



Dobot Nova Series User Guide



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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 of following the relevant practical laws and regulations of the country, in order that there is no significant danger in the use of the robot.

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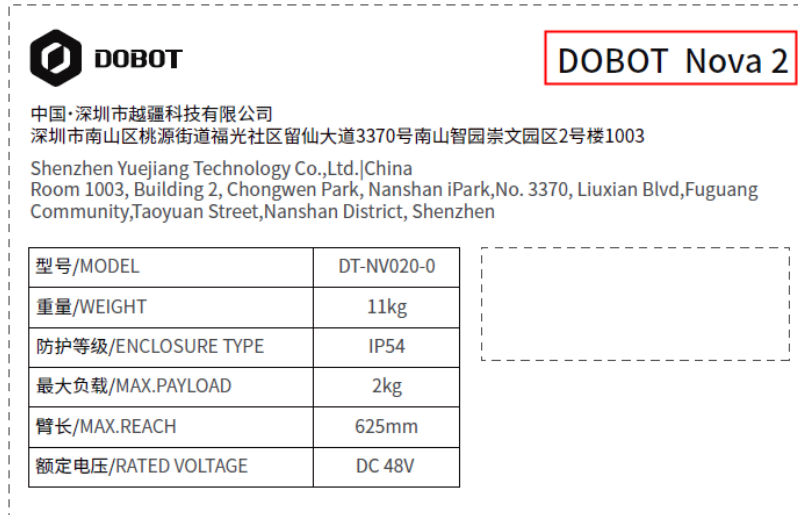
Website: www.dobot-robots.com

Preface

Scope of Application

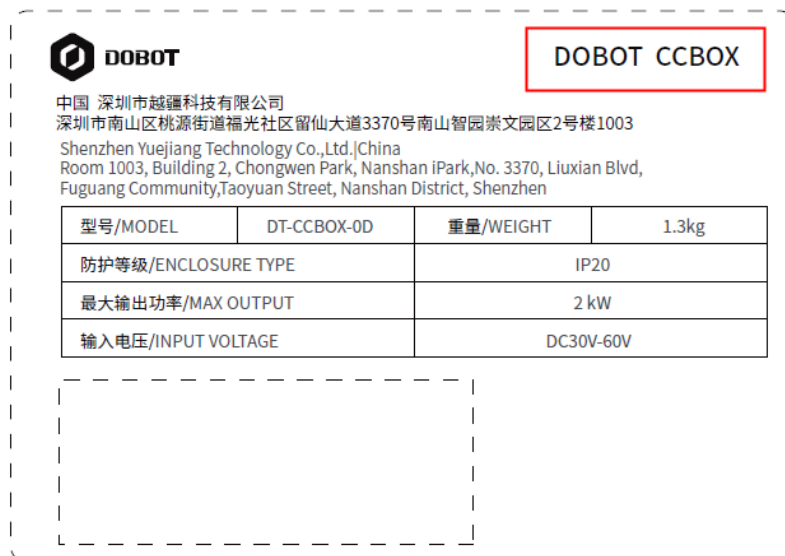
Robot arm: DOBOT Nova 2, DOBOT Nova 5

You can find the model of robot arm on the right-top corner of the nameplate on the robot base.



Controller: DOBOT CCBOX

You can find the model of controller on the right-top corner of the nameplate.



Purpose

This document introduces the functions, technical specifications and installation procedure of Dobot Nova series robots, which is convenient for users to understand and use the robot.

Intended Audience

This document is intended for:





- Customer
- Sales Engineer
- Installation and Commissioning Engineer
- Technical Support Engineer

Change History

| Date | Issue | Change Description |
|------------|-------|--|
| 2023/07/19 | V1.3 | Update description of tool io Update content styles |
| 2023/02/23 | V1.2 | Add wiring diagram of emergency stop switch |
| 2023/02/02 | V1.1. | Update description on power interface and energy feedback resistance interface Add load curves |
| 2022/11/18 | V1.0 | The first release |

Symbol Conventions

The symbols that may be found 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 |

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1. Safety

1.1 Liability

1.1.1 Validity and Responsibility

The information in this document does not cover designing, installing and operating a complete robot system, nor does it cover all peripheral equipment that can affect the safety of the complete system. The complete system must be designed and installed in accordance with the safety requirements set forth in the standards and regulations of the country where the robot is installed.

The integrators of Dobot are responsible for ensuring that the applicable safety laws and regulations in the country concerned are observed and that any significant hazards in the complete robot application are eliminated. This includes, but is not limited to:

- Performing a risk assessment for the complete robot system.
- Adding safety machines and mechanisms based on the risk assessment, including but not limited to building a proper safety circuit to achieve safe stop.
- Setting up the appropriate safety settings in the software.
- Ensuring that the user will not modify any safety measures.
- Validating that the total robot system is designed and installed correctly.
- Specifying instructions for use.
- Marking relevant signs and contact information of the integrators on the robot.
- Archiving relevant technical files.

1.1.2 Limitation of Liability

Any safety information provided in this document should not be construed as a warranty, by Dobot. The robot may cause injury or damage even if all safety instructions are observed.

1.1.3 Intended Use

Dobot Nova series robots are commercial robots only for general commercial use, such as processing or delivering food or other products through end tools.

Dobot Nova series robots are equipped with special safety mechanisms including collision detection. These mechanisms are purposely designed for human-robot collaborative operation, but only intended for non-hazardous applications after risk assessment, where tools, commodities, environments and other machines have been demonstrated to be incapable of significant risk through application-specific risk assessments.








Any use or application deviating from intended use is deemed to be impermissible misuse, including, but is not limited to:

- Use in potentially explosive environments.
- Use in life critical applications.
- Use before performing a risk assessment.

- Use over-stated specifications.
- Use as a climbing aid.

1.2 Safety warning signs

The following safety warning signs may appear in the products, and their meanings are described as follows.

| Sign | Description |
|---|--|
|  DANGER | Indicates a high degree of potential danger, which, if not avoided, will result in death or serious injury. |
|  ELECTRICITY | May cause dangerous power consumption soon, which, if not avoided, will cause personal injury or serious damage to the equipment. |
|  HOT or  | May cause dangerous hot surfaces, which, if touched, may cause personal injury. |
|  WARNING | Indicates a moderate or low potential hazard, which, if not avoided, may cause minor personal injury and damage to the equipment. |
|  ATTENTION | Indicates a potential risk, which, if ignored, may result in damage to the robot arm, loss of data or unpredictable results |
|  NOTICE | A situation that, if not avoided, can cause personal injury or damage to the equipment. For items marked with such signs, depending on the specific situation, there is sometimes a possibility of significant consequences |

1.3 General safety

Follow the safety instructions below when starting and using the robot for the first time.

DANGER

- The robot system is electrical equipment. Non-professional technicians should not modify the circuit, otherwise, it may cause damage to devices or personal injury.
- 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.
- Use the robot in the specified environment scope. Exceeding the specifications or load conditions will shorten the service life of the robot, even damage it.

- 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 degraded performance of the main circuit components inside the controller. If turning on or off the power continually is required, please keep the frequency less than once per 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 to where the control cabinet gets hot.

 **NOTICE**

- The personnel responsible for installation, operation and maintenance of equipment must first receive strict training, understand various safety precautions, and master 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 Dobot 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.
- Please establish safety measures (such as guardrails, ropes or warning lines) near the operating area of the robot to ensure that personnel remain out of reach of the robot being operated or the robot about to start operation.
- Do not enter the safety range of the robot as determined by the risk assessment or touch the robot while the system is in operation.
- Do not expose the robot to permanent magnetic fields all the time. Strong magnetic fields can cause damage to the robot.
- Dobot assumes no responsibility for robot damage or personal injury caused by failure to follow product instructions or other improper operations.
- Use appropriate and reliable lifting equipment during handling operations such as lifting rings and bridge crane. 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.
- Make sure that there are no obstacles within 2 meters of the robot during transportation. Relevant personnel should stay away from the suspended robot.
- Dobot is not responsible for any damage caused during the transportation and handling of equipment.
- Make sure that the robot is in the packing posture before packaging, and the brakes on each axis are normal.
- Make sure that there are no obstacles around the packing area, so that the staff can leave in a timely manner in case of an emergency.

- When the robot is transported, the packaging needs to be fixed to ensure that the robot is stable.
- After removing the outer packaging, make sure that the robot maintains the original packing posture and the brakes of each axis are normal.
- During the commissioning process, make sure 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 (such as RF source without shielding), otherwise, it could interference robot work.

**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 the equipment, please find and be familiar with the operation method of the emergency stop function to ensure that the robot arm can be stopped urgently in the case of sudden stress. The emergency stop function is Stop Category 1.
- Be careful when carrying or installing the robot. Please follow the instructions on the packing box to put down the robot gently and place it correctly in the 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 ensure that the robot and tools are installed correctly.
- Please ensure that the robot has enough space to move freely.
- If the robot is damaged, 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.

1.4 Personal security

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

**WARNING**

- Please comply with local laws or 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 within 10 minutes after the power is shut off, so as to avoid an electric shock since there is residual capacitance inside the controller.
- 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, so as to avoid an electric shock since there is residual capacitance inside the controller.
- When working with robots, do not wear loose clothing or jewelry. When operating the robot, make sure that you have bundle your hair 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. Do not approach the robot.

1.5 Emergency

1.5.1 Emergency stop switch

After you press the emergency stop switch in emergency, the robot will immediately stop all motions and be locked. According to IEC 60204-1 and ISO 13850, the emergency stop switch is not a safeguard. It is a complimentary protective measure and not intended to prevent injury.

1.5.2 Emergency recovery

The emergency stop switch will be locked after you press it. To unlock the switch, you need to rotate the switch according to the mark on the switch. The alarm can be cleared through the software only after the emergency stop switch is unlocked. Then the robot arm can be enabled and resumed from the emergency status.



WARNING

Please operate the robot to recover from the emergency only after the danger of the robot system is completely removed.

1.5.3 Forced joint movement

In the unlikely event of an emergency, you may need to move the robot joint/s when the robot power is either impossible or unwanted. In this case, you must push or pull the robot arm hard to move the joint.



WARNING

Moving the locked joints forcefully may cause joint damage. Please operate only in emergencies.

2. Transportation

You need to transport the robot in its packaging posture (set in the control software in reference to the user manual of the control software for details), and use the original packaging for transportation.

During transportation, ensure that the robot arm is stable and fixed by corresponding measures.

During transportation and long-term storage, ensure that the ambient temperature ranges from -20°C to $+55^{\circ}\text{C}$, and the ambient humidity is no more than 95% without condensation.

When moving the robot from its packaging to the installation space, hold the robot arm in place until all mounting bolts are securely tightened at the base of the robot.

After transportation, store the original package in a dry place for repacking and transporting it in the future.



WARNING

- Ensure that the operator is not unduly stressed on their back or other body parts when lifting the equipment, and use appropriate lifting equipment if necessary.
- Dobot shall not be held responsible for any damage caused by transportation of the equipment.
- Be sure to follow all installation instructions when installing the robot.

3. Product Introduction

3.1 Overview

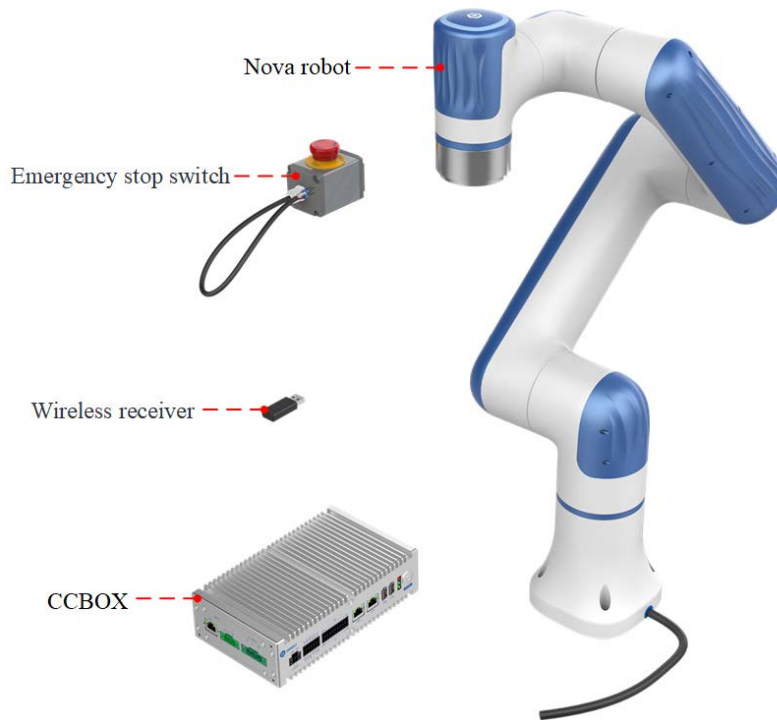


Figure 3.1 Robot overview

The main components of the robot system include:

- **Nova robot:** six-axis robot arm, main moving parts.
- **CCBOX:** core computing and electrical components.
- **Emergency stop switch:** connected to the control cabinet to realize the emergency stop function.
- **Wireless receiver:** plugged into the CCBOX, so that the operating terminal can be connected to and control the robot via WiFi.

In addition, the system includes an operating terminal (tablet or PC) for installing the robot control software.



Pad



PC

Figure 3.2 Operation terminal

3.2 Robot arm

3.2.1 Composition

Nova series robot arm includes 6 rotating motion joints, and two connecting rods (upper arm and forearm), as shown in Figure 3.3. The robot arm is equipped with a hand-guiding button and an indicator light at its end, and an aerial plug on its end flange side.

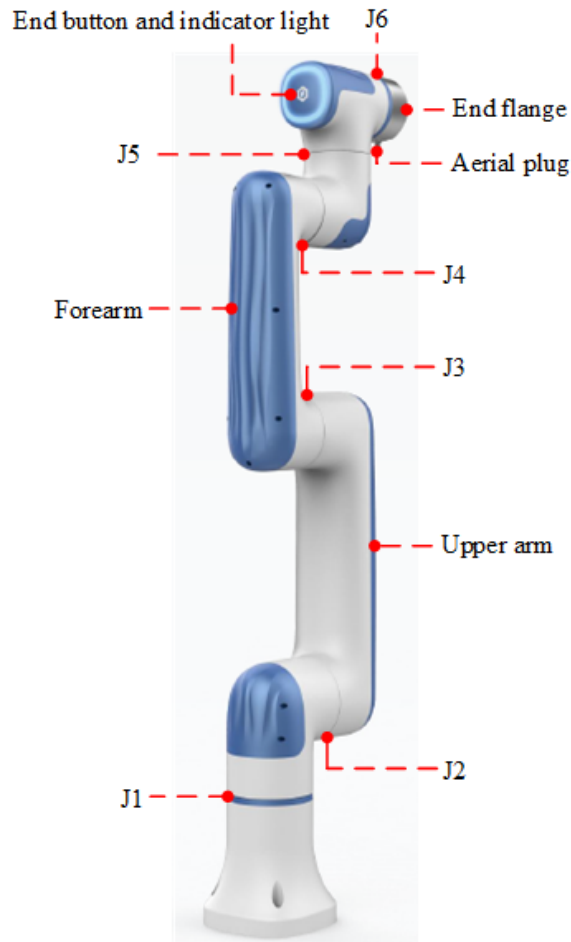


Figure 3.3 Nova robot arm

3.2.2 End button and indicator lights

Nova series robot arm is equipped with a button and an indicator light, as shown in Figure 3.4.

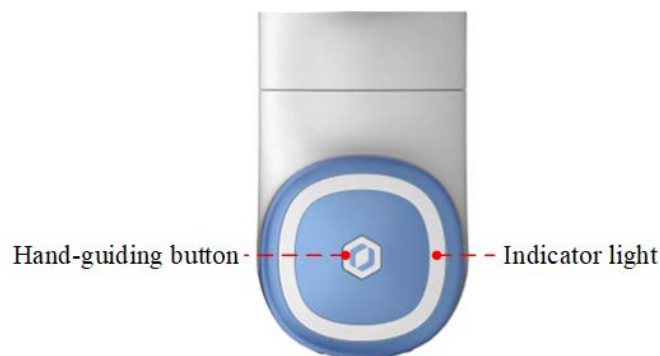


Figure 3.4 End button and indicator light

The definition of the indicator lights of the robot arm is shown in Table 3.2.

Table 3.1 Definition of indicator lights

| Color | Status | Definition |
|--------------|-----------|---|
| Blue light | Steady on | CCBOX has been started and the robot arm is not enabled |
| | Flash | Hand-guiding (rapid flashing indicates CCBOX is starting /The robot arm and CCBOX failed to be connected) |
| Green light | Steady on | The robot arm is enabled (not running projects) |
| | Flash | Automatic running (project is running) |
| Yellow light | Steady on | Trajectory recording |
| | Flash | Trajectory playback |
| Red light | Steady on | System error |

When the robot arm is in the enabled status, long press the end button for 3 seconds and then release it, and the robot arm will enter the hand-guiding status. After dragging the robot arm to the teaching point, press the end button again for a short time, and the robot arm will exit the hand-guiding status.

3.3 CCBOX

Nova series robot arms need to be used with a small control cabinet (CCBOX). Figure 3.5 shows the appearance of the CCBOX. For details on its electrical interfaces, see *6 Electrical Features*.



Figure 3.5 CCBOX

The definition of the indicator lights of the CCBOX is the same as the robot arm.

After connecting the power supply and the robot arm, press the power switch to turn on the CCBOX and the robot arm. Then the blue light starts to flash. When the blue light is steady on, it

indicates the CCBOX is started successfully.

After the CCBOX is started, long press the power switch for more than 3s and release it, then the CCBOX and the robot arm will be powered off. When the blue light is off, it indicates the CCBOX is powered off.

3.4 Operation terminal

Nova series robot arms support control through PC and App, as shown in Table 3.3. If you need to use WiFi for control, you need to plug the WiFi module into the CCBOX.

Table 3.2 Operation terminal parameters

| Terminal type | PC | Tablet (Android) | iPad |
|-----------------------|--|--|-------------------|
| Operation system | Windows7/10/11 | Android 10 and above | iOS 10 and above |
| Control software | DobotStudio Pro | Dobot CRStudio | Dobot CRStudio |
| Minimum configuration | CPU: Intel Core i3 Memory: 4GB Memory space: 256GB | CPU: 4-core Running memory: 2G Memory space: 32G | Memory space: 32G |
| Communication mode | LAN/WiFi | WiFi | WiFi |

When purchasing Nova series robot arms, you can ask for matching Android tablets; or use self-prepared operating terminal which meets the minimum configuration in Table 3.3.

4. Product Features

4.1 Coordinate system

4.1.1 Joint coordinate system

The joint coordinate system is determined based on all motion joints. All joints are rotating joints, as shown in Figure 4.1.

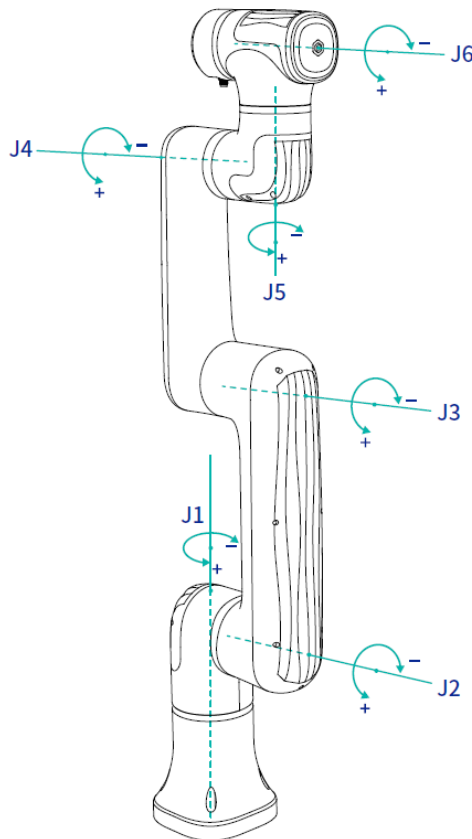


Figure 4.1 Joint coordinate system

4.1.2 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 the site requirements to measure point data within the workspace and arrange tasks conveniently. The default user coordinate system is determined based on the center point at the robot base, as shown in Figure 4.2.

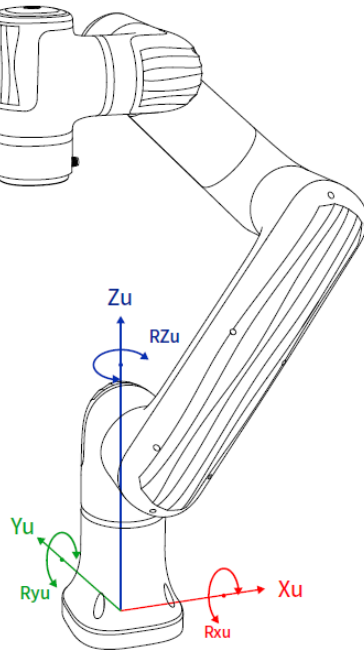


Figure 4.2 User coordinate system

4.1.3 Tool coordinate system

The tool coordinate system defines the tool center point (TCP) and tool posture, of which the origin and orientations vary with the position and angle of the workpiece at the end of robot. The default tool coordinate system is determined based on the center point of the end flange, as shown in Figure 4.3.

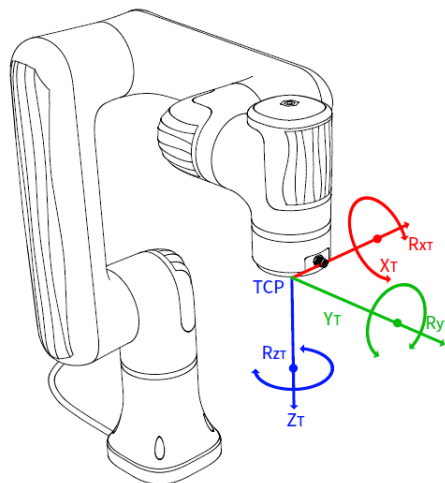


Figure 4.3 Tool coordinate system

4.2 Home posture

When the robot arm is in the vertical state shown in Figure 4.1, the angle of all joints is 0

degrees. This posture is called the home posture. The home-point stickers as shown in Figure 4.4 are attached to each joint of the robot arm. When the joint is 0 degree, the stickers on both sides of the joint will be aligned.

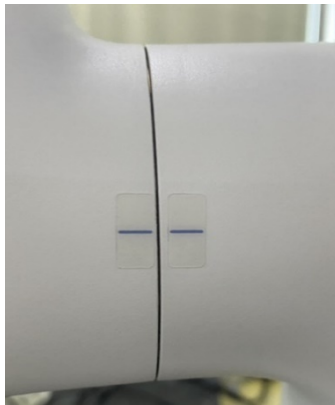


Figure 4.4 Home point sticker

If the home point of the robot arm changes due to the replacement of the transmission parts or the collision, you can move the robot arm to a state where all the home-point stickers of each joint are aligned, and then calibrate the home-point through the control software.

4.3 Singularity Point

4.3.1 Shoulder singularity

When the intersection of the J5 axis and the J6 axis of the robot arm is located in the plane formed by the J1 axis and the J2 axis, it will lead to singularity, as shown in Figure 4.5.



Figure 4.5 Shoulder singularity

4.3.2 Elbow singularity

When the upper arm and forearm are in the same line, it will lead to singularity, as shown in Figure 4.6.

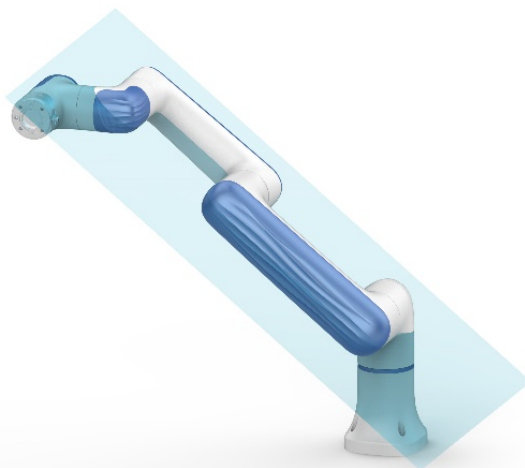


Figure 4.6 Elbow singularity

4.3.3 Wrist singularity

When the J4 axis and J6 axis are parallel, it will lead to singularity, as shown in Figure 4.7.

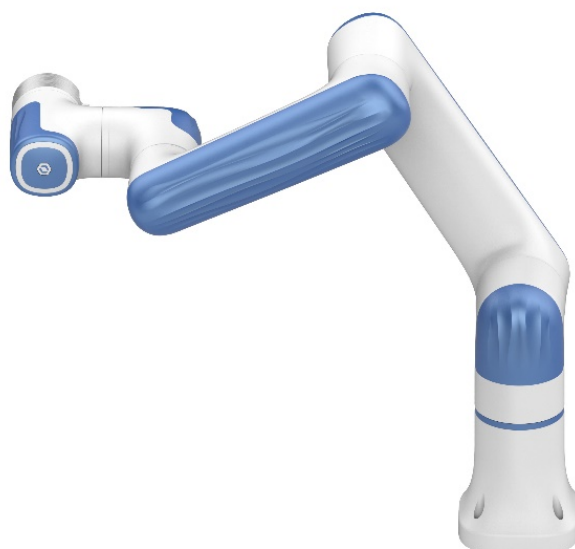


Figure 4.7 Wrist singularity

5. Mechanical Specifications

All dimensions in this chapter are in millimeters (mm).

5.1 Nova 2 mechanical specifications

5.1.1 Nova 2 dimensions and working space

When selecting the installation position for the robot, you must consider the cylindrical space directly over and under the robot, and avoid moving the tool to the cylindrical space as much as possible. Because this will cause the joints to rotate too fast while the tool moves slowly, resulting in low working efficiency of the robot and difficult risk assessment.

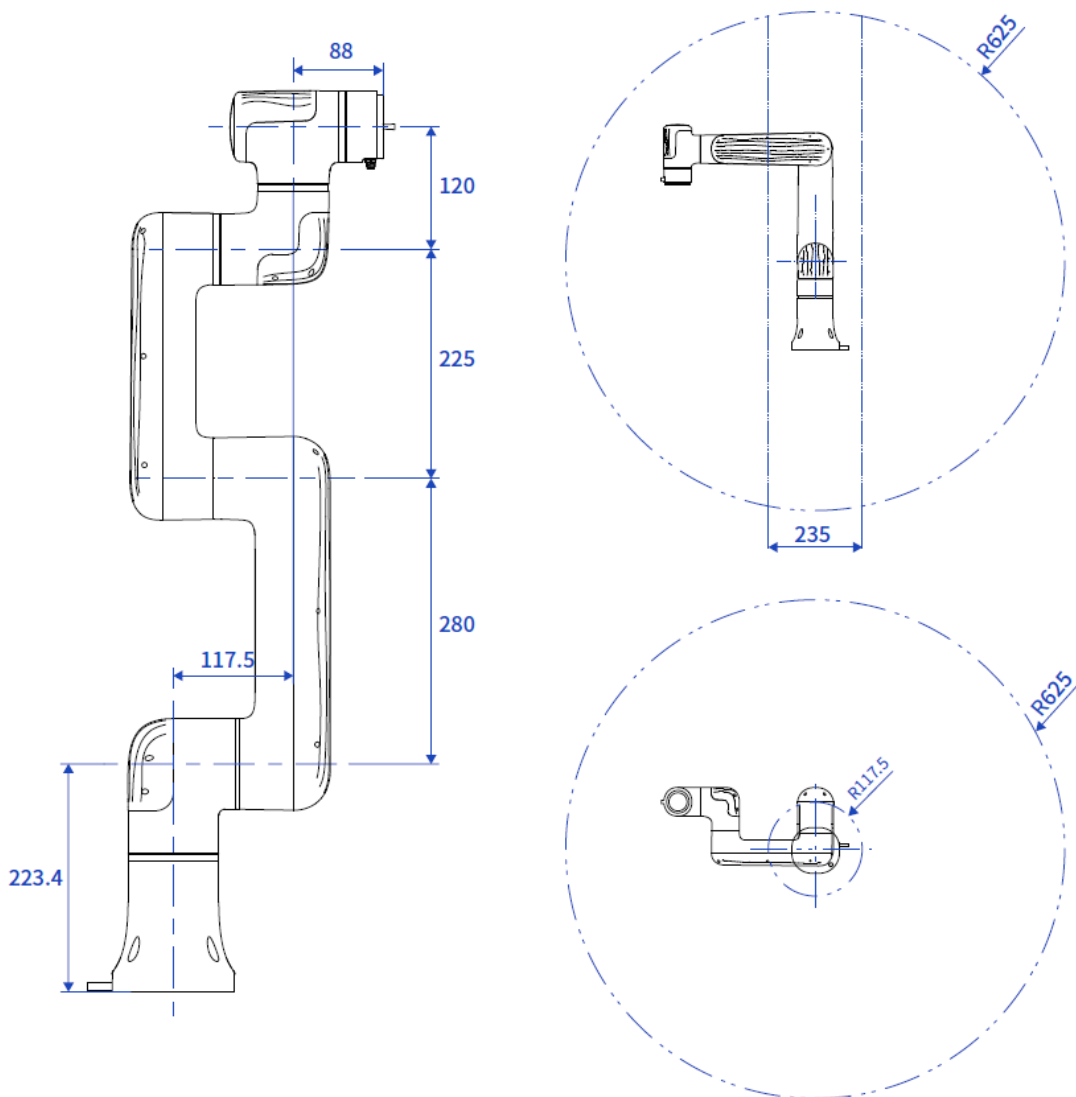


Figure 5.1 Nova 2 dimensions and working space

5.1.2 Nova 2 base

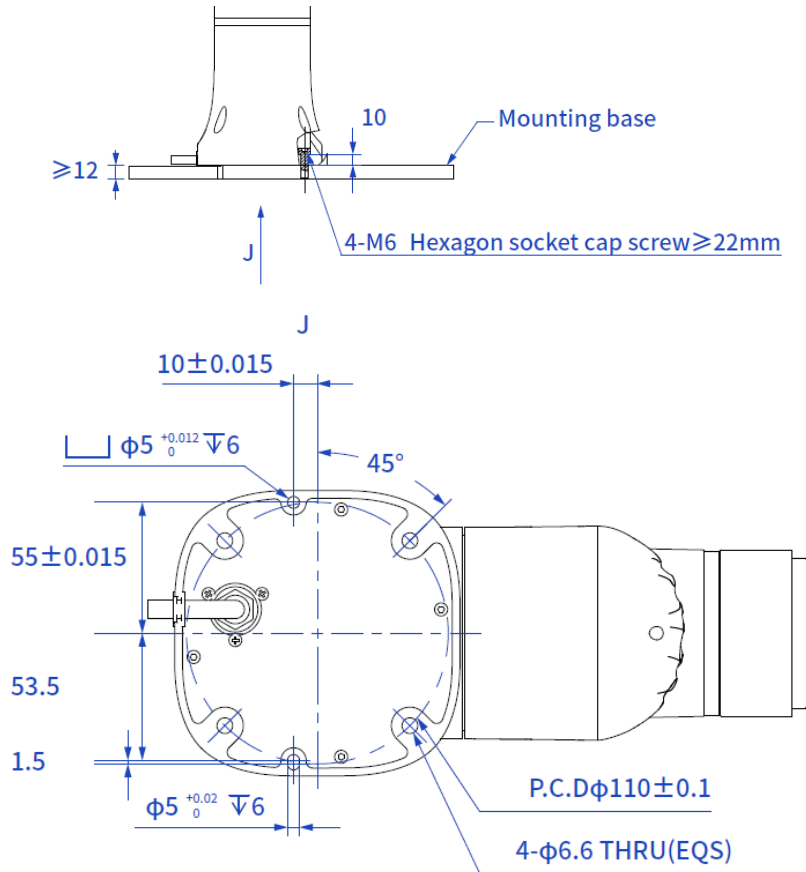


Figure 5.2 Nova 2 base installation dimensions

5.1.3 Nova 2 flange specifications

The end flanges of Nova series robot arms are all the same size. The flange design conforms to ISO 9409-1.

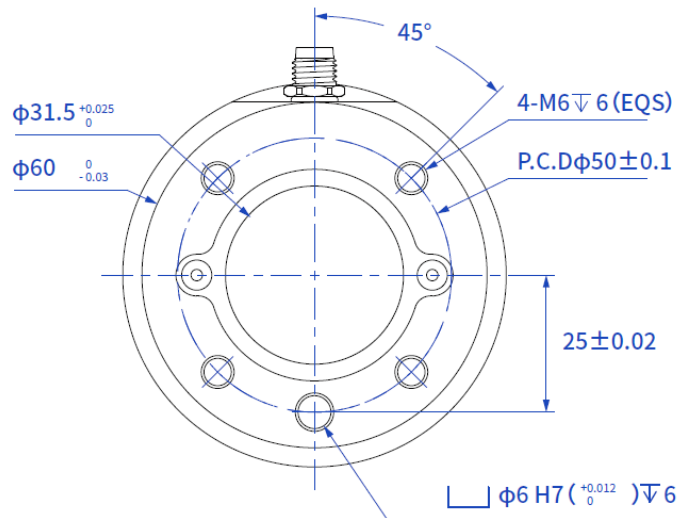


Figure 5.3 Nova 2 end flange dimensions

5.1.4 Nova 2 load curve

In the load curve, the coordinate origin is the center of the end flange, and X, Y represent the distance between the gravity center of load and the robot flange in X and Y directions. According to $r = \sqrt{X^2 + Y^2}$, the value r corresponds to the vertical coordinate X, Y[cm] of the load curve, and the abscissa Z[cm] represents the distance from the gravity center of the load to the robot flange in Z direction. You can determine the working condition of the robot according to the statistical results. For example, if the load is 1.5kg, X = 6cm, Y = 8cm, Z = 5cm, and you can get $r = 10$ cm. The steps for judgement are as follows:

- According to $r = \sqrt{X^2 + Y^2}$, calculate $r = 10$ cm.
- Select the corresponding curve according to the weight of the load. As the load is 1.5kg, you need to find the curve of 1.5kg correspondingly.
- Determine a point according to the r and Z coordinates, and compare the positional relationship between the point and the 1.5kg curve to judge the working condition. If the point is below the curve, the model is proper, otherwise you need to select other models.

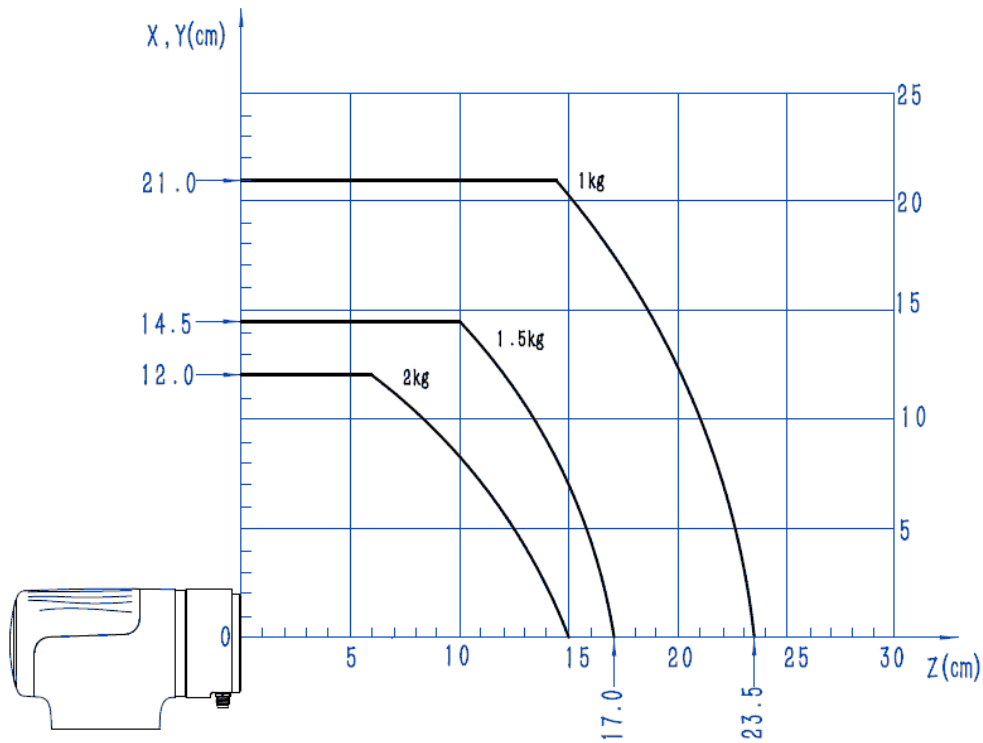


Figure 5.4 Nova 2 end load curve

5.2 Nova 5 mechanical specifications

5.2.1 Nova 5 dimensions and working space

When selecting the installation position for the robot, you must consider the cylindrical space directly over and under the robot, and avoid moving the tool to the cylindrical space as much as possible. Because this will cause the joints to rotate too fast while the tool moves slowly, resulting in low working efficiency of the robot and difficult risk assessment.

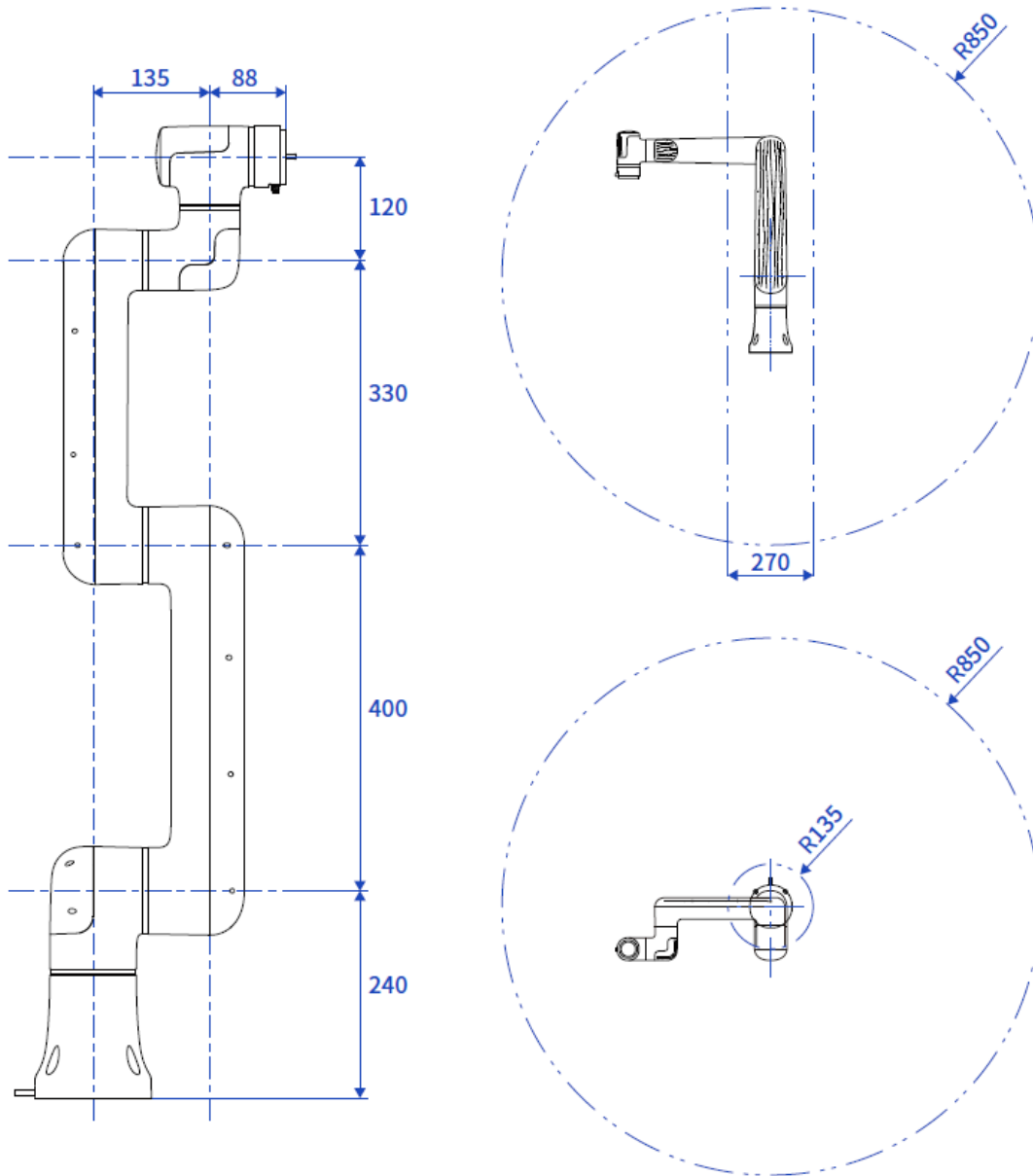


Figure 5.5 Nova 5 dimensions and working space

5.2.2 Nova 5 base installation dimensions

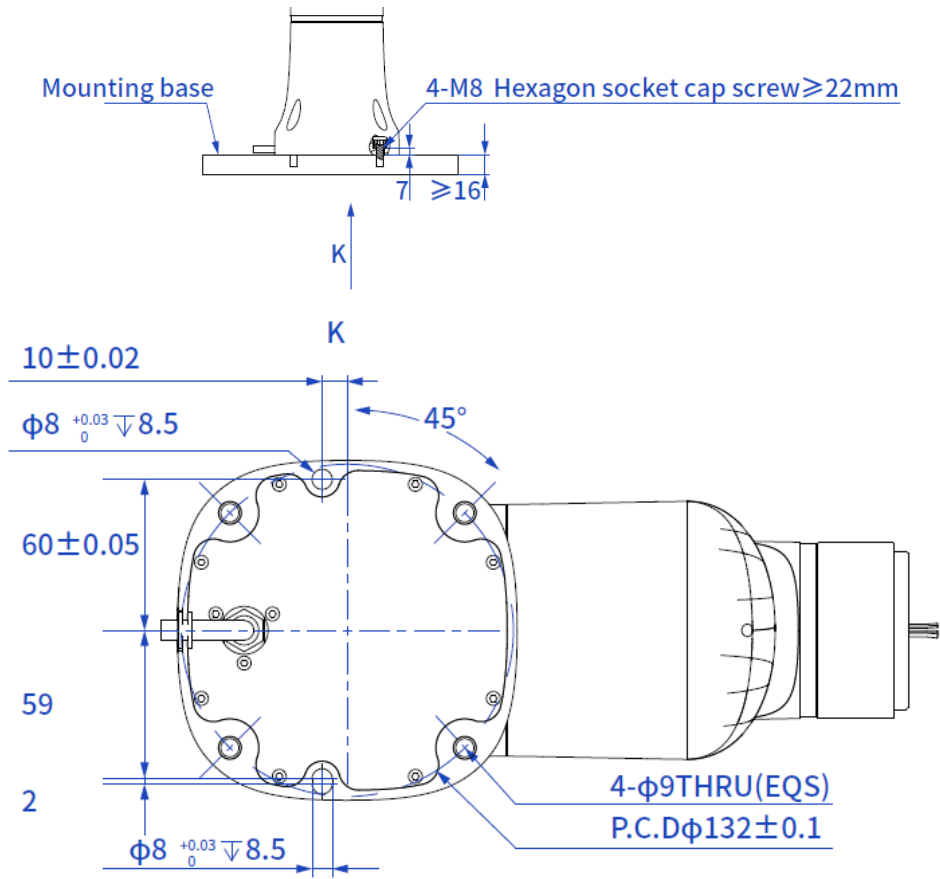


Figure 5.6 Nova 5 base installation dimensions

5.2.3 Nova 5 flange dimensions

The end flanges of Nova series robot arms are all the same size. The flange design conforms to ISO 9409-1.

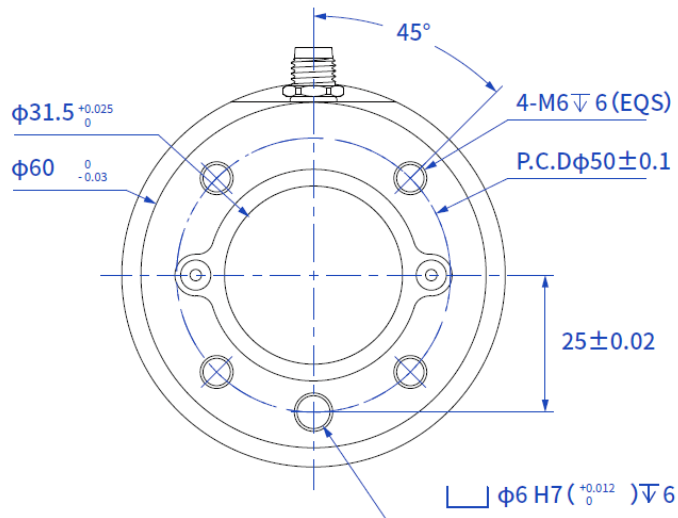


Figure 5.7 Nova 5 end flange dimensions

5.2.4 Nova 5 load curve

In the load curve, the coordinate origin is the center of the end flange, and X, Y represent the distance between the gravity center of load and the robot flange in X and Y directions. According to $r = \sqrt{X^2 + Y^2}$, the value r corresponds to the vertical coordinate X, Y[cm] of the load curve, and the abscissa Z[cm] represents the distance from the gravity center of the load to the robot flange in Z direction. You can determine the working condition of the robot according to the statistical results. For example, if the load is 3.8kg, X = 6cm, Y = 8cm, Z = 5cm, and you can get $r = 10$ cm. The steps for judgement are as follows:

- According to $r = \sqrt{X^2 + Y^2}$, calculate $r = 10$ cm.
- Select the corresponding curve according to the weight of the load. As the load is 3.8kg, you need to find the curve of 4kg correspondingly.
- Determine a point according to the r and Z coordinates, and compare the positional relationship between the point and the 4kg curve to judge the working condition. If the point is below the curve, the model is proper, otherwise you need to select other models.

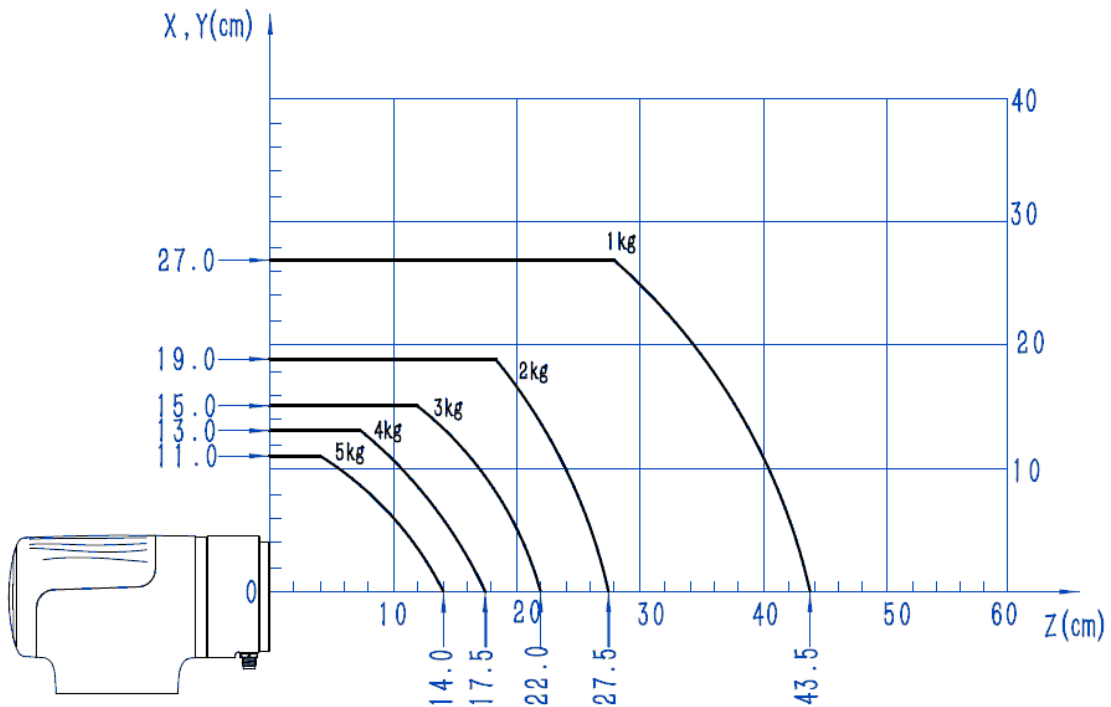


Figure 5.8 Nova 5 load curve

5.3 CCBOX dimensions

5.3.1 CCBOX product dimensions

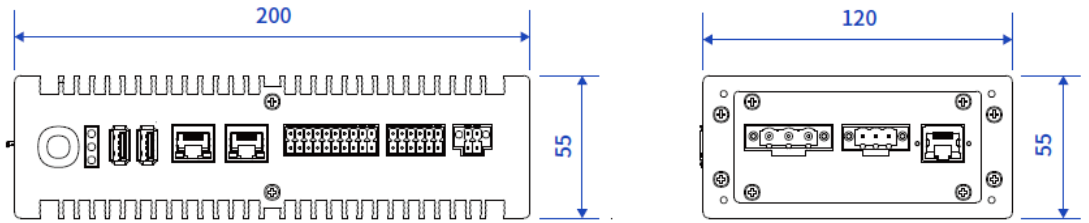


Figure 5.9 CCBOX dimensions

5.3.2 CCBOX horizontal-type installation specifications

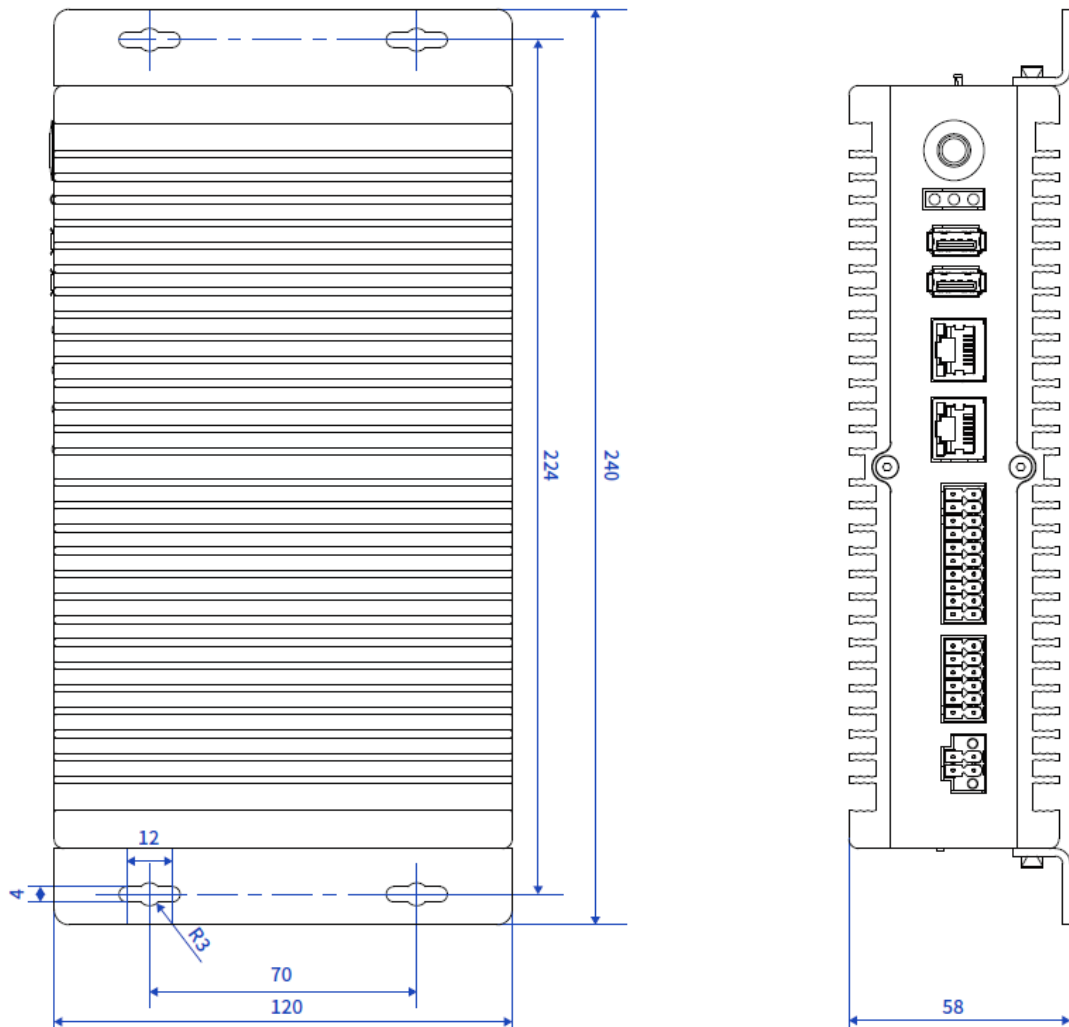


Figure 5.10 Horizontal-type dimensions

5.3.3 CCBOX vertical-type installation specifications

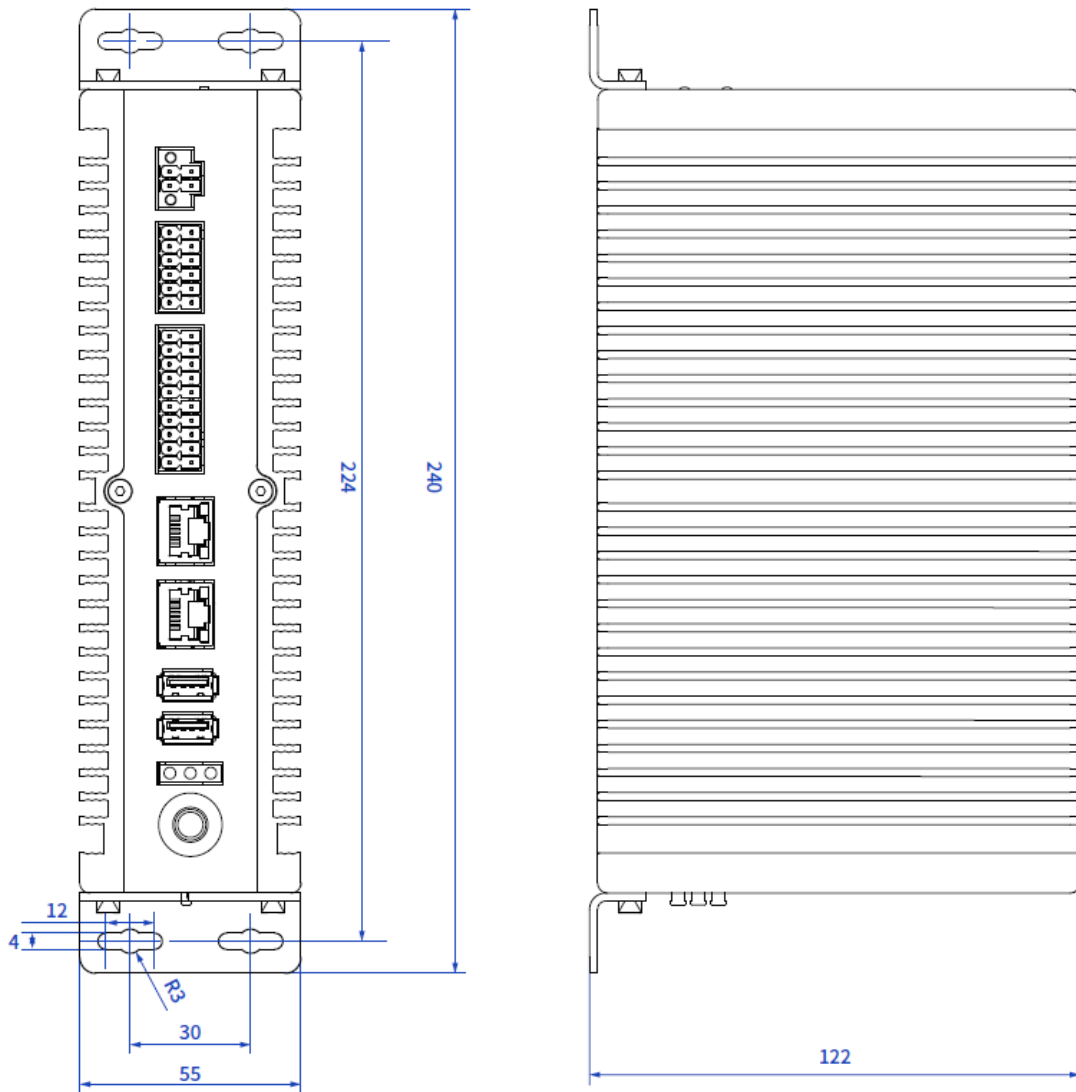


Figure 5.11 Vertical-type dimensions

6. Electrical Features

6.1 CCBOX interface

6.1.1 Overview

The interfaces of the CCBOX are shown in Figure 6.1.

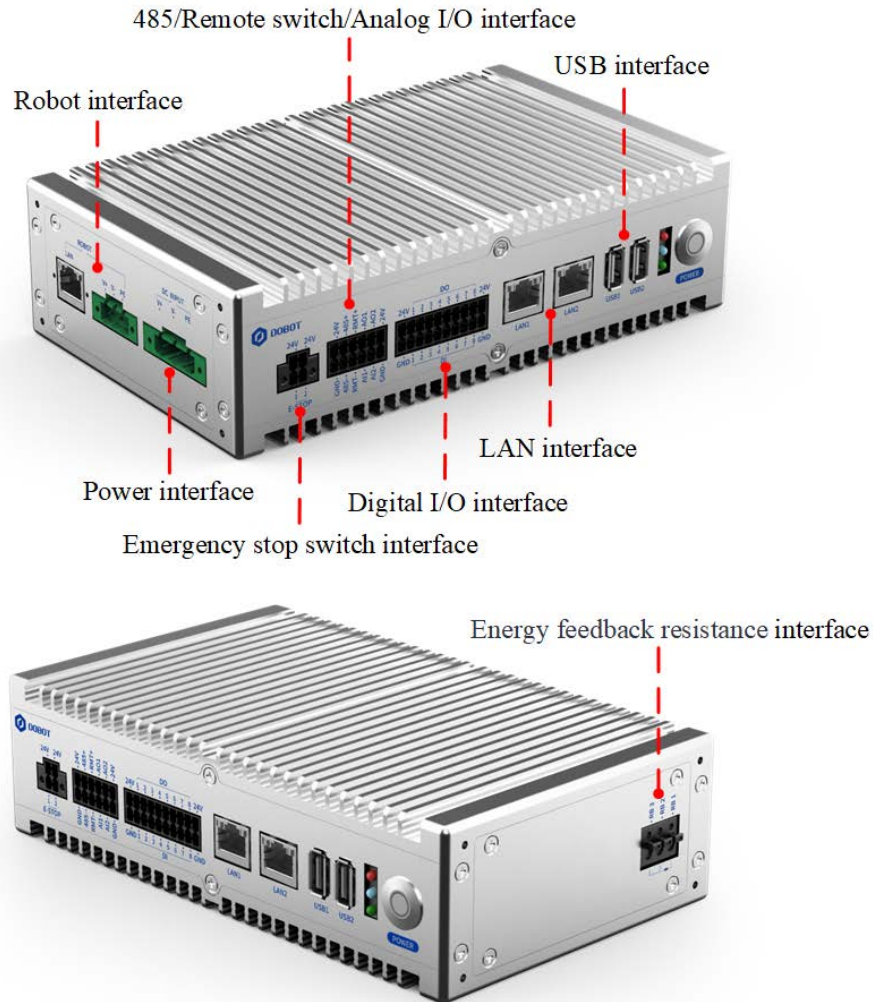


Figure 6.1 CCBOX interfaces

6.1.2 Robot interface

It is used to connect the robot arm for powering the robot arm and communicating with the robot arm.

6.1.3 Power interface

It is used to connect the external power supply for powering the CCBOX.

The nominal voltage of the robot is 48V. You can use the AC to DC power supply shown in Appendix to connect to the mains power. If you use your own DC power supply, ensure that the voltage fluctuation ranges within 30V~60V.

6.1.4 Emergency stop switch interface

It is used to connect the emergency stop switch for controlling the emergency stop of the robot arm.

Nova series robot arm includes an emergency stop switch in its delivery accessories. The wiring terminals has been connected. You just need to plug it into the corresponding interface.

If you use your self-prepared emergency stop switch, please connect as shown below.

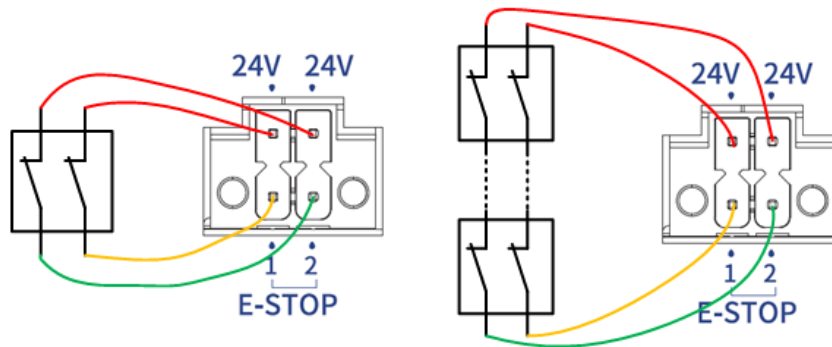


Figure 6.2 Connect one or more emergency switches

6.1.5 RS485 interface

The RS485 interface is shown in Figure 6.3, which can be used for Modbus RTU communication (not available now).

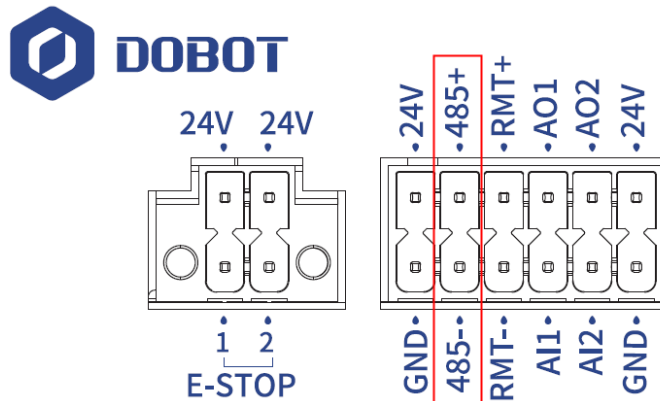


Figure 6.3 RS485 interface

6.1.6 Remote switch interface

The remote switch interface is shown in Figure 6.4, which can be used for turning on/off the CCBOX remotely.

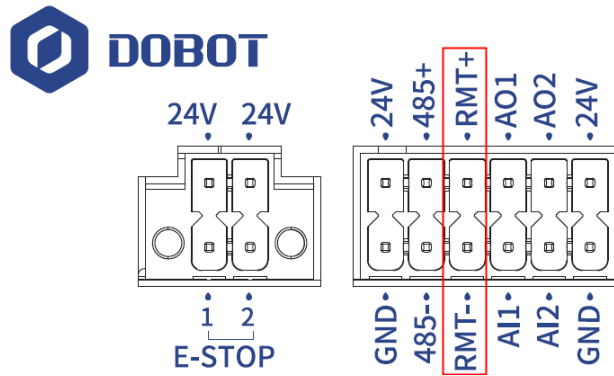


Figure 6.4 Remote switch interface

The wiring of connecting external switch is shown in Figure 6.5.

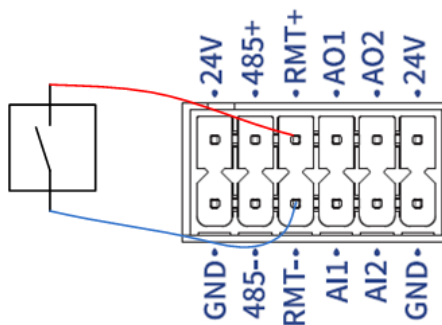


Figure 6.5 Remote switch wiring

If the switch is turned on for 1 seconds and then disconnected, the CCBOX will be powered on. If the switch is turned on for more than 3 seconds and then disconnected, the CCBOX will be powered off.

6.1.7 Analog I/O interface

The analog input/output have 2 channels respectively, as shown in Figure 6.6, which are used for the input and output of analog signal.

The type of analog signal is voltage, ranging from 0V to 10V.

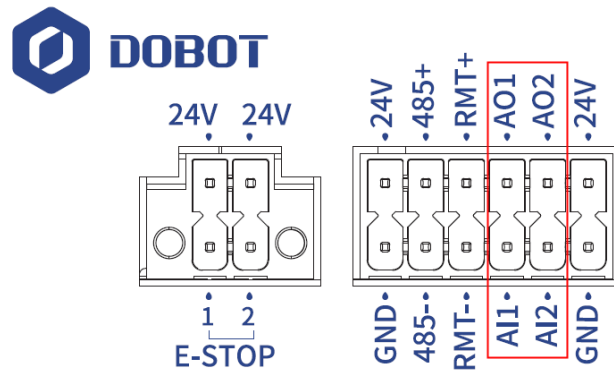


Figure 6.6 Analog I/O interface

AI wiring

The wiring between the AI interface and the tested object is shown in Figure 6.7.

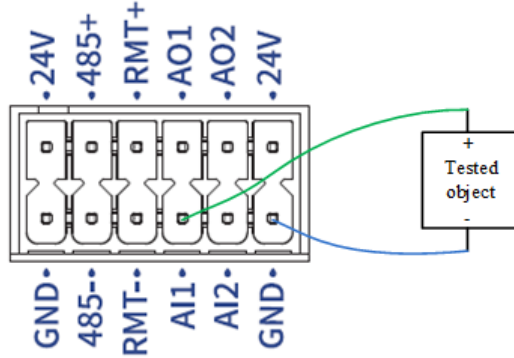


Figure 6.7 AI wiring

AO wiring

The wiring between the AO interface and the external load is shown in Figure 6.8.

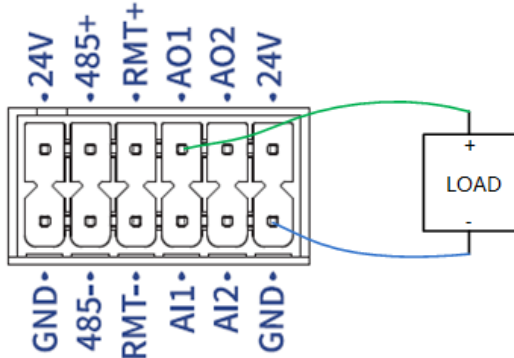


Figure 6.8 AI wiring

6.1.8 Digital I/O interface

The digital input/output have 8 channels respectively, as shown in Figure 6.9, which can be used for the input and output of digital signals.

The digital signal is PNP type by default, which can be set to NPN type through the control software.

The I/O power supply is equipped inside, with voltage of 24V and total maximum current output of 2A (0.5A maximum for each channel). The external power supply is not supported.

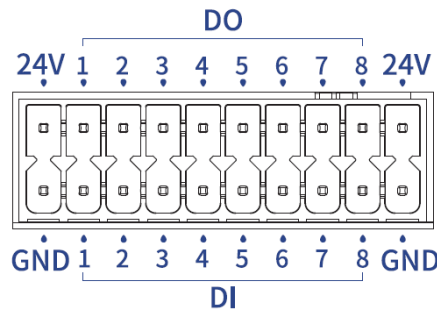


Figure 6.9 Digital signal interface

DI wiring

1. When you use an external simple circuit as the DI input, the wiring is shown in Figure 6.10.

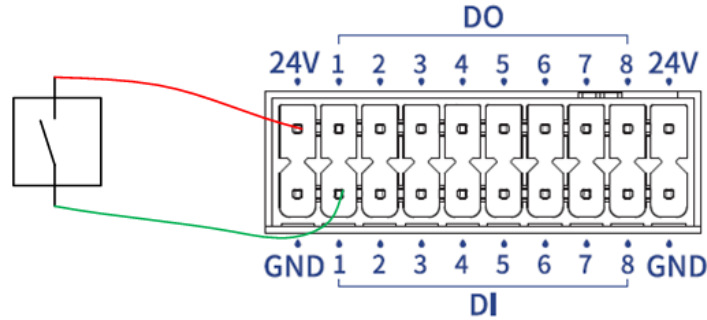


Figure 6.10 DI wiring (simple switch)

2. When you use the 3-wire sensor as the DI input, connect the cables as shown in Figure 6.11. The sensor signal type (PNP/NPN) needs to match the signal type of the controller.

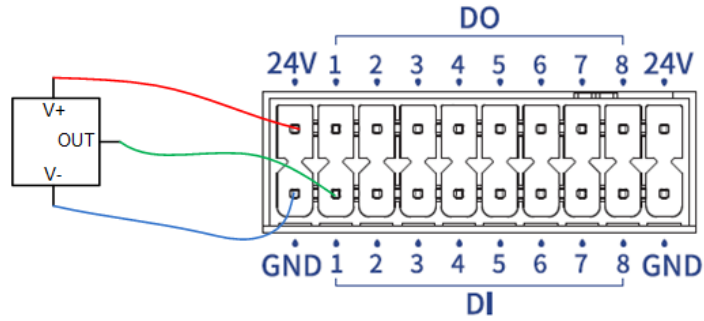


Figure 6.11 DI wiring (3-wire sensor)

DO wiring

The wiring of DO interface connecting an external load is shown in Figure 6.12.

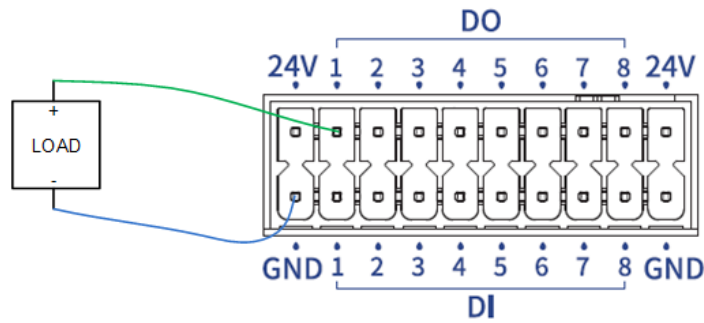


Figure 6.12 DO wiring

6.1.9 LAN interface

The CCBOX has two LAN interfaces used for TCP/IP and Modbus TCP communication. The default IP address of LAN1 is 192.168.5.1 (can be modified by control software), and the default IP address of LAN2 is 192.168.100.6 (cannot be modified).

6.1.10 USB interface

The CCBOX has two USB interfaces. You can use any of them to connect wireless receiver, and the other can be reserved.

6.1.11 Energy feedback resistance interface

When the robot arm moves at a fast speed and decelerates for a short time, the overvoltage may occur (the control software will report an overvoltage alarm). If the overvoltage often occurs, you can connect an additional energy feedback resistance to the CCBOX to inhibit.

It is recommended to use a 150W 2R aluminum shell resistance. During installation, you need to remove the cable between RB2 and RB3, and then connect the resistance between RB1 and RB2, as shown in Figure 6.13.

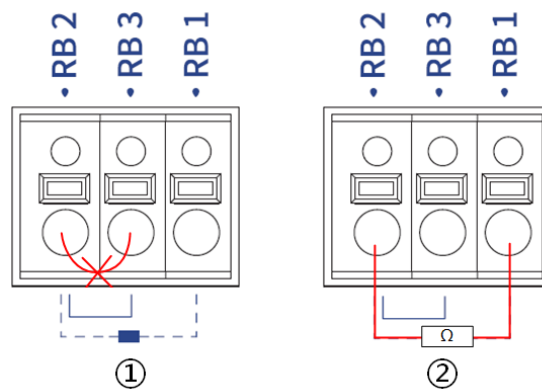
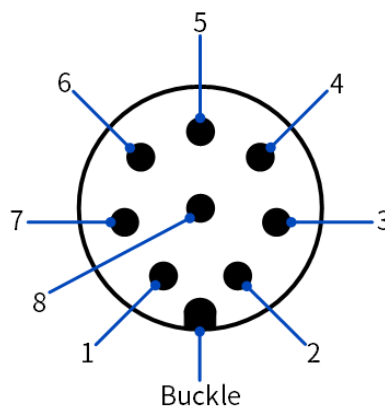


Figure 6.13 Connecting feedback resistance

6.2 Tool I/O interface

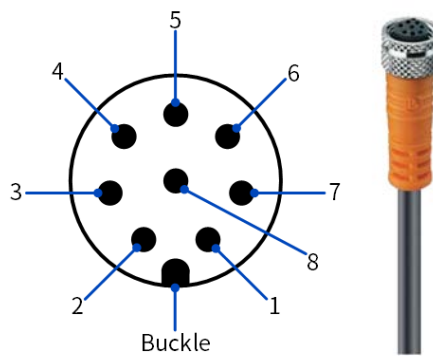
The tool I/O interface is an aerial socket located on the end flange. The socket pins are distributed and defined as follows.



| Pin | Name | Description |
|-----|------|-------------|
| 1 | 485A | 485A |
| 2 | 485B | 485B |

| | | |
|---|------|------------------|
| 3 | DI_2 | Digital input 2 |
| 4 | DI_1 | Digital input 1 |
| 5 | 24V | 24V output |
| 6 | DO_2 | Digital output 2 |
| 7 | DO_1 | Digital output 1 |
| 8 | GND | GND |

The cable used in the tool I/O is specified by Dobot (model: Lutronic FP-222460). The pin distribution and cable definition of the plug are shown as follows.



| Pin | Wire color | Description |
|-----|------------|------------------|
| 1 | white | 485A |
| 2 | brown | 485B |
| 3 | green | Digital input 2 |
| 4 | yellow | Digital input 1 |
| 5 | grey | 24V output |
| 6 | pink | Digital output 2 |
| 7 | blue | Digital output 1 |
| 8 | red | GND |

The maximum current of 24V output of tool I/O is 2A (no more than 1s continuously), and the digital input is PNP type.

When using external simple switching circuit as the DI input source, the wiring is shown in Figure 6.14.

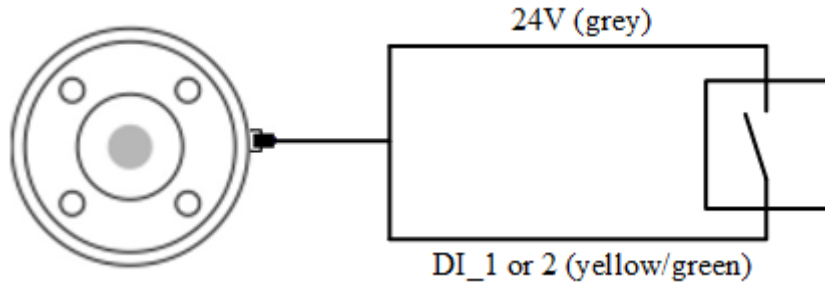


Figure 6.14 End DI wiring (simple switch)

When using the 3-wire sensor as the DI input source, the wiring is shown in Figure 6.15.

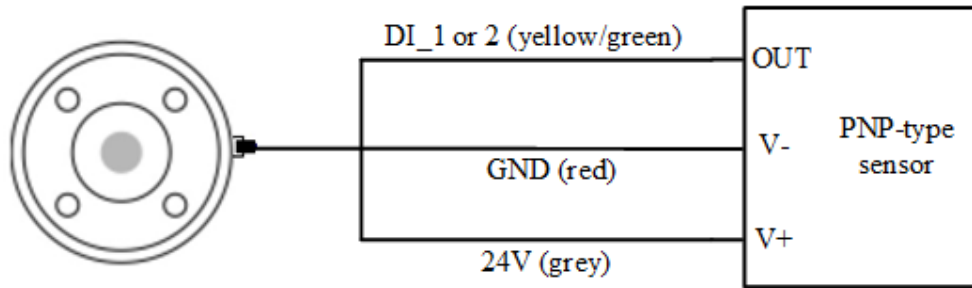


Figure 6.15 End DI wiring (PNP type DO)

The digital output of the tool I/O is NPN type, with the single output current no more than 400mA and the total output current no more than 400mA. The wiring is shown as follows.

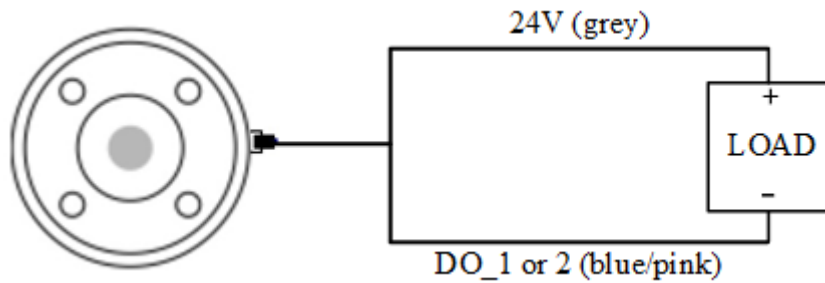


Figure 6.16 End DO wiring

7. Installation and Use

7.1 Installation environment

To maintain the controller performance and ensure safe use, please place the controller and robot in an environment with the following conditions.

 NOTICE

Please make sure that the installation environment meets the following conditions to avoid damage.

- Install indoors with good ventilation.
- Keep away from excessive vibration and shock.
- Keep away from direct sunlight.
- Keep away from dust, oily smoke, salinity, metal powder, corrosive gases, and other contaminants.
- Do not use in a closed environment. A closed environment may cause high temperature of the controller and shorten its service life.
- Keep away from flammable.
- Keep away from cutting and grinding fluids
- Keep away from sources of electromagnetic interference, such as large transformer, large electromagnetic contactor, electric welding machine, etc.
- When the robot is transported, ensure that the robot is stable and kept in proper place.
- When the robot is hoisted, be sure to take appropriate measures 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 mounting position, hold the robot until all bolts on the robot base are fastened.
- When the robot is installed, take corresponding measures to locate it. Be sure to use 4 hex bolts M6 (Nova 2)/M8 (Nova 5) (ISO898-1: 2013, property class: 12.9) with 20N•m torque to fix and tighten the robot base.
- When the robot is installed on the wall or upside down, be sure to take the anti-fall measures of the robot base.
- When the robot is installed, fix the robot on a sufficiently strong base, which needs to be able to fully withstand the reaction force of the robot acceleration and deceleration and the static weight of the robot and the workpiece.

7.2 Unpacking

When unpacking, please check the attached shipping list to ensure that all contents are included. If there is anything missing, please contact your supplier.

7.3 Robot installation

7.3.1 Robot arm installation

Nova robotic arm supports 360° installation at any angle. Figure 7.1 shows several typical installation postures.

i NOTE

The installation posture at the left of the figure is the standard mounting angle. When installing the robot in a non-standard mounting angle, you need to calibrate the mounting angle through the software after powering on the robot arm, See the user guide of the control software for details.

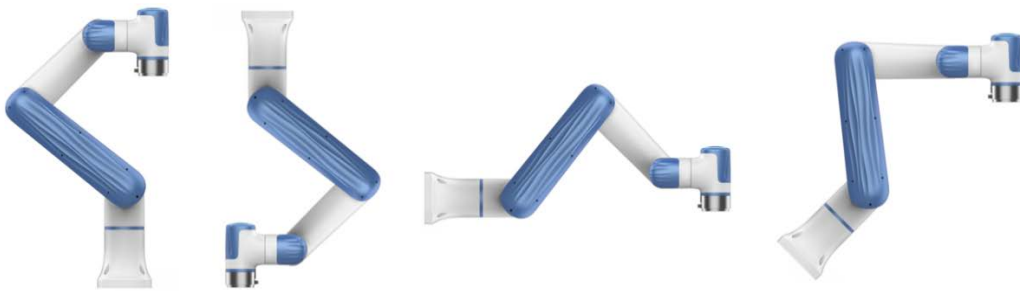


Figure 7.1 Nova robot installation posture

The installation platform of the robot arm should be stable enough to withstand at least 10 times the maximum torque of the J1 joint, and at least 5 times the weight of the robot arm.

If the robot arm is mounted on a linear axis or a moving platform, the acceleration of the platform should be low, and high acceleration may trigger the robotic arm's collision detection mechanism and cause the robotic arm to stop.

Position the mounting holes on the installation platform according to the installation size of the robot base. Fix the robot arm base on the surface using bolts (4 M6 bolts for Nova 2, and 4 M8 bolts for Nova 5). You can refer to *5 Mechanical Specifications* for the specific dimensions of the robot base.

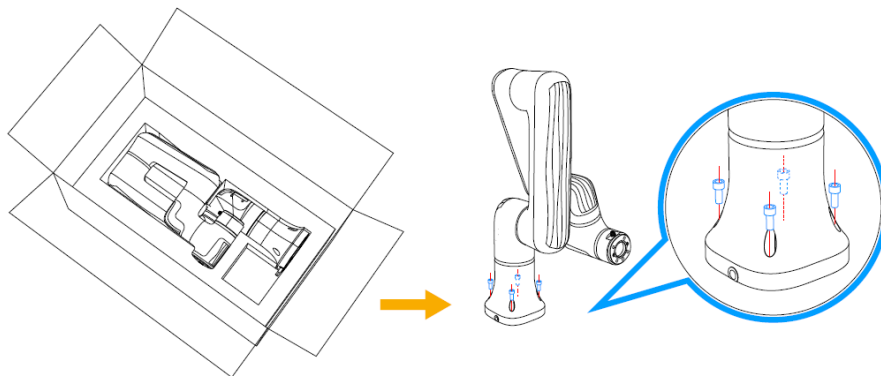


Figure 7.2 Base installation

7.3.2 CCBOX installation

The CCBOX supports horizontal-type, vertical-type and rail-type installation. Please leave at least 50 mm gap on each side except the installation surface to ensure enough space for heat dissipation.

Horizontal-type

After installing the horizontal bracket to the bottom of both sides of the CCBOX, place the CCBOX horizontally on the flat and stable installation surface, and fixed it on the surface with 4 M3*8 screws.

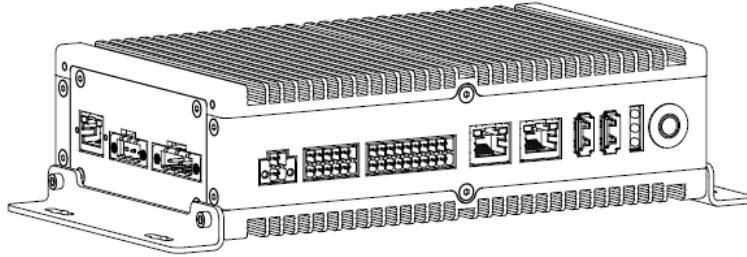


Figure 7.3 Horizontal-type installation

Vertical-type

After installing the vertical bracket on the rear of both sides of the CCBOX, place the CCBOX vertically on the flat and stable installation surface, and fixed it on the surface with 4 M3*8 screws.

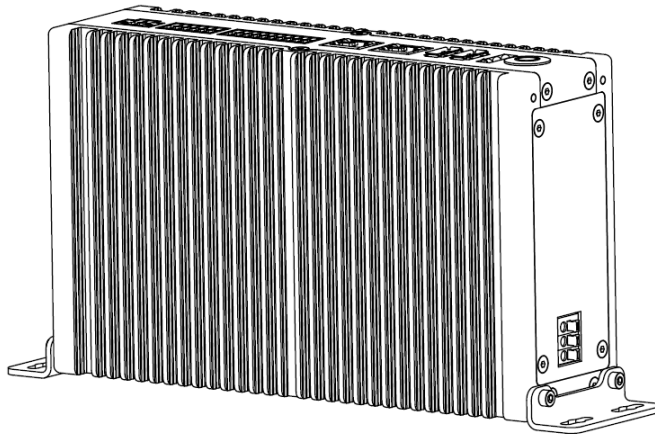


Figure 7.4 Vertical-type installation

Rail-type

After installing the rail-type bracket to the middle of the rear side of the CCBOX, hang the CCBOX on the 35mm mounting rail.

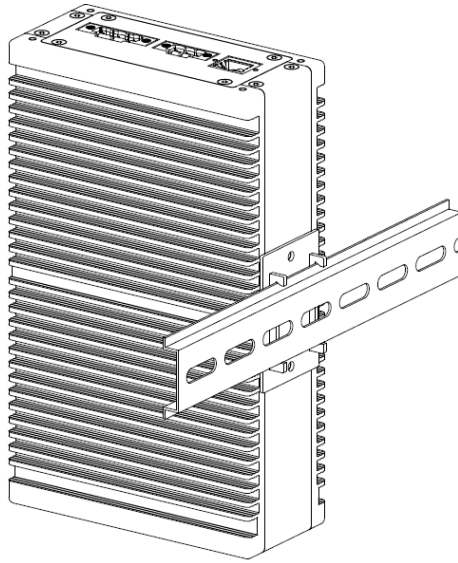


Figure 7.5 Rail-type installation

7.3.3 End tool installation

The end flange of the robot arm has four M6 threaded holes, which can fix the tool to the end of the robot arm. In order to accurately adjust the position of the tool, you can also use the reserved $\Phi 6$ positioning hole. The end flange of Nova 2 and Nova 5 robot arms is in the same size. For detailed dimensions, refer to *5 Mechanical Specifications*.

7.4 Wiring

1. Connect the cable extending from the base of the robot arm to the robot interface of the CCBOX. Plug the RJ connector of the network cable to the LAN interface (①), and connect the power cable to the power interface (②) through the wiring terminal. Tighten the screws on the wiring terminal.
2. Connect the emergency stop switch to the emergency stop switch interface (④) of the CCBOX through the wiring terminal. Tighten the screws on the wiring terminal.
3. Plug the wireless receiver into any of the USB interface (⑤).
4. Connect the matched DC power supply to the power interface of the CCBOX through the wiring terminal. Tighten the screws on the wiring terminal.

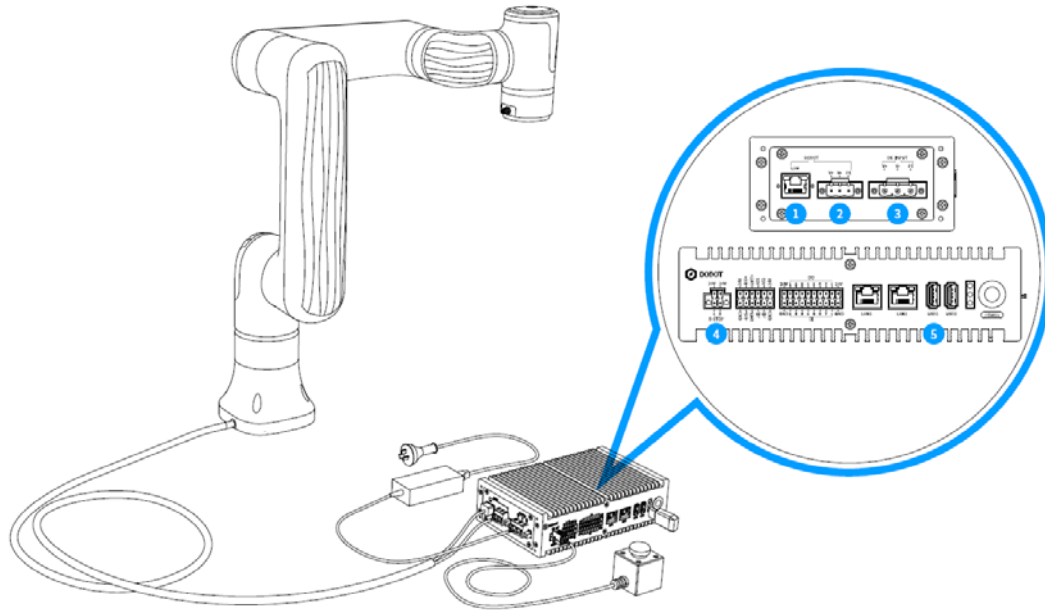


Figure 7.6 Wiring

 NOTICE

- Set the specifications and installation method of external cables in compliance with local power distribution laws and regulations.
- Do not disassemble the robot by yourself, otherwise it may cause electricity leakage.
- Make sure the device is grounded.
- Do not bend the cable excessively, otherwise it may cause poor contact or cable breakage.
- Make sure the power outlet for the control system is disconnected when connecting an external device, otherwise it may cause an electric shock or device failure.
- Use supporting cables to protect device and personal safety.
- After wiring, ensure that there are no fallen screws or exposed cables in the device.
- Do not plug or remove the power cable or communication cable when the device is running normally.
- Power on the device only after connecting all the cables required.
- Ensure that the cables are connected correctly, otherwise, it may cause fault in internal modules or external devices.
- Before connecting, check whether there is breakage in the insulation and shield of the external cables.
- After the power supply of the robot arm (②) and the power supply of the control cabinet (③) are connected, additional protection measures need to be applied to avoid the wires and terminals being directly exposed, and the terminals cannot withstand direct stress.

7.5 Debugging

After turning on the external power supply, press **Power** button on the CCBOX. When the indicator lights at the end of the robot arm and on the CCBOX turn blue, you can connect the robot arm, enable it and jog it for debugging through the operation terminal.

For specific operations, refer to *DobotStudio Pro User Guide* (for PC) or *Dobot CRStudio User Guide* (for App).

8. Maintenance

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.

8.1 Safety instructions

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



NOTICE

- Replace faulty components using new components with the same model or equivalent components approved by Dobot.
- Reactivate all 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 power source connected to the robot or controller. Take necessary precautions to prevent other people from powering on the system during the repair period.
- Observe ESD regulations during the disassembly of the parts of the robot arm or controller.
- Avoid disassembling the power supply inside the controller. High voltage may remain inside the power supply for several hours after the controller has been powered off.
- Prevent water and dust from entering the robot arm or controller.

8.2 Robot maintenance

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

Table 8.1 Check items

| Period | | | Maintenance item | Maintenance essential |
|--------|----------|----------|---------------------|---|
| Daily | 3 months | 6 months | | |
| √ | | | Robot clean | Wipe off dirt, dust, cutting residue on the body with water or 10% alcohol |
| | | √ | Joint bolts | Check the torque of exposed bolts based on the specified tightening torque table |
| | √ | | Tool mounting bolts | Check the torque based on the specified tightening torque table |
| √ | | | Motor | Confirm abnormal heating or sound |
| √ | | | Brake | Check whether the robot arm or end-effector will fall when the servo is powered off |
| | √ | | Reducer | Check abnormal vibration, noise, and oil leakage |

The bolt tightening torque is shown in Table 8.2.

Table 8.2 Bolt tightening torque

| Bolt size | Outer hexagonal bolt (joint) | Inner hexagonal bolt (12.9) | Hexagonal bolt (rear cover) |
|-----------------|------------------------------|-----------------------------|-----------------------------|
| 3 mm / 0.118 in | 2 Nm | 2.4 Nm | 0.7 Nm |
| 4 mm / 0.157 in | 4 Nm | 4.5 Nm | - |
| 5 mm / 0.197 in | 7.5 Nm | 9 Nm | - |
| 6 mm / 0.236 in | 15 Nm | 18 Nm | - |
| 8 mm / 0.32 in | - | 37 Nm | - |

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

In addition, overall maintenance is required every 20,000 hours of operation time or every 4 years (select the shorter of the two periods for maintenance). If you are not clear about the maintenance processes, please contact Dobot technical support.

9. Warranty

9.1 Product warranty

Without prejudice to any claim agreement that the user (customer) may reach with the distributor or retailer, the manufacturer shall guarantee the quality of the products to the customer in accordance with the terms and conditions below:

If defects caused by manufacturing and/or improper material occur in a new device and its components within 12 months (15 months at most if the shipping time is included) after the device is put into use, Dobot shall provide the necessary spare part, and the user (customer) shall offer personnel to replace the spare part, using another part that represents the latest technology level to replace or repairing the related part.

If the device defects are caused by improper handling and/or failure to follow the relevant information set out in the User Guide, the warranty is invalid.

This warranty does not apply to or extend to maintenance (e.g. installation, configuration, software download) performed by the authorized distributor or customer.

The user (customer) must provide the purchase receipt and the purchase date as valid evidence for the warranty. Claims under this warranty must be made within two months of the apparent failure to perform the product warranty.

The ownership of the equipment or components that are replaced or returned to Dobot shall remain with Dobot. Any other claims arising from or related to the equipment are not covered by this warranty.

Any items in this product warranty do not intend to limit or exclude the legal rights of the customer or to limit or exclude the liability of the manufacturer for the personnel casualty resulting from its negligence. The duration of this product warranty shall not be extended due to the services provided under the product warranty terms. Under the principle of not violating the warranty, Dobot reserves the right to charge customers for the replacement or maintenance. The foregoing does not imply a change in the burden of proof to the detriment of the client. If there are defects on the equipment, Dobot shall not be liable for any damage or loss arising therefrom, including but not limited to loss of production or damage to other production equipment.

9.2 Disclaimer

Dobot is committed to improve the reliability and performance of its products, and as such reserves the right to upgrade products without prior notice. Dobot strives to ensure the contents of the User Guide are precise and reliable, but takes no responsibility for any errors or missing information.

Appendix Technical Specifications

Appendix A Robot technical specifications

| Product | | Nova 2 | Nova 5 |
|-------------------------------|-------|---------------------|---------------------|
| Weight | | 11kg (24.3lb) | 14kg (30.9lb) |
| Nominal load | | 2kg (4.4lb) | 5kg (11lb) |
| Working radius | | 625mm (24.6in) | 850mm (33.5in) |
| Maximum working speed | | 1.6m/s (63in/s) | 2m/s (78.7in/s) |
| Range of joint motion | J1 | $\pm 360^\circ$ | $\pm 360^\circ$ |
| | J2 | $\pm 180^\circ$ | $\pm 180^\circ$ |
| | J3 | $\pm 156^\circ$ | $\pm 160^\circ$ |
| | J4 | $\pm 360^\circ$ | $\pm 360^\circ$ |
| | J5 | $\pm 360^\circ$ | $\pm 360^\circ$ |
| | J6 | $\pm 360^\circ$ | $\pm 360^\circ$ |
| Maximum joint speed | J1 | 135°/s | 100°/s |
| | J2 | 135°/s | 100°/s |
| | J3 | 135°/s | 100°/s |
| | J4 | 135°/s | 100°/s |
| | J5 | 135°/s | 100°/s |
| | J6 | 135°/s | 100°/s |
| End IO | DI | 2 inputs | 2 inputs |
| | DO | 2 outputs | 2 outputs |
| | RS485 | Support | Support |
| Repeated Positioning accuracy | | $\pm 0.05\text{mm}$ | $\pm 0.05\text{mm}$ |
| IP rating | | IP54 | IP54 |
| Noise | | 65dB(A) | 70dB(A) |
| Temperature range | | 0~50°C | 0~50°C |
| Typical power consumption | | 100W | 230W |
| Maximum power consumption | | 250W | 770W |

| | | |
|---------------------------|---|---|
| Installation mode | Any angle | Any angle |
| Cable length ^① | 3m (118.1 in) | 3m (118.1 in) |
| Material | acrylonitrile butadiene styrene plastic | acrylonitrile butadiene styrene plastic |

① cable length between the robot arm and the controller.

Appendix B CCBOX technical specifications

| | | |
|-------------------------|--|--------------------------------|
| Product | CCBOX | |
| Size | 200*120*55 mm (7.9*4.7*2.2 in) | |
| Weight | 1.3 kg (2.9 lb) | |
| Input power | 30~60V DC | |
| IO power | 24V, Max 2A, Max 0.5A for each channel | |
| IO interface | DI | 8 inputs (PNP or NPN) |
| | DO | 8 outputs (PNP or NPN) |
| | AI | 2 inputs, voltage mode, 0~10V |
| | AO | 2 outputs, voltage mode, 0~10V |
| Communication interface | LAN | 2 |
| | USB | 2 |
| | RS485 | 1 |
| Environment temperature | 0~50°C | |
| Environment humidity | ≤95%, no condensation | |
| Remote power on/off | Support | |
| IP rating | IP20 | |
| Cooling mode | Passive heat loss | |
| Teaching mode | PC (Windows), APP (iOS/Android) | |