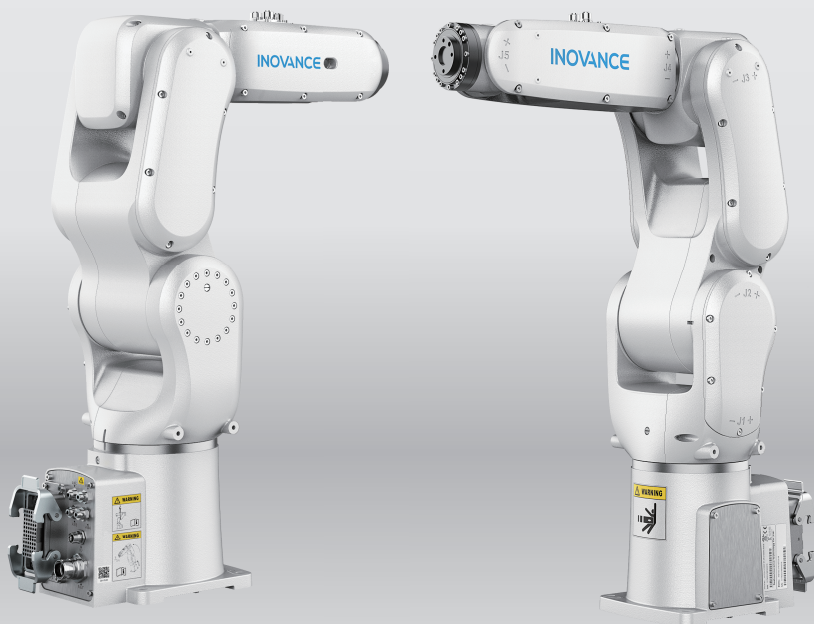




## IR-R4-INT Series 6-Axis Robot User Guide - Manipulator



Industrial  
Automation



Intelligent  
Elevator



New Energy  
Vehicle



Industrial  
Robot



Rail  
Transit



Data code PS00017834A00

# Preface

## Introduction

The IR-R4 series robot is a 6-axis industrial robot requiring a small payload capacity. With a compact and lightweight design, this robot can handle a maximum load of 4 kg. It finds extensive use in handling, loading, and unloading tasks in the 3C industry, as well as in handling tasks in the photovoltaic industry. Moreover, it is adaptable to grinding, assembly, and gluing tasks. Its compact structure and versatile installation facilitate a condensed arrangement of work units, empowering users to enhance productivity and efficiency.

## More Documents

| Name                                                                         | Data Code  | Description                                                                                    |
|------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------------|
| IRCB501 Series Robot Control Cabinet User Guide                              | PS00010914 | Describes the specifications, installation, and wiring of the IRCB501 series control cabinet.  |
| IRTP80 Series Teach Pendant User Guide                                       | 19012261   | Describes the product information, wiring, and operation of the IRTP80 series teach pendant.   |
| IR-R4 Series International 6-Axis Robot User Guide - Mechanical (this guide) | PS00017834 | Describes the information, installation, wiring, motion range, and maintenance of the product. |

## Revision History

| Date          | Version | Description   |
|---------------|---------|---------------|
| November 2024 | A00     | First release |

## Access to the Guide

This guide is not delivered with the product. You can obtain the PDF version in the following ways:

- **Inovance website:** Visit [www.inovance.com](http://www.inovance.com), go to "Support" > "Download", search by keyword, and then download the PDF file.
- **QR code:** Scan the QR code on the product with your smart phone.
- **My Inovance app:** Scan the QR code below to install the My Inovance app, and search for the file in the app.



## Warranty

For faults and damage incurred during normal use in the warranty period, Inovance provides free repair service. (For details of the warranty period, see the purchase order.) A maintenance fee will be charged out of the warranty period.

Even in the warranty period, a maintenance fee will be charged for repair of the following damage:

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by unintended use of the product
- Damage caused by use beyond the specified scope of application of the product
- Damage or secondary damage caused by force majeure (such as natural disaster, earthquake, and lightning strike)

The maintenance fee will be charged according to our latest Price List if not otherwise agreed upon.

For details, see the Product Warranty Card.

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# Safety Precautions

## Safety Disclaimer

- This chapter presents essential safety instructions for proper use of the equipment. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply with the safety precautions may result in equipment damage, severe physical injuries, or even death.
- "CAUTION", "WARNING", and "DANGER" items in the guide only indicate some of the instructions that need to be followed; they just supplement the safety instructions.
- Use this product in an environment that complies with the design specifications. Malfunctions or component damage caused by improper use is not covered by warranty.
- InnoVance shall not be held liable for any physical injuries or property damage caused by improper use.

## Safety Categories and Definitions



indicates that failure to comply with the notice will result in severe physical injuries or even death.



indicates that failure to comply with the notice may result in severe physical injuries or even death.



indicates that failure to comply with the notice may result in minor or moderate physical injuries or equipment damage.

## Safety Precautions

- Some drawings in this guide show the equipment without covers or protective guards to display more details. Be sure to install the covers and protective guards before using the equipment and operate the equipment in accordance with this guide.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.

### Unpacking



- Do not install the product if you find damage, rust, or signs of use on it or its accessories upon unpacking.
- Do not install the product if you find water seepage or any components being missing or damaged upon unpacking.
- Do not install the product if the packing list does not match the product you received.



**CAUTION**

- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the product layer by layer. Do not strike the package violently.
- Check the surfaces of the equipment and accessories for any damage, rust, and scratches.
- Check the equipment, accessories, and materials in the package against the packing list.

**Storage and Transportation**



**WARNING**

- Large-scale or heavy equipment must be transported by qualified professionals using specialized hoisting equipment. Failure to comply may result in physical injuries or equipment damage.
- Before hoisting the equipment, ensure the equipment components such as the front cover and terminal blocks are secured firmly with screws. Loosely-connected components may fall off and result in physical injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply may result in physical injuries or equipment damage.



**CAUTION**

- Handle the equipment with care and mind your steps. Failure to comply may result in physical injuries or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in physical injuries.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply will result in equipment damage.
- Avoid storage and transportation in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storage for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the product properly before transportation by vehicle. Use an enclosed box for long-distance transportation.
- Never transport the product with devices or materials that may damage or negatively impact the product.

**Installation**



**DANGER**

- Installation must be carried out by technicians who have received relevant training on electrical equipment and have sufficient electrical expertise. Non-professionals are not allowed to operate the equipment.

 **WARNING**

- Read through the guide and safety instructions before installation.
- Do not install the product in places with strong electric or magnetic fields.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply will result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in a closed environment (such as a cabinet or casing), use a cooling device (such as a fan or air conditioner) to cool the environment down to the required temperature. Failure to comply may result in equipment over-temperature or fire.
- Do not modify the product.
- Do not fiddle with the bolts used to fix parts and components or the bolts marked in red.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- If any equipment with strong electromagnetic interference, such as a transformer, is needed, install a shielding device to prevent malfunction of this product.
- Install the equipment on metal or other incombustible objects. Keep the equipment away from combustible objects. Failure to comply will result in fire.

 **CAUTION**

- Cover the top of the equipment with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the equipment and causing faults. After installation, remove the cloth or paper on the top of the equipment to prevent over-temperature caused by poor ventilation due to blocked ventilation holes.
- Resonance may occur when a machine supposed to run at a constant speed is running at variable speeds. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

### Wiring

 **DANGER**

- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.
- Before wiring, cut off all the power supplies of the equipment. Wait for at least the time designated on the equipment warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply may result in an electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board while power is on. Failure to comply may result in an electric shock.
- Ensure that the equipment is well grounded. Failure to comply may result in an electric shock.



**WARNING**

- Do not connect the input power supply to the output end of the equipment. Failure to comply may result in equipment damage or even fire.
- When connecting a drive to the motor, check that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Use cables with required diameter and shield. Properly ground one end of the shield if a shielded cable is used.
- Fix the terminal screws with the tightening torque specified in the user guide. Improper tightening torque may overheat or damage the connecting part, resulting in fire.
- After wiring is done, check that all cables are connected properly and no screws, washers, or exposed cables are left inside the equipment. Failure to comply may result in an electric shock or equipment damage.



**CAUTION**

- During wiring, follow the proper electrostatic discharge (ESD) procedures and wear an anti-static wrist strap. Failure to comply will result in damage to the equipment or internal circuits of the product.
- Use shielded twisted pairs for the control circuit. Connect the shield to the grounding terminal of the equipment for grounding purpose. Failure to comply will result in equipment malfunction.

**Power-on**



**DANGER**

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Check that the power supply meets equipment requirements before power-on to prevent equipment damage or fire.
- After power-on, do not open the cabinet door or protective cover of the equipment, touch any terminal, or disassemble any unit or component of the equipment. Failure to comply may result in an electric shock.



**WARNING**

- Perform a trial run after wiring and parameter setting to ensure the equipment operates safely. Failure to comply may result in physical injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in fire.
- Before power-on, check that no one is near the equipment, motor, or machine. Failure to comply may result in physical injuries or even death.

**Operation**



**DANGER**

- The equipment must be operated only by professionals. Failure to comply will result in physical injuries or even death.
- Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply may result in an electric shock.



- Do not touch the equipment casing, fan, or resistor to check the temperature. Failure to comply may result in burns.
- Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in fire or equipment damage.

### Maintenance



- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.
- Do not maintain the equipment while power is on. Failure to comply may result in an electric shock.
- Before maintenance, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.
- In case of a permanent magnet motor, do not touch the motor terminals immediately after power-off because the motor terminals will generate induced voltage during rotation even after the equipment power supply is off. Failure to comply may result in an electric shock.



- Carry out daily and periodic inspection and maintenance on the equipment according to maintenance requirements and retain a maintenance record.

### Repair



- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.
- Do not repair the equipment while power is on. Failure to comply may result in an electric shock.
- Before inspection and repair, cut off all the power supplies of the equipment and wait for at least the time designated on the equipment warning label.



- Submit the repair request according to the warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage current breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply may result in equipment damage, physical injuries, or even death.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the product according to the replacement instructions.
- Do not use damaged equipment. Failure to comply may result in further equipment damage, physical injuries, or even death.
- After equipment replacement, check the wiring and set parameters again.

**Disposal**



- Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, physical injuries, or even death.
- Recycle retired equipment in accordance with waste disposal standards of the industry to avoid environmental pollution.

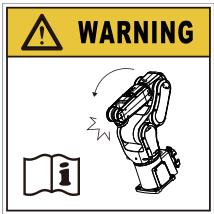
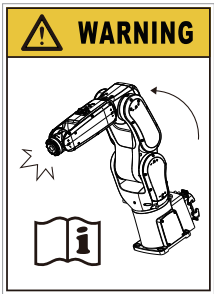
**Safety Label**

For safe equipment operation and maintenance, comply with the safety labels on the equipment. Do not damage or remove the safety labels. The following table describes the safety labels.

| Safety Label                                                                      | Description                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"><li>• Read through the safety instructions before operating the equipment. Failure to comply may result in equipment damage, physical injuries, or even death.</li><li>• Do not touch the terminals or remove the cover while power is on or within 10 min after power-off. Failure to comply may result in an electric shock.</li></ul> |

## Warning Label

The following table describes the warning labels affixed on the robot body. Pay special attention that specific dangers exist around the positions where these labels are affixed. Comply with the cautions and warnings on the warning labels to operate and maintain the robot system safely. Do not damage or remove the warning labels.

| Warning Label                                                                      | Description                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p>Secure the robot before removing the fastening screws on the base to prevent the robot from tilting forward due to its center of gravity for the posture at delivery, which may cause equipment damage or physical injury.</p> |
|   | <p>Secure the robot on the base table to prevent the robot from tilting forward due to its center of gravity, which may cause equipment damage or physical injury.</p>                                                            |
|  | <p>Never enter the robot motion range during robot running. Otherwise, you may bump into the robot, and severe safety issues may occur.</p>                                                                                       |



| Warning Label                                                                     | Description                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>If a lifting is required, follow the lifting diagram. Otherwise, the robot may tilt and cause damage to the machine or injury to personnel.<br/>See the user guide for information on lifting the robot.</p> |
|  | <p>Do not touch the energized parts during power-on. Failure to comply may result in an electric shock.</p>                                                                                                     |

## Special Reminder

To prevent accidents with the robot, please be sure to set up relevant safety measures according to the specific situation. All operators must fully comply with the requirements.

1. Please ensure that the safety protection range of the robot is greater than the maximum motion range of the robot. Comprehensive safety protection devices (fences, etc.) must be installed on the periphery, and emergency stop devices must be installed within easy reach of the operator. Leave sufficient space (safe area) around for the operator to avoid abnormal operations or emergency situations.
2. The safety protection devices should only have one entrance and must be equipped with a safety latch. The safety latch must be manually removed when closing or opening the entrance. Please ensure that the safety devices (such as emergency stop buttons and safety latch) are working properly before accessing the safety protection device.
3. The safety fence must be strong enough to withstand both internal and external impacts and pressures. The position of the safety fence must be fixed to prevent operators from easily dismantling or breaking the safety fence. In addition, the safety fence must be free of any potential hazardous parts such as sharp corners, edges, or spikes.
4. Clearly display the status information of the robot on the safety protection device (fence), such as automatic mode, teaching, emergency stop, etc., so that everyone can see the current status of the robot.

Before turning on or starting the robot, be sure to confirm all safety conditions and ensure that there are no people or obstructions within the robot's range of motion.

# 1 Product Information

## 1.1 Model and Nameplate

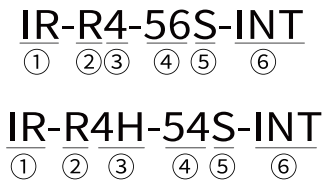


Figure 1-1 Model

|                                                                                         |                                                                        |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| ① <b>Product family</b><br>INOVANCE Robot                                               | ④ <b>Arm length</b><br>54: 545.7 mm<br>56: 560.6 mm                    |
| ② <b>Series</b><br>S: SCARA robot<br>R: 6-axis robot<br>TS: Ceiling-mounted SCARA robot | ⑤ <b>Installation environment</b><br>S: Standard<br>P: High-protection |
| ③ <b>Maximum payload</b><br>4: 4 kg<br>4H: 4 kg (hollow wrist)                          | ⑥ <b>Version</b><br>INT: International (With functional safety)        |

---

### Note

The product information in this guide is the information of standard models in a standard environment. For information about non-standard models or high-protection models, contact the provider.

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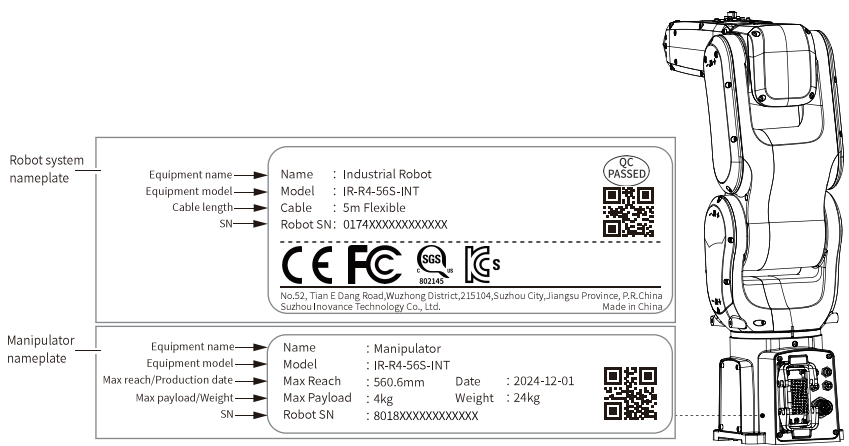


Figure 1-2 Nameplate

## Note

Before use, make sure that the system manufacturing numbers of the robot body and control cabinet are consistent. Otherwise, the robot may not work properly.

## 1.2 Components

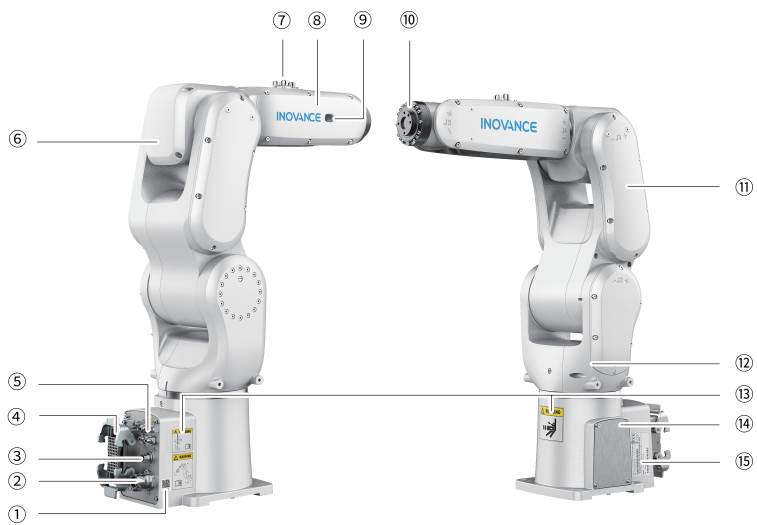


Table 1-1 Components

| No. | Component                     | No. | Component                               |
|-----|-------------------------------|-----|-----------------------------------------|
| ①   | QR code                       | ⑨   | Hollow wrist (for standard models only) |
| ②   | 19-pin I/O aviation connector | ⑩   | Wrist flange                            |
| ③   | Network cable connector       | ⑪   | Upper arm                               |
| ④   | Heavy-duty connector          | ⑫   | Swivel base                             |
| ⑤   | Air tube connector            | ⑬   | Warning label                           |
| ⑥   | Elbow                         | ⑭   | Base                                    |
| ⑦   | 12-pin I/O aviation connector | ⑮   | Nameplate                               |
| ⑧   | Forearm                       | -   | -                                       |

---

**Note**

Standard models are equipped with a hollow wrist, while customized models do not include a hollow wrist.

---

**1.3 Rotation Directions**

The following figure illustrates the rotation direction of each axis.

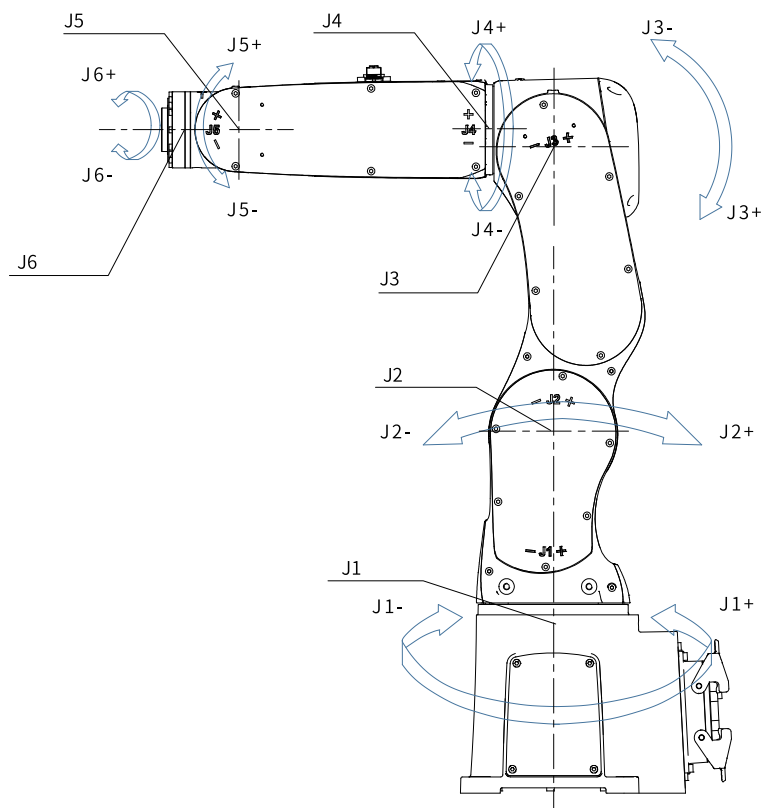


Figure 1-3 Axis rotation directions

# 1.4 Outline Dimensions

## IR-R4-56S-INT dimensions

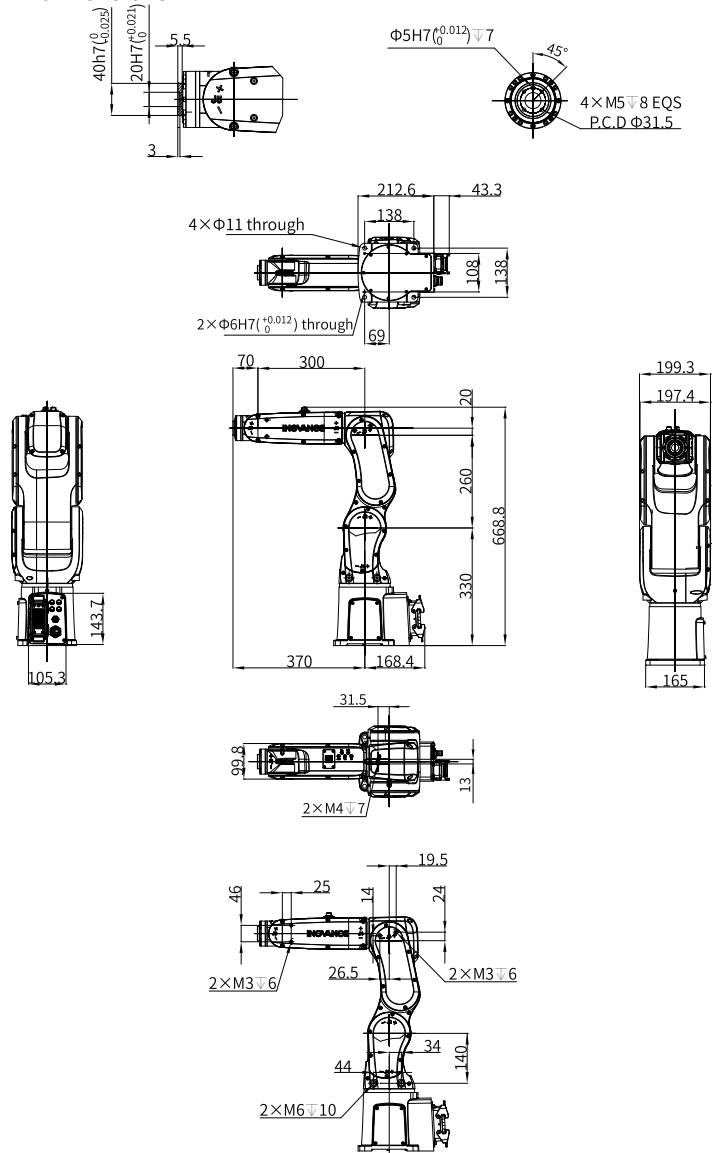


Figure 1-4 Outline dimensions for IR-R4-56S-INT (unit: mm)

## IR-R4H-54S-INT dimensions

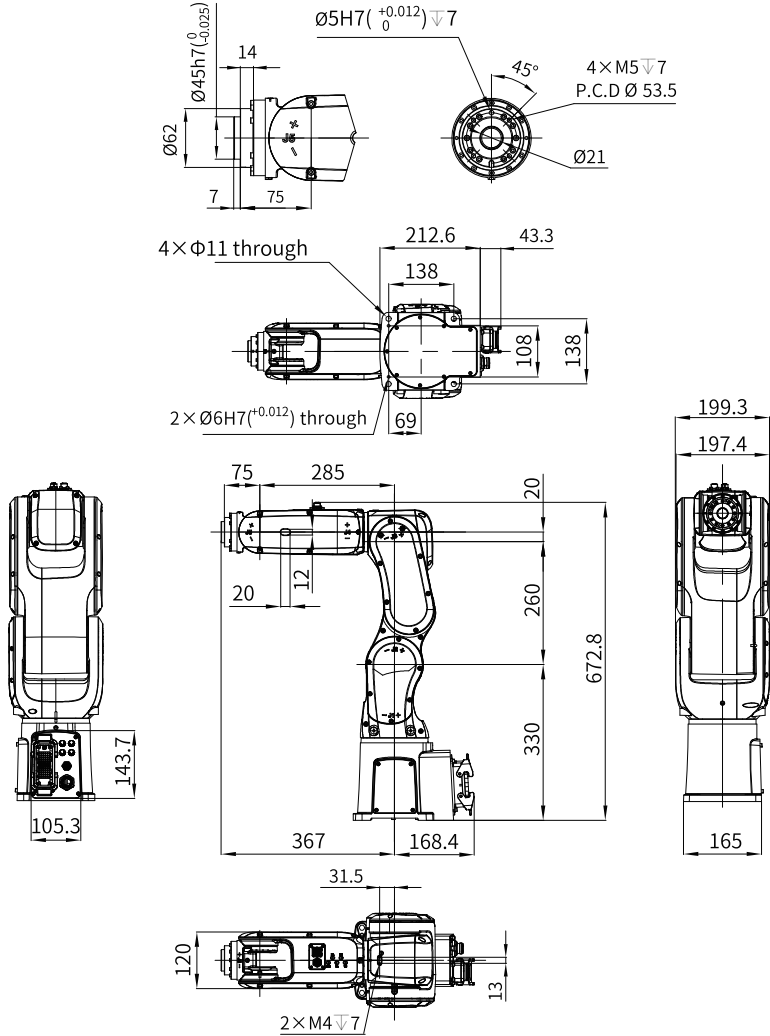


Figure 1-5 Outline dimensions for IR-R4H-54S-INT (unit: mm)

## 1.5 Specifications

| Model            |                  | IR-R4-56S-INT                           | IR-R4H-54S-INT                          |
|------------------|------------------|-----------------------------------------|-----------------------------------------|
| Structural style | Structural style | Vertical multi-axis cascading structure | Vertical multi-axis cascading structure |
| Number of axes   | Number of axes   | 6 axes                                  | 6 axes                                  |



| Model                                      |                                            | IR-R4-56S-INT                                        | IR-R4H-54S-INT                                       |
|--------------------------------------------|--------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| Maximum reach                              | Maximum reach                              | 560.6 mm                                             | 545.7 mm                                             |
| Repeat positioning accuracy                | Repeat positioning accuracy                | ±0.01 mm                                             | ±0.02 mm                                             |
| Maximum wrist load                         | Maximum wrist load                         | 4 kg                                                 | 4 kg                                                 |
| IP rating                                  | IP rating                                  | Standard IP40, optional IP67                         | Standard IP40, optional IP67                         |
| Maximum velocity                           | J1                                         | 450°/s                                               | 450°/s                                               |
|                                            | J2                                         | 460°/s                                               | 460°/s                                               |
|                                            | J3                                         | 520°/s                                               | 520°/s                                               |
|                                            | J4                                         | 560°/s                                               | 560°/s                                               |
|                                            | J5                                         | 560°/s                                               | 560°/s                                               |
|                                            | J6                                         | 900°/s                                               | 900°/s                                               |
| Maximum motion range                       | J1                                         | −170° to +170°                                       | −170° to +170°                                       |
|                                            | J2                                         | −120° to +110°                                       | −120° to +110°                                       |
|                                            | J3                                         | −69° to +205°                                        | −65° to +195°                                        |
|                                            | J4                                         | −190° to +190°                                       | −190° to +190°                                       |
|                                            | J5                                         | −120° to +120°                                       | −120° to +120°                                       |
|                                            | J6                                         | −360° to +360°                                       | −360° to +360°                                       |
| Allowed wrist torque                       | J4                                         | 8.86 N·m                                             | 8.86 N·m                                             |
|                                            | J5                                         | 8.86 N·m                                             | 8.86 N·m                                             |
|                                            | J6                                         | 4.9 N·m                                              | 4.9 N·m                                              |
| Allowed wrist inertia                      | J4                                         | 0.2 kg·m <sup>2</sup>                                | 0.2 kg·m <sup>2</sup>                                |
|                                            | J5                                         | 0.2 kg·m <sup>2</sup>                                | 0.2 kg·m <sup>2</sup>                                |
|                                            | J6                                         | 0.067 kg·m <sup>2</sup>                              | 0.067 kg·m <sup>2</sup>                              |
| User interface                             | Wiring                                     | 12-channel signals of 30 V<br>0.5 A                  | 12-channel signals of 30 V<br>0.5 A                  |
|                                            | Air tube                                   | Air tube: Φ4 mm x 4<br>Pressure resistance: 0.59 MPa | Air tube: Φ4 mm x 4<br>Pressure resistance: 0.59 MPa |
| Ambient conditions                         | Ambient temperature <sup>[1]</sup>         | 0°C to 45°C                                          | 0°C to 45°C                                          |
|                                            | Ambient humidity                           | 5% RH to 95% RH (non-condensing)                     | 5% RH to 95% RH (non-condensing)                     |
|                                            | Maximum temperature gradient               | 1.5°C/min                                            | 1.5°C/min                                            |
| Body weight                                | Body weight                                | 24 kg                                                | 24.5 kg                                              |
| Input power<br>(average power consumption) | Input power<br>(average power consumption) | 2 kVA (0.5 kW)                                       | 2 kVA (0.5 kW)                                       |
| Applicable control cabinet<br>(standard)   | Applicable control cabinet<br>(standard)   | IRCB501-6LD-INT                                      |                                                      |
| Installation method                        | Installation method                        | Floor-standing installation                          | Floor-standing installation                          |
| Noise level                                | Noise level <sup>[2]</sup>                 | ≤ 75 dB                                              | ≤ 80 dB                                              |

| Model                        |                                                                                                                                                        | IR-R4-56S-INT                      | IR-R4H-54S-INT                     |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|
| Base installation dimensions | Base installation dimensions                                                                                                                           | 138 mm x 138 mm (4 x $\Phi$ 11 mm) | 138 mm x 138 mm (4 x $\Phi$ 11 mm) |
| Certification                | CE, cSGSUS, FCC, KCs, and functional safety certification (supported by the "-INT" control cabinet only, requiring a functional safety expansion card) |                                    |                                    |

## Note

[1] Ambient temperature: In low temperatures close to the minimum allowed temperature in the product specifications, or after a long time of unuse during holidays or nights, it is recommended to preheat the robot for 10 minutes before operation.

[2] Noise level: The value is the noise level equivalent to load A, which is measured according to ISO 11201 (EN31201). (Measuring conditions: operation at a rated load and a high speed)

## 1.6 Motion Range



### Caution

- Ensure a safety protection range that is greater than the maximum operating area of the robot. Set up comprehensive guard devices (such as fences) around the safety protection range, with an emergency stop device easily accessible to operators.
- On the guard devices (fences), clearly display robot status, such as automatic running, teaching, and emergency stop, so that on-site personnel can easily see the status of the robot.
- The safety fences must be sturdy enough to withstand impacts and pressures from both internal and external sources. The safety fences must be fixed and immovable to prevent operators from easily dismantling or breaking them. The safety fences must also be free of sharp angles, edges, or spikes, and must not contain any potentially hazardous components.

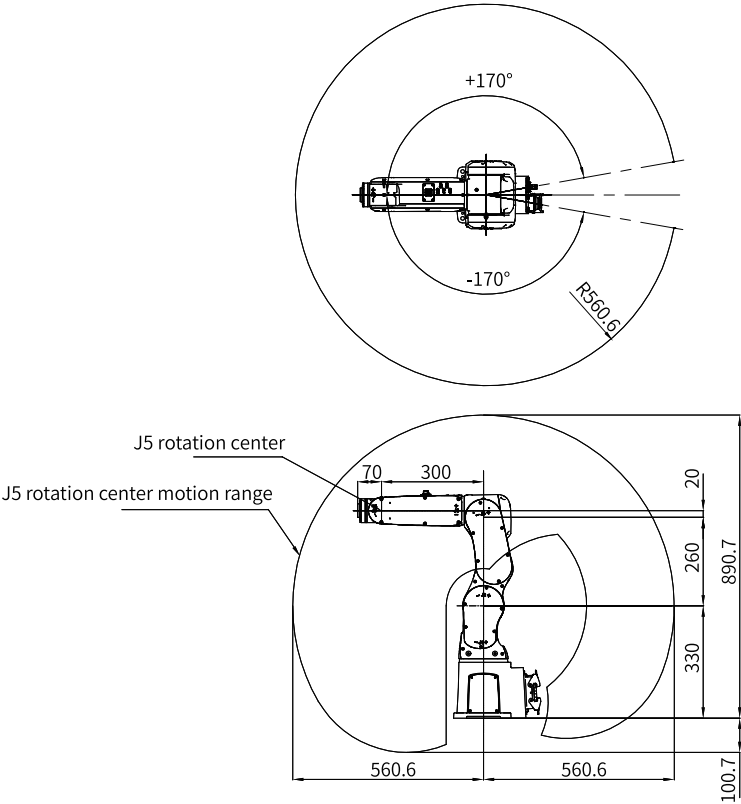


Figure 1-6 IR-R4-56S-INT robot motion range (unit: mm)

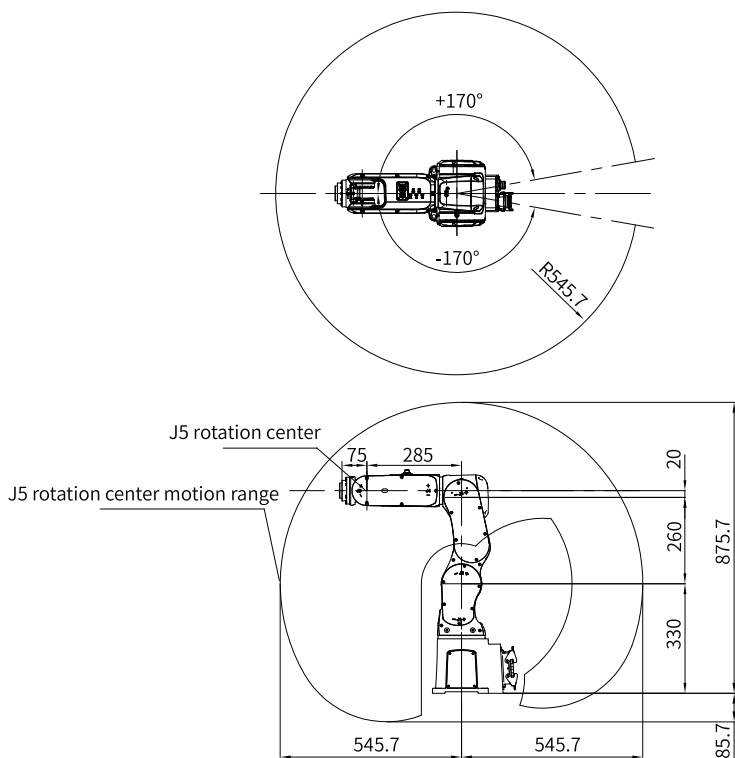


Figure 1-7 IR-R4H-54S-INT robot motion range (unit: mm)

## 1.7 Maximum Load of Wrist Flange

The IR-R4-56S-INT and IR-R4H-54S-INT models each support a maximum payload of 4 kg. The allowed wrist torque and inertia should meet the following requirements. External force (other than gravity) applied to the robot should not exceed the range in the table below.

| Wrist Load Condition                       |    | IR-R4-56S-INT/IR-R4H-54S-INT |
|--------------------------------------------|----|------------------------------|
| Allowed wrist torque (N·m)                 | J4 | 8.86 N·m                     |
|                                            | J5 | 8.86 N·m                     |
|                                            | J6 | 4.9 N·m                      |
| Allowed wrist inertia (kg·m <sup>2</sup> ) | J4 | 0.2 kg·m <sup>2</sup>        |
|                                            | J5 | 0.2 kg·m <sup>2</sup>        |
|                                            | J6 | 0.067 kg·m <sup>2</sup>      |

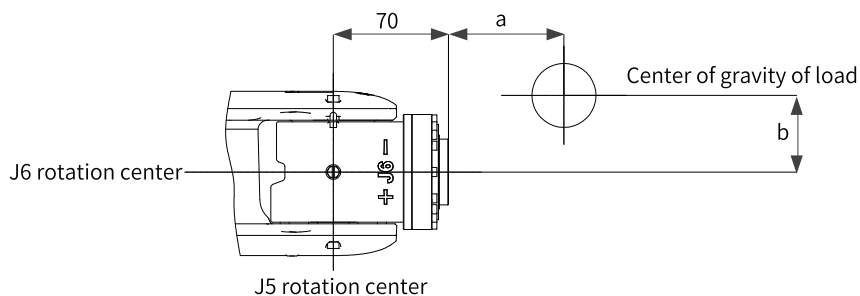


Figure 1-8 Distance to the rotation center of the J5/J6 axis of IR-R4-56S-INT (unit: mm)

### Note

- Distance to the rotation center of J5:  $a + 70$  (mm)
- Distance to the rotation center of J6:  $b$  (mm)

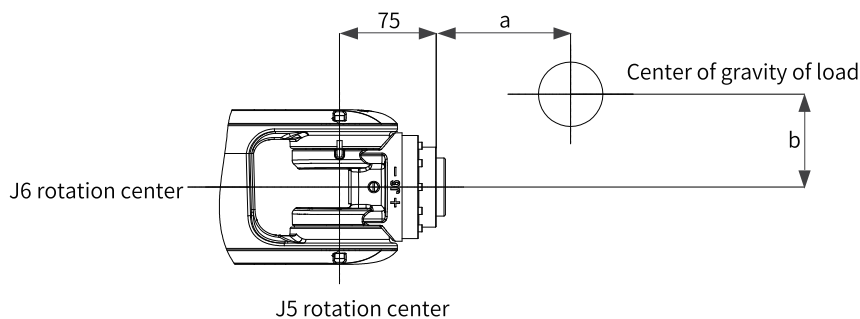


Figure 1-9 Distance to the rotation center of the J5/J6 axis of IR-R4H-54S-INT

### Note

- Distance to the rotation center of J5:  $a + 75$  (mm)
- Distance to the rotation center of J6:  $b$  (mm)

# 1.8 Wrist Load Curve

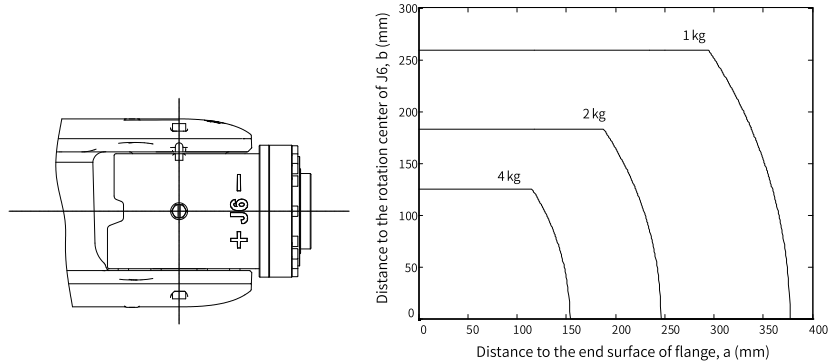


Figure 1-10 IR-R4-56S-INT wrist load curve

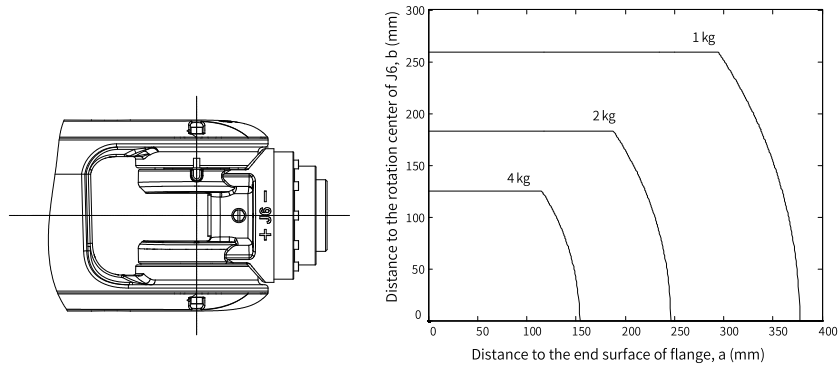


Figure 1-11 IR-R4H-54S-INT wrist load curve

## 2 Preparation for Installation

### 2.1 Installation Personnel Requirements

- Ensure that the installation personnel have obtained mechanics knowledge or received mechanics training in advance to understand various dangers and risks in the installation process.
- The installation personnel must be familiar with the installation requirements and relevant technical information.
- Do not allow non-professionals to perform equipment installation, wiring, maintenance, inspection, or parts replacement.

### 2.2 Installation Environment Requirements

#### General environment requirements

Set up the robot system in accordance with the following environment requirements to maximize and maintain the performance of the robot and to use it safely.

Table 2-1 Ambient conditions

| Item                                     | Requirements                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ambient temperature and humidity         | <ul style="list-style-type: none"> <li>• Operating temperature range: 0°C to 45°C Air temperature change rate less than 1.5°C/min</li> <li>• Humidity range: 5% RH to 95% RH, non-condensing</li> </ul>                                                                                                                                                                                                |
| Storage temperature and humidity         | <ul style="list-style-type: none"> <li>• Temperature range: -10°C to +55°C</li> <li>• Humidity range: Up to 95% RH, non-condensing</li> </ul>                                                                                                                                                                                                                                                          |
| Transportation temperature and humidity  | <ul style="list-style-type: none"> <li>• Temperature range: -10°C to +55°C</li> <li>• Humidity range: Up to 95% RH, non-condensing</li> </ul>                                                                                                                                                                                                                                                          |
| Electrical fast transient/burst immunity | ≤ 2 kV                                                                                                                                                                                                                                                                                                                                                                                                 |
| Static immunity                          | ≤ 6 kV                                                                                                                                                                                                                                                                                                                                                                                                 |
| Environment                              | <ul style="list-style-type: none"> <li>• Install indoors</li> <li>• Keep away from direct sunlight.</li> <li>• Keep away from dust, oil smoke, salt, and iron filings.</li> <li>• Keep away from flammable and corrosive liquids and gases.</li> <li>• Keep away from water.</li> <li>• Keep away from shocks and vibrations.</li> <li>• Keep away from sources of electrical interference.</li> </ul> |

**Caution**

The robot is not suitable for use in harsh environments such as explosive spraying operations. Contact your provider if the robot needs to be used in an environment that does not meet the preceding conditions.

The EMC test is performed according to IEC 61800-3:2017.

---

### Special environment requirements

- The surface of the robot provides certain protection. However, contact your provider and confirm in advance if the robot may come into contact with special liquid or gas during use.
  - There may be condensation inside the robot if it is used in an environment with large changes in temperature and humidity. Consult your provider.
  - If you want to use the robot to handle food directly, consult your provider in advance to avoid contamination of the food by the robot.
- 

**Caution**

Do not wipe the robot hard with alcohol or benzene, as this may cause the gloss of the painted surface to deteriorate.

---

## 2.3 Installation Base Table Requirements

You need to make a base table to fix the robot. The shape and size of the base table vary depending on the purpose of the robot system. You may refer to the following requirements when designing a base table.

- The base table supports not only the weight of the robot, but also the dynamic forces produced by the robot when it moves at maximum acceleration. Ensure that the base table has sufficient bearing capacity by reinforcing it with materials like connecting beams.
- Use M10 threaded holes on the base table to mount the robot. Use screws with a strength equivalent to the performance level of Grade 12.9 specified in GB/T 3098.1.
- To dampen vibrations, use a steel plate with a thickness over 30 mm, a surface roughness of 25  $\mu\text{m}$ , and a flatness below 0.2 mm as the robot mounting surface.
- Fix the base table firmly on the ground.
- Keep the Z axis of the robot perpendicular to the horizontal plane during installation.



- Reserve enough space for the robot control cabinet in the base table design. For space requirements of control cabinets, see the user guide of the robot control cabinet.
- Consider the following torques and reaction forces produced by movements of the robot.

Table 2-2 Maximum force and torque on the robot

| Series         | Torque in the Vertical Plane, $M_k$ (N·m) | Vertical Force, $F_v$ (N) | Torque in the Horizontal Plane, $M_r$ (N·m) | Horizontal Force, $F_o$ (N) |
|----------------|-------------------------------------------|---------------------------|---------------------------------------------|-----------------------------|
| IR-R4-56S-INT  | 500                                       | 1,000                     | 500                                         | 1,200                       |
| IR-R4H-54S-INT |                                           |                           |                                             |                             |

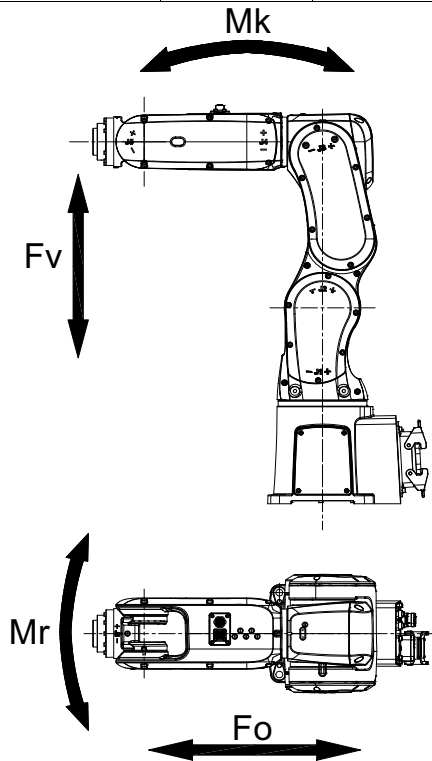


Figure 2-1 Forces and torques on the robot

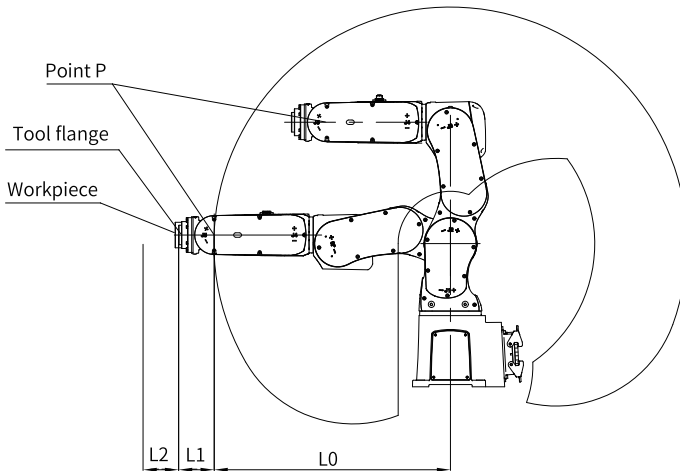
## 2.4 Installation Space Requirements

### 2.4.1 Safety Fence Range



#### Caution

- Ensure a safety protection range that is greater than the maximum motion range of the robot. Set up comprehensive guard devices (such as fences) around the safety protection range, with an emergency stop device easily accessible to operators.
- On the guard devices (fences), clearly display robot status, such as automatic running, teaching, and emergency stop, so that personnel outside the safety fences can easily see the status of the robot.
- The safety fences must be sturdy enough to withstand impacts and pressures from both internal and external sources. The safety fences must be fixed and immovable to prevent operators from easily dismantling or breaking them. The safety fences must also be free of sharp angles, edges, or spikes, and must not contain any potentially hazardous components.



- L0: Motion range of the robot
- L1: Total length of the wrist, tool flange, and workpiece
- L2: Safety margin, where  $L0 + L1 + L2 > 900 \text{ mm}$

## 2.4.2 Installation Space

1. In addition to the space required for the robot body, control cabinet, and peripherals, ensure the following minimum required spaces:
  - Space for teaching
  - Space for maintenance and inspection (for mounting fixtures)
  - Space for cables
2. The minimum bending radius of power cords and signal cables is 170 mm. When installing the robot, pay attention to the distance from obstacles. Reserve enough space for cable bending radius to avoid cable damage or breakage caused by extreme bending. For details, see ["4.5.3 Cable Hole Dimensions" on page 47](#).
3. Reserve at least 100 mm between the boundary of the motion range and the safety fence.

## 2.5 Preparation of Installation Tools

| Tool                      | Quantity (pcs) |
|---------------------------|----------------|
| M8 outer hexagon wrench   | 1              |
| Scissors or utility knife | 1              |
| Protective gloves         | 1              |
| Anti-smash shoes          | 1              |
| Lifting rope              | 1              |
| Forklift                  | 1              |

## 3 Unpacking and Handling

### 3.1 Precautions



#### Caution

Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.

Unpack the product layer by layer. Do not strike the package violently.

Check the surfaces of the equipment and accessories for any damage, rust, and scratches.

Check the equipment, accessories, and materials in the package against the packing list.



#### Warning

Do not install the equipment if you find damage, rust, or indications of use on the equipment or accessories.

Do not install the equipment if you find water seepage, component missing or damage upon unpacking.

Do not install the equipment if you find the packing list does not conform to the equipment you received.

Unpack the packing box according to the direction instructed.



### Danger

Only qualified personnel are allowed to carry out transportation including rigger operation, hoisting by crane, and forklift driving.



### Warning

- Transport the equipment with a hoist or forklift with the original package.
- Wear personal protective equipment (PPE) during transportation with a hoist or forklift. Prohibit any personnel to stand or stay in the transportation route.
- Stabilize the equipment with hands when hoisting it. Unstable hoisting may result in the equipment falling over. This may cause severe bodily injury or equipment damage.



### Caution

- Store and transport this equipment based on the storage and transportation requirements for humidity and temperature.
- Avoid transporting the equipment in environments such as water splashing, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport this equipment with other equipment or materials that may harm or have negative impacts on this equipment.
- If condensation occurs on the device during transportation or storage, remove the condensation before turning on the power.

## 3.2 Unpacking

1. Remove the outer carton.

Cut the PET straps on the carton with scissors or a utility knife. Remove the carton cover and the paper corner protectors. Lift the carton vertically to remove it.

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### Note

Wear gloves to prevent scratches.

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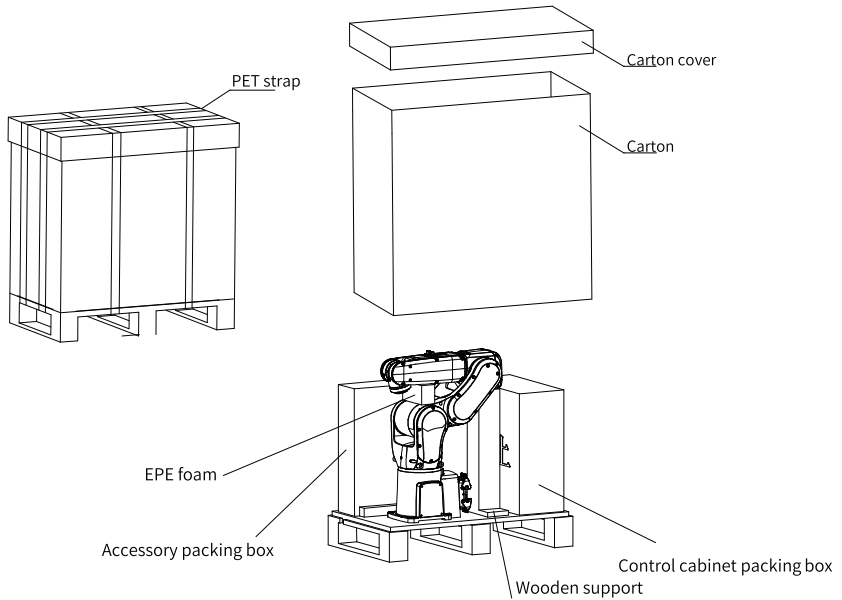
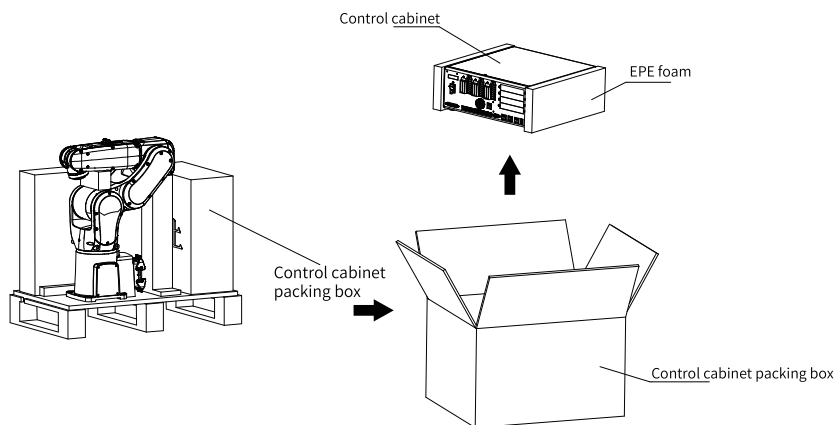


Figure 3-1 Removing the outer carton

2. Unpack the control cabinet.

- a. Cut the packing straps securing the control cabinet and accessory packing boxes with scissors.
- b. Remove the accessory packing box from the pallet. Then, transfer the control cabinet packing box from the pallet to an open area, ensuring to follow the orientation instructions on the box.
- c. Cut the sealing tape on the control cabinet packing box with scissors, and then open the box.
- d. Remove the expanded polyethylene (EPE) foam from the sides of the control cabinet. Grip the holes on the sides of the control cabinet or hold the bottom to remove the control cabinet from the packing box. Transfer the control cabinet to the desired location.



3. Remove the bolts securing the robot body.

Remove the M8x80 bolts securing the robot body on the pallet by using an M8 outer hexagon wrench.

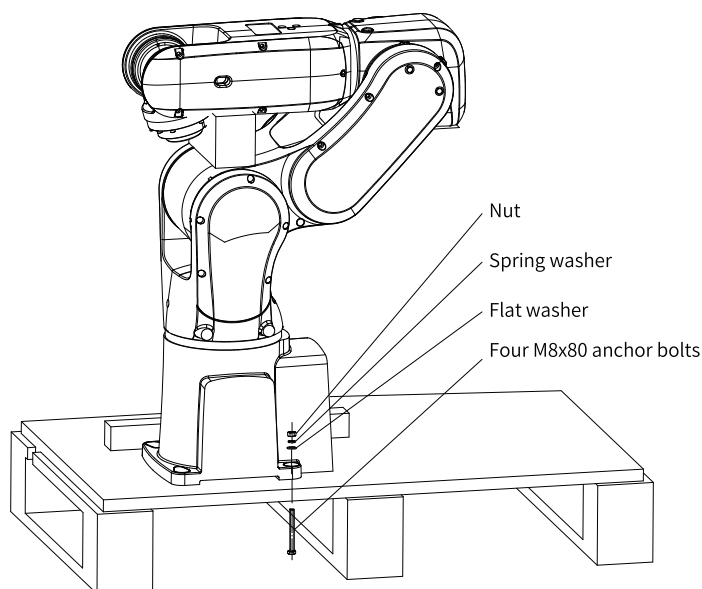


Figure 3-2 Packing of the robot

4. Take out the robot body.

Lift the robot vertically and then move it horizontally to remove it from the pallet. Avoid interference between the bottom of the robot body and the top of the fixtures. Then, transfer the robot body to the desired location.

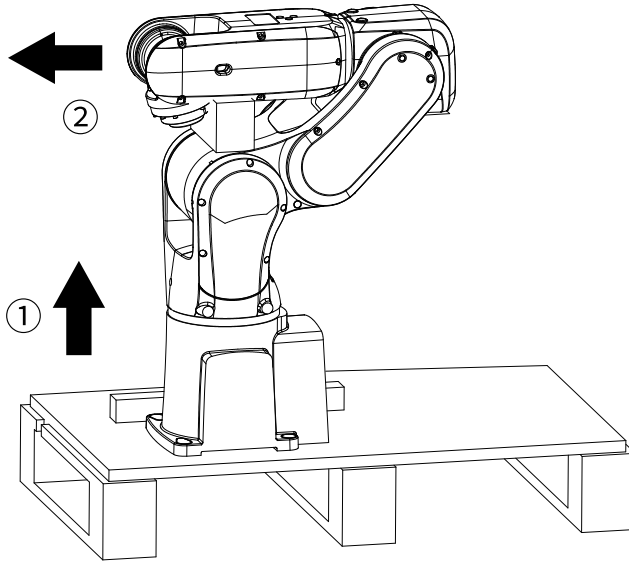


Figure 3-3 Taking out the robot body

### Note

- Take out the robot carefully to avoid collision.
- To repack the robot, reverse the steps above. Please wear protective gloves to prevent scratches and work carefully to prevent damaging the machine.

## 3.3 Check After Unpacking

Check the products and accessories against the packing list after unpacking.

Table 3-1 Packing list

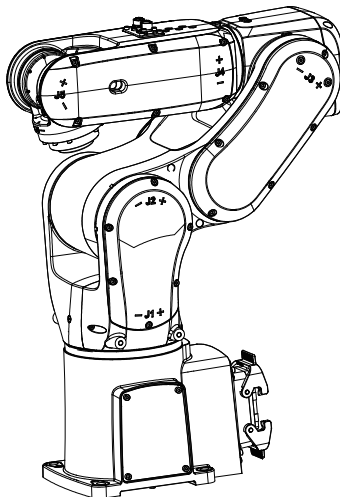
| Description                                                    | Quantity (pcs) |
|----------------------------------------------------------------|----------------|
| Robot body                                                     | 1              |
| Robot control cabinet                                          | 1              |
| Inovance Product Warranty Card                                 | 1              |
| Control cabinet cable connector kit                            | 1              |
| Connecting wire between the robot body and the control cabinet | 1              |
| M10x35 hexagon bolt (GB/T 70.1-2000)                           | 4              |
| Spring washer (GB/T 93-1987)-10                                | 4              |
| Plain washer (GB/T 97.1-2002)-10                               | 4              |



### 3.4 Handling

#### Preparation for handling

1. If the robot is newly manufactured, keep it in the same posture as it was in the factory, as shown in the following figure.



Angles of the axes:

| J1 | J2   | J3   | J4 | J5    | J6 |
|----|------|------|----|-------|----|
| 0° | +55° | -55° | 0° | -105° | 0° |

2. If the robot has been used and needs to be moved to another location, complete the following steps before handling:
  - a. Adjust the robot to the posture for handling.
  - b. Disconnect power to all devices.
  - c. Unplug power and signal cables connected to the control cabinet.
  - d. Unscrew the base mounting screws and remove the robot from the mounting base.
  - e. Secure the robot to the handling equipment.

## Handling procedure

### Note

- The equipment is heavy and manual handling is strictly prohibited.
- Wear safety shoes for handling and at least two people are required.
- Wear protective equipment and ensure that the lifting area is safe enough to avoid collision hazards.



### Warning

- Take care when lifting the robot with a crane or forklift. When placing the robot on the ground, avoid any strong collision between the robot mounting face and the ground.
- Before handling the robot, remove the end effector and the pallet. When it is necessary to handle the robot with the pallet, observe the following precautions.
- The end effector may oscillate due to vibration during transportation and excessive loads may be applied to the robot.
- When handling the robot with the pallet installed, lift the pallet rather than the robot directly.

### Handling with a crane

In principle, use a crane to move and transport the robot.

1. Adjust the robot to the same posture as it was in the factory, as shown in the following figure. Set up screw mounting holes for the handling sheet metal on the robot body, fix the handling sheet metal to the robot body using M6x12 screws, and then lift the robot with four steel slings. It is recommended that the steel sling length be 1 m, with a total weight capacity of at least 50 kg. Use rubber hoses or similar protection at contact points between the steel sling and the robot body.

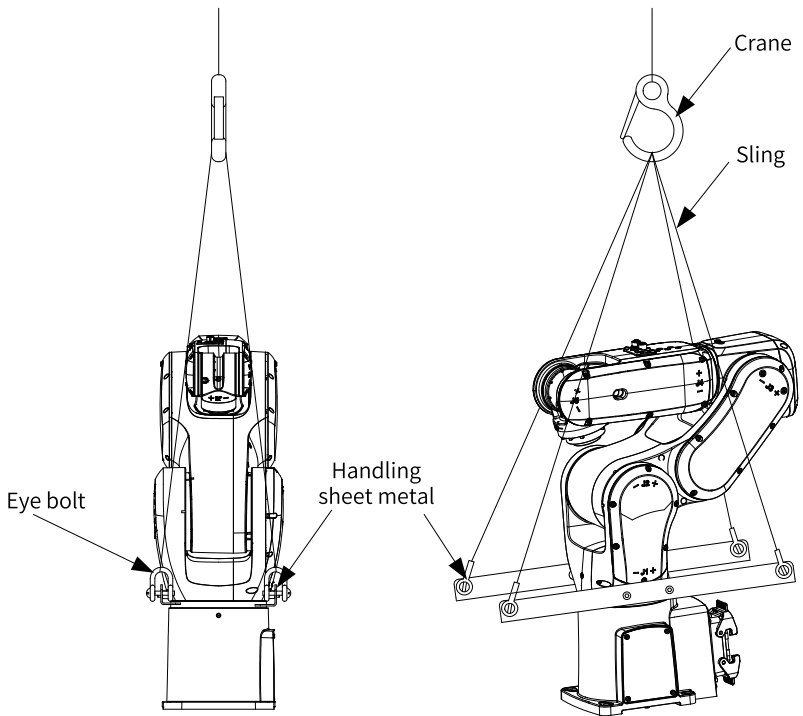


Figure 3-4 Lifting the robot

2. Use four steel slings to lift the robot. Ensure that the robot is balanced before moving the crane.
3. Two people should work together for the handling. One person should observe in the safety zone to ensure that the ambient conditions are met during the operation, while the other operates the crane to slowly lift the robot body and move it to the base table.

#### **Handling with a forklift**

When handling the robot using a forklift, use bolts to secure the robot onto its original pallet or use screws to secure it on a baseplate with sufficient load-carrying capacity, and lift the robot together with the pallet or baseplate.

Transport the robot slowly and carefully to prevent it from toppling or tilting over.

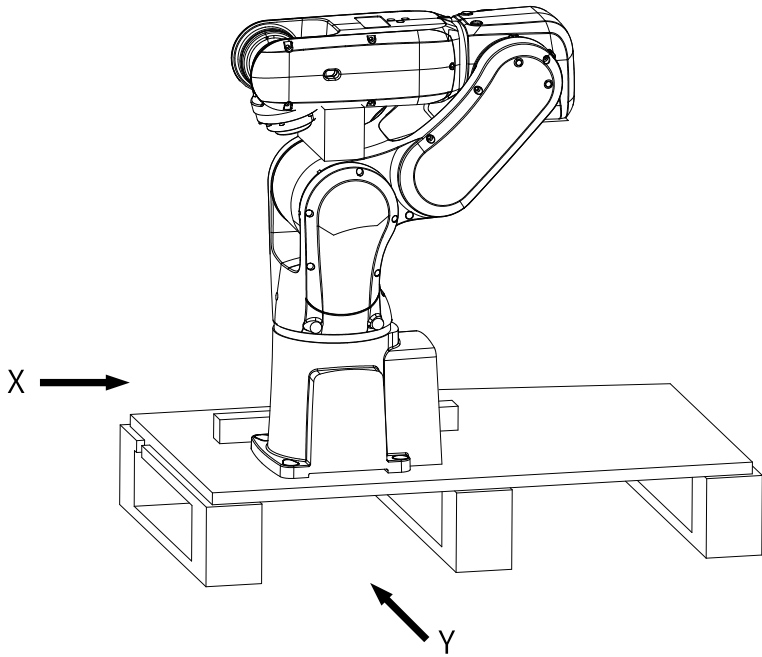


Figure 3-5 Handling the robot with a forklift

---

### **Note**

When the factory pallet is used and the robot is located on one side of the pallet, apply a counterweight on the other side upon forklift insertion, to prevent the robot from tipping over.

---

## 4 Installation

### 4.1 Installation Precautions

**Danger**

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by professionals.
- Install a safety fence for the system. Failure to comply will result in serious accidents.
- Reserve sufficient space between the equipment and surrounding buildings, structural parts, and devices. Failure to comply may cause serious injury or major damage.
- Fix the manipulator before turning on the power or operating the system. Otherwise, the manipulator may fall over and cause serious injury or major damage.

**Note**

- Do not modify the equipment.
- Do not install this equipment in places with strong electric or magnetic fields.
- Remove the mounting screws of the manipulator and adjust the robot to its transport posture.
- For the tabletop mounting, at least two people are required for the operation.

### 4.2 Installing the Robot Body

Follow the following steps to install the robot body:

1. Disconnect power to all devices.
2. Clean the surface onto which the robot is to be mounted.

---

**Note**

To dampen vibrations, use a steel plate with a thickness over 30 mm and a surface roughness below 25  $\mu\text{m}$  as the robot mounting surface.

---

3. Move the robot near the mounting surface.
4. Align the robot base with the two locating pin holes.
5. Install the two locating pins.

6. Install four spring washers and four plain washers, and tighten them with four M10x35 hexagon bolts (tightening torque: 75 N·m). Use screws with a strength equivalent to the performance level of Grade 12.9 specified in GB/T 3098.1.

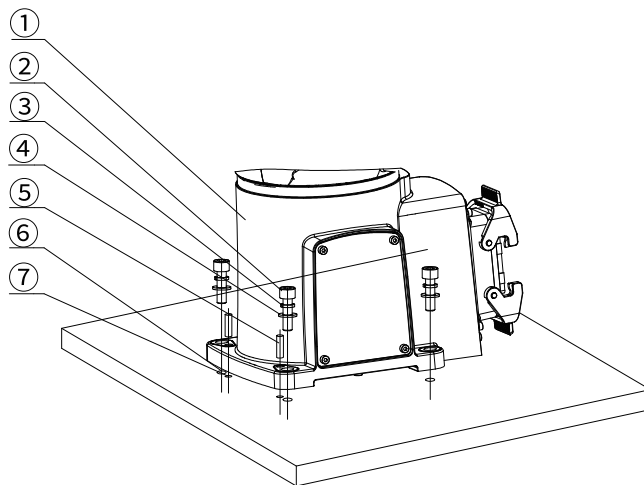


Figure 4-1 Installing the base

| No. | Component                                                |
|-----|----------------------------------------------------------|
| ①   | Robot base                                               |
| ②   | Four M10x35 hexagon bolts (Grade 12.9 in GB/T 70.1-2000) |
| ③   | Four spring washers (GB/T 93-1987)-10                    |
| ④   | Four plain washers (GB/T 97.1-1985)-10                   |
| ⑤   | Two $\Phi 6 \times 32$ parallel pins (GB/T 119.1-2000)   |
| ⑥   | Threaded mounting holes (depth: > 20 mm)                 |
| ⑦   | Mounting pin holes (depth: > 20 mm)                      |

### 4.3 Installing an End Effector

Customers shall prepare end effectors. Observe the following precautions when installing an end effector.



### Caution

- Perform installation only when the power supply is disconnected and the workpiece is not placed. If the emergency stop switch is pressed when the power is still connected, the workpiece may be released at this time, which may cause damage to the robot system and workpiece.
- Pay attention to the interference area of the end effector during system layout design. After the end effector is installed, the end effector or workpiece may come into contact with the robot body during motion due to the outer diameter of the end effector, the size of the workpiece, or the position of the robot arm, which may cause damage to the robot system and the workpiece.

Use M5 screws (Grade 12.9) to attach the end effectors to the wrist flange.

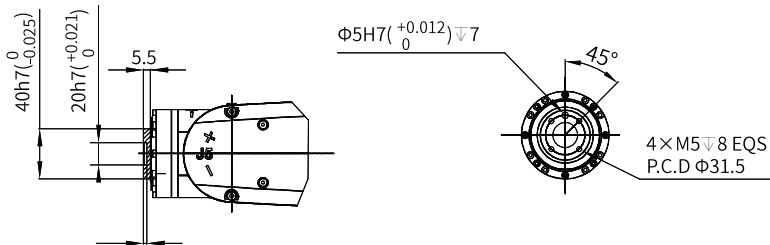


Figure 4-2 IR-R4-56S-INT wrist flange (unit: mm)

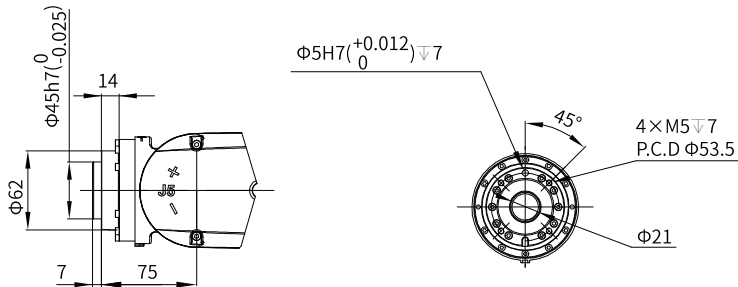


Figure 4-3 IR-R4H-54S-INT wrist flange (unit: mm)

## 4.4 Installing the Pneumatic Valve and Other Auxiliary Accessories

Connectors are provided on the upper arm, forearm, and upper end of the elbow to install the pneumatic valve and other auxiliary accessories. The following figure shows the mounting positions and dimensions.

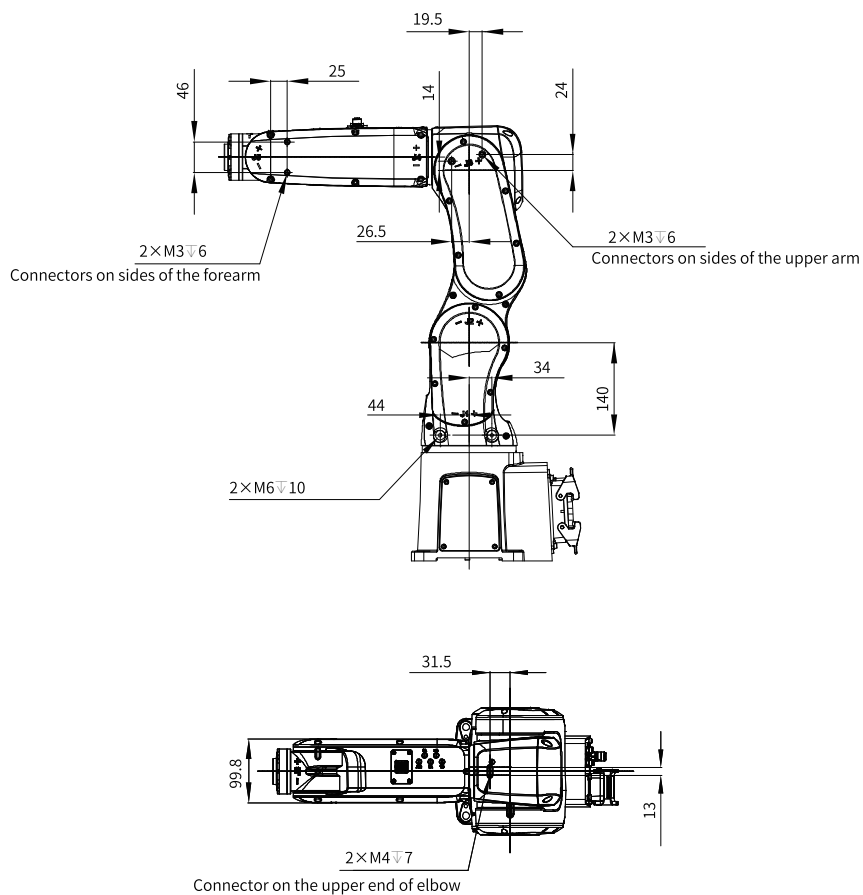


Figure 4-4 Auxiliary accessory mounting positions on IR-R4-56S-INT (unit: mm)



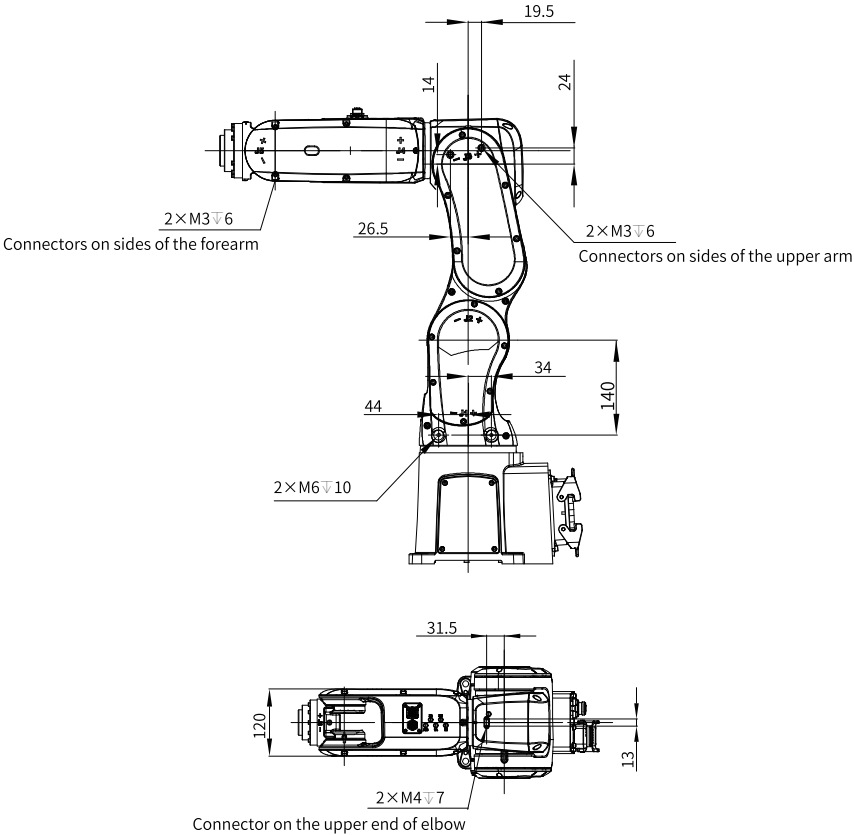


Figure 4-5 Auxiliary accessory mounting positions on IR-R4H-54S-INT (unit: mm)

## 4.5 Cable Connection

### 4.5.1 Connecting the Power Line and Signal Cable



#### Danger

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by professionals.
- Cut off the power before wiring. Failure to comply will result in electric shock or system fault.
- Before wiring, cut off all equipment power supplies. Residual voltage exists after power cut-off. Therefore, wait at least 10 minutes before further operations.
- Ensure that the safety input signals, such as the emergency stop switch and safety door switch are connected correctly before wiring. Otherwise, the safety protection will not work properly in emergency cases, causing serious injury or damage.
- Make sure that the equipment is well grounded. Failure to comply will result in an electric shock.
- During wiring, follow the proper electrostatic discharge (ESD) procedure, and wear an antistatic wrist strap. Failure to comply will damage the equipment or the internal circuits of the equipment.



#### Warning

- Connect the cables securely. Do not lay heavy objects on the cables, or bend or pull the cables forcibly. Failure to comply will result in cable damage, wire breaking, or poor contact, causing electric shock or system fault.
- Wiring cables must meet diameter and shielding requirements. The shielding layer of the shielded cable must be reliably grounded at one end.
- Make the connections in correct sequence. Otherwise, the system may not work properly, which may cause safety hazards.
- After wiring, make sure there are no fallen screws and exposed cables inside the equipment.

Connection method:

1. Connect the heavy-duty connector for the user cable to the heavy-duty connector on the robot base.
2. Connect the power connector and signal connector of the user cables to the electric control cabinet.
3. Connect the safety terminals in the accessory kit to the corresponding terminals in the control cabinet.

4. Connect the power terminals in the accessory kit and then plug them into the power connectors of the control cabinet. Check that the L/PE/N sequence of the cable is correct.

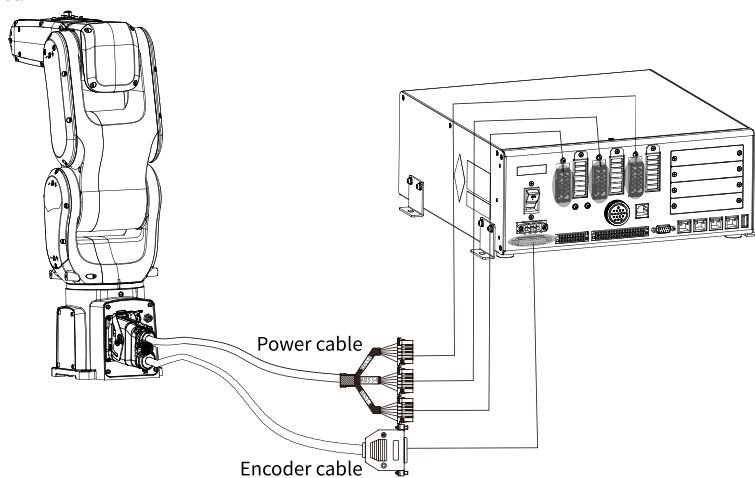
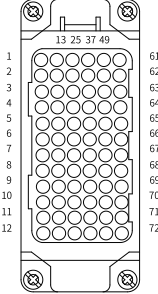


Figure 4-6 Power line and encoder cable connection

## 4.5.2 Terminal Assignment of the Heavy-Duty Connector

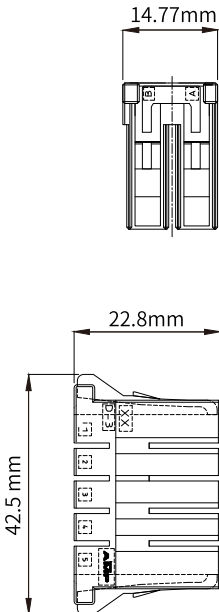
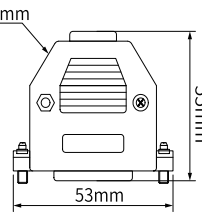
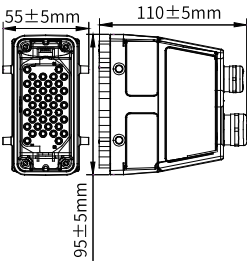
Table 4-1 Terminal assignment

| Connector pin layout                                                              | Pin No. | Assignment | Pin No. | Assignment | Pin No. | Assignment | Pin No. | Assignment |
|-----------------------------------------------------------------------------------|---------|------------|---------|------------|---------|------------|---------|------------|
|  | 1       | 1U         | 21      | 23FG       | 41      | 4BK-       | 61      | 6U         |
|                                                                                   | 2       | 1V         | 22      | 14GND      | 42      | 56BK+      | 62      | 6V         |
|                                                                                   | 3       | 1W         | 23      | 2PS-       | 43      | -          | 63      | 6W         |
|                                                                                   | 4       | 1PE        | 24      | 2PS+       | 44      | GND        | 64      | 6PE        |
|                                                                                   | 5       | 1BK-       | 25      | 3U         | 45      | 56FG       | 65      | 6BK-       |
|                                                                                   | 6       | 0V         | 26      | 3V         | 46      | 23GND      | 66      | -          |
|                                                                                   | 7       | -          | 27      | 3W         | 47      | 4PS-       | 67      | -          |
|                                                                                   | 8       | -          | 28      | 3PE        | 48      | 4PS+       | 68      | B-         |
|                                                                                   | 9       | 1FG        | 29      | 3BK-       | 49      | 5U         | 69      | A-         |
|                                                                                   | 10      | 14VCC      | 30      | 34BK+      | 50      | 5V         | 70      | 56GND      |
|                                                                                   | 11      | 1PS-       | 31      | -          | 51      | 5W         | 71      | 6PS-       |
|                                                                                   | 12      | 1PS+       | 32      | 0V         | 52      | 5PE        | 72      | 6PS+       |
|                                                                                   | 13      | 2U         | 33      | 4FG        | 53      | 5BK-       | -       | -          |
|                                                                                   | 14      | 2V         | 34      | 23VCC      | 54      | -          | -       | -          |
|                                                                                   | 15      | 2W         | 35      | 3PS-       | 55      | -          | -       | -          |
|                                                                                   | 16      | 2PE        | 36      | 3PS+       | 56      | B+         | -       | -          |
|                                                                                   | 17      | 2BK-       | 37      | 4U         | 57      | A+         | -       | -          |
|                                                                                   | 18      | 12BK+      | 38      | 4V         | 58      | 56VCC      | -       | -          |
|                                                                                   | 19      | -          | 39      | 4W         | 59      | 5PS-       | -       | -          |
|                                                                                   | 20      | 24V        | 40      | 4PE        | 60      | 5PS+       | -       | -          |

## 4.5.3 Cable Hole Dimensions

When cutting cable holes on the base table, refer to the following connector dimensions.

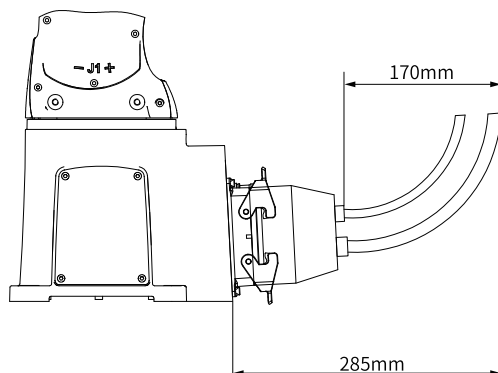
Table 4-2 Cable hole dimensions (IRCB501 series robot control cabinet)

| Name       | Power Line Connector<br>(Cabinet Side)                                            | Encoder Cable Connector<br>(Cabinet Side)                                         | Heavy-Duty Connector<br>(Robot Side)                                               |
|------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Dimensions |  |  |  |
|            | 42.5 mm x 22.8 mm x 14.7 mm (L x W x H)                                           | 53 mm x 55 mm x 16.4 mm (L x W x H)                                               | 95 mm x 110 mm x 55 mm (L x W x H)                                                 |

 **Caution**

- During cable connection, reserve a margin for cables at turns and do not pull the cables tight. The bending radius of a cable is about 10 times its diameter (170 mm).
- Do not bind the redundant power cables into a bundle of coils (two coils are acceptable) stacked together. Otherwise, cables may be damaged due to overheating.
- Connect the male heavy-duty connector straight to the female connector to avoid damaging the guide pin or contact.
- Never violently connect heavy-duty connectors (male and female) to avoid pin displacement or bending.
- The clips on the heavy-duty connectors are only used to fasten the connectors.

Reserved space (connector size+cable bending radius) for cables on the robot side: 285 mm. The bending radius of cables is approximately 170 mm, as shown in the following figure.



Opening size: the size of the opening reserved on the housing or sheet metal for the robot plug to pass through, as shown in the following figure.

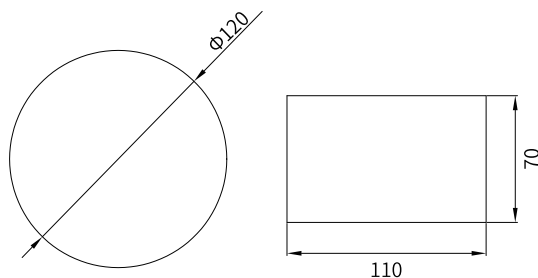


Figure 4-7 Opening size (unit: mm)

## 4.6 User Wiring and Tubing

### 4.6.1 Wiring (Cables)

---

#### Note

- Perform wiring and air tubing of the chuck only when the power supply is disconnected and the workpiece is not placed.
  - Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
-

Available cables are built in the robot body. The following table describes the specifications of signal cables.

| Rated Voltage | Allowable Current | Number of Lines | Nominal Cross-sectional Area of Conductor | Remarks      |
|---------------|-------------------|-----------------|-------------------------------------------|--------------|
| 30 VAC/VDC    | 0.5 A             | 12              | 26 AWG                                    | Signal cable |



### Warning

Current higher than 0.5 A is not allowed.

The following table describes the specifications of connectors.

| Cable                                    | Code     |
|------------------------------------------|----------|
| 12-pin aviation connector on the forearm | 15050817 |
| 5 m 19-pin I/O cable on the base         | 1504B978 |
| Network cable                            | 1504NN47 |

## 4.6.2 Tubing (Air Tubes)

### User tubing (air tubes)

The following table describes the specifications of air tubes.

| Maximum Operating Pressure        | Qty | Specifications (Outer Diameter x Inner Diameter) |
|-----------------------------------|-----|--------------------------------------------------|
| 0.59 MPa (6 kgf/cm <sup>2</sup> ) | 4   | Φ4 mm x Φ2.5 mm                                  |

### Note

The IR-R4-56S-INT standard model does not come with a network port, while the IR-R4-56S-INT optional model and the IR-R4H-54S-INT standard model come with a network port.

**说明** The IR-R4-56S-INT standard model does not come with a network port.

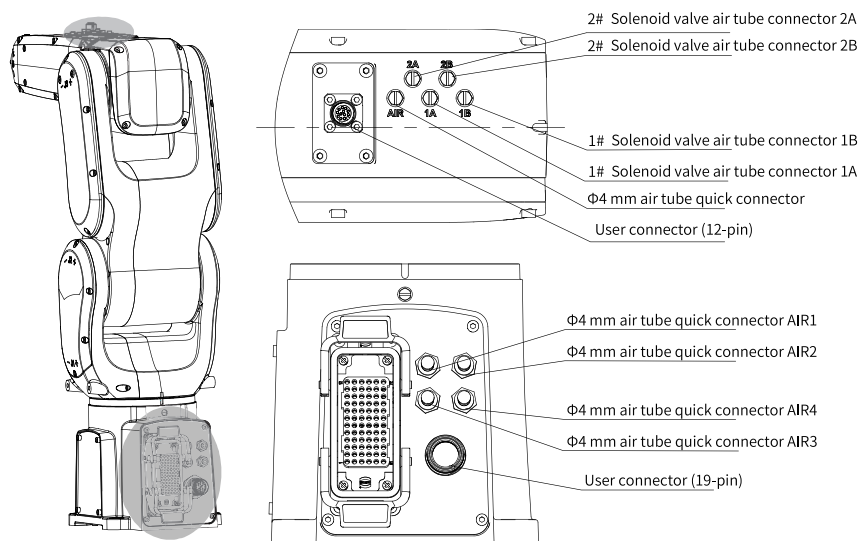


Figure 4-8 User wiring/tubing connectors of the standard model

**说明** The IR-R4-56S-INT optional model and the IR-R4H-54S-INT standard model come with a network port.

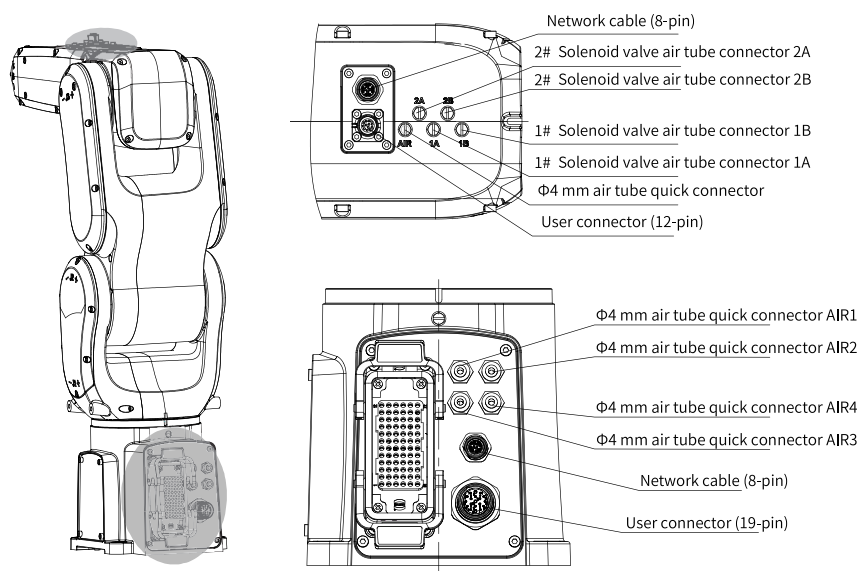


Figure 4-9 User wiring/tubing connectors of the optional model



### Air tubes for the optional model

The optional model can include a solenoid valve, which supports one  $\Phi 4$  mm straight-through line and the conversion of up to two  $\Phi 4$  mm input lines to four  $\Phi 4$  mm output lines.

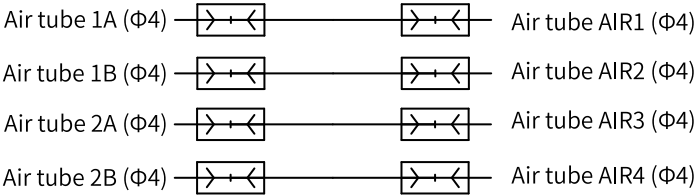


Figure 4-10 Air circuit connection for the standard model

### 4.6.3 Robot Aviation Connector Pins

#### I/O aviation connector

The robot provides a 12-pin aviation connector on the forearm top and a 19-pin aviation connector on the base. The two connectors are interconnected by a special cable inside the robot body.

Connection of the two aviation connectors:

- Pins 1 to 12 of the 19-pin connector are directly connected to pins 1 to 12 of the 12-pin connector.
- Pins 13 to 19 of the 19-pin connector are connected to the reserved solenoid valve connector.

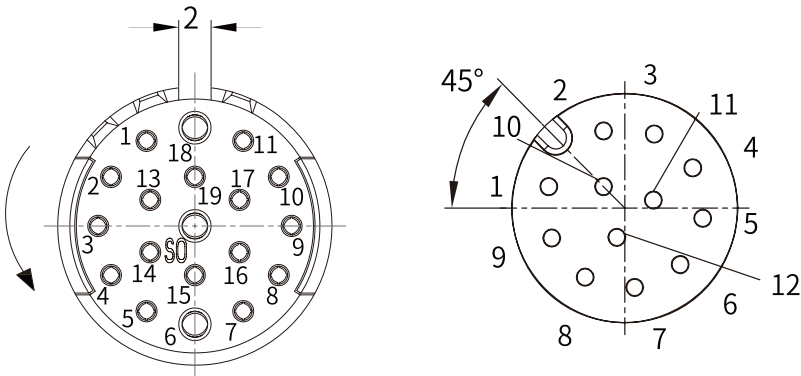


Figure 4-11 Arrangement of pins on the 19-pin and 12-pin connectors

#### Network cable aviation connector for the optional model

Network cable aviation connectors are available for the optional model. The connectors are installed on the electrical mounting plate of the base and the forearm.

Technical data of the network cable aviation connector:

| Name                 | Parameter                     |
|----------------------|-------------------------------|
| Number of pins       | 8                             |
| Rated current (40°C) | 0.2 A                         |
| Rated voltage        | 30 VAC/VDC                    |
| Network cable type   | CAT5A                         |
| I/O cable size       | 0.05 mm <sup>2</sup> (30 AWG) |

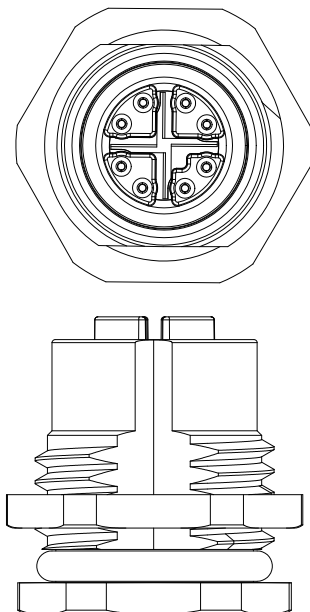


Figure 4-12 Pins of the network cable aviation connector

## 5 Motion Range

### 5.1 Methods of Setting the Motion Range

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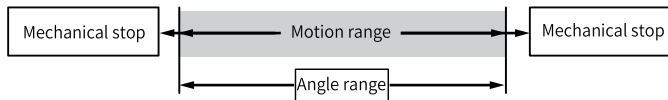
#### **Note**

The default motion range at delivery is the maximum motion range of the robot.

---

To improve layout efficiency and to take into account the maximum safe range of motion of the robot, the following motion range setting methods are provided:

- Angle range (all joints)
- Mechanical stop (for J1 to J3)



### 5.2 Setting Motion Range By Using Angle Range

#### 5.2.1 Description of Angle Ranges

The basic unit of robot motion is degree. The robot's motion limit (motion range) is set based on the angle lower limit and angle upper limit (angle range) of each axis.

The motion angle is determined by the encoder output pulse value of the servo motor, and the angle range must be set within the mechanical stop range.

When the robot receives a motion command, it will check whether the target position of the command is within the angle range before moving. If the target position is beyond the set angle range, an error occurs and the robot does not move.

---

#### **Note**

You can set the angle range by choosing Set > Motion > AxisPara > AxisLimit on the teach pendant.

---

## 5.2.2 Maximum Angle Range of J1

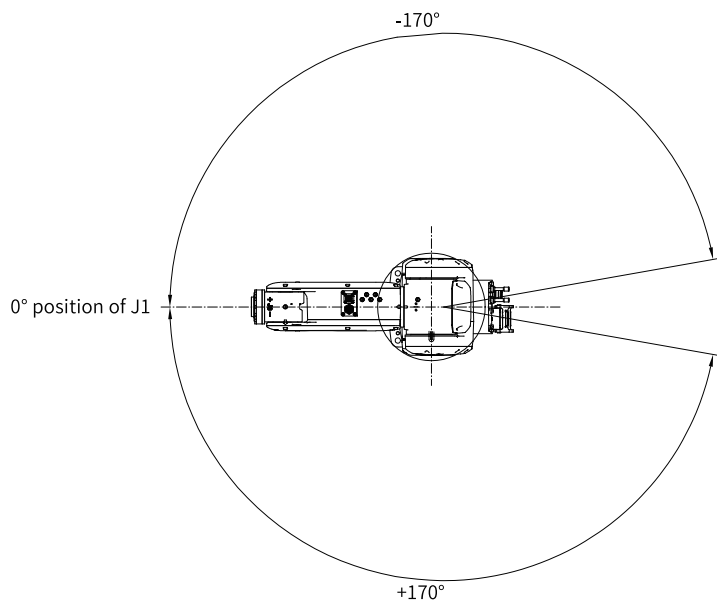


Figure 5-1 Maximum angle range of J1

5.2.3 Maximum Angle Range of J2

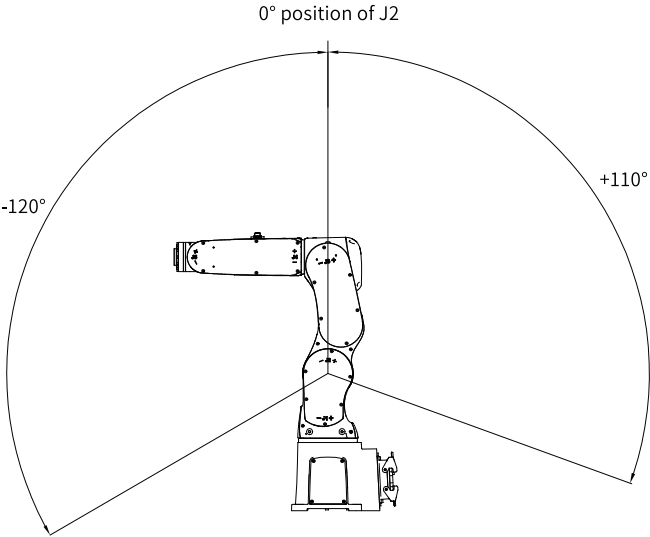


Figure 5-2 Maximum angle range of J2

5.2.4 Maximum Angle Range of J3

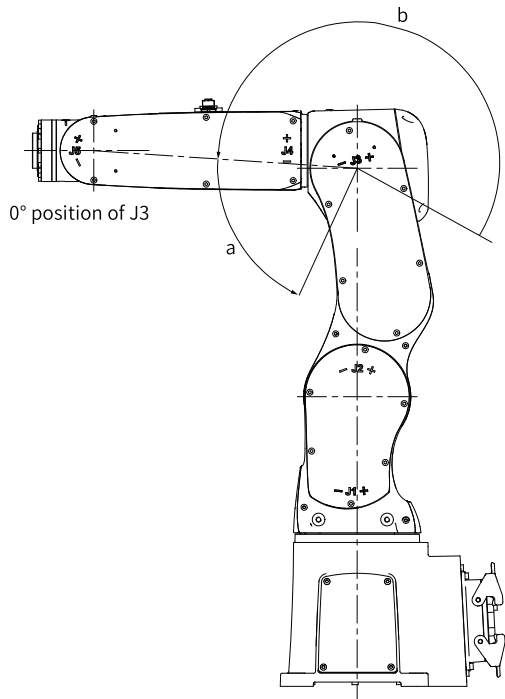


Figure 5-3 Maximum angle range of J3

| Model          | Max Angle Range a | Max Angle Range b |
|----------------|-------------------|-------------------|
| IR-R4-56S-INT  | -69°              | +205°             |
| IR-R4H-54S-INT | -65°              | +195°             |

5.2.5 Maximum Angle Range of J4

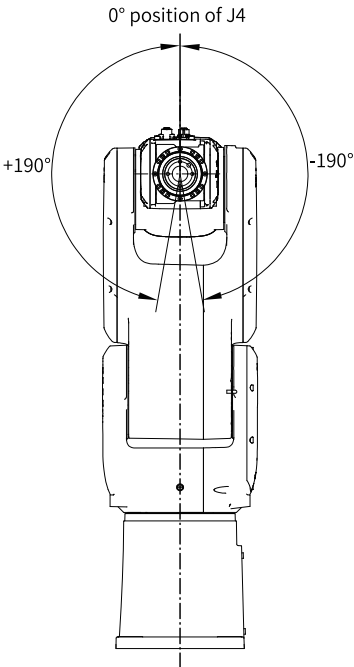


Figure 5-4 Maximum angle range of J4

5.2.6 Maximum Angle Range of J5

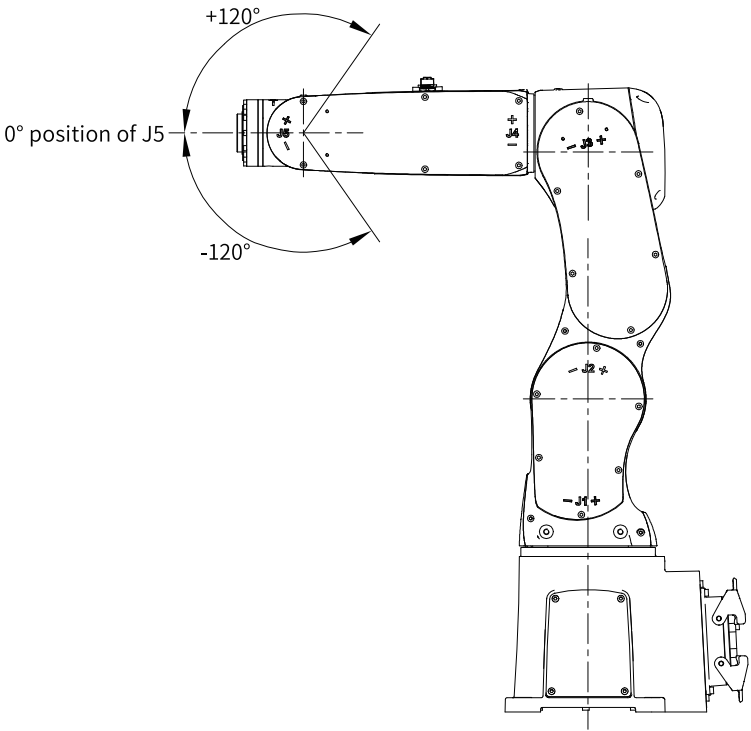


Figure 5-5 Maximum angle range of J5



5.2.7 Maximum Angle Range of J6

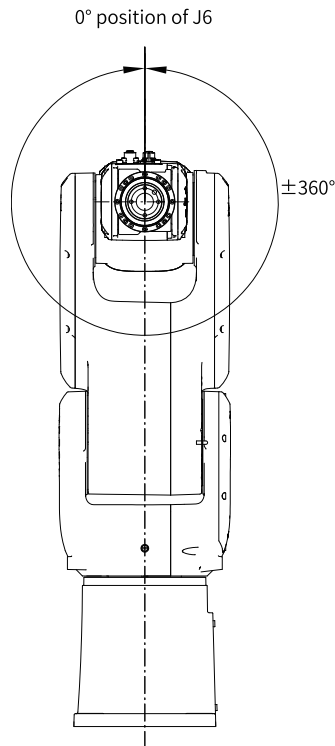


Figure 5-6 Maximum angle range of J6

5.3 Mechanical Limit Stops

As shown in the following figure, the IR-R4-56S-INT and IR-R4H-54S-INT models have mechanical stops at J1 and J3, while mechanical limits are achieved at J2 and J5 through the enclosure. Set angle ranges must not exceed the angle ranges allowed by the mechanical stops.

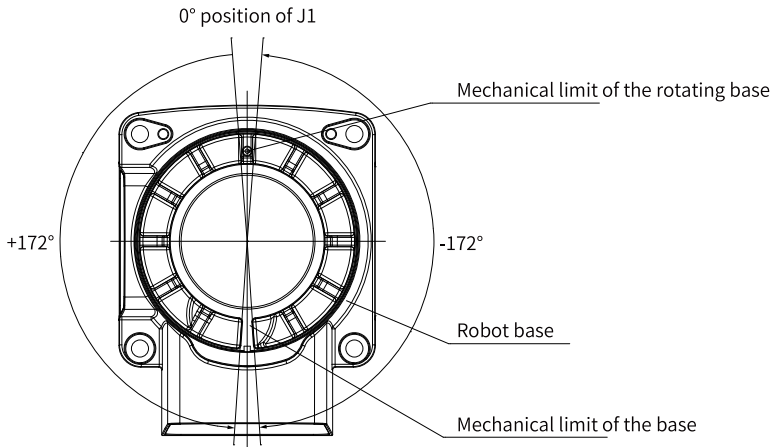


Figure 5-7 J1 limit position

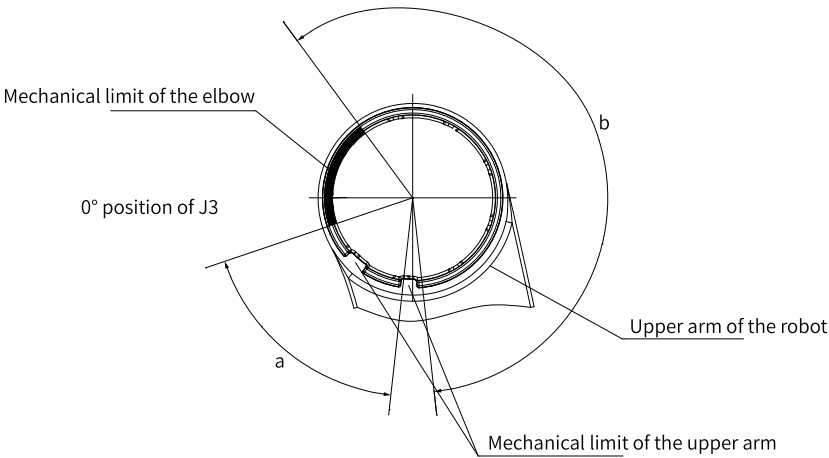


Figure 5-8 J3 limit position

Table 5-1 J3 angle range limits

| Model          | Angle Range Limit a | Angle Range Limit b |
|----------------|---------------------|---------------------|
| IR-R4-56S-INT  | -71°                | +206.5°             |
| IR-R4H-54S-INT | -67°                | +197°               |

## 6 Maintenance

### 6.1 Safety Instructions

Before maintenance, read the precautions for maintenance, this guide, and other related guides carefully to fully understand the methods of safe maintenance.



#### Danger

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed by professionals.
- Do not maintain the equipment after power-on. Failure to comply will result in an electric shock.
- Do not remove the parts not mentioned in this document. Do not maintain any part with a method different from that described in this document.
- Check the motion of the robot after parts replacement outside the safety fence. Failure to comply may cause severe safety issues due to abnormal movement of the robot.
- Make sure that the emergency stop switch and safety door switch work properly before operation. Otherwise, safety protection function will not work properly in emergency cases, causing serious injury or damage.



#### Warning

- Require for repair services according to the product warranty agreement.
- Perform daily and periodic inspection and maintenance for the equipment according to maintenance requirements and keep a maintenance record.
- When the equipment is faulty or damaged, require professionals to perform troubleshooting and repair by following repair instructions and keep a repair record.
- Replace quick-wear parts of the equipment according to the replacement guide.
- Prevent foreign objects from entering the equipment and terminals during maintenance.
- Open the equipment cover only when repair and maintenance.
- After the equipment is replaced, perform wiring inspection and parameter settings again.

### 6.2 Inspection and Maintenance Items

Inspect and maintain the robot regularly for the robot to run more safely and efficiently. The target parts can be inspected and maintained daily, monthly, quarterly, semi-annually, and annually as needed.

The list of maintenance items lists the necessary maintenance items at each stage. In the rightmost column of the table, the maintenance personnel are divided into "Professionals", "Qualified Personnel", and "Manufacturer" (that is, Inovance). You can designate skilled personnel to carry out various maintenance operations.

- Inspection during power-off (not operating)

| Item                                                                           | Position                                                      | Daily | Monthly | Quarterly | Semi-annual | Annual | Three Years | Maintenance Personnel   |                     |                       |
|--------------------------------------------------------------------------------|---------------------------------------------------------------|-------|---------|-----------|-------------|--------|-------------|-------------------------|---------------------|-----------------------|
|                                                                                |                                                               |       |         |           |             |        |             | Professionals Personnel | Qualified Personnel | Manufacturing Company |
| Check whether the screws are loose. If yes, tighten the screws.                | Mounting screws of the end effector                           | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
|                                                                                | Robot mounting screws                                         | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
|                                                                                | Locking screws for each arm                                   | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
|                                                                                | Screws around each axis                                       | -     | -       | -         | -           | ✓      | ✓           | -                       | ✓                   | ✓                     |
|                                                                                | Screws for the motor and reducer                              | -     | -       | -         | -           | ✓      | ✓           | -                       | ✓                   | ✓                     |
| Check whether the connectors are loose. If yes, insert/tighten the connectors. | External part of the robot body (such as the connector board) | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
|                                                                                | Robot cable unit                                              | -     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |

| Item                                                                           | Position                               | Daily | Monthly | Quarterly | Semi-annual | Annual | Three Years | Maintenance Personnel   |                     |                       |
|--------------------------------------------------------------------------------|----------------------------------------|-------|---------|-----------|-------------|--------|-------------|-------------------------|---------------------|-----------------------|
|                                                                                |                                        |       |         |           |             |        |             | Professionals Personnel | Qualified Personnel | Manufacturing Company |
| Inspect for any external defects and clear attached dust.                      | Robot body and external cables         | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Clean the ventilation unit of the control unit.                                | Ventilation unit of the control unit   | -     | -       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Check whether the robot and pipeline accessories are complete, worn, or rusty. | Cable sheath, connector, and tie strap | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |

| Item                                                                                 | Position                                                                                           | Daily | Monthly | Quarterly | Semi-annual | Annual | Three Years | Maintenance Personnel   |                     |                       |
|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-------|---------|-----------|-------------|--------|-------------|-------------------------|---------------------|-----------------------|
|                                                                                      |                                                                                                    |       |         |           |             |        |             | Professionals Personnel | Qualified Personnel | Manufacturing Company |
| Check whether the peripheral circuits and buttons of the robot are normal.           | Connectors on both sides of the drag chain cable, and common cables used as highly-flexible cables | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Check for deformation and position offset. Repair or place it properly if necessary. | Safe guard and teach pendant cables                                                                | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Check tension of timing belt. Tighten it if necessary.                               | Inside J5 and J6 robot arms                                                                        | -     | -       | -         | ✓           | ✓      | ✓           | -                       | ✓                   | ✓                     |

| Item                                                        | Position                                        | Daily                                                                                                                                                                                                                           | Monthly | Quarterly | Semi-annual | Annual | Three Years | Maintenance Personnel   |                     |                       |
|-------------------------------------------------------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------|-------------|--------|-------------|-------------------------|---------------------|-----------------------|
|                                                             |                                                 |                                                                                                                                                                                                                                 |         |           |             |        |             | Professionals Personnel | Qualified Personnel | Manufacturing Company |
| Check for lubricant leakage for the robot.                  | Oil supply port and oil drain port of each axis | ✓                                                                                                                                                                                                                               | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Replace lubricants for the reducer, gear cavity, and wrist. | Reducer, gear cavity, and wrist                 | -                                                                                                                                                                                                                               | -       | -         | -           | -      | ✓           | -                       | ✓                   | ✓                     |
| Battery                                                     | -                                               | Replace the battery every 1.5 years. When the battery is low, the servo will report an alarm, and the teach pendant will display "Servo drive reports an alarm". You can choose Monitor > Servo Status to check the alarm code. |         |           |             |        |             | -                       | ✓                   | ✓                     |

- Inspection during power-on (not operating)



| Item                                                                          | Position                                             | Daily | Monthly | Quarterly | Semi-annual | Annual | Three Years | Maintenance Personnel   |                     |                       |
|-------------------------------------------------------------------------------|------------------------------------------------------|-------|---------|-----------|-------------|--------|-------------|-------------------------|---------------------|-----------------------|
|                                                                               |                                                      |       |         |           |             |        |             | Professionals Personnel | Qualified Personnel | Manufacturing Company |
| Shake the cable gently by hand to check for wire breakage.                    | External cables (including cable units of the robot) | -     | -       | -         | ✓           | ✓      | ✓           | -                       | ✓                   | ✓                     |
| Check whether the fan on the rear of the control cabinet ventilates smoothly. | Fan on the rear of the control cabinet               | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Press each arm by hand in the enabled state to check whether the arms shake.  | Arms                                                 | -     | -       | -         | -           | ✓      | ✓           | -                       | ✓                   | ✓                     |

- Inspection during power-on (operating)

| Item                                     | Position                                                     | Daily | Monthly | Quarterly | Semi-annual | Annual | Three Years | Maintenance Personnel   |                     |                       |
|------------------------------------------|--------------------------------------------------------------|-------|---------|-----------|-------------|--------|-------------|-------------------------|---------------------|-----------------------|
|                                          |                                                              |       |         |           |             |        |             | Professionals Personnel | Qualified Personnel | Manufacturing Company |
| Confirm the motion range.                | Each axis                                                    | -     | -       | -         | -           | ✓      | ✓           | -                       | ✓                   | ✓                     |
| Check for abnormal noises or vibration.  | Abnormal noises or vibration of each drive mechanism         | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Check for interference.                  | Stable running and abnormal jittering of the drive mechanism | ✓     | ✓       | ✓         | ✓           | ✓      | ✓           | ✓                       | ✓                   | ✓                     |
| Measure the repeatability using a gauge. | Robot body                                                   | -     | -       | -         | -           | ✓      | ✓           | -                       | ✓                   | ✓                     |

## 6.3 Part Replacement

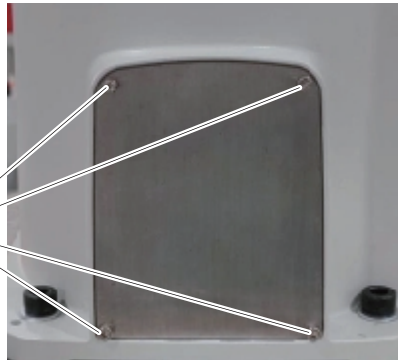
### 6.3.1 Battery (Lithium Battery) Replacement



- Do not perform equipment maintenance or servicing while power is on. Failure to comply will result in an electric shock.
- When disposing of waste batteries, consult a professional disposal company or follow relevant local regulations.
- Use lithium batteries correctly. Incorrect usage may result in overheating, leakage, explosion, or fire, causing severe risks to personal and property safety.
  - Charging lithium batteries is prohibited.
  - Applying pressure to deform lithium batteries is prohibited.
  - Disassembling lithium batteries is prohibited.
  - Short-circuiting or incorrect connections to lithium batteries are prohibited.
  - Heating lithium batteries is prohibited.
  - Disposing of lithium batteries in fire is prohibited.
  - Welding battery terminals is prohibited.
  - Forcing discharge of lithium batteries is prohibited.

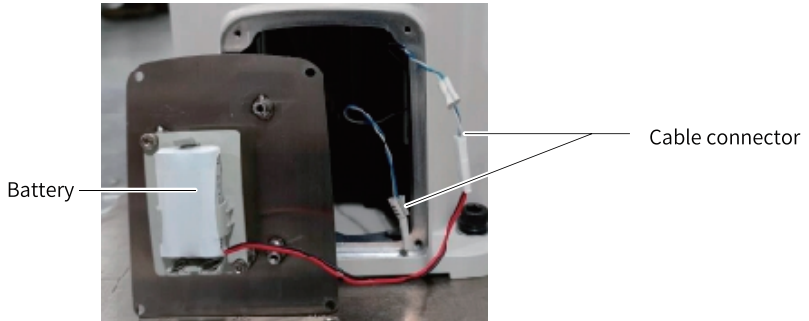
1. Remove the four M4x8 screws on the back cover and remove the back cover.

Four M4x8 screws



2. Replace the battery as follows:

- Cut the zip tie securing the battery to the cable plate.
- Tie the new battery onto the cable plate with a zip tie.
- Connect the terminal of the new battery to the empty white 2P connector.
- Remove the used battery.



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## Note

Failure to comply with the procedure described above may cause loss of zero points. For details, see ["6.4.1 Overview of Zero Point Adjustment" on page 71](#).

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## 6.4 Zero Point Adjustment

### 6.4.1 Overview of Zero Point Adjustment

The zero point is the reference point and base point for the robot. When robot parts (such as the motor, reducer, synchronous belt, and cables) are replaced, the zero point stored on the motor side may deviate from that stored on the controller side, which leads to failure of correct positioning. Therefore, after the parts are replaced, zero point adjustment is required.

---

## Note

After home position calibration, the absolute accuracy of the robot may deviate from the default absolute accuracy at delivery.

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## Warning

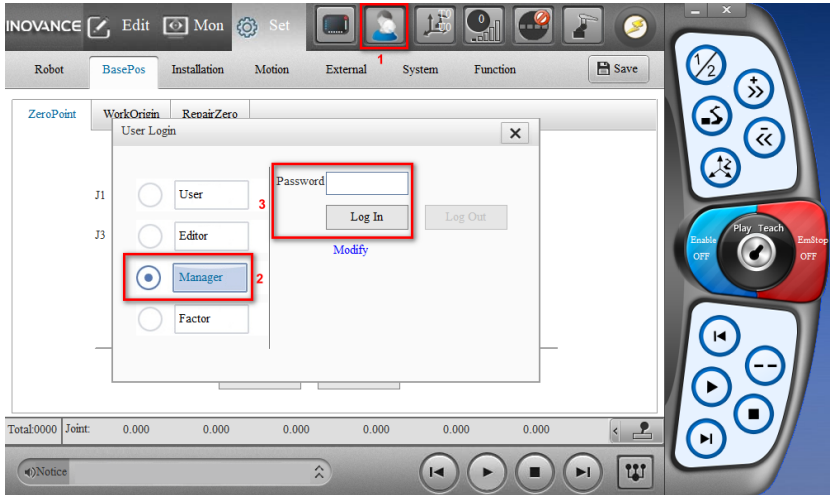
- Install a safety fence for the system to prevent people from entering the motion range of the system. Failure to comply may result in severe safety issues.
- Before operation, ensure that there is no person within the safety fence. Do not enter the motion range during system running. Failure to comply may result in severe safety issues.
- Operating the robot system in teach mode can ensure the safety of the operator to a certain extent, although the motion is limited (low speed and low power). However, severe safety issues may also occur when the robot performs unexpected actions.

### 6.4.2 Procedure of Zero Point Adjustment

Both the PC-based teach pendant and the hand-held teach pendant provide an operation interface for zero point adjustment. The following is an explanation using the PC-based teach pendant, with similar operations for the hand-held teach pendant.

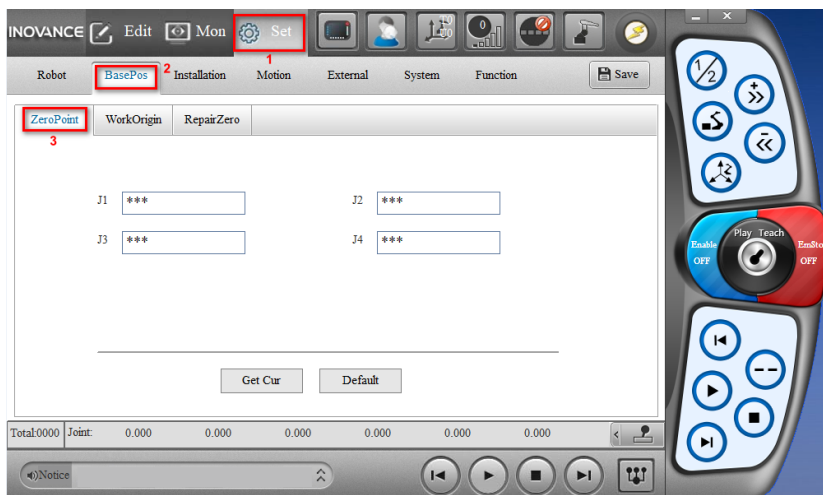
When performing zero point adjustment using the teach pendant, adjust J4 and J3 at the same time.

1. Select a role and log in to the system.
  - a. On the main screen of the PC-based or hand-held teach pendant, click the user icon to open the "User Login" screen.
  - b. Enter the password in the password input box and click "Log In".



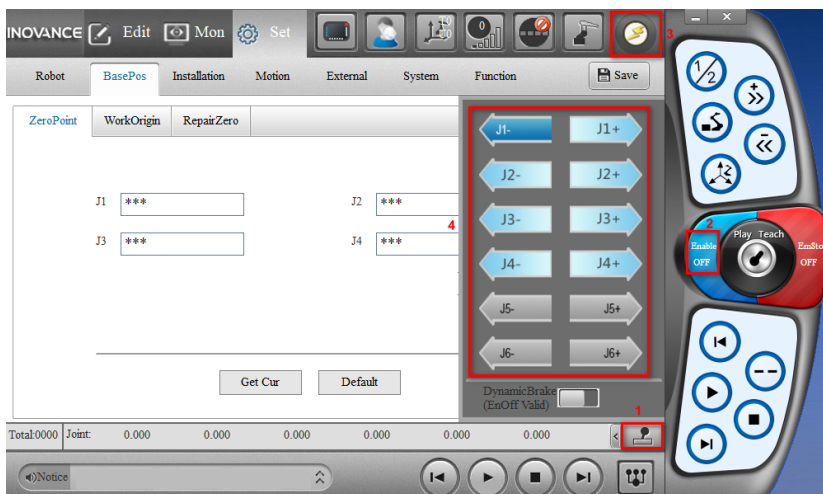
## 2. Switch to the ZeroPoint setting screen.

On the main screen of the PC-based or hand-held teach pendant, choose "Set" > "BasePos" > "ZeroPoint" to open the "ZeroPoint" screen.



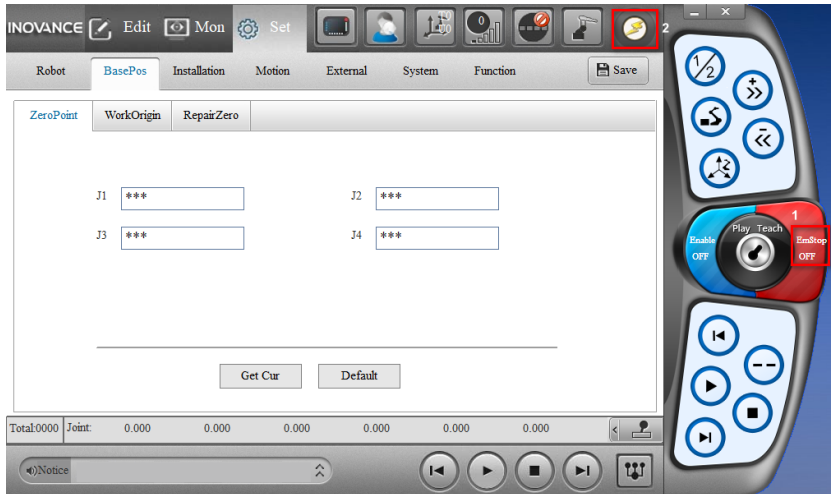
## 3. Move each axis of the robot to the corresponding zero point.

- a. Move the robot axes to their respective zero points by using the joystick on the hand-held teach pendant or the operation interface of the PC-based teach pendant. For details, see Teach Pendant User Guide.
- b. For the zero point of each axis, see ["6.4.3 Zero Point of Each Axis" on page 75](#). Calibrate the zero points using the calibration tool.



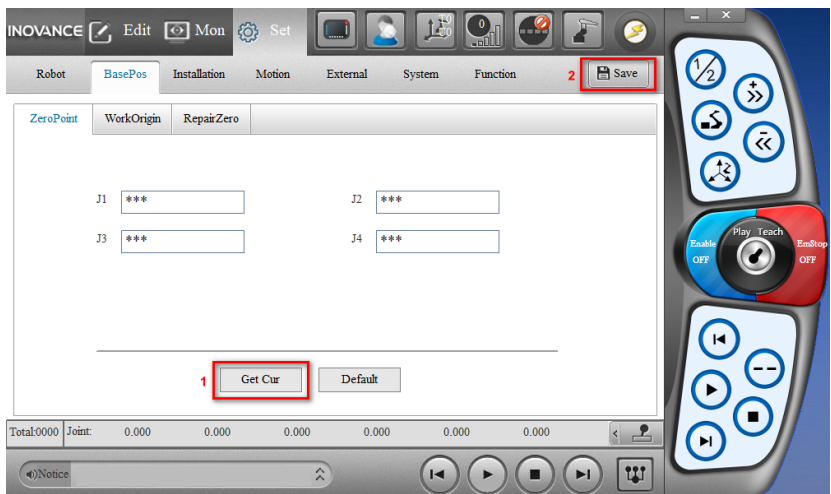
## 4. Switch to the emergency stop state.

- Click the virtual emergency stop button on the PC-based teach pendant, or press the red "EmStop" button on the hand-held teach pendant.
- The status indicator in the upper right corner of the PC-based teach pendant (or the display of the hand-held teach pendant) indicates the emergency stop state (red).



## 5. Obtain and save the zero point information.

- When the robot axes are at their zero points, click "Get Cur" to obtain the encoder pulses.
- Click "Save" to complete zero point adjustment.



### 6.4.3 Zero Point of Each Axis

- **Calibration tool**

The calibration tool is used to calibrate the rotary axes of the robot manually.

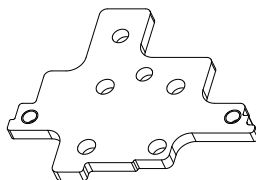


Figure 6-1 Calibration tool

- **Calibration of J1 to J6**

During calibration, control the robot to move at the lowest speed by using the teach pendant. Adjust axes J1 to J6 until the calibration tools fit snugly in the reference slots. J6 should be aligned with a taper pin, and the  $\Phi 5 \times 14$  taper pin should just touch the screw of the reducer, as shown in the following figure.

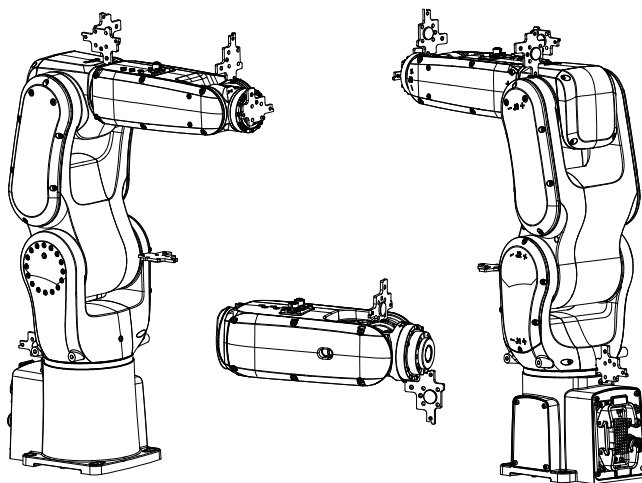


Figure 6-2 Calibration of axes J1 to J6



## 6.5 Options

| Options                               | Description                                                                                | Specifications | Code     |
|---------------------------------------|--------------------------------------------------------------------------------------------|----------------|----------|
| Base I/O cable                        | Connects the body of the IR-R4 series 6-axis robot to an electric cabinet                  | 5 m            | 1504B978 |
| 90° I/O aviation connector on forearm | Connects a cable to the aviation connector on the forearm of the IR-R4 series 6-axis robot | 12-pin         | 15050817 |
| Network cable accessory               | Connects a cable to the network port of the IR-R4 series 6-axis robot                      | CAT5           | 1504NN47 |

## 7 Certification and Standard Compliance

### Third-party certification

| Certification Mark                                                                  | Certification | Description                                                                                                                                                                                               | Instruction                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | CE            | This product complies with Low Voltage Directive (LVD), Machinery Directive (MD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives and carries the CE mark. | <ul style="list-style-type: none"> <li>• EN 60204-1:2018</li> <li>• EN ISO 10218-1:2011</li> <li>• EN ISO 12100:2010</li> <li>• EN 61000-6-2:2019</li> <li>• EN 61000-6-4:2019</li> <li>• ISO 13849-1:2023,</li> <li>• EN ISO 13849-1:2015</li> </ul> |
|    | SGS           | This product is certified by Societe Generale de Surveillance (SGS) for functional safety.                                                                                                                |                                                                                                                                                                                                                                                       |
|    | cSGSUS        | This product is certified by SGS North America of Nationally Recognized Test Laboratory (NRTL).                                                                                                           | <ul style="list-style-type: none"> <li>• UL 1740, 4th Ed., Jan. 26, 2018</li> <li>• NFPA 79 2021 Edition, Dated Oct. 25, 2020</li> <li>• CAN/CSA Z434-14 (R2019), Reaffirmed 2019</li> </ul>                                                          |
|   | FCC           | This product has passed the Federal Communications Commission (FCC) EMC testing and carries the FCC mark.                                                                                                 | -                                                                                                                                                                                                                                                     |
|  | KCs           | This product is verified by Korea Occupational Safety and Health Agency (KOSHA) in terms of special equipment, labor protection supplies, and guard devices and carries the KCs mark.                     | -                                                                                                                                                                                                                                                     |

### Note

The preceding certification standards only apply to standard models of products. For specific certification information about customized products, consult Inovance technical personnel.

**Declaration of conformity with EU directives**

Inovance robots have been certified by the following directives and meet basic requirements of the CE-MD, CE-LVD, CE-EMC, and RoHS directives.

|                                               |                                                                                                                                                                                                                                              |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Machinery Directive (MD)                      | 2006/42/EC                                                                                                                                                                                                                                   |
| Low Voltage Directive (LVD)                   | 2014/35/EU                                                                                                                                                                                                                                   |
| Electromagnetic Compatibility Directive (EMC) | 2014/30/EU                                                                                                                                                                                                                                   |
| RoHS Directive (ROHS)                         | 2011/65/EU<br>Amended by (EU)2015/863                                                                                                                                                                                                        |
| Applied Harmonized Standards                  | <ul style="list-style-type: none"><li>• EN 60204-1:2018</li><li>• EN ISO 10218-1:2011</li><li>• EN ISO 12100:2010</li><li>• EN 61000-6-2:2019</li><li>• EN 61000-6-4:2019</li><li>• ISO 13849-1:2023</li><li>• EN ISO 13849-1:2015</li></ul> |



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