Dobot CR5 Hardware User Guide

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Shenzhen Yuejiang Technology Co., Ltd

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Before using our product, please thoroughly read and understand the contents of this document and related technical documents that are published online, to ensure that the robot is used on the premise of fully understanding the robot and related knowledge. Please use this document with technical guidance from professionals. Even if follow this document or any other related instructions, Damages or losses will be happening in the using process, Dobot shall not be considered as a guarantee regarding all security information contained in this document.

The user has the responsibility to make sure following the relevant practical laws and regulations of the country, in order that there is no significant danger in the use of the robot.

If this document is incorrect, please refer to the original document.

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Preface

Purpose

This Document describes the functions, technical specifications, installation guide of DOBOT CR5 robot, making it easy for users to fully understand and use it.

Intended Audience

This document is intended for:

- Customer

- Sales Engineer

- Installation and Commissioning Engineer

- Technical Support Engineer

Change History

Date	Change Description
2021/07/07	Replace the figure of Robot base size.
2021/04/27	Add product size, nameplate and so on.
2021/03/29	Add Home Description and Factory posture chapter
2020/11/19	Add Maintenance and Repair chapter
2020/07/08	The first releases

Symbol Conventions

The symbols that may be founded in this document are defined as follows.

Symbol	Description
⚠DANGER	Indicates a hazard with a high level of risk which, if not avoided, could result in death or serious injury
⚠WARNING	Indicates a hazard with a medium level or low level of risk which, if not avoided, could result in minor or moderate injury, robot damage
⚠NOTICE	Indicates a potentially hazardous situation which, if not avoided, can result in equipment damage, data loss, or unanticipated result
📖NOTE	Provides additional information to emphasize or supplement important points in the main text

Referenced Document

The reference document for this manual: DobotSCStudio User Manual (CR Robot).

Contents

1. **Security Precautions**

This topic describes the security precautions that should be noticed when using this product. Please read this document carefully before using the robot for the first time. This product needs to be carried out in an environment meeting design specification. You cannot remold the product without authorization, otherwise, it could lead to product failure, and even personal injury, electric shock, fire, etc. People who use this product for system design and manufacture must be trained by our company, relevant institution, or must have the same professional skills. The installation personnel, operators, teaching personnel, programmers and system developers of the robot must read this document carefully and use the robot strictly according to the regulations of this document strictly.

1.1 **Security Warning Sign**

The following safety warning signs may appear in this manual, and their meanings are as follows.

Sign	Description
⚠DANGER	Indicates a high degree of potential danger, which, if unavoidable, will result in death or serious injury
⚠ELECTRICITY	Dangerous power consumption will soon be caused. If it cannot be avoided, it will cause personal injury or serious injury to the equipment.
⚠HOT	May cause dangerous hot surfaces, if touched, may cause personal injury
⚠WARNNING	Indicates that there is a moderate or low potential hazard. If it cannot be avoided, it may cause minor injuries to the equipment and damage to the equipment.
⚠ATTENTION	Indicates a potential risk, and ignoring these texts may result in damage to the robotic arm, loss of data, or unpredictable results
⚠NOTICE	A situation that, if unavoidable, can cause personal injury or equipment damage For items marked with such symbols, depending on the specific situation, there is sometimes the possibility of significant consequences

1.2 **General Security**

The following security rules should be followed when using the robot for industrial design and manufacture.

⚠DANGER

- Robot is electrical equipment. Non-professional technicians cannot modify the

circuit, otherwise, it is vulnerable to injury the device or the person.

- You should comply with the local laws and regulations when operating the robot. The security precautions in this document are only supplemental to the local laws and regulations.

- Please use the robot in the specified environment scope. If not, exceeding the specifications or load conditions will shorten the service life of the robot, even damage it.

- Please ensure that the robot is operated under the security conditions and there is no harmful object around the robot.

- Turning on or off the power continually may result in that the performance of the main circuit components inside the controller is degraded. If turning on or off the power continually is required, please keep frequency less than once a minute.

⚠HOT

- The robot and the controller will generate heat during operation. Please do not operate or touch the robot when the robot is working or has just stopped working.

- Turn off the power and wait an hour for the robot to cool down.

- Do not put your fingers where the control cabinet gets hot.

⚠NOTICE

- The personnel responsible for installation, operation and maintenance of equipment must first undergo rigorous training, understand various safety precautions, and master the correct operation and maintenance methods before they can operate and maintain equipment.

- Personnel without professional training shall not disassemble and repair the equipment without authorization. If the device fails, please contact Shenzhen Yuejiang Technology Co., Ltd technical support engineer in time.

- Be sure to carry out daily inspections and regular maintenance, and replace faulty components in time to ensure the safe operation of the equipment.

- If the equipment is scrapped, please comply with relevant laws to properly handle industrial waste and protect the environment.

- In order to prevent personnel from accidentally entering the working space of the robotic arm, be sure to set up safety fence to prevent personnel from entering the hazardous area.

- Before operating the robot, make sure that no one is inside the safety fence. When operating the robot, be sure to operate outside the safety fence.

- Do not expose the robot to permanent magnetic fields all the time. Strong magnetic fields can cause damage to the robot.

- Shenzhen Yuejiang Technology Co., Ltd. assumes no responsibility for robot damage or personal injury caused by failure to follow product instructions or other improper operations.

- Handling operations such as lifting rings and driving need to use appropriate and reliable lifting equipment. According to the relevant regulations of various countries, it must be carried out by personnel with operating qualification certificates or personnel authorized by the company.

- Please make sure that there are no obstacles within 2 meters of the robot during transportation, and relevant personnel should stay away from the suspended robot.

- Shenzhen Yuejiang Technology Co., Ltd. is not responsible for the damage caused during the transportation and handling of equipment.

- Please make sure that the robot is in the packing posture before packaging, and the brakes on each axis are normal.

- Please make sure that there are no obstacles around the packing area, so that the staff can leave in a timely manner.

- When the robot is transported, the packaging needs to be fixed to ensure that the robot is stable.

- After removing the outer packaging, please make sure that the robot maintains the original packing posture and the brakes on each axis are normal.

- During the commissioning process, it is necessary to confirm that no relevant personnel and equipment (include computer used for debugging) stay in the dangerous area of the machine.

- If necessary, wear corresponding safety protective equipment, such as safety helmets, safety shoes (with non-slip soles), face shields, protective glasses and gloves. Inappropriate clothing may cause personal injury.

- In order to prevent personnel from entering the working space of the robot arm by mistake, please set up safety barriers to prevent personnel from entering the hazardous area.

- Do not enter the working space of the manipulator at will during operating the robot, otherwise cause injury to the robot or yourself.

- The personnel responsible for installation, operation, and maintenance of the equipment must first undergo strict training, understand various safety precautions, and master the correct operation and maintenance methods before operating and maintaining the equipment.

- When an abnormality occurs in the mechanical arm, it is necessary to ensure that the machine is stopped and then checked.

- After the commissioning of the operator is completed, the test needs to be performed in the Manual mode first, and then it is automatically run after it is confirmed to be

correct.

- If the controller needs to be restarted due to power failure, when restarting, the robot must be manually returned to the initial position of the automatic operation program before restarting the automatic operation.

- Before maintenance and wiring work, the power supply must be cut off, and the sign **No power supply** must be put on. Otherwise, electric shock and personal injury may result.

- Please observe the ESD regulations when disassembling the robot or controller.

- Avoid dismantling the power supply system in the controller. After the controller is turned off, its power supply system may still have high voltage for several hours.

- Please contact our technical support staff for the disassembly and repair of the robot.

- Maintenance and repair work must be carried out by designated personnel, otherwise electric shock and personal injury may result.

- If the brake is manually released, the robot may move because of the action of gravity. So, when manually releasing the brake, please ensure that the robot body and the tools or workpieces installed on the robot are effectively supported.

- In order to prevent electric shock, when replacing parts, please turn off the circuit breaker in advance and cut off the main power before proceeding.

- Turn off the main power supply for 5 minutes before replacing parts.

- The replacement operation must be performed by the specified operator.

- The robot is designed and tested according to the group I class A engineering medical robot standard. In order to reduce the radio interference in in light industry or family environment, please take protective measures.

- It is prohibited to operate the robot in strong radiation environment, for example, RF source without shielding, otherwise, it could lead to robot abnormally.

⚠WARNING

- Before the operation, please wear protective clothing, such as antistatic uniform, protective gloves, and protective shoes.

- It is prohibited to modify or remove the nameplates, instructions, icons, and marks on the robot and the related equipment.

- Before operating and maintaining the robot, the personnel responsible for the installation, operation and maintenance must be trained to understand the various security precautions and to master the correct methods of operation, and maintenance.

- All the required cables must be connected before powering on the equipment.

- Be careful during the robot carrying or installing. Please follow the instructions on the packing box to put down the robot gently and place it correctly in direction of the arrow.

- Please use the matched cables when connecting a robot to internal or external equipment for personal security and equipment protection.

- Please do not plug or unplug the power cables or communication cables when equipment is normally operated.

- Please ensure that robot and tools are installed correctly.

- Please ensure that the robot has enough space to move freely.

- If the robot is damaged, please do not continue to use it.

- Any impact will release a lot of kinetic energy, which is much higher than that under high speed and high load.

1.3 Personal Security

When operating the robot system, it is necessary to ensure the personal safety of the operator. The general precautions are listed below, please strictly follow.

⚠ WARNING

- To reduce the risk of personal injury, please comply with local regulations with regard to the maximum weight one person is permitted to carry.

- Do not touch the terminal blocks or disassemble the equipment with the power **ON.** Otherwise, it may result in an electric shock

- Please confirm that the equipment is well grounded, otherwise it will endanger personal safety.

- Do not touch the terminal blocks or remove the interval circuit components in 10 minutes after the power is shut off, to avoid an electric shock since there is residual capacitance inside the controller.

- Please do not reach out into the workspace of the robot when operating it, otherwise, it will be vulnerable to injury the device or the person.

- Even if the power switch of the controller is already in the **OFF** status, touching the terminal blocks or removing the interval circuit components is not allowed, to avoid an electric shock since there is residual capacitance inside the controller.

- Please do not reach out into the workspace of the robot when operating it, otherwise, it will be vulnerable to injury the device or the person.

- When working with robots, please do not wear loose clothing or jewelry. When operating the robot, make sure that the long hair bundle is behind your head.

- If the robot appears to have stopped during the operation of the equipment, it may be because the robot is waiting for the start signal and is in the state of being about to move. In this case, the robot should also be considered to be in motion, please do not approach the robot.

- Please ensure that the robot establishes safety measures near the operation area, such as guardrails, to protect the operator and surrounding people.
- When a person is trapped by the robot, rescuers can push hard on the joints of the robot until the person is freed.

2. **Overview**

The collaborative robot work system is composed of the collaborative robot body, robot control software, and robot operation software. DOBOT CR5 supports APP wireless direct connection, which is really simple and easy to use. With the self-developed dynamic algorithm, one-handed teach-in and sensor less collision detection are realized to ensure the safety of human and machine working together. The drag trajectory reproduction function is creatively introduced, which completely reproduces the drag trajectory and reduces the threshold for robot use. DOBOT CR5 has a repeat positioning accuracy of ±0.03mm, a max load of 5kg, and a joint speed of 180 ％s. It is a product with the advantages of both industrial robots and collaborative robots.

Figure 2.1　Robot system

2.1　**Technical Specifications**

2.1.1　**Robot Body Technical Parameters**

Table 2.1　Robot body technical parameters

Product Name	DOBOT CR5
Product Model	DT-CR-6R050-00I
Weight	25 kg
Max Load(kg)	5 kg
Reach(mm)	900 mm
Full-load Current	6.3 A

Rated Voltage	DC 48V	
Maximum Speed of End-effector	3 m/s	
Motion Range (°)	J1	$\pm 360°$
	J2	$\pm 360°$
	J3	$\pm 160°$
	J4	$\pm 360°$
	J5	$\pm 360°$
	J6	$\pm 360°$
Joint Maximum Speed(°/s)	J1	180 °/s
	J2	180 °/s
	J3	180 °/s
	J4	180 °/s
	J5	180 °/s
	J6	180 °/s
End-effector I/O Interface	DI	2
	DO	2
	AI (RS485 multiplexing)	2
	RS485（AI multiplexing）	ModBus_RTU
Repeatability	± 0.03mm	
IP Classification	IP54	
Temperature	0℃~45℃	
Typical Power Supply	150W	
Material	Aluminum alloy, ABS	
Operating Altitude Range	≤ 1000 m	
Package Size	812 mm x 512 mm x 398 mm	
Packing Weight (including the robot)	30.7 kg	
Safety Standard	UL1740: 2018-Standard for Safety：Robot and Robotic Equipment; CSA Z434-14 (R2019) Industrial robots and robot systems NFPA 79:2018 Electrical Standard for Industrial Machinery	

	EN ISO 10218-1:2011 Steel wire and wire products. General. Test methods
	EN 60204-1:2018 Safety of machinery. Electrical equipment of machines. General requirements;
	IEC 60204-1:2016 Safety of machinery. Electrical equipment of machines. General requirements;
	EN ISO 12100:2010 Safety of machinery. General principles for design. Risk assessment and risk reduction;
	ISO/TS 15066:2016 Robots and robotic devices-Collaborative robots;
	ISO 13849-1:2015 Safety of machinery-Safety-related parts of control systems -Part 1: General principles for design
EMC Standard	EN IEC 61000-6-2:2019-Generic Standards-Immunity for industrial environments;
	EN IEC 61000-6-4:2019-Generic standards - Emission standard for industrial environments;
	EN IEC 61000-6-7:2014 Electromagnetic compatibility (EMC). Generic standards. Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations

2.1.2 Controller Technical Parameters

Table 2.2 Controller technical parameters

Product Name	DOBOT CC162
Product Model	DT-CR-6R162-00I
Axis Control	6 axes
Input Power	1 PHASE AC 100V~240V, 50/60 Hz
Output Power	48V DC, MAX 12.5A
I/O Interface	• 16 Digital Inputs • 16 Digital Inputs/Outputs (Multiplexing) • 2 Analog Outputs (Voltage: 0V-10V, Current: 4mA-20mA) • 2 Analog Inputs (Voltage: 0V-10V, Current: 4mA-20mA) • 1 Incremental Encoder ABZ Input
Teaching Method	APP
Programming Language	Script/Tree Programming/Graphical Programming
Installation Method	Floor mounting
Environment	Temperature: 0℃ - 45℃

	Humidity: ≤95%, and no condensation
Protection Grade	IP20
Cooling Method	Forced air cooling
Safety Function	Emergency stop function and reserved external safety interface (can be controlled by I/O interface) Protective stop interface, Automatic Operation Remote Confirmation
Indicator Status	The indicator light will be steady red when the power is on; the indicator light will be off when the power is off
Maintenance	• Diagnostic software • Power-off Zero Save • Reserved remote service
Safety Standard	UL1740: 2018-Standard for Safety：Robot and Robotic Equipment; CSA Z434-14 (R2019) Industrial robots and robot systems NFPA 79:2018 Electrical Standard for Industrial Machinery EN ISO 10218-1:2011 Steel wire and wire products. General. Test methods EN 60204-1:2018 Safety of machinery. Electrical equipment of machines. General requirements; IEC 60204-1:2016 Safety of machinery. Electrical equipment of machines. General requirements; EN ISO 12100:2010 Safety of machinery. General principles for design. Risk assessment and risk reduction; ISO/TS 15066:2016 Robots and robotic devices-Collaborative robots; ISO 13849-1:2015 Safety of machinery-Safety-related parts of control systems -Part 1: General principles for design
EMC Standard	EN IEC 61000-6-2:2019-Generic Standards-Immunity for industrial environments; EN IEC 61000-6-4:2019-Generic standards - Emission standard for industrial environments; EN IEC 61000-6-7:2014 Electromagnetic compatibility (EMC). Generic standards. Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations

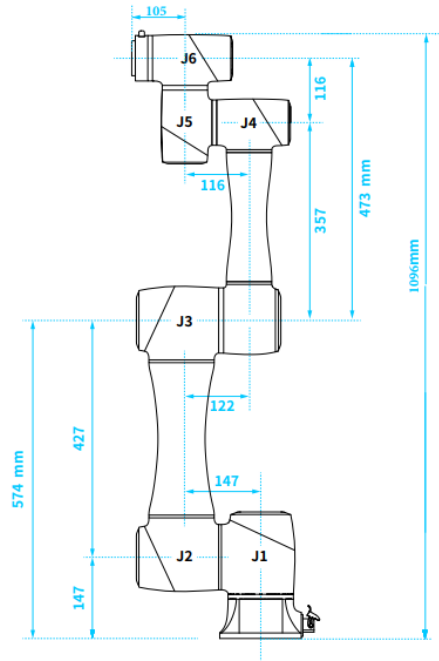## 2.2 Product Size

2.2.1 Robot Body Size

Figure 2.2   Robot body size
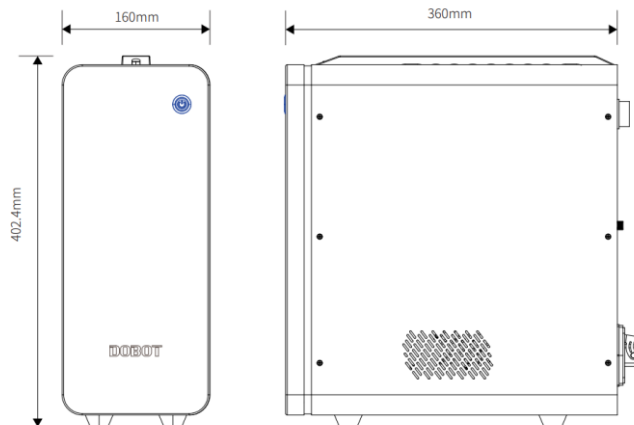
2.2.2   **Controller Size**

Figure 2.3   Controller size

2.3   **Nameplate Description**

The nameplate includes the product name, model number, weight and certification mark, as shown in Figure 2.4.

Figure 2.4 Nameplate

2.4 Security Warning Labels

The operator must strictly abide by the warning mark content on the body and controller to avoid the occurrence of danger. The specific content of the warning labels is shown in Figure 2.5.

Figure 2.5 Security warning labels

2.5 Robot Workspace

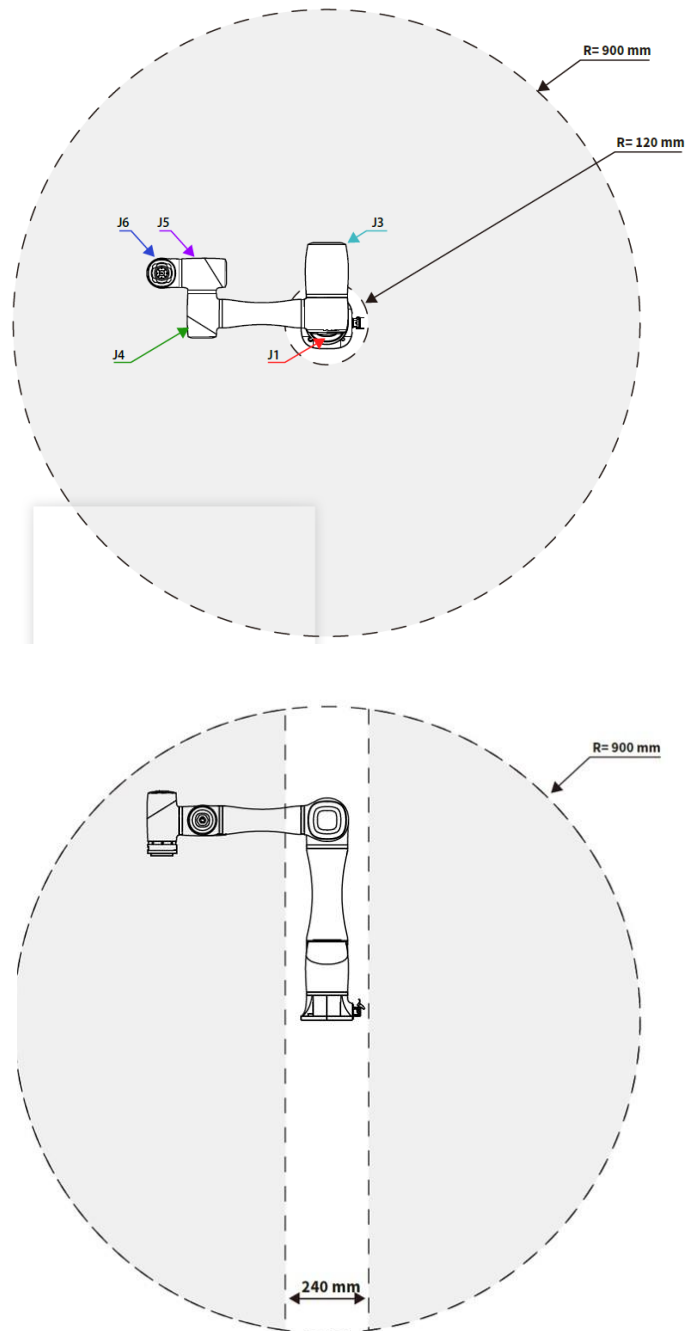Figure 2.6 shows the workspace of CR5 robot.

Figure 2.6   CR5 robot workspace
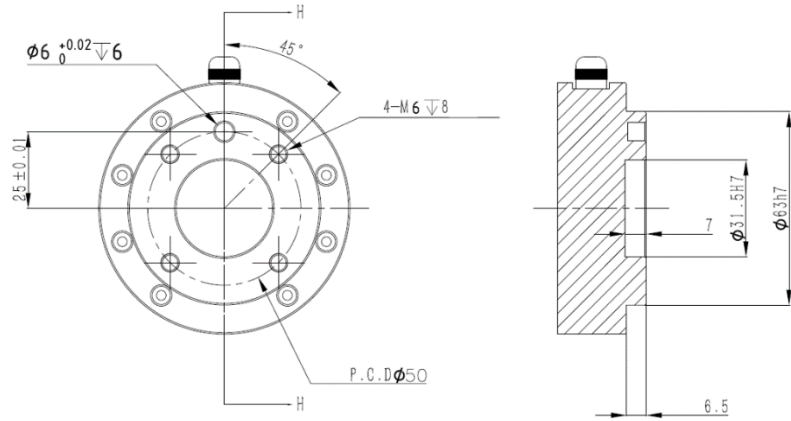
2.6 End-effector Size

Figure 2.7   End-effector Size

2.7   End-effector Load Description

The robot actuator can bear the load of the cylinder whose center of mass is located at an axial distance of LD80mm from the center of the End -effector and a radial distance of LR60mm and no more than 5kg. As shown in Figure 2.8.
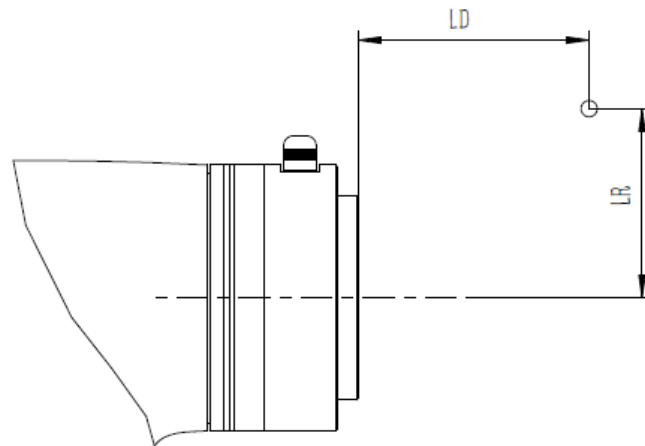

Figure 2.8   End-effector load diagram

2.8   Stop Time and Angle

The Stop time and angle of axis J1~J6 at the max speed, load and arm stretch are shown below.

Table 2.3   Stop time and angle

Axis	Stop angle（°）	Stop time（ms）
J1	10.18	138
J2	14.09	223

Axis	Stop angle（°）	Stop time（ms）
J3	15.24	167
J4	4.76	24
J5	4.48	21
J6	4.74	23

2.9 Home Description

After some parts (motors, reduction gear units) of the robot have been replaced or the robot has been hit, the origin of the robot will be changed. You need to reset the origin. Figure 2.9 shows the Home setting, for details, please see *HOME chapter of DobotSCStudio User Guide (MG400 Robot)*.
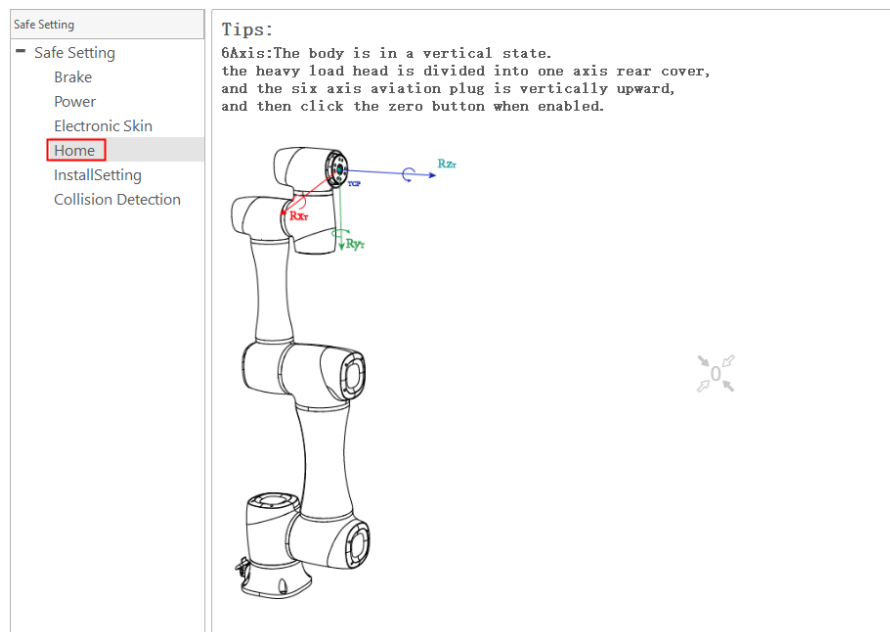

Figure 2.9   Home setting

2.10 Factory posture

When the robot leaves the factory, moving robot to the factory posture can reduce the robot space, easy to pack and transport. Figure 2.10 shows the factory posture. For details, please see *Home Point* chapter of *DobotSCStudio User Guide (MG400 Robot)*.
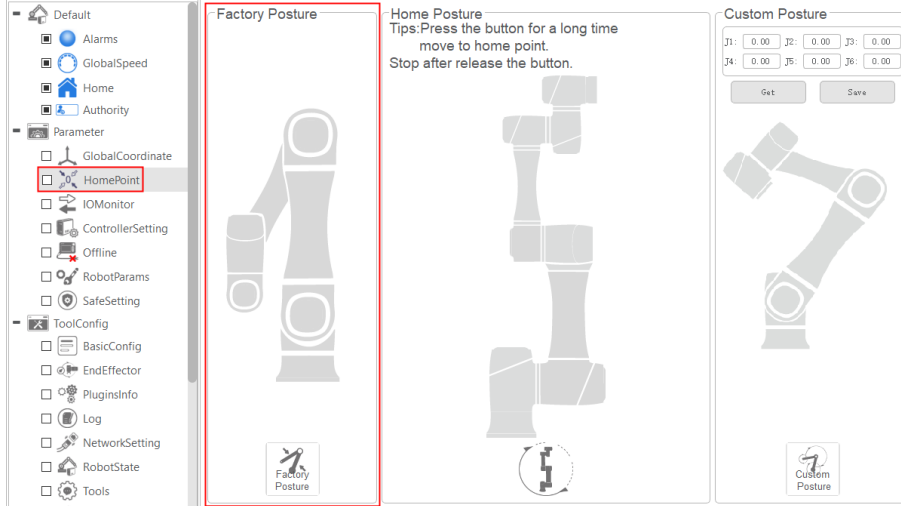
Figure 2.10   Factory posture

2.11 Product Features

2.11.1 Motion Function

The motion trajectory consists of a series of interpolated motions since the interpolated motion is the basic motion type. According to the different trajectories, motion functions are classified as joint interpolated motion, linearly interpolated motion, circular interpolated motion and continuous path. The joint interpolated motion is in the joint space. And the other interpolated motions are in the Cartesian space.

2.11.1.1 Joint Interpolated Motion

Joint interpolated motion includes **Go**, **MoveJ** modes.

* Go/MoveJ: From point A to point B, each joint will run from an initial angle to its target angle, regardless of the trajectory, as shown in Figure 2.11.

Figure 2.11 Go/MoveJ modes

2.11.1.2 Linearly Interpolated Motion

The joints will perform a straight line trajectory from point A to point B, as shown in Figure 2.12.

Figure 2.12   Move mode

- Jump: The trajectory looks like a door. From point A to point B, the robot will move in the **Move** mode

    1. Move up to the lifting height (**StartHeight** is a relative height).

    2. Move up to the maximum lifting height (**zLimit**).

    3. Move horizontally to a point that is above point **B**.

    4. Move down to a point where the height is point **B** plus the dropping height (**EndHeight** is a relative height).
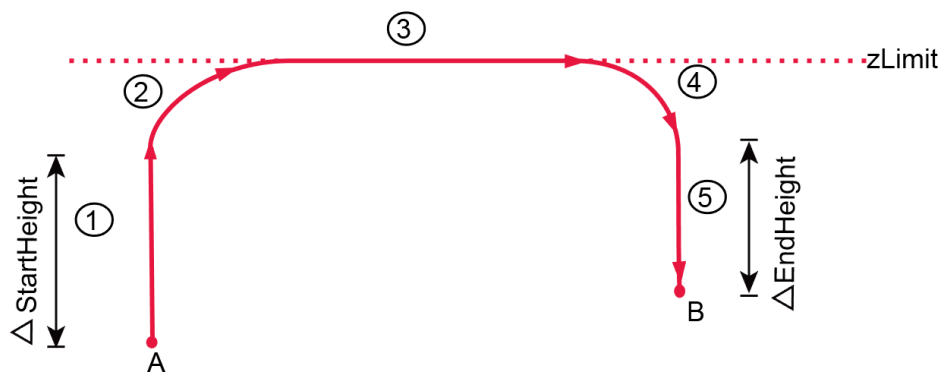
    5. Move down to Point **B**.

Figure 2.13   Jump mode

⚠ NOTICE

- Point **A** and point **B** cannot be higher than **zLimit**. Otherwise, an alarm will be triggered.

- If point **A** plus **StartHeight** or point **B** plus **EndHeight** is higher than **zLimit**, the robot moves up from point **A** to **zLimit** or moves down from **zLimit** to point **B** directly, the trajectory looks like a door without transition, as shown in Figure 2.14.
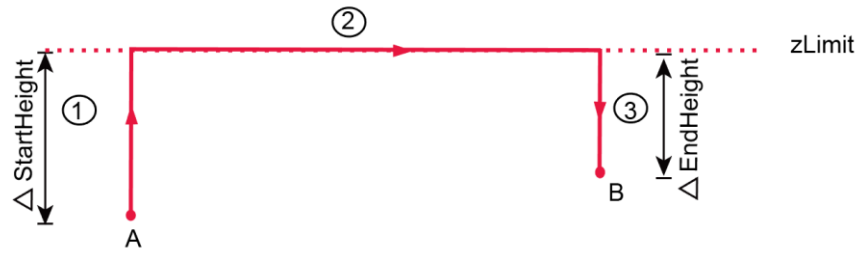
Figure 2.14   Jump mode (1)

- If the heights of point **A** and point **B** are the same with **zLimit**, the trajectory is shown in Figure 2.15.

Figure 2.15   Jump mode (2)

2.11.1.3 **ARC (Circular Interpolated Motion)**

The trajectory is an arc, which is determined by three points (the current point, any point and the end point on the arc), as shown in Figure 2.16.

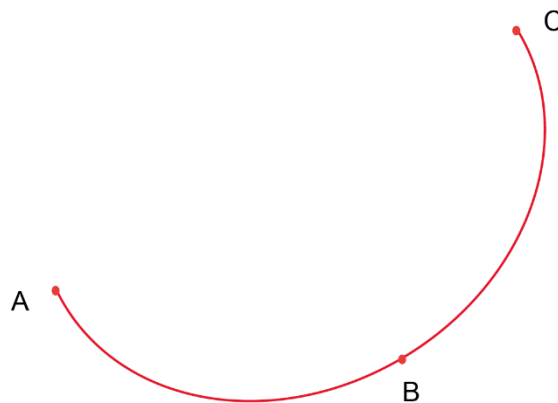

Figure 2.16   Arc trajectory

2.11.1.4 **Circle (Circular Interpolated Motion))**

The trajectory is a circle, which is determined by three points (the current point, any point and the end point on the arc) as well, as shown in Figure 2.17.
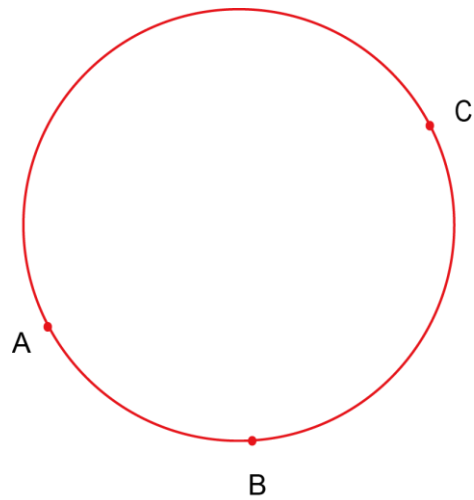
Figure 2.17   Circle trajectory

2.11.2   **Coordinate System**

This topic describes the coordinate systems for different types of robots, which are divided into Joint coordinate system, Base coordinate system, User coordinate system, and Tool coordinate system. The next three coordinate systems which are based on the right-handed rule are called the Cartesian coordinate system.

2.11.2.1 **Joint Coordinate System**

The Joint coordinate system is determined by the motion joints.

Figure 2.18 shows the Joint coordinate system of a CR5 robot. All the joints are rotating joints.
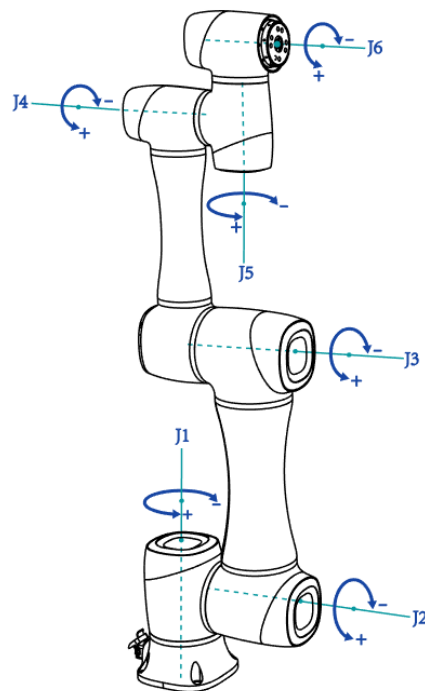

Figure 2.18   Joint coordinate of a CR5 robot

2.11.2.2 **Base Coordinate System**

The Base coordinate system is determined by the base.

Figure 2.19 shows the Base coordinate system of a CR5 robot. $\mathbf{Rx_B}$, $\mathbf{Ry_B}$, $\mathbf{Rz_B}$ are the orientation data, which are designated by rotating the tool center point (TCP) around the X, Y, Z axes under the Base coordinate system.
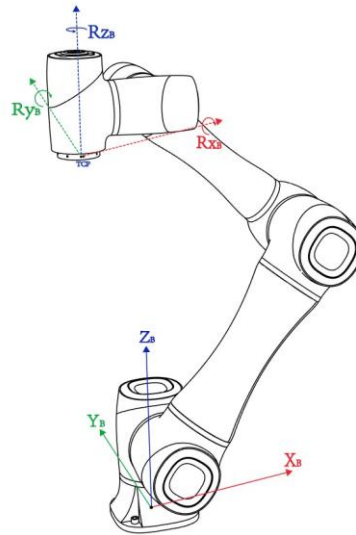

Figure 2.19   Base coordinate system of CR5 robot

2.11.2.3 **Tool Coordinate System**

Tool coordinate system is the coordinate system that defines the distance and rotation angle of the offset, of which the origin and orientations vary with the position and attitude of the workpiece located at the robot flange. The 10 types of tool coordinate systems can be defined. Tool 0 coordinate system is the predefined Tool coordinate system which is located at the robot flange without end effector and cannot be changed. And the others can be customized by users.

Figure 2.20 shows the default Tool coordinate system of a CR5 robot. $\mathbf{R_{XT}}$, $\mathbf{R_{YT}}$, $\mathbf{R_{ZT}}$ are the orientation data, which are designated by rotating the tool center point (TCP) around the X, Y, Z axes under the default Tool coordinate system.
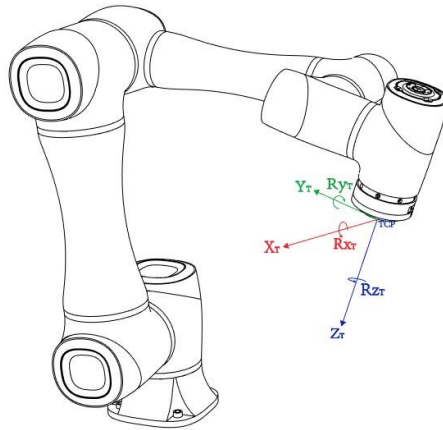
Figure 2.20   The default Tool coordinate system of CR5 robot

2.11.2.4 **User Coordinate System**

The User coordinate system is a movable coordinate system which is used for representing equipment like fixtures, workbenches. The origin and the orientations of axes can be defined based on site requirements, to measure point data within the workspace and arrange tasks conveniently.

There are totally 10 groups of User coordinate systems, of which the first one is defined as the Base coordinate system by default and cannot be changed. And the others can be customized by users.

Figure 2.21 shows the default User coordinate system of a CR5 robot. R_{XU}, R_{YU}, R_{ZU} are the orientation data, which are designated by rotating the tool center point (TCP) around the X, Y, Z axes under the selected User coordinate system.
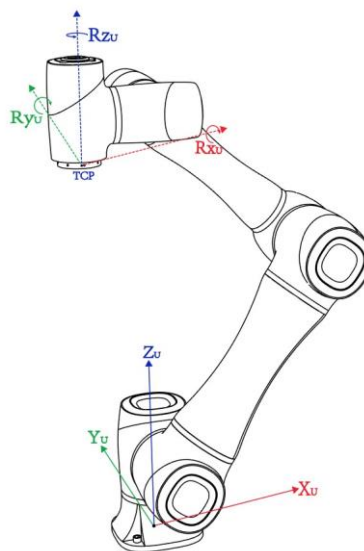

Figure 2.21   The default User coordinate system of CR5 robot

2.11.3 **Singularity Point**

When the robot moves under the Cartesian coordinate system, the resultant velocity of the two axes cannot be in any direction if the directions of them are aligned, resulting in that the degrees of freedom of the robot are degraded. Namely, the robot moves to the singularity point and an alarm about singularity point is triggered. However, when the robot moves to the singularity point under the Joint coordinate system, the movement will not be affected. And also, the alarm will not be triggered.

There are three singularity points shown as follows.

• Wrist singularity point: The axes of J4 and J6 are aligned.
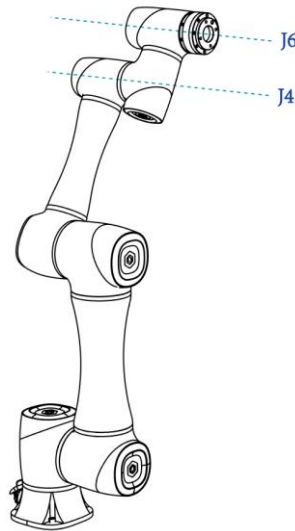
Figure 2.22   Wrist singularity point

• Shoulder singularity point: The TCP is located in the plane performed by Joint1 and Joint2.
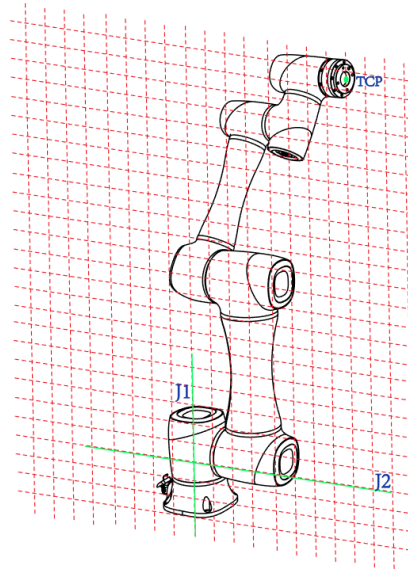
Figure 2.23   Shoulder singularity point

- Elbow singularity point: The Rear arm and Forearm in a straight line.
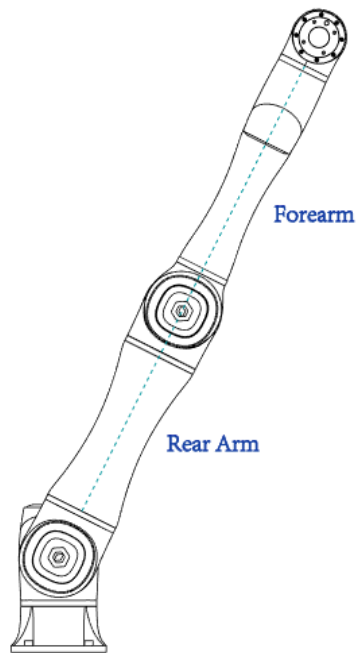
Figure 2.24   Elbow singularity point

2.11.4 **Collision Detection**

Collision detection is mainly used for reducing the impact on the robot, to avoid damage to the robot or external equipment. If the collision detection is activated, the robot arm will stop running

automatically when the robot arm hit an obstacle.

2.12 **Key Description on Robot**

There are function keys and LED indicator on the robot for user to manually control robot.
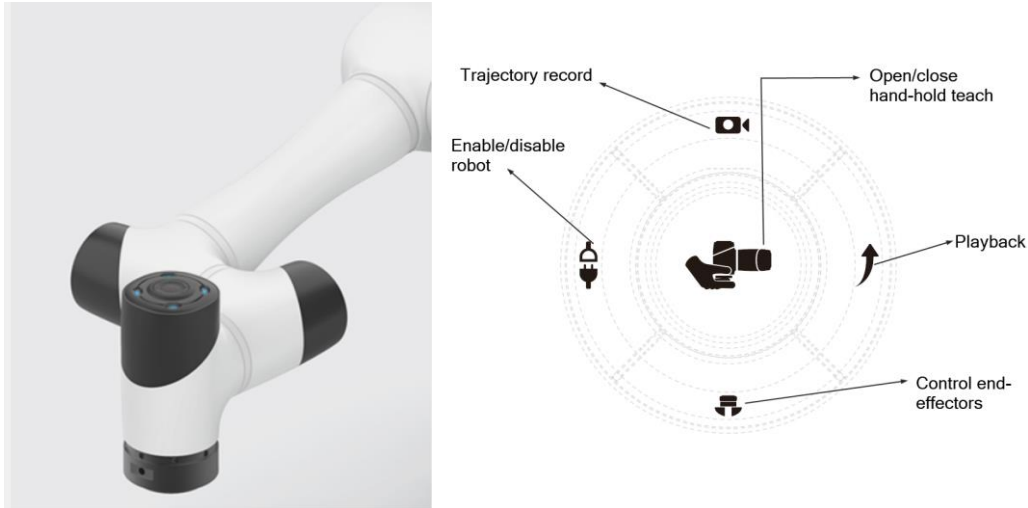
Figure 2.25   Keys on robot

Table 2.4   Key description

| Key	Description
Open/close hand-hold teach	• Long press and then release: Open hand-hold teach, and the LED indicator turns blue and blinks • Short press and then release: Close hand-hold teach, and the LED indicator turns green
Trajectory record	• Long press and release: Open trajectory record, and the LED indicator turns yellow • Short press and release: Close trajectory record, and the LED indicator turns green
Playback	• Long press and then release: Open playback, and the LED indicator turns yellow and blinks • Short press and then release: Close playback, and the LED indicator turns green
Control end-effectors	Short press and then release: Open or close end-effectors
Enable/disable robot	Long press 3s and then release: Enable robot., the LED indicator turns green from blue and blinks Long press 6s and then release: Disable robot, the LED indicator turns blue from green and blink.

📖NOTE

- If there is an error on robot, the LED indicator turns red.

- If you switch the robot mode to auto mode on the APP, the LED indicator turns green and blinks.

- The connection between robot and he controller is abnormal, the LED indicator turns blue and blinks.

3. Electrical Specifications

3.1 Controller I/O Interface Description

A robot controller contains I/O interfaces, for connecting to external equipment, such as air pump, PLC, etc. These I/O interfaces provide 32 digital inputs, 16 digital outputs, 2 analog outputs, and 2 analog inputs, as shown in Figure 3.1.
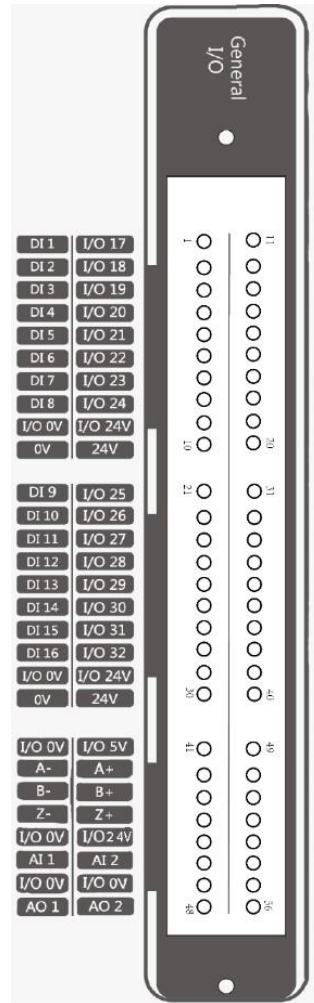
Figure 3.1   I/O interface

Table 3.1   PIN definition of digital output terminal J1

PIN	Name	Definition
1	DI1	Digital input 1
2	DI2	Digital input 2
3	DI3	Digital input 3
4	DI4	Digital input 4

PIN	Name	Definition
5	DI5	Digital input 5
6	DI6	Digital input 6
7	DI7	Digital input 7
8	DI8	Digital input 8
9	I/O 0V	I / O interface reference level
10	0V	Internal reference level
11	I/O17	Digital input 17 /output 1
12	I/O18	Digital input 18 /output 2
13	I/O19	Digital input 19 /output 3
14	I/O20	Digital input 20/output 4
15	I/O21	Digital input 21/output 5
16	I/O22	Digital input 22/output 6
17	I/O23	Digital input 23/output 7
18	I/O24	Digital input 24/output 8
19	I/O 24V	I / O interface 24V power input
20	24V	Internal 24V power output
21	DI9	Digital input 9
22	DI10	Digital input 10
23	DI11	Digital input 11
24	DI12	Digital input 12
25	DI13	Digital input 13
26	DI14	Digital input 14
27	DI15	Digital input 15
28	DI16	Digital input 16
29	I/O 0V	I / O interface reference level
30	0V	Internal reference level
31	I/O25	Digital input 25/output 9
32	I/O26	Digital input 26/output 10
33	I/O27	Digital input 27/output 11
34	I/O28	Digital input 28/output 12

PIN	Name	Definition
35	I/O29	Digital input 29/output 13
36	I/O30	Digital input 30/output 14
37	I/O31	Digital input 31/output 15
38	I/O32	Digital input 32/output 16
39	I/O 24V	I / O interface 24V power input
40	24V	Internal 24V power output
41	I/O 0V	I/O interface reference level
42	A-	Incremental Encoder ABZ Input
43	B-	
44	Z-	
50	A+	
51	B+	
52	Z+	
45	I/O 0V	I / O interface reference level
46	AI 1	Analog input 1
47	I/O 0V	I / O interface reference level
48	AO 1	Analog output 1
49	I/O 5V	Internal 5V power output
53	I/O 24V	I / O interface 24V power input / output (in the case of other I / O 24V input, this interface can be used as an output to power the analog module)
54	AI 2	Analog input 2
55	I/O 0V	I / O interface reference level
56	AO 2	Analog output 2

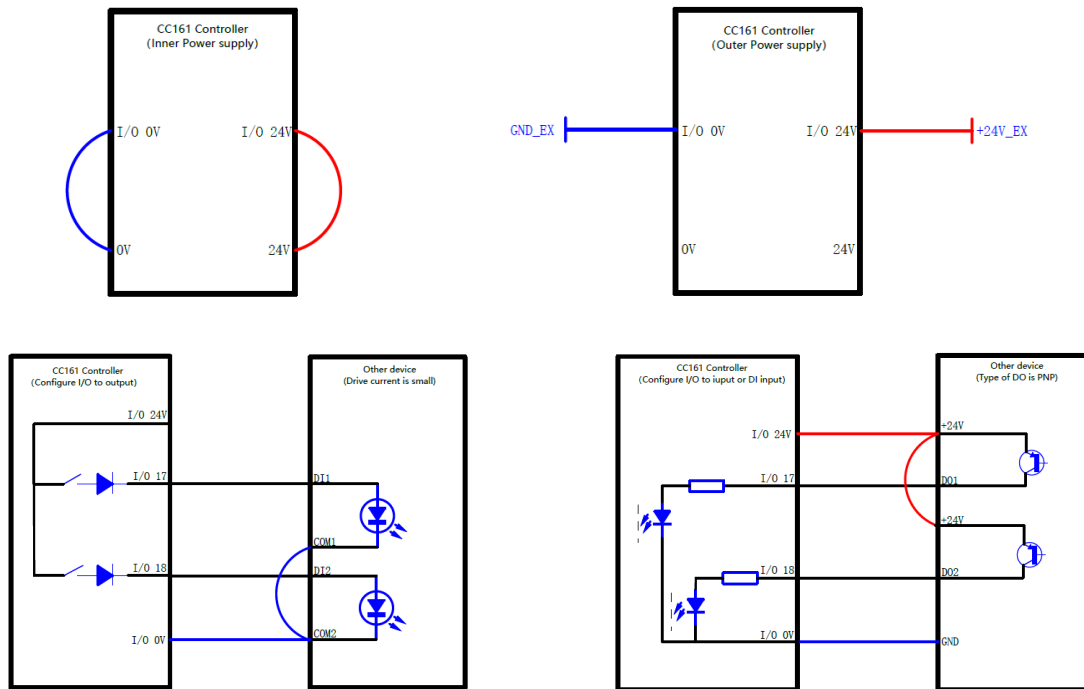The controller I/O connection is shown below.

Figure 3.2　Controller I/O Connection

☐NOTE

- The inner power supply and the outer power supply of every I/O can't exceed 500mA.

- The inner power supply and the outer power supply can't exist at the same time, the inner supply power outputs the max current which can't exceed 2A; the outer power supply outputs the max current which can't exceed 4A.

- At least one set of I/O 0V and 0V is short-connected, and at least one set of I/O 24V and 24V is short-connected when IO is internally powered. At least one set of I/O 0V and I/O 24V is short-connected to external 0V and 24V when IO is externally powered.

3.2　Emergency Stop I/O Description

3.2.1　User Emergency Stop

User emergency stop I/O is an emergency stop interface provided to users, and users can connect external emergency stop devices. The interface description is as follows:

☐NOTE

The emergency stop I/O is located at the safety I/O plate in controller, if you need to use those emergency stop I/O, please contact our technology support.

Table 3.2　User emergency stop I/O description

Output Interface	Input Interface	Factory connection	Description

I/O28（X18:4）	DI12（X19:4）	Short connection	I/O28 and DI12, I/O29 and DI13 are redundant circuits of the user emergency stop interface. Any one of the disconnections will cause the user emergency stop function to be triggered
I/O29（X18:5）	DI13（X19:5）	Short connection	

3.2.2 **Protective Stop**

Protective stop I/O is a protective stop interface provided to users, and users can connect external protective stop devices. The interface description is as follows:

Table 3.3　Protective stop I/O description

Output Interface	Input Interface	Factory connection	Description
I/O31（X18:7）	DI15（X18:7）	Short connection	I/O31 and DI15, I/O32 and DI16 are redundant circuits of the protective stop interface, Any one of the disconnections will cause the protective stop function to be triggered
I/O32（X18:8）	DI16（X19:8）	Short connection	

3.2.3 **Automatic Operation Remote Confirmation**

The automatic operation remote confirmation interface is an interface for users to access the automatic operation remote confirmation button. The main function is that the user can manually confirm the operation at the remote before automatic operation to ensure the safety of personnel. The interface description is as follows:

Table 3.4　Automatic Operation Remote Confirmation I/O description

Output Interface	Input Interface	Factory connection	Description
I/O27（X18:3）	DI11（X19:3）	Short connection	I/O27 and DI11 are one circuits of automatic remote confirmation interface, users can confirm the operation script of the robot arm through APP
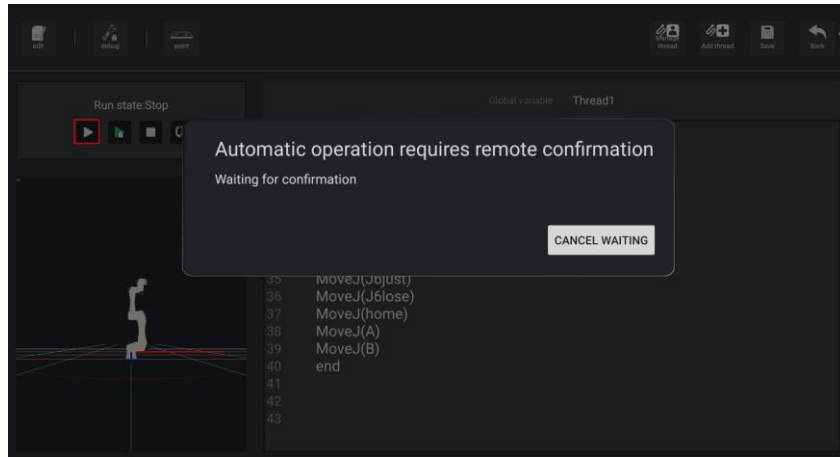
Figure 3.3   Remote confirmation tips

3.3 **End I/O Interface Description**

The cable used for the end pins is the designated cable, the model is **Lumberg RKMV 8-354**.
The end I/O pins are shown below.
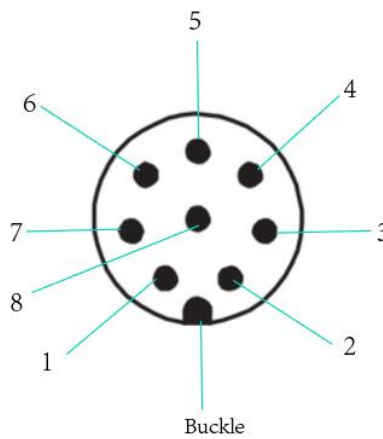
Figure 3.4   End I/O pins

Table 3.5   End I/O pins description

Pins	Name	Define
1	AI_1/485A	Analog input 1 / 485A
2	AI_2/485B	Analog input 2 / 485B
3	DI_2	Digital input 2
4	DI_1	Digital input 1
5	24V	24V（Out）

6	DO_2	Digital output 2
7	DO_1	Digital output 1
8	GND	GND

Figure 3.5   End I/O connection

Lumberg RKMV 8-354 I/O pins are shown below.

Figure 3.6   Lumberg RKMV 8-354 I/O pins

Table 3.6   Lumberg RKMV 8-354 I/O pins description

Pins	Cable color	Name
1	White	485A
2	Brown	485B
3	Green	DI_2
4	Yellow	DI_1
5	Gray	24V
6	Pink	DO_2

7	Blue	DO_1
8	Red	GND

3.4 Interface Board
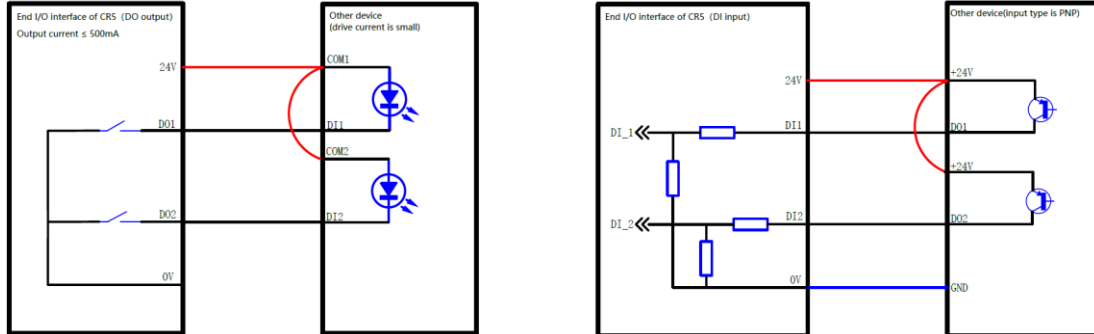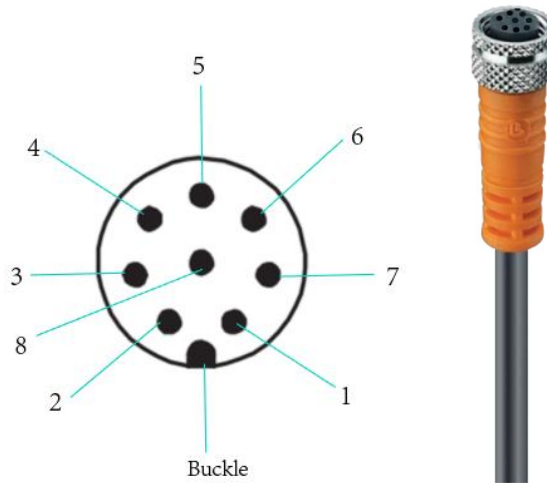
3.4.1 External Interface Board Description

Figure 3.7 shows the interface board of the CC series controller. Table 3.7 lists the description.
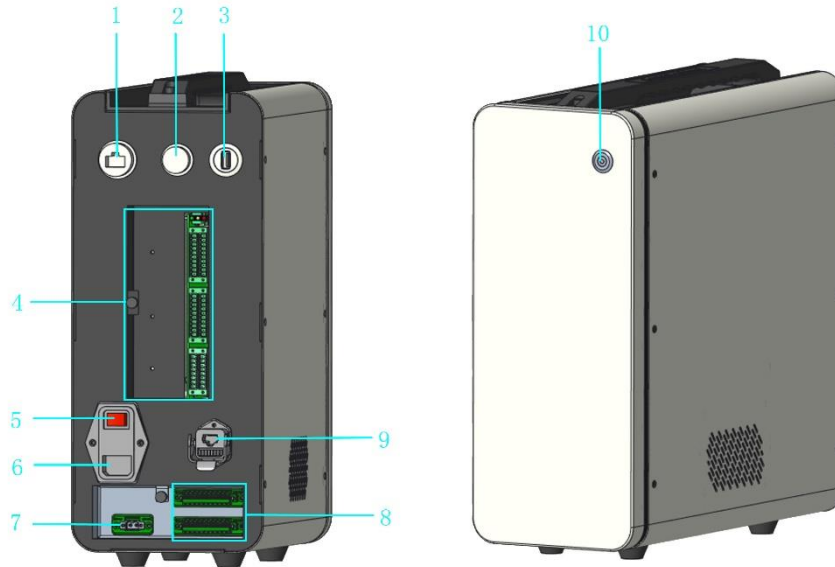
Figure 3.7   Interface board of the controller

Table 3.7   Interface description

No.	Description
1	LAN interface For connecting to external network equipment (Used for debugging). The network segment of the external device should be set to 192.168.5.X, and the default network segment of the machine is network segment 5
2	Emergency stop interface For connecting to emergency stop switch
3	USB interface For connecting to WiFi module
4	I/O interface. For details, please see *3.1 Controller I*/O Interface Description
5	Power switch of controller

No.	Description
	For controlling the controller power on and off
6	Power interface For accessing single-phase 1100/220V power supply
7	External DC 48V power supply reserved port For accessing the AGV, the AGV will supply 48V DC power to the robot
8	System security I/O interface For the safe use and operation of robots
9	Heavy-duty connector interface For connecting to robot
10	Power switch of robot For controlling the robot power on and off

3.4.2 Digital Input

Figure 3.8 shows the simple digital input circuit and Table 3.8 lists the technical specifications.
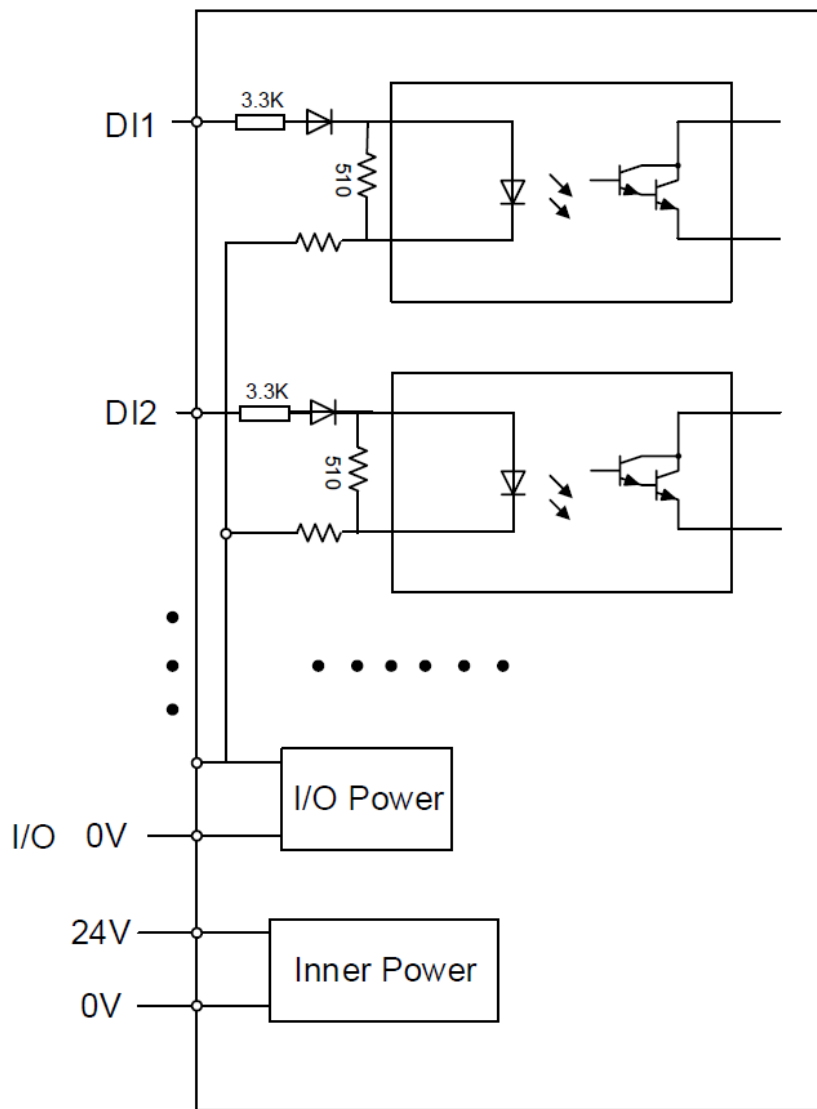
Figure 3.8   Simple digital input circuit

Table 3.8   Technical specifications

Item	Specification
Input channel	16 channels
Connection method	Crimping terminal
Input type	Optical coupling type
Input voltage (DC)	0V or 24V±10%
Isolation method	Optical coupling isolation

3.4.3   Multiplex Digital Input/ Digital Output

3.4.3.1 **Introduction**

The multiplex digital input/ digital output interface can be powered by the internal or external power supply. Figure 3.9 shows the simple digital output circuit and Table 3.9 lists the technical specifications.
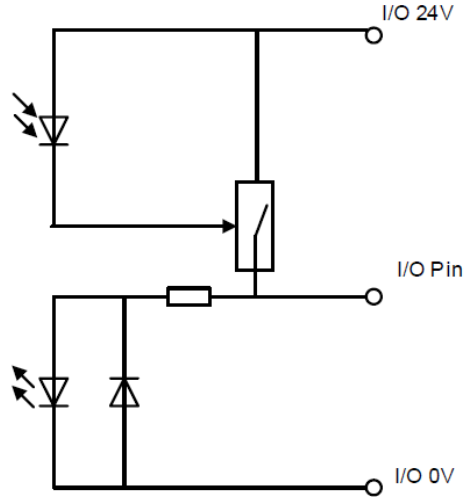
Figure 3.9   Simple digital output circuit

Table 3.9   Technical specifications

Item	Specification
Output channel	16 channels
Connection method	Crimping terminal
Output type	High-side switch
Power supply (DC)	24V±10%
Load current of single channel	500mA
Output current	2A
Isolation method	Digital isolation

3.4.4 **Analog Input**

3.4.4.1 **Introduction**

An analog input can be set to a current input or voltage input by the DIP switch for measuring current or voltage. A controller uses 2-channel DIP switches to control 2 channel analog inputs. Each channel can be controlled separately. Figure 3.10 shows the simple analog input circuit. **V** indicates the voltage input and **I** indicates the current input. The default is voltage input. If you need to change, please contact our technical support.

Figure 3.10   Simple analog input circuit

Table 3.10 lists the relation between the DIP switch and analog input.

Table 3.10   The relation between the DIP switch and analog input

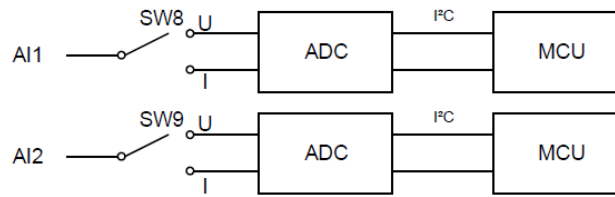| Analog input type	Range
Current input	Current : 4mA - 20 mA
Voltage input	Voltage : ±10V

3.4.5   Analog Output

3.4.5.1   Introduction

Much like the analog input, an analog output can be set to a current output or voltage output by the DIP switch. A controller uses 2-channel DIP switches to control 2 channel analog outputs. Each channel can be controlled separately. Figure 3.11 shows the simple analog output circuit. **V** indicates the voltage output and **I** indicates the current output. The default is voltage output. If you need to change, please contact our technical support.
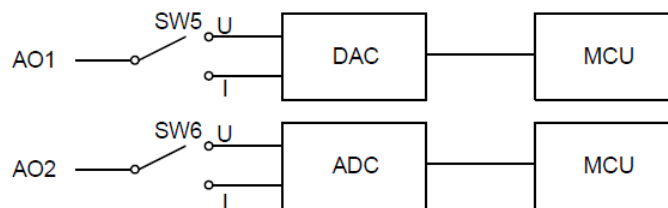

Figure 3.11   Simple analog output circuit

Table 3.11 lists the relation between the DIP switch and analog output.

Table 3.11   The relation between the DIP switch status and analog output

Analog output type	Range
Current output	Current : 4mA - 20mA
Voltage output	Voltage: 0V - 10V

3.4.6   **Incremental Encoder ABZ Input**

An encoder is a device that converts angular or linear displacement into electrical signals. Namely, it converts displacement into periodic electrical signals and then converts electrical signals into count pluses. So, the displacements can be measured by the number of pluses.

This topic takes OMRON E6B2-CWZ1X as an example to describe how to use.

As the different color cables of the encoder, connect the 5V power line to Pin49, the 0V power line to Pin41, and then connect each coded wiring in turn.

The cable color description is shown as follow.

Table 3.12   Cable color description

Color	Description
Brown	I/O 5V
Blue	I/O 0V
Black	A+
White	B+
Orange	Z+
Black and red	A-
White and red	B-
Orange and red	Z-
Shield	Ground

☐NOTE

If a ground wire is required, it can be fixed to the control cabinet with screws. Non-special circumstances (strong magnetic interference, etc.)

4. Installation and Commissioning

4.1 Installation Environment

To maintain the controller and robot performance and to ensure the safety, please place them in an environment with the following conditions.

- Install indoors with good ventilation.

- Do not install in a closed environment.

- Keep away from excessive and shock.

- Keep away from direct sunlight.

- Keep away from dust, oily smoke, salinity, metal powder, corrosive gases, and other contaminants.

- Keep away from flammable.

- Keep away from cutting and grinding fluids

- Keep away from sources of electromagnetic interference.

- When the robot is transported, it is necessary to ensure that the robot is stable and kept in the proper position.

- When the robot is hoisted, proper measures should be taken to locate the moving parts so as not to cause accidental movement and harm during hoisting and transportation.

- When moving the robot from the packing box to the installation position, hold the robot until all the bolts of the robot base are fastened.

- When the robot is installed, corresponding measures should be taken for positioning. The base of the robot must use four hexagon socket bolts M8 (GB / T 3098.1-82 strength level 12.9) and tighten with 20 N • m torque.

- When the robot is mounted on the wall or upside down, just in case, the anti-falling measures of the robot base must be done.

- When the robot is installed, the robot must be fixed on a sufficiently strong base. The base must be able to withstand the reaction force of the robot during acceleration and deceleration and the static weight of the robot and the workpiece.

4.2 Installation Location

4.2.1 Controller Installation Location

Please place the controller on the horizontal surface outside robot's workspace and reserve enough space for connecting cables and operating controller. Figure 4.1 shows the installation space requirement. There is no blockage near the air outlet for sufficient heat dissipation.
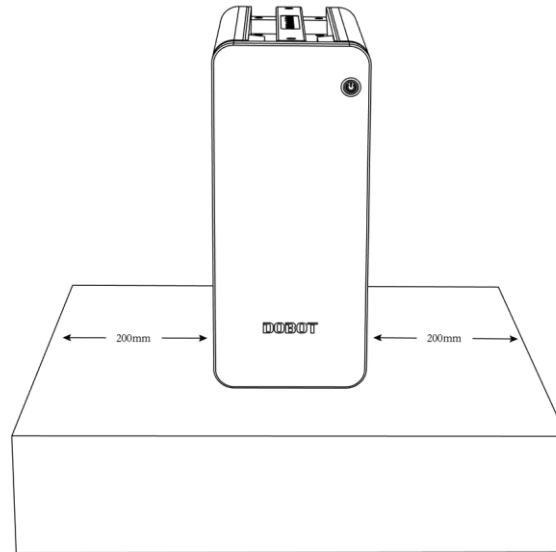
Figure 4.1　Installation space requirement

4.2.2　**Robot Installation Location**

The stability of a robot depends on the installation. You can design the platform according to the size of the hole of the base and the real environment for mounting a robot. And the installation height of the robot should be above 0.6 meters. The platform must not only bear the robot but also bear the dynamic force by the maximum acceleration. Note the following before mounting the robot.

- Design the platform according to the robot's workspace, and ensure that the robot moves without interference.
- Keep the platform level which is used to mount a robot.

Figure 4.2   Robot base size

4.3 **Connecting cables**

4.3.1 **Precautions**

- The specifications and installation of the external wiring should comply with local laws and regulations.
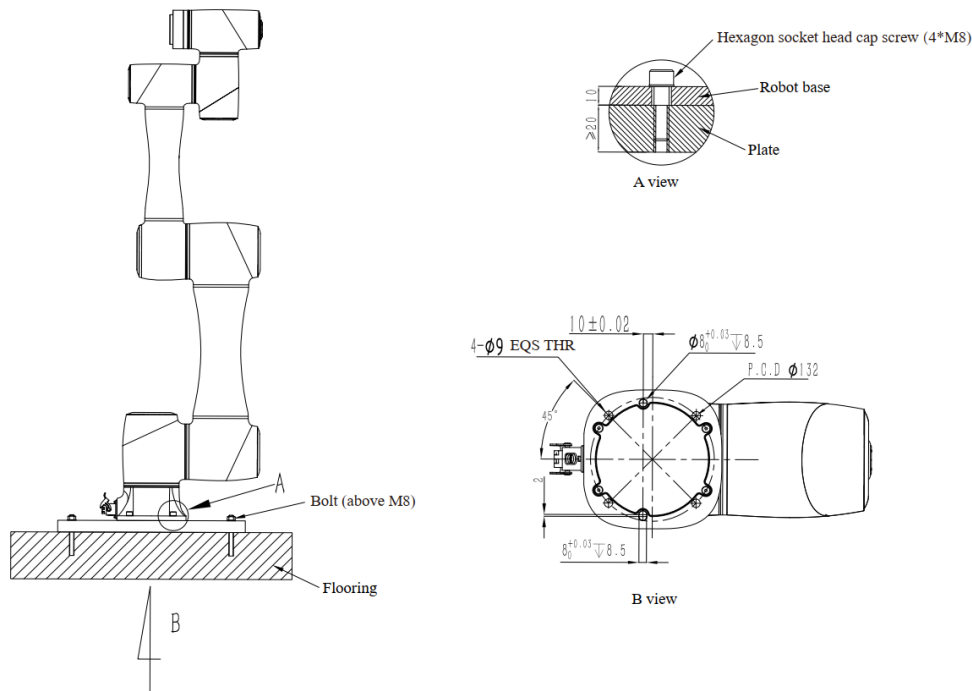
- Do not disassemble the controller by yourself. Otherwise, it may result in electric leakage.

- The equipment must be grounded properly at all times to avoid the risk of electric shock.

- Do not allow unnecessary strain on the cables. Otherwise, damaged cables, disconnection, and contact failure are extremely hazardous and may result in electric shock.

- Before connecting to external equipment, please turn off the controller and related equipment, and then unplug the power. If not, it may result in electric shock or malfunction of the robot system.

- Please make sure that the cables are connected correctly. Otherwise, it may result in a malfunction of internal modules or external devices.

- Please use the matched cables for personal security and equipment protection.

- After the cable connections are complete, please make sure that there are no redundant screws or exposed cables inside the equipment.

- When the equipment is running, please do not plug or unplug the power and communication cables.

- Please confirm that the device cable is connected correctly, otherwise it may cause the internal module or external device to malfunction.

- Before connecting, check whether the insulation and shield of the external cable are damaged.

4.3.2 **Connecting Controller and Robot by Heavy Duty Cables**

Connect controller and robot by heavy-duty cables. Figure 4.3 shows the connection of the controller with heavy-duty cables. After plugging the heavy cables into the heavy-duty connector interface of the controller, please fasten the heavy-duty connector.

Figure 4.3   Connect controller and robot by heavy-duty cables

4.3.3 **Connecting Emergency Stop Switch**

Plug emergency stop switch cable into controller, when connecting them, you need to align the red dot on the connector with the red dot on the interface. As shown in Figure 4.4.

Figure 4.4   Connecting emergency stop switch

⚠ NOTICE

- Before running a robot, please make sure that the emergency stop switch has been turned on (the red button has been released). Otherwise, the robot cannot work normally.

- In the emergency situation, press the emergency stop switch to make the robot stop running immediately.

- Rotate the emergency stop switch (Red button) clockwise, If the red button is released, the emergency stop switch is turned on successfully.

4.3.4   Connecting WiFi Module

Plug WiFi module into USB interface.as shown in Figure 4.5. The Overall connection diagram is shown in Figure 4.5, the default IP is 192.168.1.6.

Figure 4.5   Connecting WiFi module

4.3.5   Connecting to Power Supply

Plug power cable into controller. As shown in Figure 4.6.

Figure 4.6   Connecting to Power Supply

4.3.6   **Three-Position Enabling Accessory**

The three-position enabling accessory can enable the robot, and it has the function of teaching. This accessory is an optional part, and the user can contact the sales engineer of Yuejiang Technology to buy it.

5. **Maintenance and Repair**

Maintenance and repairing must be performed in compliance with all safety instructions in this manual.

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

Repairing must be performed by an authorized system integrator or Dobot staff.

Robots or parts returned to Dobot should be as the following instructions.

- Remove all parts that do not belong to Dobot.

- Before returning to Dobot, please make a backup copy of the files. Dobot will not be responsible for the loss of programs, data or files stored in robot.

- The robot should move to the package point before returning to Dobot. For details, please see *Dobot CR Series Robot APP User Guide*.

5.1 **Safety Instructions**

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

- Replace faulty components using new components with the same article number or equivalent components approved by Dobot.

- Reactivate any deactivated safety measures immediately after the repairing is completed.

- Record all repairs and save them in the technical document with the robot system.

- Remove the main input cables from the back of the controller to ensure that it is completely unpowered. Cut off any other source of energy connected to the robot or controller. Take necessary precautions to prevent other persons from powering on the system during the repair period.

- Observe ESD regulations during the disassembly of the parts of the robot or controller.

- Avoid disassembling the power supply inside the controller. High voltages can be present inside this power supply for several hours after the controller has been powered off.

- Prevent water and dust from entering the robot or controller.

5.2 **Body Maintenance**

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

Table 5.1　Overhaul item

Cycle	Overhaul Item	Overhaul essential

Daily	3 month	6 month		
√			Robot clean	Wipe off dirt, dust, cutting residue on the body with water or 10% alcohol
		√	Joint bolts	Check the torque based on the specified tightening torque table (Push aside the rubber to check)
	√		Tool mounting bolts	Check the torque based on the specified tightening torque table
√			Motor	Abnormal heating or sound confirmation
√			Brake	Check whether the robot arm or end-effector will fall when the servo is powered off
	√		Reducer	Check for abnormal vibration, noise, and oil leakage

Table 5.2 lists the bolted tightening torque table.

Table 5.2   Bolted tightening torque table

Bolt size	Outer hexagonal bolt (Joint)	Inner hexagonal bolt (12.9)	hexagonal bolt (Rear cover)
3 mm	2 Nm	2.4 Nm	1 Nm
4 mm	4 Nm	4.5 Nm	-
5 mm	7.5 Nm	9 Nm	-
6 mm	15 Nm	18 Nm	-
8 mm	-	37 Nm	-

The tightening torques will vary depending on the type of base metal or bolt. When not specified, please contact Dobot technical engineer.

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