

**XINJE**

# **SCARA series industrial robot**

**User Manual-Mechanical Section Rev.1.1**

## **RX4-S6 series**



## **Contact us**

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## 1. Preface

This manual provides instructions for product installation, handling, operation, and precautions. To use the product's functions correctly, please read and understand the contents of this manual. Keep this manual properly for future reference.

- **This manual is the maintenance guide for the industrial robot's main unit. The following manuals are related to this product. Select the one that suits your needs:**

**User Manual for RC6F Robot Controller**

**User Manual of SCARA Series Industrial Robot RX Series-Mechanical Part**

**User Manual for the 4x6 Axis Robot General System**



- **The images in this manual are for illustrative purposes only. Some may differ from the product you ordered.**
- **For clearer illustration, some images in this manual may show the product after partial removal of the outer cover or partial shielding. The product must be in a fully installed condition for normal use.**
- **As products may be upgraded as needed, the content in this manual may be updated or revised without prior notice. Please let us know if you find any errors or inappropriate information. For manual usage requests, please contact our customer service center.**

### 1.1 About Warranty



**For warranty terms and conditions, please contact the authorized dealer where you purchased the product.**

During the product warranty period, our company provides free maintenance only for faults caused by normal use.

The following situations are not covered by the warranty. If repairs are required, appropriate repair costs will be charged.

- Failure to comply with industrial standards or improper installation, wiring, connection

- of other control devices, or misuse, inspection, and maintenance as specified in the user manual;
- exceeding the specifications or standard performance indicated in the instruction manual during use;
  - Storage methods, working conditions, and uses exceed the specified range in the instruction manual;
  - damage to the product due to improper transportation or transportation method;
  - accident or collision damage;
  - install non-original parts and accessories;
  - Modifying original components without manufacturer approval;
  - pollution, salt damage, condensation;
  - natural disasters such as fire or earthquake, tsunami, lightning, wind and flood;

Under this agreement, our company provides warranty coverage only for defects and flaws in products and components sold to distributors. We shall not be liable for any other express or implied warranties, including but not limited to implied warranties of merchantability or specific purpose. Furthermore, we shall not be held responsible for any indirect damages or consequences arising from the products.

## 2. Safety Section

Prior to use, you must thoroughly read and fully understand this manual or any accompanying materials. Only after ensuring you are familiar with the machine's operation, hazards, and precautions should you proceed. The design and operation of the robot must be performed by trained or qualified personnel. Non-compliant design or operation will significantly increase the risks or accidents during robot use.

Use the following tags to record safety precautions. Please read them carefully.

 <b>CAUTION</b>	When processing errors occur, they may result in minor injuries to users or property damage.
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 <b>WARNING</b>	When processing errors occur, they may result in the user's death or severe injury.
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	<p>It indicates a situation where incorrect processing may result in the user's death or severe injury, posing an extremely high risk.</p>
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## 2.1 Safety Measures for Unboxing and Handling

Please note the following before unpacking and acceptance:

	<ul style="list-style-type: none"> <li>● Before opening the package, please check whether the outer packaging is intact and free from damage, moisture, dampness, deformation, or other abnormalities.</li> <li>● Open the package in the order of layers. Do not force open it.</li> <li>● After unpacking, please check the packing list and verify that the machine, accessories, and documentation are complete.</li> <li>● Check for surface damage, rust, etc.</li> </ul>
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Store and transport as follows:

	<ul style="list-style-type: none"> <li>● Store and transport the machine according to its specified storage and transportation conditions, ensuring that temperature and humidity meet the required standards.</li> <li>● Avoid storage and transportation in strong magnetic fields, strong vibrations, or strong electric fields;</li> <li>● Avoid prolonged storage of the device. If storage is required for an extended period, strict protective measures and necessary inspections must be implemented.</li> <li>● Long-distance transportation requires sealed packaging boxes with strict protective measures.</li> <li>● It is strictly prohibited to store or transport other items that may cause harm to this machine in mixed conditions.</li> </ul>
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## 2.2 Design and Installation Considerations

The design and configuration of the robotic system shall be performed by trained personnel. Such personnel shall possess equivalent expertise and skills to those who have

thoroughly studied and are trained in this manual.

	<ul style="list-style-type: none"> <li>● Installation precautions are detailed in 'Basic Section: 3.3 Environmental Requirements and Installation'. Please read the instructions carefully and perform installation safely.</li> </ul>
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	<ul style="list-style-type: none"> <li>● Personnel engaged in the design and manufacture of robotic systems using this product must carefully read the "Safety Section" of this manual prior to proceeding with the design or manufacture of the robotic system. Failure to do so may result in severe injuries and/or significant damage, and may pose serious safety risks.</li> <li>● The robot and controller must be operated under the environmental conditions specified in the manual. This product is designed and manufactured for use in standard indoor environments. Failure to comply may not only reduce the product's service life but also pose serious safety risks.</li> <li>● Please use the robotic system within the product's specified specifications. Otherwise, it may not only shorten the product's lifespan but also cause serious safety issues.</li> </ul>
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The strength of ball screw spline should be considered when designing the end load.

	<ul style="list-style-type: none"> <li>● The spline shaft of ball spline is a compound shaft which can bear radial load or torque, but when the load or torque is very large, the strength of the spline shaft must be considered, otherwise the spline shaft may be damaged.</li> </ul>
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The end spline shaft of this product features a cantilever structure at its extended end, which can be categorized into three load scenarios:

- **Only radial (bending moment) load:**

- 1) Bending moment  $M = F \cdot L$ ., where  $L$  is the distance from the load to the spline nut end;

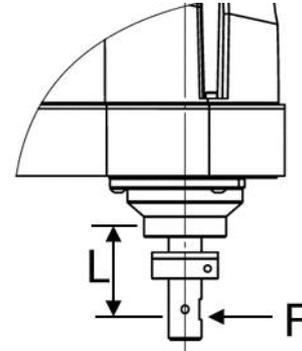
- 2) Allowable bending moment  $[M] = \sigma \cdot$

$Z$  of spline shaft:

$\sigma$  is the allowable bending moment stress of the spline shaft,  $98 \text{ N/mm}^2$

$Z$  denotes the cross-sectional modulus of the spline shaft.

For this manual's product, the cross-sectional modulus  $Z$  is  $577 \text{ mm}^3$ .



- 3) The load bending moment  $M$  must be ensured to be  $\leq [M]$

➤ **Only withstands torsional load:**

- 1) The load torque of the spline is shown in Figure T.

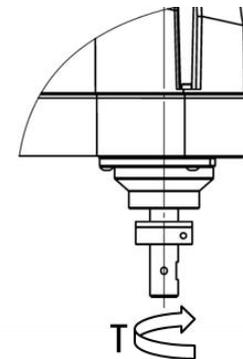
- 2) Allowable bending  $T = \tau_a \cdot$

$Z_p$  moment of spline shaft:

$\tau_a$  is the allowable bending moment stress of the spline shaft,  $49 \text{ N/mm}^2$

$Z_p$  denotes the polar section modulus of the spline shaft.

For this manual's product, the polar section modulus  $Z_p$  is  $1150 \text{ mm}^3$ .



- 3) The load bending moment  $T$  must be ensured to be  $\leq [T]$

➤ **The spline shaft is subjected to both torque and bending moment**

**simultaneously.**

- 1) The spline shaft is subjected to both torque and bending moment simultaneously, which is the most common operating condition of this robotic product.

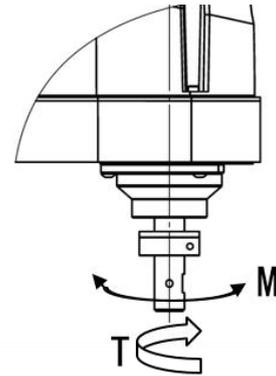
The equivalent bending moment ( $M_e$ ) and equivalent torque ( $T_e$ ) must be considered to ensure the load on the spline shaft remains within the allowable range.

- 2) Equivalent bending moment:  $M_e = \frac{M + \sqrt{M^2 + T^2}}{2}$

$$\text{Equivalent torque: } T_e = \sqrt{M^2 + T^2}$$

- 3) To ensure the safe use of spline shafts, the following must be met:

$$M_e \leq [M] \text{ and } T_e \leq [T]$$



## 2.3 Safety Considerations for Machine Wiring

	<ul style="list-style-type: none"> <li>● Workers must wear work clothes, safety helmets, and safety shoes.</li> <li>● Always disconnect the power before wiring, otherwise there is a risk of electric shock or system failure.</li> <li>● After disconnecting the power supply, wait at least 10 minutes for residual voltage in the device's internal capacitors before performing wiring operations.</li> <li>● Ensure proper grounding of the equipment to avoid electric shock risks.</li> <li>● Comply with ESD (Electrostatic Discharge) prevention protocols and wear an ESD ring during operations to prevent damage to internal equipment circuits.</li> </ul>
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	<ul style="list-style-type: none"> <li>● Do not place heavy objects on the cable or pull it forcefully, as this may cause damage, poor contact, or even electric shock.</li> <li>● Ensure the wiring is correct to avoid system failure or damage.</li> <li>● After completing the wiring, ensure there are no loose objects in the controller, especially conductive materials like screws.</li> <li>● Always connect the AC power cable to the robot controller's power plug, never directly to the factory power supply.</li> </ul>
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	<ul style="list-style-type: none"> <li>● Always perform the replacement after turning off the controller and related devices and unplugging the power cord. Working while powered on may cause electric shock or robot system failure.</li> <li>● Do not install or remove the motor connector while the power is on. This poses serious risks of electric shock or system failure, as the robot may malfunction and cause severe personal injury.</li> </ul>
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## 2.4 Machine Operation Safety

Operators must follow these safety measures:

	<ul style="list-style-type: none"> <li>● Workers must wear work clothes, safety helmets, and safety shoes.</li> <li>● Before connecting the machine to the power supply, ensure that personnel are outside the robot's range of motion.</li> <li>● If the first, second, and fourth joints are repeatedly operated within a range of</li> </ul>
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	<p>less than 5 degrees of motion, it may easily lead to insufficient bearing oil film, which could result in premature joint damage. To prevent premature damage, move the joints beyond 50 degrees and perform the operation approximately five to ten times daily.</p> <ul style="list-style-type: none"> <li>● Joint 3: If the vertical movement distance of the robotic arm is less than 10 mm, move the joint more than half of its maximum stroke, approximately five to ten times per day.</li> <li>● When the robot operates at low speed (approximately 5% to 20% of its maximum speed), continuous vibrations (resonance) may occur depending on the combination of the robotic arm's direction and the load at the end of the fixture. These vibrations result from the natural frequency of the robotic arm and can be controlled through the following measures.             <ol style="list-style-type: none"> <li>1) Change robot speed</li> <li>2) Change the teaching point</li> <li>3) Adjust the load at the fixture end</li> </ol> </li> </ul>
	<ul style="list-style-type: none"> <li>● Before operating the robot, thoroughly review the safety guidelines and operational procedures, as failure to do so may increase the risk of severe accidents.</li> <li>● Make sure the power is off before entering the robot's range of motion.</li> <li>● When operation requires power supply, two personnel must work in coordination. One person should maintain an emergency stop button ready for immediate activation. Within the robot's operational range, the operator must stay alert and act swiftly, while confirming the evacuation route beforehand.</li> <li>● Before debugging and trial operation, the emergency stop button must be ready to be pressed at any time, and safety verification should be conducted at a controllable low speed.</li> </ul>

## 2.5 Transfer, Sale, and Assignment of Robots

	<ul style="list-style-type: none"> <li>● When transferring, assigning, or selling a robot, it is essential to ensure that the robot's ancillary documents, such as the operating manual, are transferred to the new user.</li> <li>● When transferring, transferring, or selling to foreign countries, the customer must prepare appropriate language machine operation manuals and other robot accessories, modify the display language, and ensure compliance with local legal regulations.</li> <li>● New users may cause accidents by making wrong operation or unsafe operation without reading the instruction manual.</li> </ul>
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	<ul style="list-style-type: none"> <li>● When a robot is transferred, assigned, or sold abroad, the original contract terms, unless otherwise specified, shall include provisions regarding security that shall not be inherited by the new transferee.</li> <li>● The original customer and the new recipient must sign a new contract.</li> </ul>
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## 2.6 Disposal of Robot

	<ul style="list-style-type: none"> <li>● Do not disassemble, heat, or burn batteries used in control devices or robot bodies. Otherwise, fire, rupture, or combustion accidents may occur.</li> <li>● Do not disassemble the control device's substrate or components before disposal.</li> <li>● Sharp parts such as ruptures or incisions, and wires may cause injury.</li> <li>● Do not disassemble or discard cable wires and external wiring after removing them from connectors or junction boxes. Otherwise, conductors may cause hand or eye injuries.</li> <li>● When performing waste operations, take full precautions to avoid being pinched or injured.</li> <li>● Waste should be disposed of in a safe manner.</li> </ul>
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## 2.7 Warning Labels for Robots

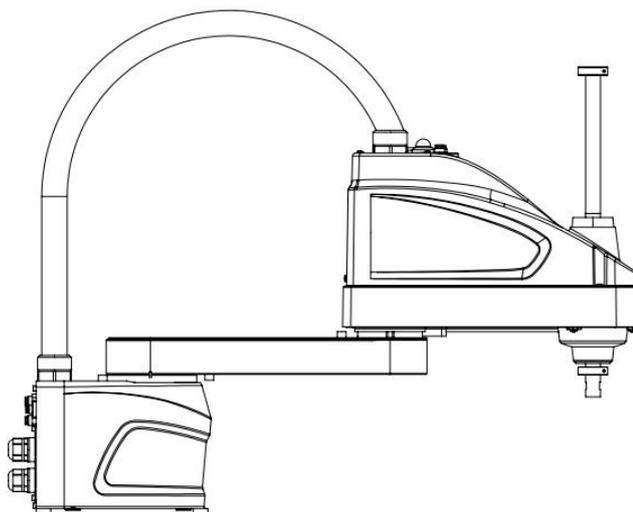


Position	Label	Warning content
A	<p>使用前仔细阅读说明书 READ INSTRUCTIONS 使用前に取付説明書 をよくお読みください</p>	<p>Attach to the side of the machine base to remind users to read the manual carefully before use.</p>
B	<p>严禁进入动作范围内 KEEP AWAY THE MOTION RANGE アーム動作範囲内 立ち入り禁止</p>	<p>Do not enter the machine's operational range to avoid personal injury.</p>
C	<p>运转过程中严禁用手触碰运转部位 DO NOT TOUCH 運動中動く部分に触らないでください</p>	<p>Do not touch moving parts during operation.</p>
D	<p>PREVENT ACCIDENTAL TOUCH</p>	<p>Prevent accidental robot descent caused by unintended brake button press</p>

### 3. Basic Section

#### 3.1 Product Naming Rules and Label Information Examples

- **Product nameplate example:**



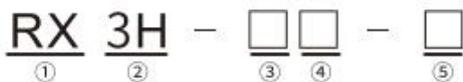
NOTE

**This image is for illustrative purposes only. The product may differ from what you ordered.**

**Before use, verify the machine to ensure the robot body matches the controller's serial number (S/N).**

- **Product naming rules:**

# Naming Rule



① Name

Display	Product Name
RX	XINJE Robot

② Serial Number

Display	Specification
3H	Serial Number
4	Serial Number

③ Robot Types

Display	Type
A6	6-Axis Articulated Robot
A4	4-Axis Articulated Robot
S	SCARA
D3	3-Axis DELTA
D4	4-Axis DELTA
C	Collaborative Robot

④ Payload

Display	Maximum Payload
3	3kg
4	4kg
5	5kg
6	6kg
7	7kg
8	8kg
10	10kg
20	20kg
24	24kg
50	50kg

⑤ Reach

Display	Reach	Display	Reach
250	250mm	800	800mm
300	300mm	910	910mm
400	400mm	1000	1000mm
500	500mm	1410	1410mm
560	560mm	1700	1700mm
600	600mm	1720	1720mm
700	700mm	2100	2100mm
720	720mm		



**This manual describes the product as a standard industrial robot.**

## 3.2 Specifications

### 3.2.1 Functional Features

This industrial robot features a horizontal multi-joint configuration with three parallel rotating joints for planar positioning and orientation, plus a single mobile joint for vertical movement of end-effector components. The end-effector can be equipped with specialized fixtures for specific tasks, making it ideal for industrial part handling and assembly operations. Its fan-shaped workspace enables high-speed, precision movements, ensuring efficient and accurate performance.

### 3.2.2 Specification Parameters

Brand series	XINJE	
	RX4-S6-600	
Way to install	Counter installation	
Brachium	Length of the first	600
	Length of first	325

	Length of second	275
Body weight		19.5kg
Repeated positioning accuracy	First + second	$\pm 0.02\text{mm}$
	The third joint	$\pm 0.01\text{mm}$
	The fourth joint	$\pm 0.01^\circ$
Maximum speed	First + second	7850mm/s
	The third joint	1100mm/s
	The fourth joint	2000°/s
Maximum range of motion	First joint	$\pm 125^\circ$
	Second joint	$\pm 142^\circ$
	The third joint	200mm
	The fourth joint	$\pm 360^\circ$
Load	Specified	2kg
	Maximum	6kg
Standard cycle time <sup>*1</sup>		0.35s
Inertial moment of the fourth joint	Specified	0.01kg·m <sup>2</sup>
	Maximum	0.12kg·m <sup>2</sup>
Ambient temperature	5–40°C (no significant variation should be observed)	
Subscriber circuit	15 pins (D-Sub interface)	
User airway	$\varnothing 4\text{mm} \times 1$ , $\varnothing 6\text{mm} \times 2$	
Third joint preload	100N	
Origin reset	absolute origin	
Maximum power	1550W	
Rated	AC200-220V 50/60Hz	

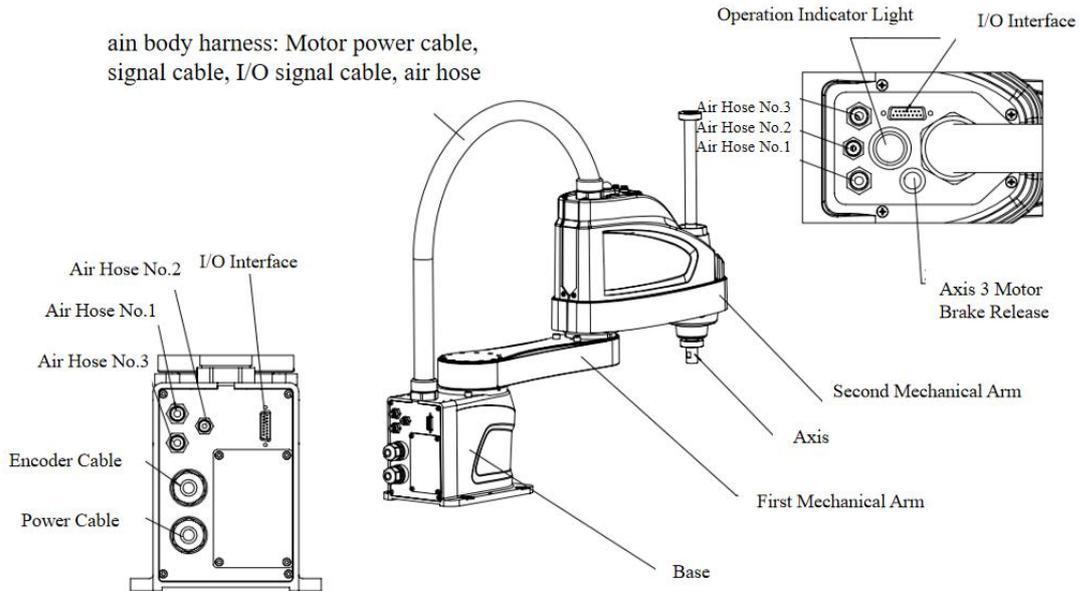
\*1: Load 2kg, 25mm-300mm-25mm motion cycle duration, as shown in the figure below:



The test parameters were obtained from laboratory tests, with standard weights as the load, and no grasping or releasing actions were performed during the process.

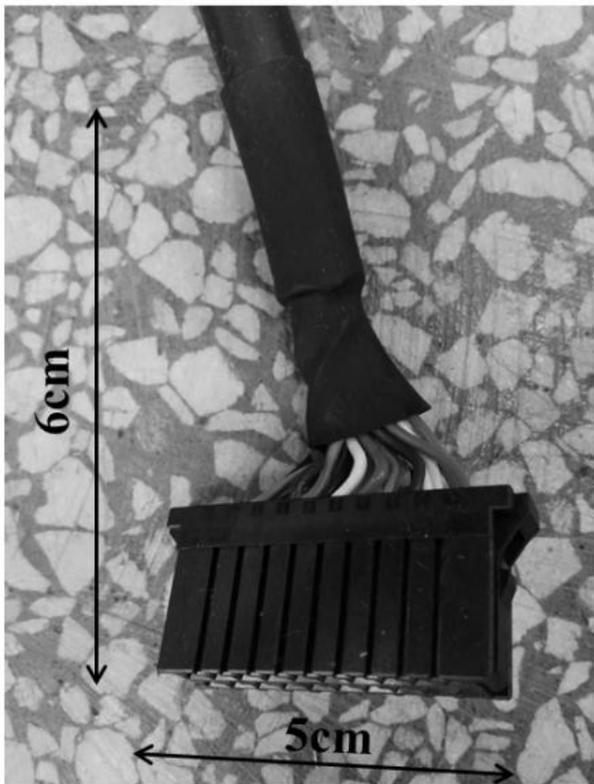
### 3.2.3 Component Names and Dimensions

#### ➤ Ontology diagram



➤ **Robotic body cable connector**

The power cable and signal cable of the robot body are 3m long.

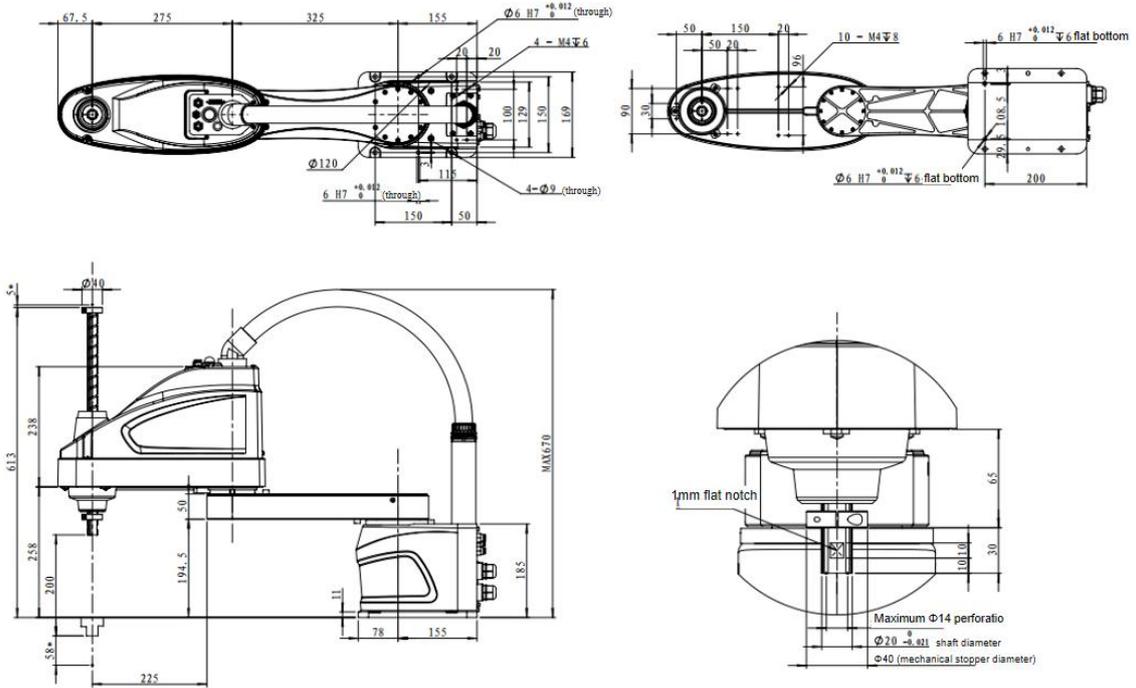


Motor power cable connector



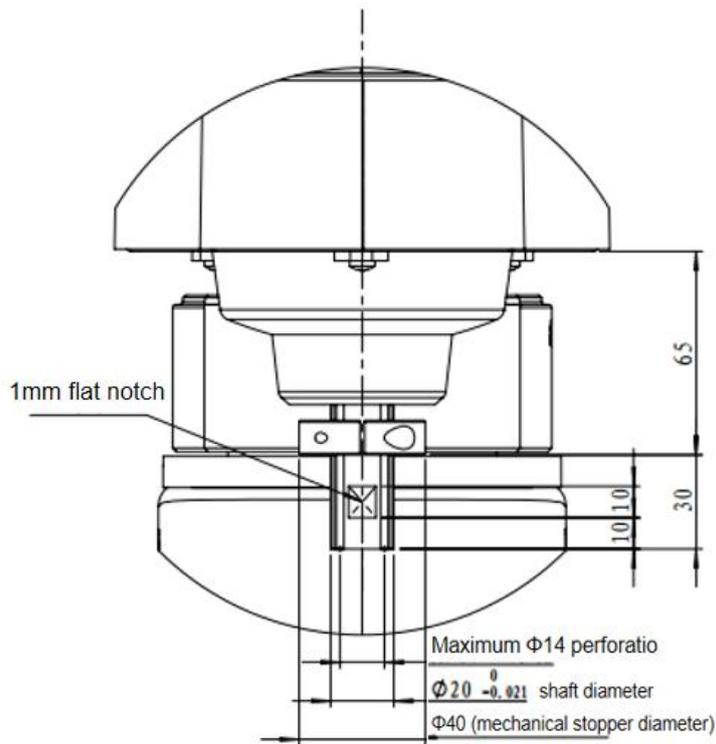
Motor signal cable connector

➤ **Outline dimension**



\*Indicates the stroke margin of the mechanical stopper

➤ **Tooling surface**



### 3.3 Environmental Requirements and Installation

#### 3.3.1 Environmental Requirements

This robot is not suitable for harsh environments such as spraying or arc welding. The operating environment must meet the following conditions:

Item	Operating Conditions	Storage & Transportation Conditions
Ambient Temperature	5-40°C (no significant temperature changes)	-40-55°C (no significant temperature changes)
Ambient Relative Humidity	10%-80% (no condensation)	≤93% (at 40°C)
Electrical Fast Transient Burst Immunity		2kV or below
Electrostatic Discharge Immunity		6kV or below
Environment	<ul style="list-style-type: none"> <li>• Indoor, no direct sunlight</li> <li>• Away from dust, oil fumes, salt, iron filings, etc.</li> <li>• Away from flammable/corrosive liquids &amp; gases</li> <li>• No contact with water</li> <li>• Away from external vibration &amp; shock</li> <li>• Away from electrical interference sources</li> </ul>	



**The ambient temperature is only the applicable condition of the robot.**

**For conditions related to the connection controller, refer to the controller manual.**

#### 3.3.2 Special Operating Environments

- The robot's surface has general oil resistance. If it may come into contact with special oils, prior confirmation is required. Please consult the seller.
- If used in environments with significant temperature and humidity fluctuations, condensation may form inside the robot.
- When handling food directly, ensure the robot does not cause contamination.

Consult the seller.

- Not suitable for use in corrosive environments such as acids or alkalis. Additionally, exposure to rust-prone conditions like salt may cause the main body to rust.

 CAUTION	<ul style="list-style-type: none"> <li>● Do not use alcohol or benzene to scrub the robot surface forcefully, as this may reduce its surface smoothness.</li> </ul>
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 WARNING	<ul style="list-style-type: none"> <li>● Always install a residual current device (RCD) on the AC power cable of the controller. Failure to use an RCD may cause electric shock or equipment failure due to accidental leakage. The RCD model varies by controller. Refer to the controller manual for details.</li> </ul>
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### 3.3.3 Robot Mounting Table

The required test bench for robot installation is not provided and must be designed and fabricated by the customer. Below are the torque and reaction forces generated by the robot's movements, which can serve as a reference for bench design.

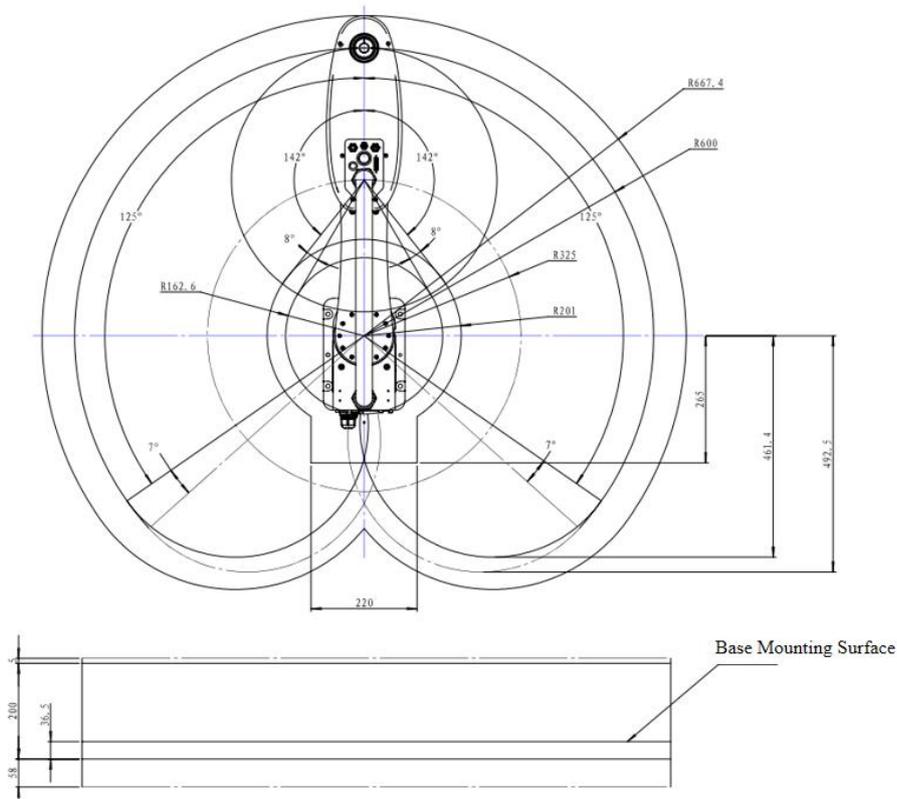
	RX4-S6-600
Maximum reaction torque at horizontal plane	350Nm
Maximum horizontal reaction	1700N
Maximum vertical reaction	1500N

The mounting frame for the robot must be designed and fabricated by the customer. The robot base shall be secured with at least four 12.9-grade M8 bolts, ensuring a thread depth of over 20mm. The robot base can be installed horizontally or vertically depending on the operational requirements.

When the robot moves back and forth at high speed, it will cause a big impact and vibration to the base. Therefore, in order to ensure the running precision and stability, it is recommended that the robot installation surface should use steel plate with a thickness of more than 20mm, and the installation and fixation should be sure not to move.

### 3.3.4 Robot Installation Space

- The robot's operational range is RX4-S6-600.



**The depicted area represents only the reachable range of the manipulator's end-effector. Please ensure the robot's overall configuration and potential interference with surrounding equipment when using large-volume payloads at the end-effector are thoroughly considered.**



NOTE

### 3.3.5 Unboxing and Handling

This product is precision equipment requiring special care during packaging and handling. When moving the control cabinet, avoid vibration or dropping to prevent personal injury or damage to the cabinet. Do not collide or drop the cabinet during unpacking.



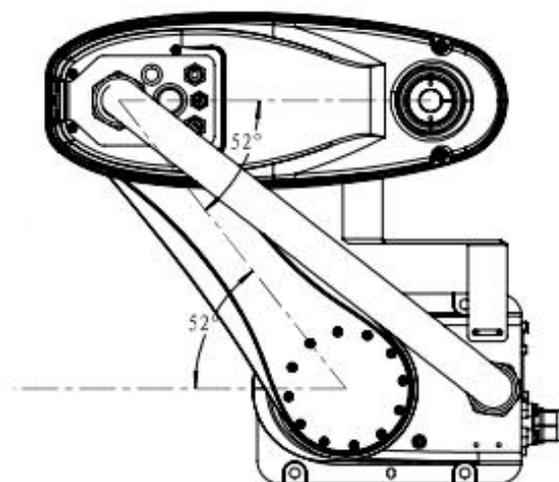
WARNING

- Hoisting operations with rigging, crane lifting, and forklift driving must be performed by qualified personnel only; otherwise, it may result in serious injury or major harm.



- If the fixing bolts of the robot base are removed, the robot will tip over due to its center of gravity shift. Therefore, be sure to avoid such a situation to prevent injuries to the machine or personnel.
- When transporting robots over long distances, first secure the robot base and retract all mechanical arms.
- Ropes can be used for securing to prevent swinging and collisions of robotic arms during transportation, with surrounding padding of shock-absorbing materials.
- When handling items by hand, please be especially careful to avoid pinching your fingers.

➤ Schematic diagram of robot packing posture RX4-S6-600



### 3.3.6 Installation Connection

 WARNING	<ul style="list-style-type: none"> <li>● The installation of desktop robots must be performed by at least two people. Exercise caution to prevent injuries or entrapment of hands or feet due to the robot falling.</li> </ul>
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 CAUTION	<ul style="list-style-type: none"> <li>● Cleaned robots must first have their surfaces thoroughly cleaned before being transferred into the cleanroom.</li> <li>● Before normal operation, connect the exhaust pipe to the exhaust port.</li> </ul>
-------------	---

### 3.3.7 Cable Connections

 WARNING	<ul style="list-style-type: none"> <li>● When connecting the robot to the controller, ensure the correct wiring. Incorrect connections may not only disable the robot system but also pose serious safety risks.</li> <li>● Refer to "Safety Section: 2.3 Machine Wiring Safety"</li> </ul>
-------------	---

### 3.3.8 User Wiring and Piping

 CAUTION	<ul style="list-style-type: none"> <li>● Wiring work must be performed by certified personnel or qualified individuals. If unqualified personnel are involved, it may result in injuries or malfunctions.</li> </ul>
-------------	--

➤ Cabling (wires)

Rated voltage	Permissible current value	Number of threads	Nominal cross-sectional area of conductor	Remarks
DC/AC 30V	0.5A	15	24AWG	twisted-p air

 WARNING	<ul style="list-style-type: none"> <li>● The current should not exceed 0.5A</li> <li>● Connector included in the box</li> </ul>
-------------	---



NOTE

**For details on tracheal distribution, refer to "3.2.3 Component Names and Dimensions".**

- Piping (air duct)

Maximum working pressure	Quantity	Outer diameter x inner diameter
0.59 MPa (6 kgf/cm <sup>2</sup> )	2	ø6 mm × ø4 mm
	1	ø4mm × ø2.5mm

### 3.3.9 Relocation and Storage

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>● When transporting long distances, secure the robot directly to the transport equipment to prevent it from tipping over.</li> <li>● Please also pack the items as you would for delivery before moving them.</li> <li>● To reassemble the robot after long-term storage for use in the robot system, perform a trial run to confirm proper operation before switching to regular operation.</li> <li>● Transport and store the robot under conditions ranging from -25°C to +55°C.</li> <li>● The recommended humidity is 10% to 90%.</li> <li>● If condensation occurs during transportation or storage, power the robot only after the condensation has been removed.</li> <li>● Do not apply excessive impact or vibration during transportation.</li> </ul>
---	---

## 3.4 Terminal Installation and Settings

### 3.4.1 Tool Installation

Customers must prepare the fixture end themselves. When installing the fixture end, please note the following points.

	<ul style="list-style-type: none"> <li>● When installing the chuck on the fixture end, ensure proper wiring and air piping to prevent the workpiece from releasing even when the power is off. If the workpiece is clamped with the power not turned off, pressing the emergency stop switch may cause the workpiece to release, potentially damaging the robot system and the workpiece.</li> <li>● The I/O output is factory-configured and automatically shuts down when the power is cut off, the emergency stop switch is activated, or the robot system's safety function is triggered.</li> </ul>
---	--

➤ **Screw shaft**

- 1) Install the fixture end at the lower end of the shaft.
- 2) For details on shaft dimensions and the robot's overall dimensions, see Section 3.2.3 'Component Names and Dimensions' in the Basic Section.
- 3) Do not move the mechanical limit blocks at both ends of the screw shaft, as this may cause collisions.
- 4) When installing the fixture end on the shaft, use a threaded clamping structure with M4 or larger threads.

➤ **J3 brake release**

The J3-axis brake button layout is specified in Section 3.2.3, 'Component Names and Dimensions'.

	<ul style="list-style-type: none"> <li>● When pressing the brake button, note that the end will freely descend due to gravity.</li> </ul>
---	---

➤ **Overall arrangement**

	<ul style="list-style-type: none"> <li>● If the fixture end is installed and moved, its outer contour may exceed the robot's maximum dimensions, potentially causing interference with surrounding objects. Exercise special caution to prevent such interference.</li> </ul>
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### 3.4.2 Camera and Pneumatic Valve Installation

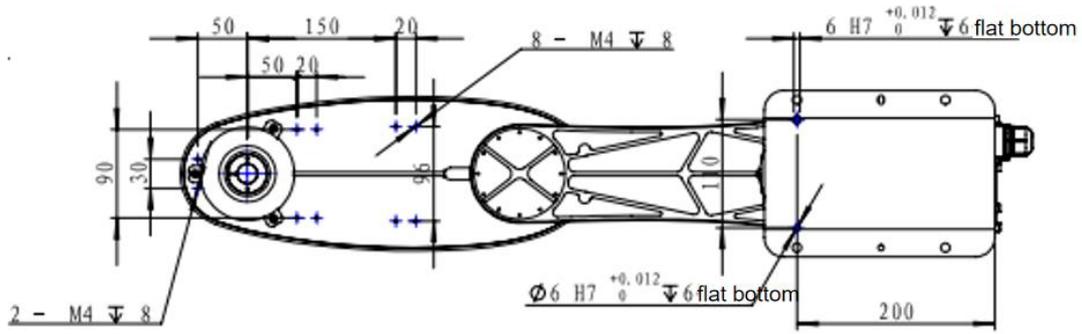


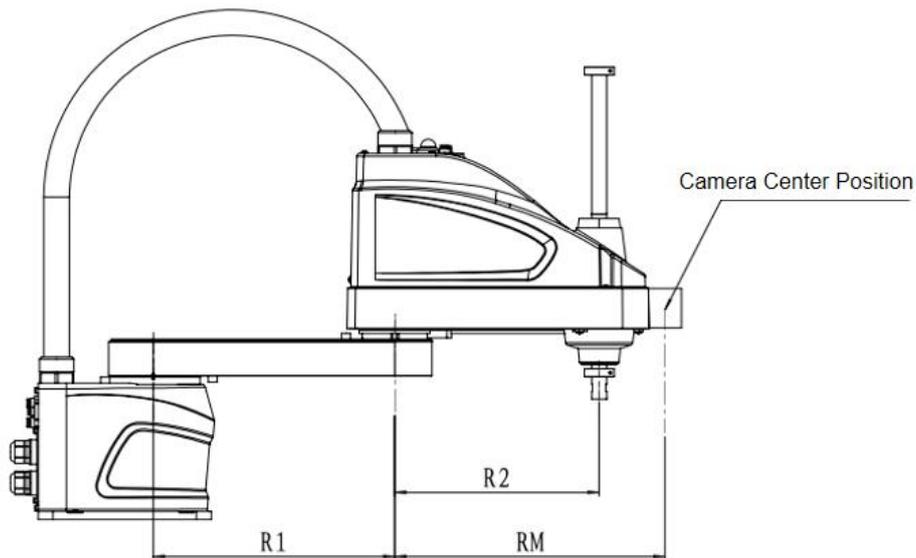
Diagram of the outer wiring installation hole size

As shown in the figure, the second robotic arm features a threaded hole (8xM4, depth 8mm) at its base. This threaded hole allows for the installation of components such as cameras and pneumatic valves on the arm.

### 3.4.3 Weight Setting

This robot model has a maximum permissible load of 6kg at its end shaft. The end fixture or load is designed and installed by the customer at the end shaft or other threaded holes. When the load's center of gravity deviates from the shaft's axis, calculate the equivalent weight of the axis and set it accordingly.

The equivalent weight is calculated as follows:



- When the load center of gravity is at the rotation center of the second joint:  $WM =$

$$M(R1)^2 / (R1 + R2)^2$$

- When the load is mounted on the second robotic arm but not at the rotation center of the second joint, the formula is:  $WM = (RM)^2 / (R2)^2$

WM: equivalent weight

M: Load weight

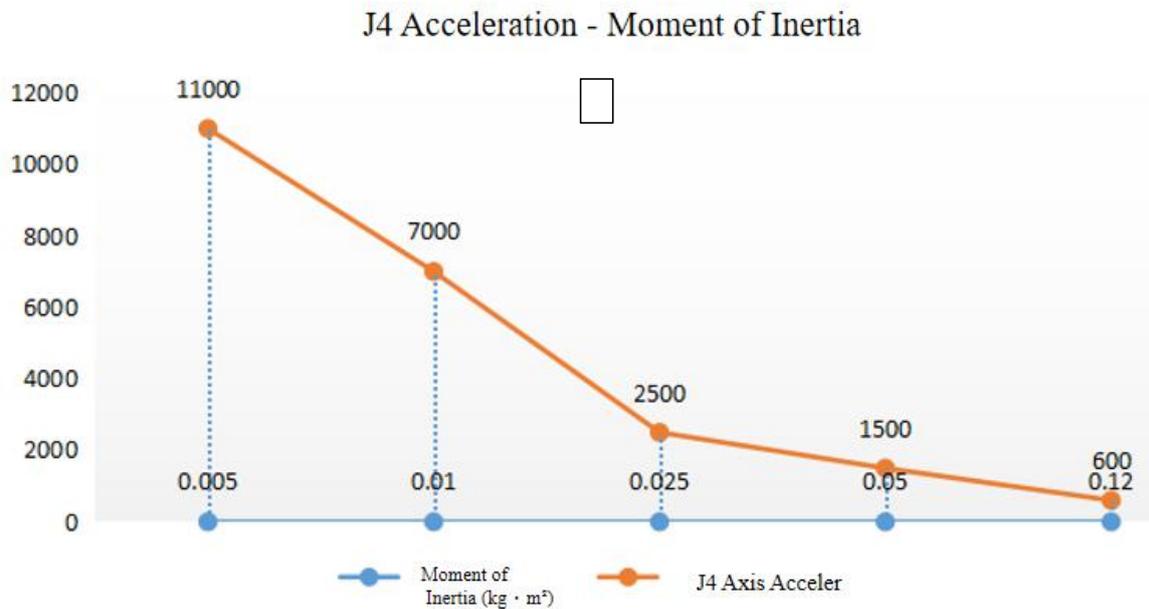
R1: Length of the first robotic arm

R2: Length of the second robotic arm

RM: Distance from the load center of gravity to the rotation center of the second joint

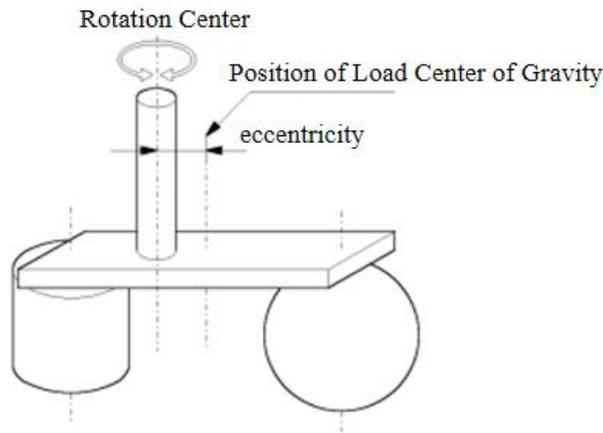
### 3.4.4 Limitation of Inertia Moment

The fourth joint of this robot is a rotary joint. When the load is mounted on the end axis, the loading inertia of the load must be considered. The allowable inertia moment at the end of the axis for the RX4-S6 series robot is 0.12 kg·m<sup>2</sup>, and the eccentricity does not exceed 150 mm.



The operating speed and acceleration must be set according to the actual load eccentricity, otherwise it may cause unexpected collision or error, and may reduce the life of each transmission mechanism.

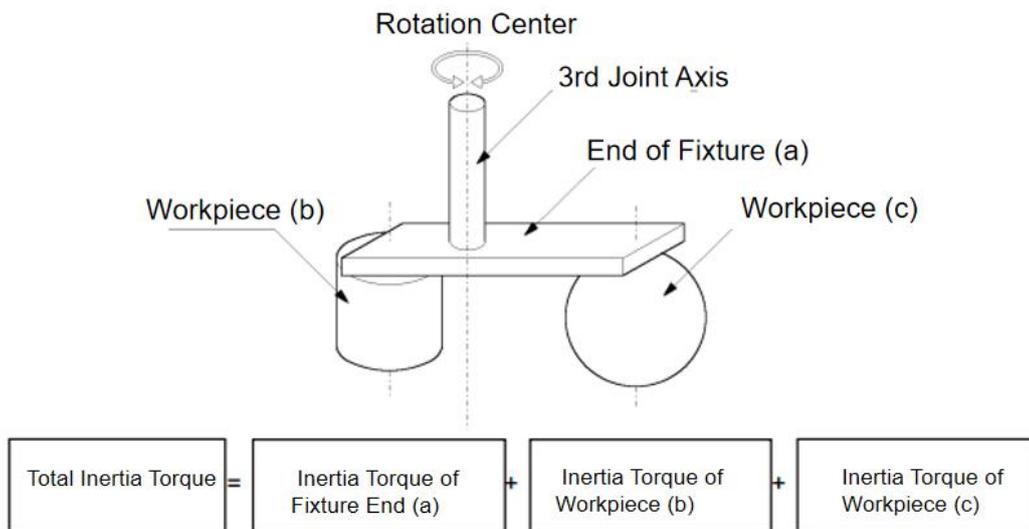
- **Axial load eccentricity**



The eccentricity (or eccentricity of the load mounted on the shaft) is illustrated in the figure, representing the distance from the load's center of gravity to the rotational center of gravity.

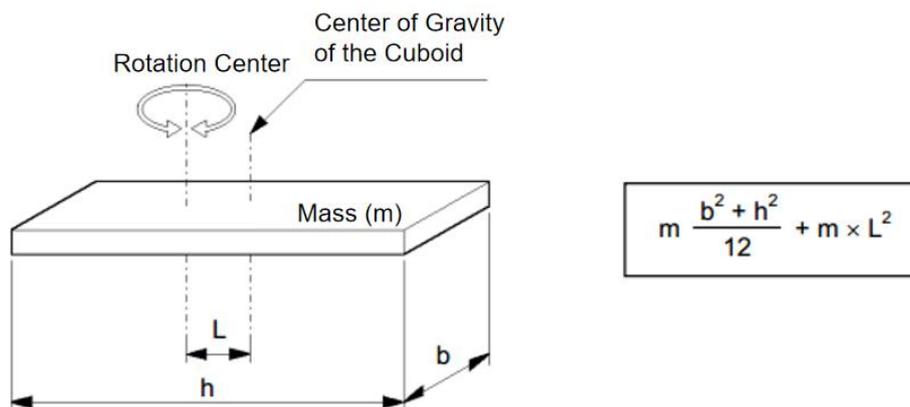
➤ **Calculation Method of Load Rotation Inertia**

The following shows an example of calculating the loading inertia (torque) of a load (the end of a fixture holding a workpiece). The total loading inertia (torque) is calculated by summing the values from parts (a) to (c).



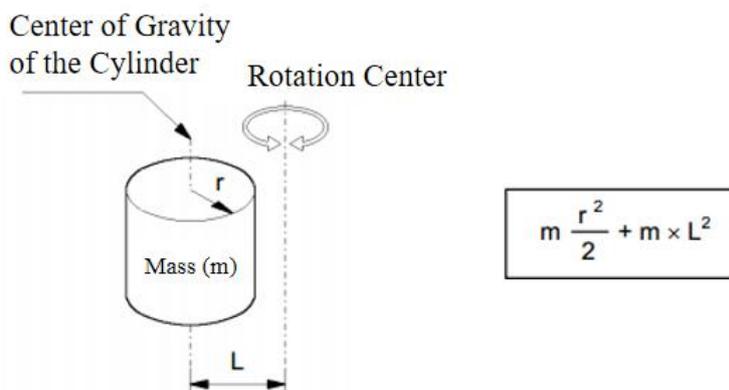
The calculation methods for the load inertial moments of a), b), and c) are shown below. Refer to these basic formulas to determine the load inertial moments of all loads.

a) Calculation Method of Inertia Moment of Rectangular Prism



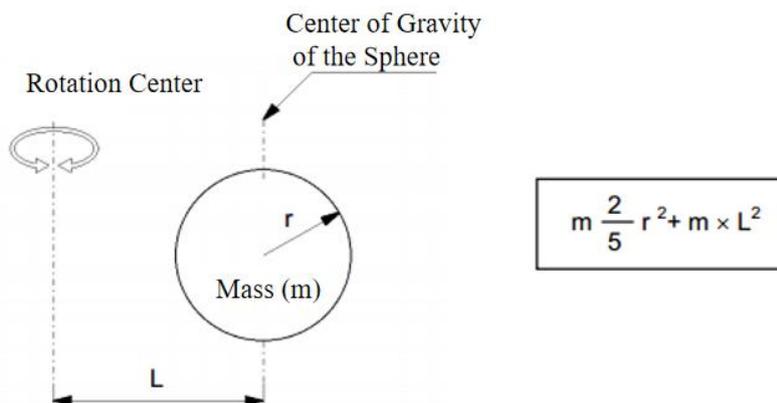
$$m \frac{b^2 + h^2}{12} + m \times L^2$$

b) Calculation Method of Inertia Moment of a Cylinder



$$m \frac{r^2}{2} + m \times L^2$$

c) Calculation Method of Inertial Moment of a Spherical Body



$$m \frac{2}{5} r^2 + m \times L^2$$

### 3.4.5 J3-axis acceleration setting

When the screw shaft end is in the high position, the robot will move faster during horizontal PTP operation. When the screw shaft end is in the low position, the speed will

decrease moderately. Adjust acceleration and speed as needed based on load and motion path in practical applications.

	<ul style="list-style-type: none"> <li>● During all joint linkage processes, the high-position states and movement speeds of the J3 and J4 axes influence the acceleration and velocity settings of the J1 and J2 axes. Setting excessively high acceleration or velocity may result in unexpected vibrations, impacts, or overshoots.</li> </ul>
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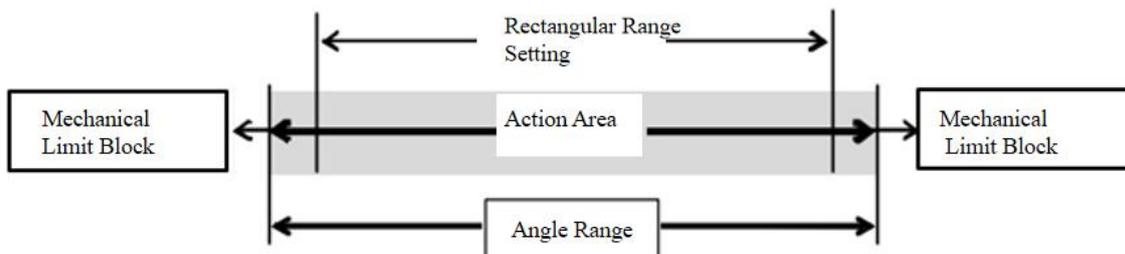
### 3.5 Action Area

	<ul style="list-style-type: none"> <li>● When restricting the motion area for safety reasons, ensure to simultaneously set the pulse range and mechanical stop block.</li> <li>● The factory preset maximum movement range for the robot</li> </ul>
---	---

Set the action area in one of the following three ways:

1. Based on the range of joint angles (total joint)
2. Based on the setting of mechanical stop blocks (Joint 1 to Joint 3)
3. Setting the rectangular range in the X and Y coordinate systems of the robot (from the

1st joint to the 2nd joint)



To optimize layout efficiency or ensure safety, you may need to define the motion range. Refer to Sections 3.5.1 to 3.5.3 for configuration instructions.

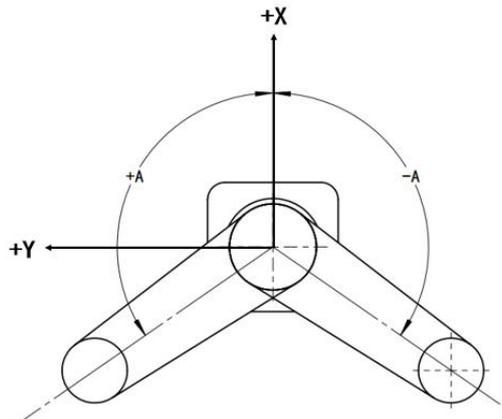
### 3.5.1 Setting the action zone based on the range of joint angles

The range of motion for the robot's joints is set in degrees or millimeters, and the software of the controller can be configured to define the movement angle range for each joint.

 <p>CAUTION</p>	<ul style="list-style-type: none"> <li>The motion range of each joint in the controller software must not exceed the maximum range specified in 'Basic Section: 3.2.2 Specifications and Parameters'; otherwise, it may cause collisions and damage the robot.</li> </ul>
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#### 1) First joint angle range setting

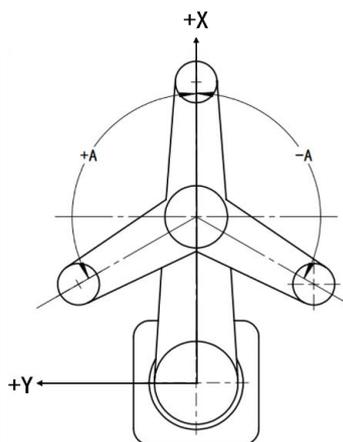
The zero-angle position of the first joint indicates the first manipulator arm is oriented toward the +X-axis. When viewed from above, counterclockwise rotation is considered positive, while clockwise rotation is negative.



Model	A: Maximum range of joint angles
RX4-S6 series	$\pm 125^\circ$

#### 2) Setting of the second joint angle range

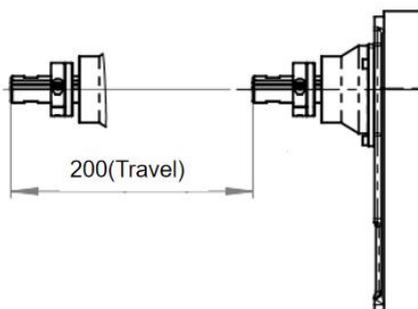
The zero-angle position of the second joint indicates the second manipulator arm is oriented toward the +X-axis. When viewed from above, counterclockwise rotation is considered positive, while clockwise rotation is negative.



Model	A: Maximum range of joint angles
RX4-S6 series	$\pm 142^\circ$

3) Range of motion setting for the third joint

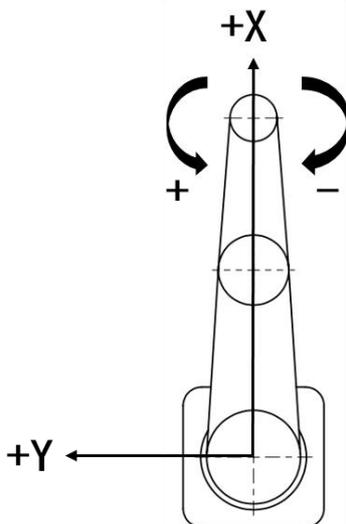
The zero position of the third joint is shown in the figure below:



Model	Effective range
RX4-S6 series	0~ -200mm

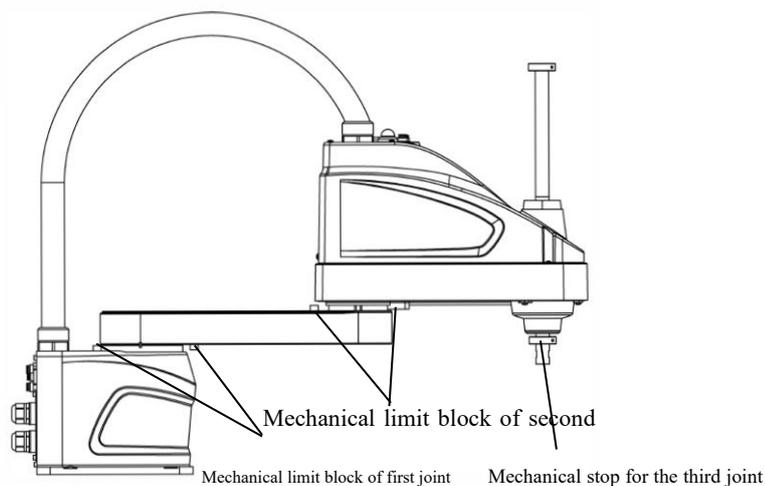
4) Range of motion setting for the fourth joint

The zero angle position of the 4th joint is the flat plane of the shaft end facing the end of the 2nd manipulator.



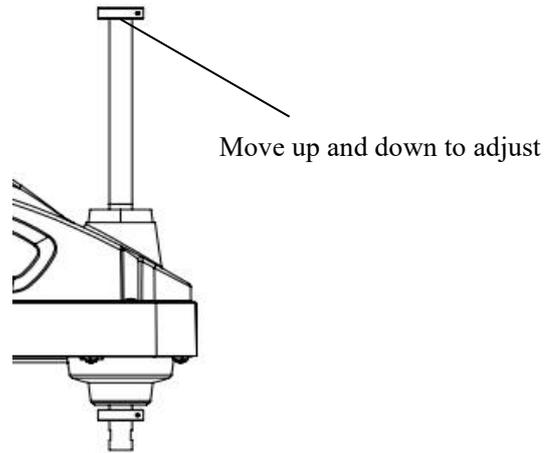
Model	Maximum motion angle
RX4-S6 series	$\pm 360^\circ$

### 3.5.2 Setting Action Area Based on Mechanical Limit Block



As shown in the figure above, the first, second, and third joints are equipped with mechanical limit blocks. The first and second joints have fixed limit blocks, while the third joint allows adjustment, enabling users to customize settings according to their needs.

Adjustment steps for the mechanical limit block of the third joint:



- 1) Turn on the controller and turn off the servo.
- 2) Press the brake button while moving the screw shaft to the new lower limit position.



- When pressing the brake button, manually support the lower end of the screw shaft to prevent it from free-falling due to gravity.

- 3) Loosen the fixing screw M4x12 of the lower limit stop block, then move the block to the desired adjustment position and retighten the screw. The recommended torque is 4Nm. For screw tightening precautions, refer to the 'Maintenance' section.
- 4) Set the new range value in the controller software.



- The adjustment of the third joint mechanical limiter is only applicable to the standard version of the robot.
- When the screw shaft reaches its upper limit, the outer cover becomes difficult to remove.
- For adjustment of the mechanical limit block at the third joint, please contact our technical personnel for confirmation. Ensure that the operating range set in the robot controller software does not exceed the permissible range of the mechanical limit block.

### 3.5.3 Standard Action Area

The standard motion range refers to the maximum permissible movement of the mechanical limit block without interference between the robot's outer contour and surrounding equipment. For details, see "Basic Section: 3.2.2 Component Names and Dimensions".

### 3.6 List of Robot Accessories

Order number	Name	Quantity	Remarks
1	Db terminal	2	I/o distribution
2	DB terminal housing	2	I/O wiring connector housing
3	Electronic Instructions	1	

## 4. Maintenance Section

### 4.1 Maintenance Notes

For routine maintenance, ensure that qualified personnel with safety training are responsible for servicing the robotic system.

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>● Do not disassemble or maintain components not listed in this manual. Incorrect disassembly or maintenance may not only cause the robot system to malfunction but also pose serious safety risks.</li> <li>● Untrained personnel must not approach powered robots. Additionally, do not enter the operational area.</li> <li>● Even if the robot appears to stop moving, it may still move and could cause serious safety problems, which is very dangerous.</li> <li>● You must confirm the robot's movement after replacing the component outside the safety guard. Otherwise, the robot may perform unexpected actions before confirmation, potentially causing serious safety issues.</li> <li>● Before starting normal operation, ensure the emergency stop switch and safety guard switch are functioning properly. If the system operates with malfunctioning switches, the safety function will fail during emergencies, potentially causing severe injuries or significant damage. This is extremely dangerous.</li> </ul>
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 <b>WARNING</b>	<ul style="list-style-type: none"> <li>● Do not place heavy objects on the cable or pull it forcefully, as this may cause damage, poor contact, or even electric shock.</li> <li>● Ensure the wiring is correct to avoid system failure or damage.</li> </ul>
---	---

	<ul style="list-style-type: none"> <li>● After completing the wiring, ensure there are no loose objects in the controller, especially conductive materials like screws.</li> <li>● Always connect the AC power cable to the robot controller's power plug, never directly to the factory power supply.</li> </ul>
--	---

## 4.2 Maintenance Overview

### 4.2.1 Maintenance Cycle

To ensure long-term high-performance operation, robots require scheduled maintenance checks. These include routine maintenance and periodic maintenance. For periodic maintenance, schedule inspections at 1-month, 3-month, 6-month, and 12-month intervals, with additional phases as needed. If the monthly workload is high and the total power usage exceeds 250 hours, additional inspection items should be added at 250-hour, 750-hour, 1500-hour, and 3000-hour intervals.

Check mode	Component name	Daily inspection	1-month check-up	3-month check-up	6-month check-up	12-month check-up
POWER OFF	Check for any looseness in the robot body and peripheral fixing screws	√	√	√	√	√
	Is the external connector of the robot cable loose?	√	√	√	√	√
	External defects and dust on the robot surface and cables	√	√	√	√	√
	Is there any oil leakage at the joint reducer?	√	√	√	√	√
	Check if the synchronous belt is loose or worn, and if necessary, re-tighten or replace it.				√	√

	Encoder battery				√	√
	Reducer grease	Under normal conditions, replacement is unnecessary. Determine whether to replace the grease based on operational status. Refer to "4.3.2 Harmonic Drive Maintenance" for details.				
	Screw spline grease	√	√	√	√	√
POWER ON	Can J3 Brake Work Effectively When Powered?	√	√	√	√	√
	Presence of abnormal joint sounds or vibrations	√	√	√	√	√
	Whether the accuracy meets the usage requirements					√
	Is the joint wobble excessive?					√

#### 4.2.2 Application of Thread Adhesive

Threaded adhesive must be used when installing screws in areas requiring mechanical strength and anti-loosening.

- Thread adhesive model: Loctite 243
- Application method of thread adhesive:
  - 1) For through-holes, apply thread sealant to the external threads of the screw head before screwing in, with a filling length of 1\*D. The amount of sealant should be sufficient to prevent it from protruding beyond the thread groove.
  - 2) For blind holes, inject an appropriate amount of thread sealant into the screw hole before screwing in.

#### 4.2.3 Screw Tightening

	<ul style="list-style-type: none"> <li>● All fastening screws must be pre-tightened, and when assembling or retightening, a torque wrench should be used to control the final</li> </ul>
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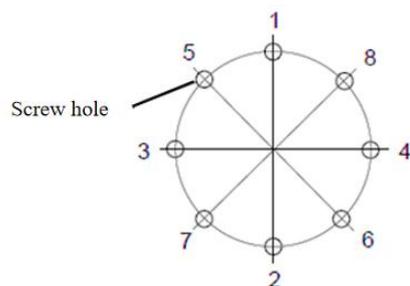
tightening torque.

Order number	Types of screws	Pre-tightening torque	Remarks
1	M3 hex screw	2 Nm	
2	M4 hex socket screw	4 Nm	
3	M5 hexagon screw	8 Nm	
5	M8 hex socket screw	30 Nm	
6	Locking screw M4	1.5 Nm	

- When tightening screws, avoid over-tightening in one go. Instead, use a hex key to gradually tighten them in a crosswise pattern—two or three turns at a time. Finally, apply the torque wrench to the specified torque as shown in the table for the final tightening.



WARNING



## 4.3 Maintenance Components

### 4.3.1 Encoder Battery

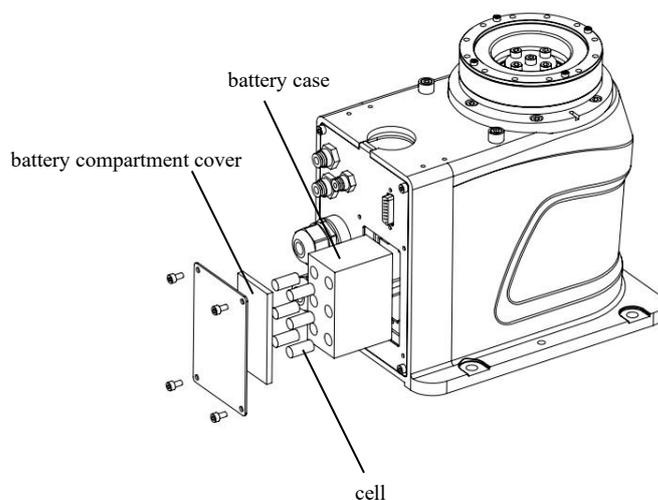
 <p>WARNING</p>	<ul style="list-style-type: none"><li>● The encoder battery is a lithium-ion battery designed to store the position data of the servo encoder, with a standard lifespan of 18 months. The actual lifespan may vary depending on the specific operating environment.</li><li>● If the old battery is removed before inserting the new one, the zero-point information will be lost, requiring origin adjustment. Refer to 'Maintenance Section: 4.4 Origin Adjustment' for details.</li></ul>
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➤ **When to replace the battery:**

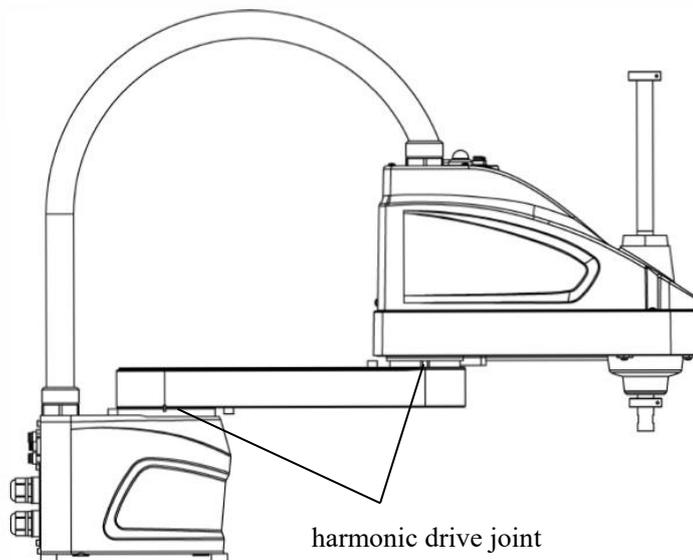
- 1) Zero point loss, battery voltage insufficient
- 2) Drive alarm, absolute encoder alarm

➤ **Step to change:**

- 1) After removing the rear panel from the base of the manipulator, insert the new battery into the corresponding 2P connectors at each of the four joints, then secure them with tie straps.
- 2) Use scissors to cut the binding straps and remove the old robot battery.
- 3) Install the bottom panel;
- 4) Adjustment of robot origin;



### 4.3.2 Harmonic Drive Maintenance

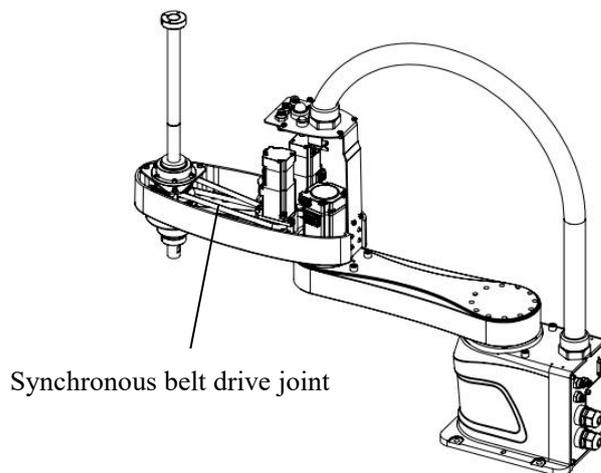


This manual specifies that the first and second joints of the product are harmonic drive joints, as shown in the shaded area of the diagram.

	<ul style="list-style-type: none"> <li>● The replacement and maintenance of harmonic reducers must be performed by the robot manufacturer or a designated authorized party.</li> <li>● Replacing or disassembling a harmonic reducer may cause the zero position to be lost, requiring a reset to the original zero point.</li> </ul>
	<ul style="list-style-type: none"> <li>● The service life of harmonic gear reducer depends on the life of the flexible bearing of the input shaft, which is determined by the speed and load of the actual working condition, so the difference of working condition may lead to the great difference of the service life of the reducer.</li> <li>● The harmonic reducer is sensitive to the external accidental impact load, which may cause the reducer to be damaged unexpectedly.</li> <li>● Harmonic reducers are highly sensitive to high-frequency vibrations. If abnormal vibrations are detected during operation, immediately stop the machine for inspection to prevent accidental damage.</li> <li>● Harmonic reducers operate with a steady sound. If abnormal noises are detected, stop the machine immediately for inspection. Contact the robot manufacturer for confirmation if necessary.</li> </ul>

	<ul style="list-style-type: none"> <li>● The wear of each moving part of the harmonic reducer is largely affected by the performance of the grease. The grease of the harmonic reducer has the limitation that the robot's operating environment temperature is 5~40°C and the temperature rise of the reducer housing is less than 40°C.</li> <li>● The performance of grease in harmonic reducers degrades rapidly with increasing temperature. The internal temperature rise depends on the reducer's actual operating speed and load variations, and the optimal replacement interval should be determined based on specific operating conditions. For general applications, we recommend replacing the grease every 10,000 hours of operation or every 2 years, whichever comes first.</li> </ul>
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### 4.3.3 Maintenance of Synchronous Gear Belt



This manual specifies that the third and fourth joints of the product are synchronized toothed belt drive joints, as shown in the shaded area of the diagram.

	<ul style="list-style-type: none"> <li>● Replacing or adjusting the tension of the synchronous belt may cause zero point information loss, requiring a reset of the origin.</li> <li>● The synchronous toothed belt will have a process of stress release and relaxation and tend to be stable after normal tensioning; after running for a certain period, the synchronous toothed belt needs to be pre-tightened again because of the possible relaxation of mechanical positioning parts or the excessive relaxation of synchronous belt caused by wear.</li> </ul>
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	<ul style="list-style-type: none"> <li>● The lifespan of a synchronous belt is significantly affected by the robot's operating conditions. Replacement is required under the following circumstances.             <ol style="list-style-type: none"> <li>1) Cracks appear on the root or tooth back of the belt;</li> <li>2) The adhesion of grease causes the belt to swell and protrude;</li> <li>3) The belt teeth wear out, resulting in precision that fails to meet operational requirements.</li> <li>4) The belt teeth wear out, causing tooth skipping;</li> <li>5) The belt broke;</li> </ol> </li> </ul>
	<ul style="list-style-type: none"> <li>● The service life of a synchronous belt is temperature-sensitive. Higher temperatures accelerate the aging of the rubber surface. Increased load or higher operating frequency on the synchronous belt can also raise its temperature, thereby affecting its lifespan. Under particularly harsh operating conditions, special attention should be paid to the replacement of the synchronous belt.</li> <li>● The replacement and adjustment of the synchronous toothed belt should be carried out by contacting the robot manufacturer.</li> </ul>

#### 4.3.4 Maintenance of Ball Screw Keyway Shaft

The end shaft of the robot is a spiral ball bearing transmission, and its normal operation depends on the normal maintenance of the grease.

	<ul style="list-style-type: none"> <li>● Lubricant category: LD super NO.096 (China green);</li> <li>● Lubrication interval: 100km (3-6 months), with special greasing for the initial 10km and 50km runs. The lubrication interval may also be adjusted based on field conditions and operational requirements.</li> <li>● Lubrication steps:             <ol style="list-style-type: none"> <li>1) First, wipe the surface of the screw shaft dry with a clean cloth.</li> <li>2) Apply a thin, even layer of grease to the grooves on the worm gear spline shaft, avoiding excessive application that may cause buildup.</li> <li>3) After several minutes of high-speed trial operation, wipe off excess grease from the nut and screw shaft surfaces.</li> </ol> </li> </ul>
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 WARNING	<ul style="list-style-type: none"> <li>● If grease enters the eyes, mouth, or adheres to the skin, perform the following procedures:</li> <li>● If it enters the eyes, rinse thoroughly with clean water and seek medical attention.</li> <li>● Do not force vomiting when swallowing into the mouth; seek immediate medical attention.</li> <li>● When taking it into your mouth, rinse your mouth thoroughly with water.</li> <li>● When it sticks to the skin, rinse it off with water and soap.</li> </ul>
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## 4.4 Origin Adjustment

When replacing components of the robot (e.g., motor, reducer, or synchronous belt), a positional deviation may occur between the reference points stored on the motor side and the controller side, preventing accurate positioning. Therefore, after component replacement, alignment adjustment (calibration) is required to synchronize these two reference points.

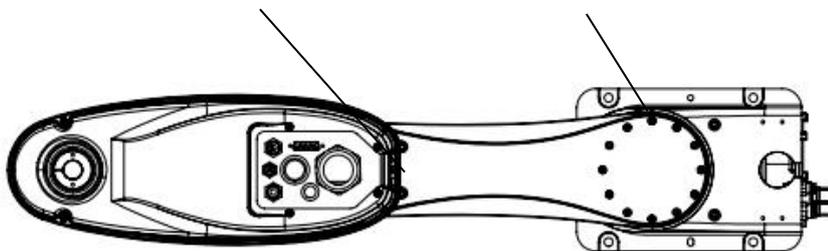


**After origin adjustment, the robot's absolute accuracy may differ from its factory setting.**

### 4.4.1 Origin Adjustment Steps

- 1) Move the robot's mechanical body to the position shown in the figure:

second joint zero point    zero point alignment





**Due to the structural characteristics of the robot, the origin adjustment of the third and fourth joints must be performed simultaneously.**

2) Write the origin position into the controller by following the origin recording method described in the "User Manual of 4x6-axis Robot General System".

## 5 Consumable Materials Details

Order number	Component name	Quantity	Remarks
1	lithium cell	6	Specific materials may vary across different production batches.
2	ball screw spline grease	appropriate amount	
3	synchronizing toothed belt	Depends on the specific model	

## Revision History

Edition	Revision date	Revision details
Rev.1.1	2023.08	editio princeps

