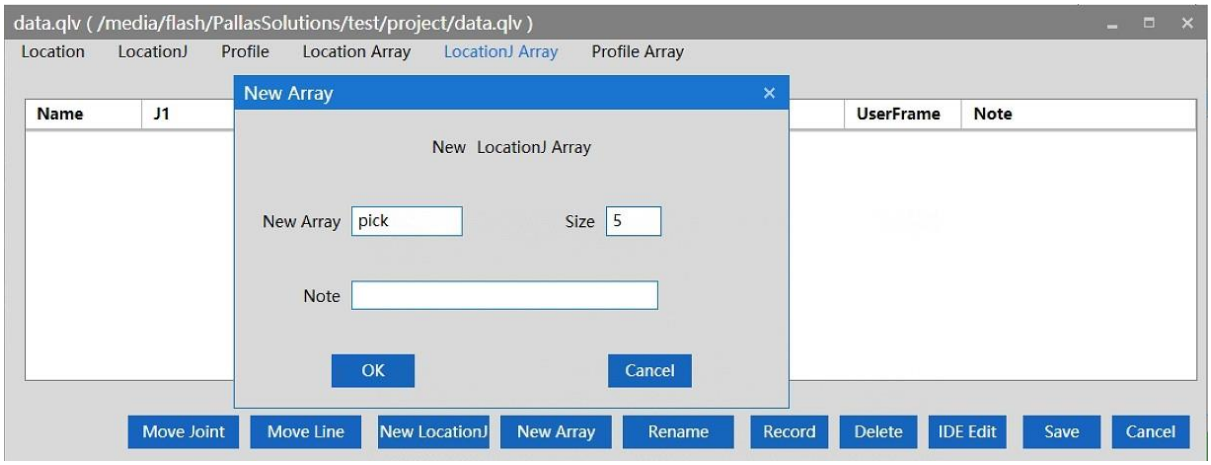


Figure 6-38 New LocationJ Array

After completion, the "LocationJ Array" information will appear, and the point

will be recorded as the robot's current axis coordinates, as shown in Figure 6-39.

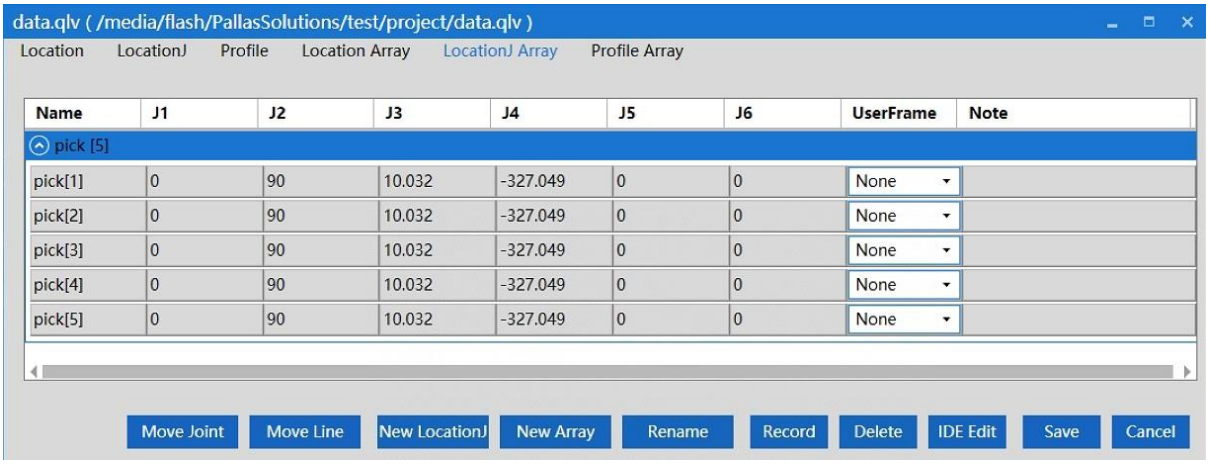


Figure 6-39 "LocationJ Array" information interface

Step 6 New Profile Array; Click "New Array" in "Profile Array", and the "New Array" interface will pop up. Enter the array name and array length, and click "OK", as shown in Figure 6-40.

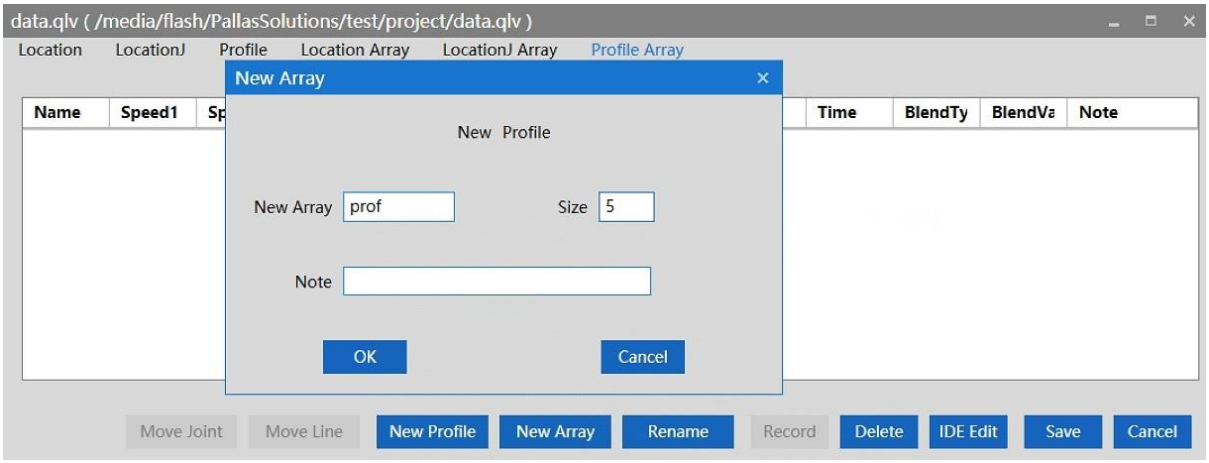


Figure 6-40 New Profile Array

After completion, the "Profile Array" information will appear, and the motion parameter information will be the default value, as shown in Figure 6-41.

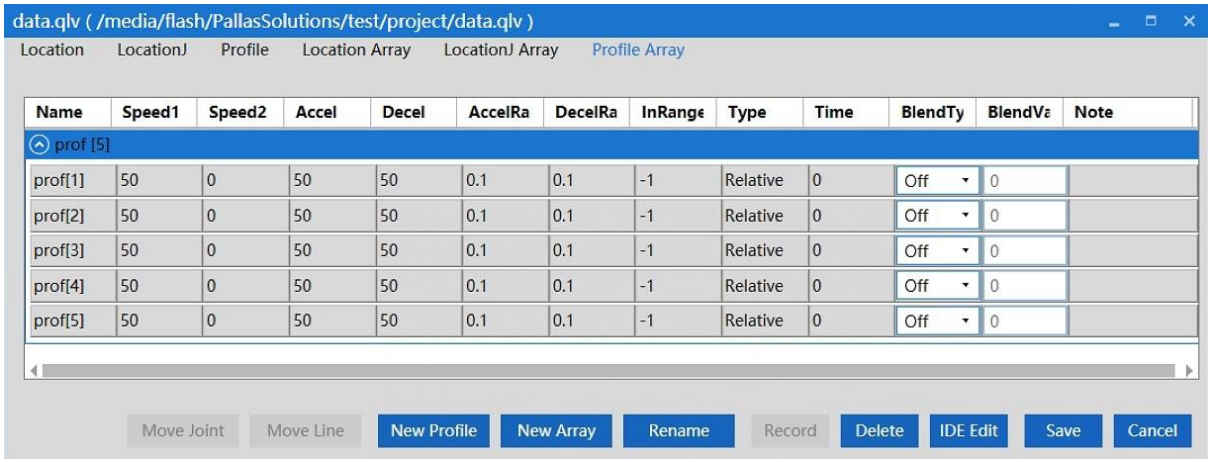


Figure 6-41 "Profile Array" information interface

Step 7 Click "IDE Edit", and the program contents of "data.qlv" will appear in the ARM debugging interface, showing the point and motion parameter information added in the above steps, as shown in Figure 6-42.

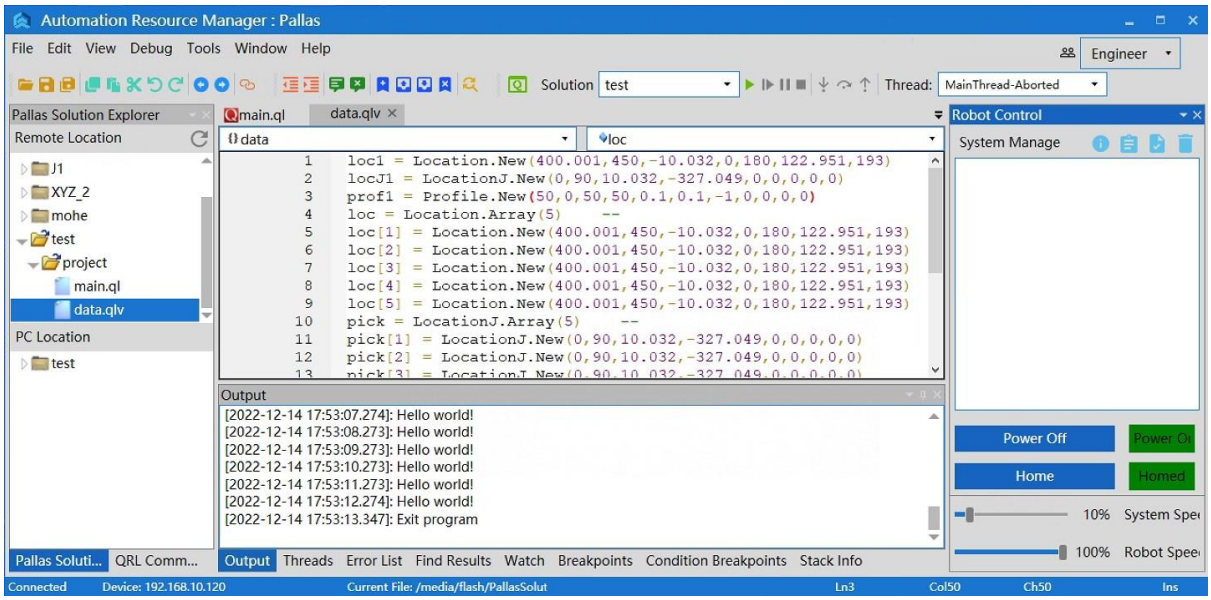


Figure 6-42 "data.qlv" program content

6.5.5 Saving and downloading program locally

Step 1 Select the solution folder to be saved, such as "test", click "test" and drag it to "PC Location", the download history path will pop up, as

shown in Figure 6-43.

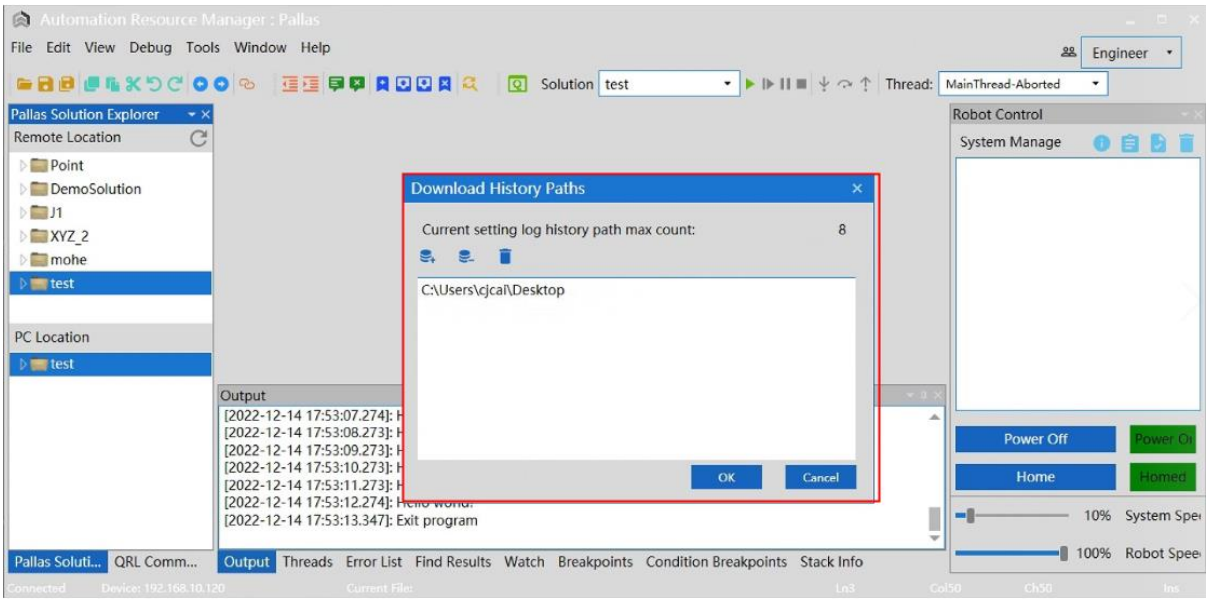


Figure 6-43 Save to "PC Location"

Step 2 Click the button  in the download history path, select the path where the file needs to be saved, and click "OK".

Step 3 A path will appear in the download history path, select this path, and click "OK" below.

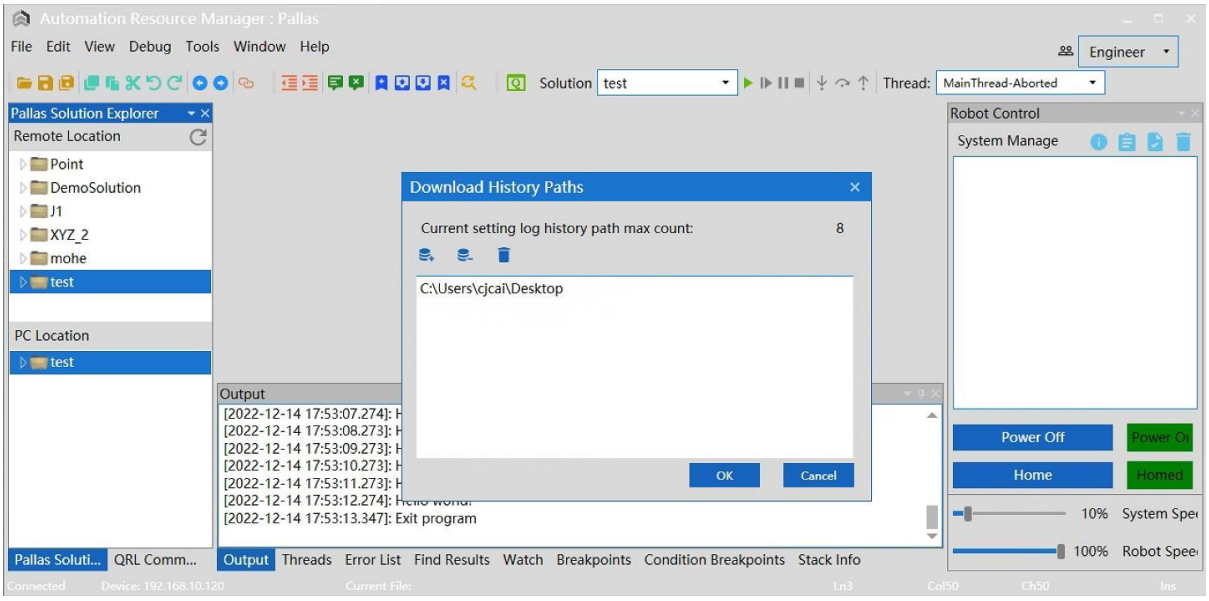


Figure 6-44 "Download History Paths" interface

Step 4 After completion, the file will appear in "PC Location", and the program file will also appear in the corresponding save path, as shown in Figure 6-45.

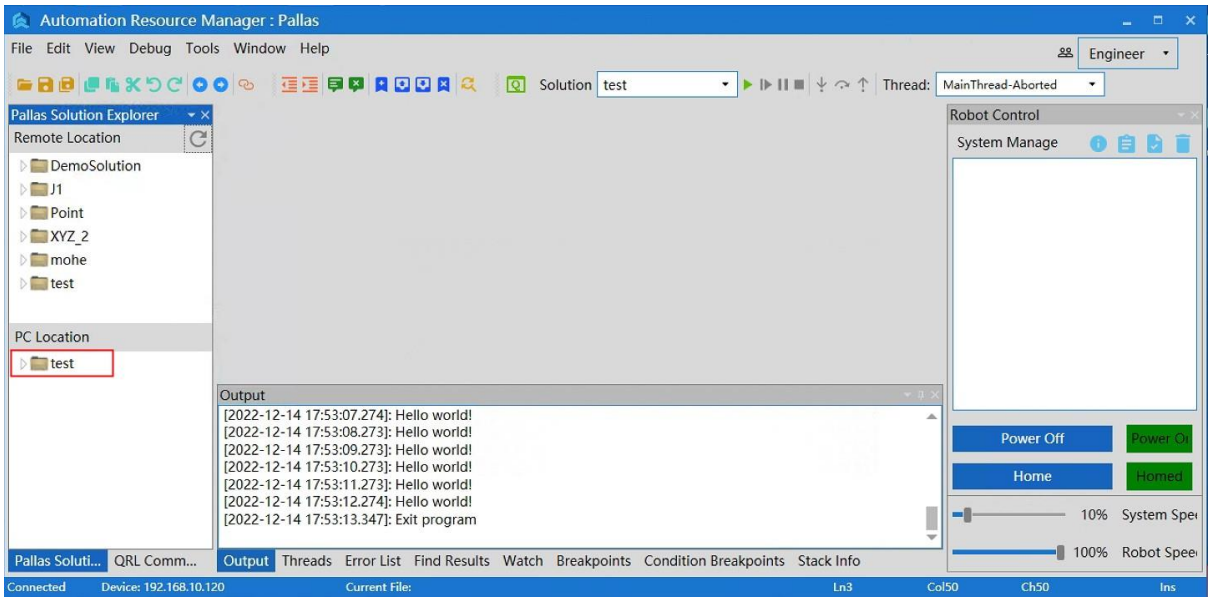


Figure 6-45 "PC Location" file interface

6.6 Manual jog teach

On the ARM interface, click < Tools >→< Robot Controls >→< Jog Control >, and the point teaching interface pops up as shown in Figure 6-47.

NOTE When the click operation is enabled, the system automatically switches to manual mode.

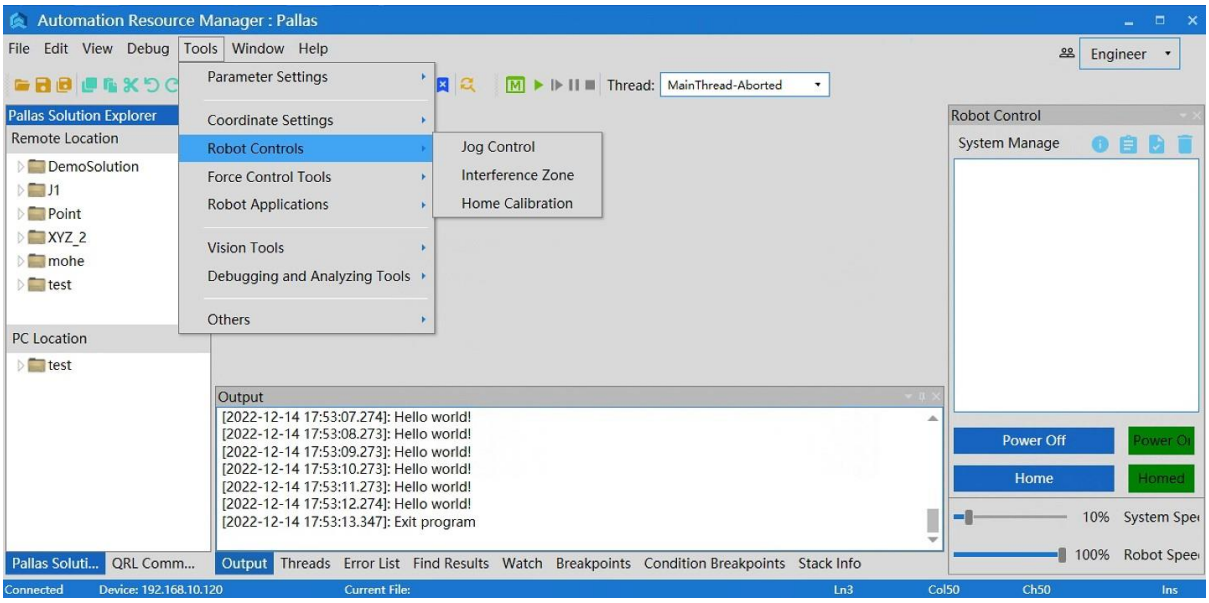


Figure 6-46 Jog teach

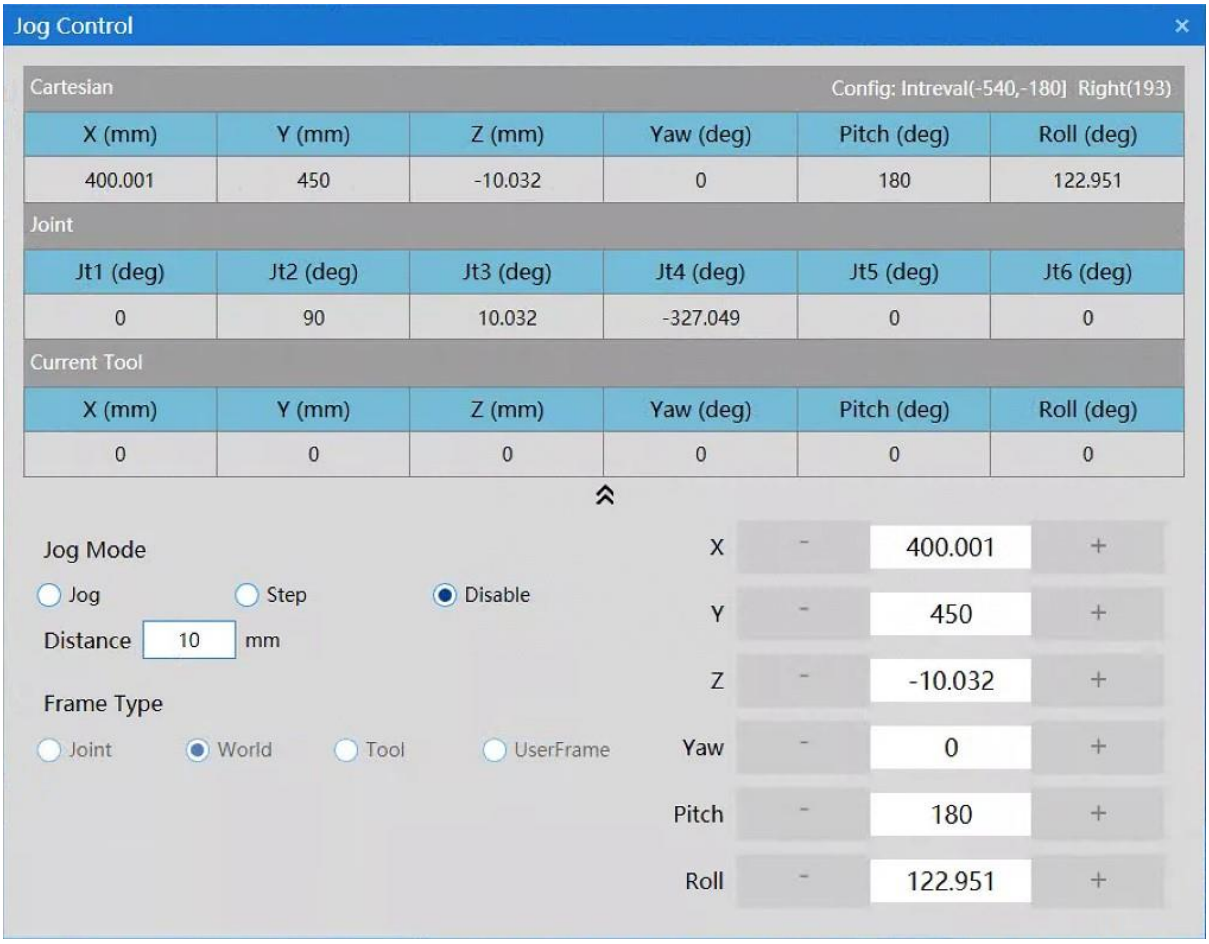
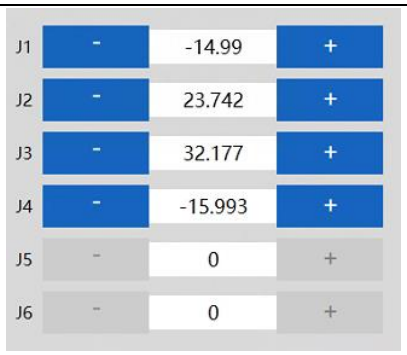
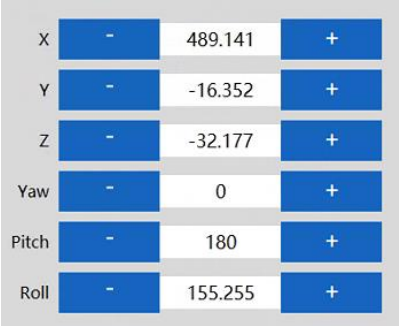
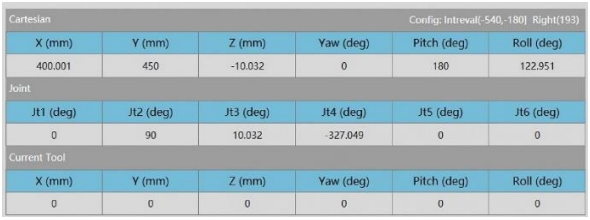


Figure 6-47 Teach interface

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

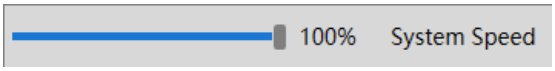
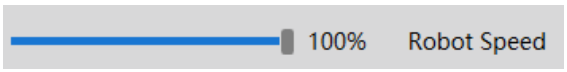
Function	Diagram	Description
Frame Type		You can select [Joint],[World],[Tool]or [UseFrame].
Jog Mode		You can select [Jog],[Step]or[Disable] in this mode.
Inching distance		Manually enter the distance value for each inching.
Robot coordinate	 Coordinates in [Joint] mode Or	The coordinate values of ends of the current robot in different coordinate systems include X,Y,Z,Yaw,Pitch,Roll; or J1,J2,J3,J4,J5,J6. "+"and"-"light up to

	 Coordinates in [World/Tool/UseFrame] mode	indicate that it can be jogged.
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 direction of X,etc.

6.7 Servo power-on

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

Table 6-3 Introduction to tools on the Servo power-on interface

Power on		Click < power on > to control the robot to power on
Home		Click < Home > to control the robot to return Home
System Speed		The user adjusts the running speed of the whole system by percentage.
Robot Speed		The user adjusts the running speed of the robot by percentage.

The robot can be powered on using the two methods as follows.

NOTE

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.

Method 2 (send macro instruction):

Enter Robot.Home [robotIndex] in the instruction editing area on the macro command debugger 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
```

Method 1 (jog teach):

Click <Power> button on the jog teach interface to power on the robot via servo,as shown in Figure 6-48.

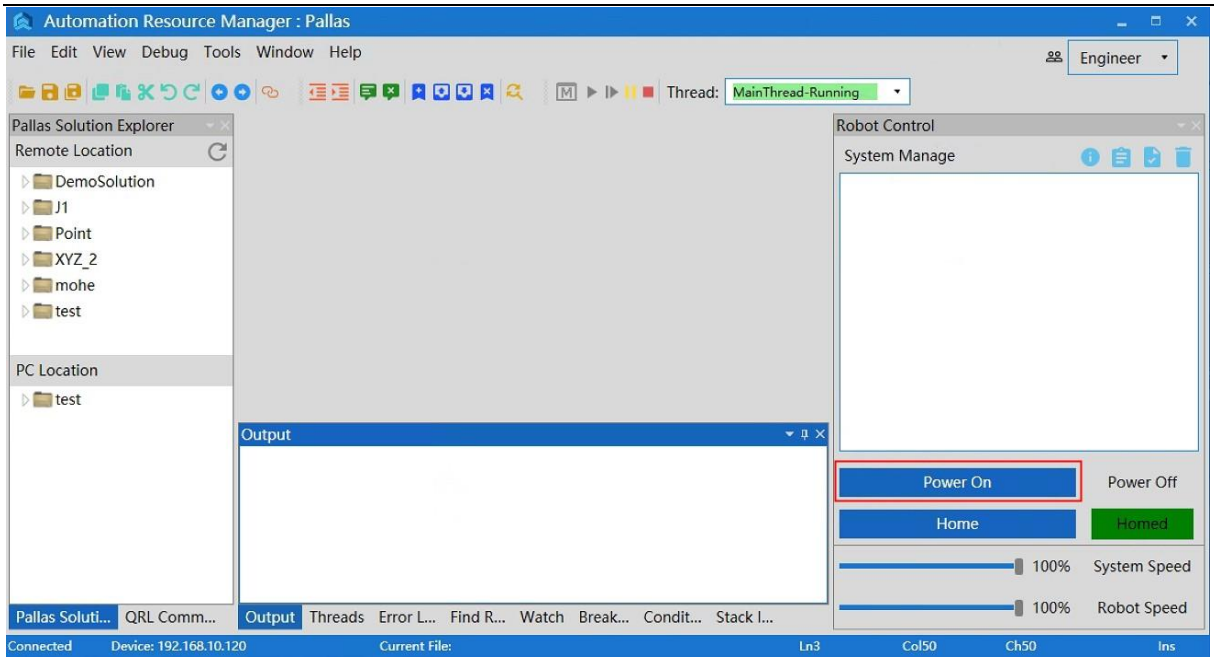


Figure 6-48 Power-on button interface

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 command debugger 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
```

6.8 Speed adjustment

There are three speeds:

- System speed;

- Robot speed;
- Speed in robot motion parameters.

6.8.1 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):

Click the <System speed> slider on the bottom right of the ARM debugging interface and slide it to adjust the motion speed of the robot,as shown in Figure 6-49.

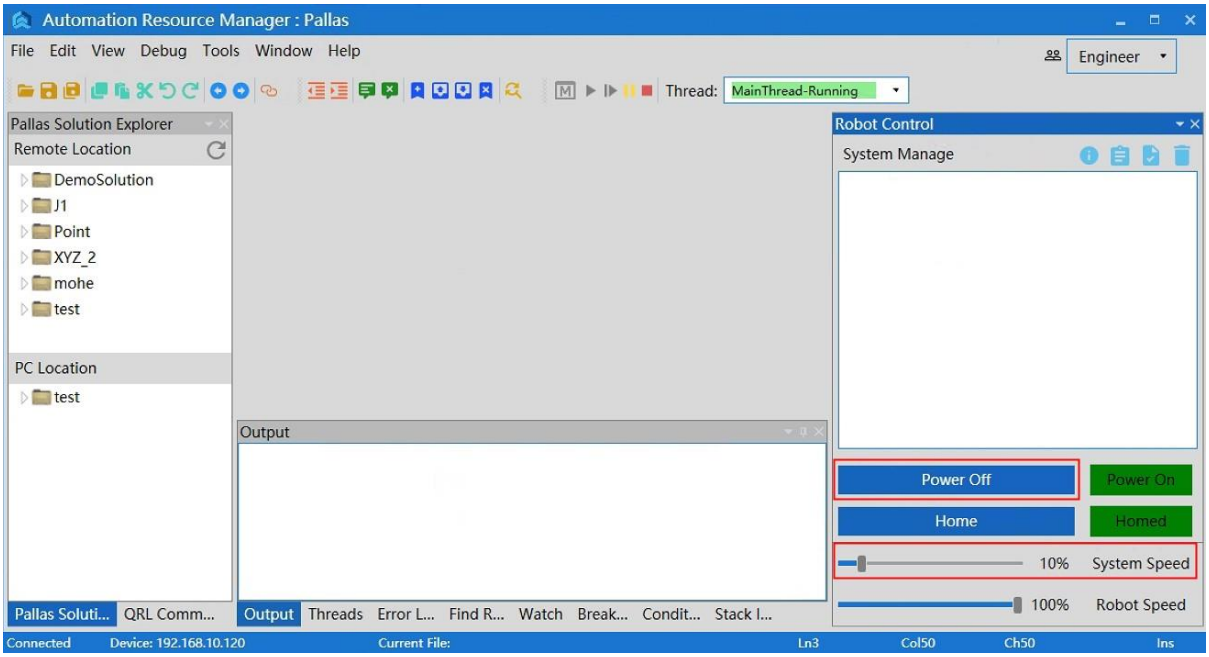


Figure 6-49 Adjustment of system speed

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.
```

6.8.2 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):

Click the < Robot speed> slider on the bottom right of the ARM debugging interface and slide it to adjust the motion speed of the robot, as shown in Figure 6-50.

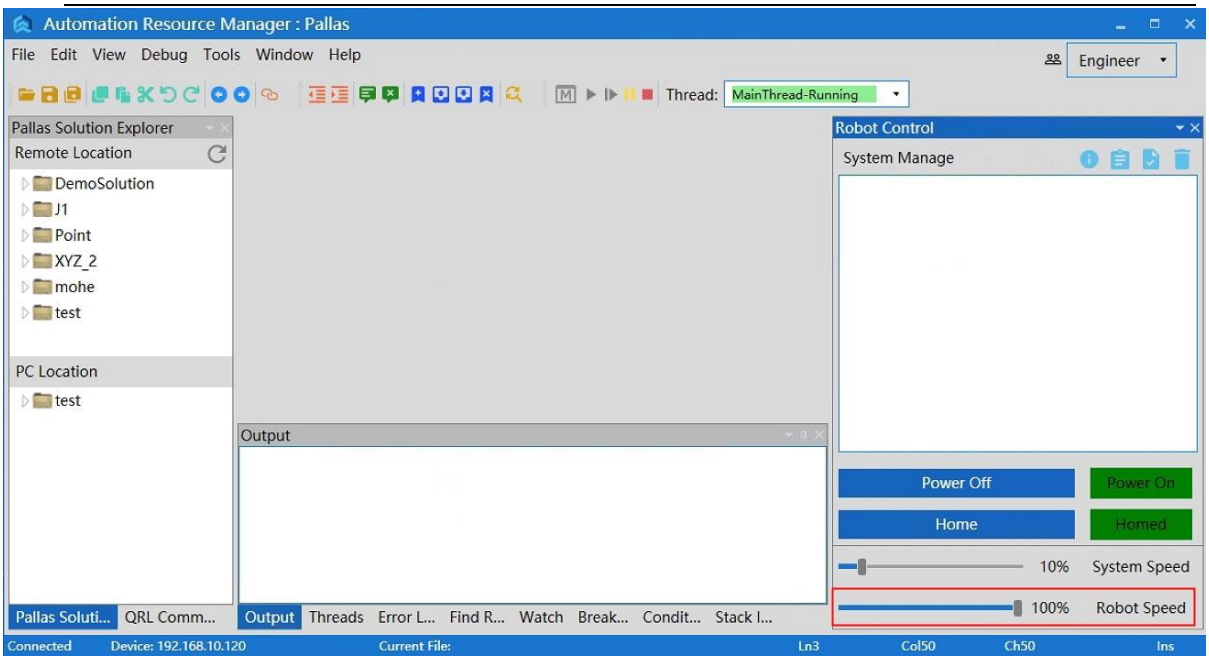


Figure 6-50 Speed adjustment

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

6.8.3 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, Time,BlendType,BlendValue] 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/Time/BlendType/BlendValue 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 错误!未找到引用源。.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 6-4 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	Release the brake button and manually operate the robot to move it to a safe position.

robot and 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 the ARM interface):

Step 1 Stop the program that the robot is running.

Step 2 Click the <Power Off>at the bottom right of the ARM debugging interface,as shown in Figure 6-51.

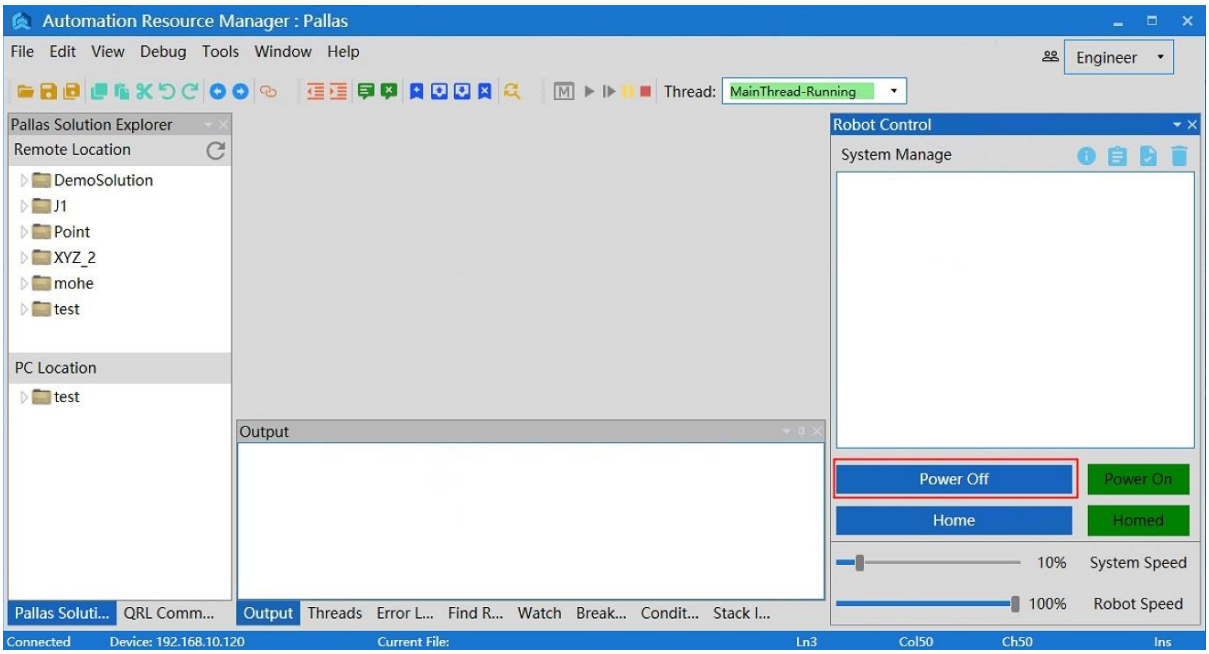


Figure 6-51 Interface of teaching in powered-on state

Step 3 Unplug the power cable plug from the robot (turn off the power switch before unplugging the power cable plug 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 Stop the program that the robot is running.

Step 2 Enter Robot.PowerEnable [robotIndex], 0 in the instruction editing area on the macro command debugger. (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 3 Unplug the power cable from the robot (turn off the power switch before unplugging the power cable plug if there is a power switch on the robot).

Method 3 (press the emergency stop button):

Step 1 Stop the program that the robot is running.

Step 2 Press the emergency stop button and the robot is power off.

Unplug the power cable plug from the robot (turn off the power switch before unplugging the power cable plug 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.

Provide Superior Robot Products and Services to Global Manufacturers

QKM Technology(Dongguan)Co.,Ltd

Tower A, Building 17, Headquarters 1, No.4 Xinzhu Road, Songshan Lake

High-tech Industrial Development Zone, Dongguan , Guangdong,China

Tel: +86 0769-27231381

Fax: +86 0769-27231381-8053

Zip code: 523808

Email: service@qkmtech.com

Website: www.qkmtech.com

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