# **INOVANCE**



# IR-S50 Series **SCARA Robot**

User Guide - Manipulator















## **Preface**

#### Introduction

The IR-S50 series SCARA robots provides a maximum arm length of 1200 mm, a maximum paylaod of 50 kg, and a Z-axis travel of 400 mm, featuring high efficiency, accuracy, and speed.

- Repeatability: ±0.05 mm
- The robot uses a harmonic reducer to directly drive the spline, effectively improving its rigidity.
- Optimized motion control algorithms and vibration suppression algorithms improve the smoothness of robot motion to reduce the impact of the robot on the base and line during the motion, extending the service life of the equipment.

The IR-S50 series SCARA robots are widely used in loading and unloading, precision assembly, handling, dispensing, gluing, screw tightening, labeling, material insertion, sorting in new energy, 3C and food packaging industries. The robot can be used in high-load occasions, such as handling of large parts, machine loading and unloading, machine assembly, industrial parts transfer, and other occasions.

This document describes the basic specifications, installation, and maintenance of the IR-S50 series SCARA robots.

#### **Audience**

Mechanical engineers

Electrical engineers

System engineer

#### **More Documents**

Name	Data Code	Description
IRCB500 Series Robot Controller User Guide	PS00003526	This guide describes the specifications, installation, wiring and more of the IRCB500 series high-protection controller.
IRP80 Series Teach Pendant User Guide	19010502	This guide describes the basic information, cable connection, operations and more of the IRTP80 series teach pendant.

#### **Revision History**

Date	Version	Description
March 2023	B03	Corrected the outline drawing. Updated content of lubricating grease.
December 2022	B02	Updated maximum motion range of J4. Updated lifting diagram. Added parts maintenance.
June 2022	B01	Updated drawings
May 2022	A02	Updated modifications, packaging diagram and connection cables. Changed system model to IR-S50-120Z40S3-B1 and updated drawings.
January 2022	A00	First release.

### **Document Acquisition**

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

- Scan the QR code on the cover of this document to directly download the document.
- Visit <u>www.inovance.com</u>, click Download under Support and enter a keyword to search.

## **General Safety Instructions**

#### **Safety Precautions**

- This section describes the safety precautions that help you use this product correctly. Before operating the equipment, read through the guide and comprehend all the safety instructions. Failure to comply may result in severe personal injuries or even death or equipment damage.
- 2. "DANGER", "WARNING", and "DANGER" items in the user guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
- 3. Use this equipment according to the designated environment requirements. Damage caused by improper usage is not covered by warranty.
- 4. Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

#### **Safety Levels and Definitions**

DANGER Indicates that failure to comply with the notice will result in severe personal injuries or even death.

WARNING Indicates that failure to comply with the notice may result in severe personal injuries or even death.

CAUTION Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

#### **General Safety Instructions**

- For illustration purpose, the drawings in this user guide are sometimes shown
  without covers or protective guards. Remember to install the covers or protective
  guards as specified before using the product, and perform operations following
  the instructions.
- The drawings in this guide are for reference only and may not match the product you purchased.

## Unpacking



- Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking.
- Do not install the equipment if you find water seepage or missing or damaged components upon unpacking.
- Do not install the equipment if you find the packing list does not conform to the equipment you received.



- Check whether the packing is intact and whether there is damage, water seepage, damp, and deformation.
- Unpack the package by following the package sequence. Do not hit the package with force.
- Check whether there are damage, rust, or injuries on the surface of the equipment or equipment accessories.
- Check whether the number of packing materials is consistent with the packing list.

#### **Storage and Transportation**



- Use professional loading and unloading equipment to carry large-scale or heavy equipment. Failure to comply may result in personal 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 personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is lifted by hoisting equipment.
- 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
  personal injuries or equipment damage.



- Handle the equipment with care during transportation and mind your steps to prevent personal 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 personal injuries.
- Store and transport this product in strict accordance with the storage and transportation requirements. Failure to comply may result in damage to the product.
- Avoid transporting the equipment in environments such as water splashing, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing the equipment for more than three months. Long-term storage requires stricter protection and necessary inspections.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

#### Installation



• Installation must be performed by only experienced personnel who have been trained with necessary electrical information. Operations by others are prohibited.



- Read through the guide and safety instructions before installation.
- Do not install this equipment 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 a fire.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When this equipment is installed in a cabinet or final equipment, protection measures such as a fireproof enclosure, electrical enclosure, or mechanical enclosure must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Before installing equipments with strong electromagnetic interference, such as a transformer, install a shielding equipment for the equipment to prevent malfunction.
- Install the equipment onto flame retardant materials, such as metal. Keep the
  equipment away from combustible objects. Failure to comply will result in a fire.



- 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 for effective
  ventilation and cooling.
- Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

#### Wiring



#### DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, cut off all equipment power supplies. Wait as specified on the product
  warning sign before further operations because residual voltage exists after power-off.
  Measure the DC voltage of the main circuit and make sure that it is below the safety
  voltage. Failure to comply will result in an electric shock.
- Never perform wiring at power-on. Failure to comply will result in an electric shock.
- Check that the equipment is grounded properly. Failure to comply can result in electric shock.



- Do not connect the input power supply to the output end of the equipment. Failure to comply can result in equipment damage or even a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- Fasten screw terminals with the specified tightening torque. Insufficient or excessive torque may cause overheating, damage, and even a fire.
- After wiring, make sure that no screws are fallen and cables are exposed in the equipment. Failure to comply may result in an electric shock or equipment damage.



- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- In wiring the control circuit, use shielded twisted pair cable and connect the shield to the PE terminal. Otherwise, the equipment may not function properly.

#### Power-on



- Before power-on, make sure that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Before power-on, make sure that the power supply meets product requirements to prevent product damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Do not touch any terminals, or remove any part of the equipment at power-on. Failure to comply will result in an electric shock.



- Perform a trial run after wiring and parameter setting to ensure that the equipment operates safely. Failure to comply may result in personal 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 a fire. If the power supply voltage is
  used incorrectly, it will result in a fire.
- Before power-on, check that no one is near the equipment, motor, or other mechanical parts. Failure to comply may result in personal injuries or even death.

#### Operation



- The equipment must be operated only by professionals. Failure to comply will result in personal injuries or even death.
- Do not touch any terminals or remove any part of the equipment during operation.
   Failure to comply will result in an electric shock.



- Do not touch the equipment casing, fan, or resistor with bare hands to feel the temperature. Failure to comply may result in personal injuries.
- Prevent metal or other objects from falling into the device during operation. Failure to comply may result in fire or equipment damage.

#### Maintenance



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power ON. Failure to comply will result in an electric shock.
- Before maintenance, cut off all equipment power supplies and wait as specified on the product warning sign.
- In case of a permanent magnet motor, do not touch the motor terminals even after power-off because there is still induced voltage generated during rotation. Failure to comply will result in an electric shock.



• Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

#### Repair



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply will result in an electric shock.
- Before inspection and repair, cut off all equipment power supplies and wait as specified on the product warning sign.



- Require for repair services according to the product warranty agreement.
- When the fuse is blown or the circuit breaker or earth leakage circuit breaker (ELCB) trips, wait as specified on the product warning sign before power-on or further operations. Failure to comply may result in personal injuries, equipment damage or even death.
- 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 instructions.
- Do not operate damaged equipment. Failure to comply may result in worse damage.
- After the equipment is replaced, 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, personal injuries, or even death.
- Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

### **Safety Labels**

To ensure safe operations, comply with safety signs on the device, and do not damage or remove the safety labels. The following table describes the meaning of the safety labels.

Safety label	Description
<b>承</b> (2) 10min	<ul> <li>Before using the product, read the user guide and safety precautions carefully. Failure to comply will result in personnel injuries or death or product damage.</li> <li>Do not touch the terminals or remove the cover with power ON or within 10 minutes after power-off. Failure to comply will result in an electric shock.</li> </ul>

## **Table of Contents**

Preface	1
General Safety Instructions	1
1 Product Information	9
1.1 Nameplate and Model Number	9
1.2 Components	10
1.3 Dimensions	11
1.4 Specifications	11
2 Preparation	13
2.1 Requirements Installation Personnel	13
2.2 Requirements on Installation Environment	13
2.3 Requirements on Mounting Stand	14
2.4 Requirements on Installation Space	15
2.5 Installation Tools	16
3 Unpacking and Handling	17
3.1 Unpacking	
3.1.2 Unpacking Procedure.	
3.2 Handling	
3.2.1 Cautions for Handling     3.2.2 Pre-Handling Preparation	
3.2.3 Handling Procedure	
4 Installation	26
4.1 Installation Precautions	26
4.2 Installing Manipulator	26
4.3 Installing End Effector	27
4.4 Installing Camera and Pneumatic Valve	28
4.5 Cable Connection	30
4.6 Wiring and Tubing	32
5 Motion Range	34
5.1 Method for Setting the Motion Range	34
5.2 Motion Range Setting by Angle Range	
5.2.1 Description of Angle Range	
5.2.2 Maximum Angle Range of Joint 1	
5.2.4 Maximum Travel of Joint 3	

5.2.5 Maximum Angle Range of Joint 4	37
5.3 Description of Mechanical Stops	37
5.4 Standard Motion Range	38
6 Maintenance	40
6.1 Safety Instructions for Maintenance and Repair	40
6.2 Periodic Inspection Items	40
6.3 Component Replacement 6.3.1 Replacing Battery (Lithium Battery) 6.3.2 Replacing Indicator Lamp 6.3.3 Replacing Cable 6.3.4 Replacing Grease	46 47 48
6.4 Home Position Calibration.  6.4.1 Description of Home Position Calibration.  6.4.2 Home Position Calibration Procedure.  6.4.3 Home Position Calibration of Joint 2	52 53 56

## 1 Product Information

## 1.1 Nameplate and Model Number

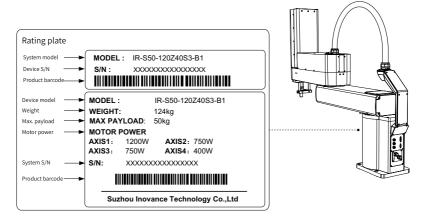


Figure 1-1 Nameplate



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



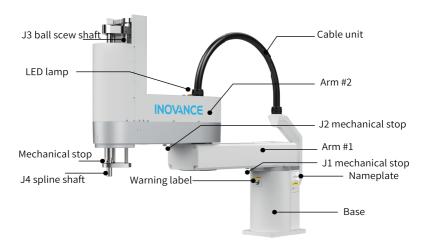
Figure 1-2 Model number

① Family INOVANCE Robot	4 Arm Length 40: 400 mm 120: 1200 mm	<ul> <li>Cable Length</li> <li>No drag cable</li> <li>3 m standard cable</li> <li>5 m standard cable</li> <li>3 m highly flexible cable</li> </ul>
Serial Number     S: SCARA robot     R: 6-axis robot     TS: Ceiling-mounted     SCARA robot	(5) Max. Z-axis stroke (empty for models without lead screw) Z40: Max. 400 mm stroke	(8) Controller Identity A: ARM-based dive-control integrated controller (IP20) B: RM-based dive-control integrated controller (IP54) E: Discrete controller
③ <b>Load</b> 3: 3 kg 7: 7 kg 50: 50 kg	<ul><li>6 Mounting Mode</li><li>C: Cleanroom</li><li>S: Standard</li><li>P: Protection</li></ul>	<ul> <li>Manipulator Platform Identity</li> <li>0: 1.0 series</li> <li>1: With gyroscope</li> <li>2: 2.0 series</li> </ul>

### Note

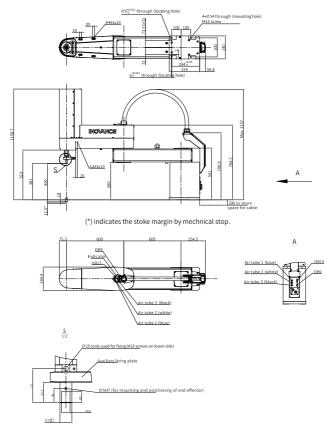
The product information in this guide is the information of standard models in a standard environment. For information about non-standard models or cleanroom models, contact the provider.

## 1.2 Components



## 1.3 Dimensions

#### Dimensions of IRB-S50-120Z40S3-B1



## 1.4 Specifications

Model		IR-S50-120Z40S3-B1
Arm length	Arm 1 + Arm 2	1200 mm
	Arm 1	600 mm
	Arm 2	600 mm
Max. speed	J1 + J2	7400 mm/s
	J3	750 mm/s
	J4	600°/s
Repeatability	J1 + J2	±0.05 mm
	J3	±0.02 mm
	J4	±0.005°

	Model	IR-S50-120Z40S3-B1
Load	Max. load	50 kg
	Max. load inertia	2.45 kg.m <sup>2</sup>
	Mounting hole	200 mm x 200 mm
Weight (excluding cables)	Manipulator weight	124 kg
Drive mode	All joints	AC servo motor
Motor power	J1	1200 W
	J2	750 W
	J3	750 W
	J4	400 W
Signal line	24 (15pin: D-sub + 9pin)	
Air tube	Ф6 mm x 3, 0.59 Mpa (6 kgf/cm²:86 psi)	
Operating conditions	Ambient temperature	5°C to 40°C (no excessive temperature changes)
	Relative humidity	10% to 80% RH
Noise level	Laeq=75 dB(A)	
Matching controller	IRCB500–4MD, IRCB500–4MD-E	
Maximum motion	J1	±128°
range	J2	±150°
	J3	400 mm
	J4	±360°
Cycle time	0.84s (5 kg load)	

## 2 Preparation

## 2.1 Requirements Installation Personnel

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 all the installation requirements and related technical documents.

Non-professionals are strictly prohibited from product installation, wiring, maintenance, inspection and part replacement.

## 2.2 Requirements on Installation Environment

#### **General environmental requirements**

Set up the robot system in an environment that complies with the following conditions in order to maximize and maintain the performance of the equipment and to use it safely.

Item	Requirement
Operating temperature and humidity	5°C to 40°C, 10% to 80%RH, non- condensing
Storage temperature and humidity	-10°C to 55°C, ≤80%RH, non-condensing
Transportation temperature and humidity	-10°C to 55°C, ≤80%RH, non-condensing
EFT/B immunity	2 kV or less
Static immunity	6 kV or less
Environment	◆Install indoors

Table 2-1 Environmental conditions

#### Special environmental 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. Please consult your provider.
- If you want to use the robot to handle food directly, please consult your provider in advance to avoid contamination of the food by the robot.



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

## 2.3 Requirements on Mounting Stand

You need to make a stand for fixing the robot. The shape and size of the stand vary depending on the purpose of the robot system. Requirements on the stand are listed as follows for your reference during design.

- The stand supports not only the weight of the robot, but also the dynamic forces generated by the robot when it moves at maximum acceleration. Ensure that the stand has sufficient bearing capacity by using the transverse beam and other reinforcement materials.
- The torque and reaction force generated by the robot action are described in the table below:

Туре	Size
Maximum torque in horizontal plane	1200 N.m
Maximum reaction force in horizontal direction	3200 N
Maximum reaction force in vertical direction	5600 N

- The threaded holes on the stand for mounting the manipulator are M12. Use screws conforming to the strength of GB/T 3098.1 class 10.9 or 12.9. For details about the dimensions, see "1.3 Dimensions" on page 11.
- The plate for the robot mounting face should be 20 mm thick or more and made of steel to reduce vibration. The surface roughness of the steel plate should be 25  $\mu$ m or less.
- Fix the stand firmly on the ground or wall.
- Keep the Z-axis of the robot perpendicular to the horizontal plane during installation.
- When using a level for height adjustment of the stand, use screws with a diameter larger than M16.
- When cutting holes in the stand for passing cables, ensure that the diameter of the holes is not less than 60 mm.

• Take the storage space of the controller into account when designing the stand. Please see the user guide of the controller for detailed data.

## 2.4 Requirements on Installation Space

#### Motion range of IR-S50-120Z40S3-B1 standard model

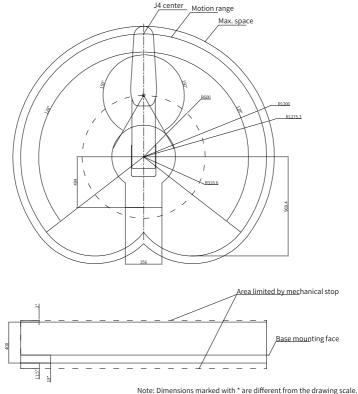
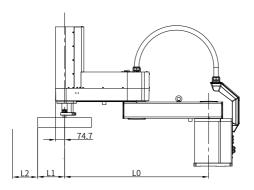


Figure 2-1 Motion range of IR-S50-120Z40S3-B1 standard model (mm)

#### Maximum range

The maximum range is the range where the robot arm may cause interference. When an end effector with a radius of 74.7 mm or more is mounted, set the maximum range to the length of the two robot arms plus the radius of the end effector.



- L0: Length of the robot arms
- L1: Radius of the end effector
- L2: Safety space
- The safety distance should be greater than L0+L1+L2.

## 2.5 Installation Tools

Table 2-2 Installation tools

Tool	Quantity (PCS)
M12 outer hexagon wrench	1
Scissors or utility knife	1
Protective gloves	1
Safety shoes	1
Hoisting sling	1

## 3 Unpacking and Handling

## 3.1 Unpacking

#### 3.1.1 Cautions for Unpacking



Check whether the packing is intact and whether there is damage, water seepage, damp, and deformation.

Unpack the package by following the package sequence. Do not hit the package with force.

Check whether there are damage, rust, or injuries on the surface of the equipment or equipment accessories.

Check whether the number of packing materials is consistent with the packing list.



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.

## 3.1.2 Unpacking Procedure

1. Unpack the carton.

Cut the PET tape using scissors or a utility knife, and remove the cover of the carton and the paper corner protectors. Move the carton from bottom to top and remove it.



Wear gloves to prevent scratches.

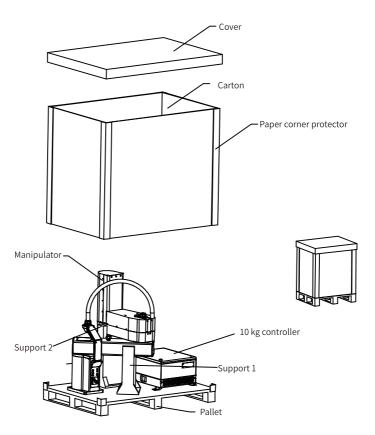
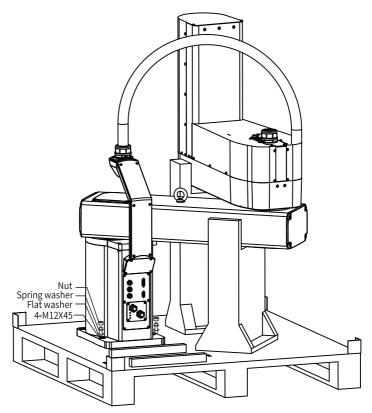


Figure 3-1 IR-S50 series robot packaging

 Remove the manipulator from the pallet.
 Remove bolts connecting the manipulator and the pallet using the M12 outer hexagon wrench.

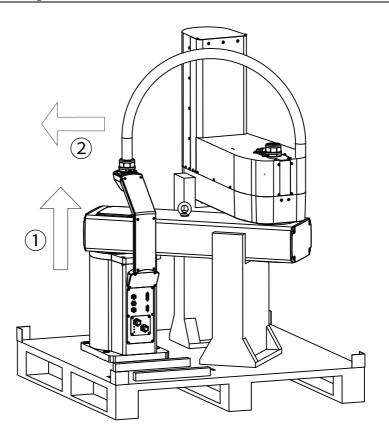


Stabilize the robot when removing the bolts fixing the manipulator to avoid bodily injury or equipment damage caused by titling of the equipment due to unstable center of gravity.



### 3. Take out the manipulator.

Take out the manipulator by lifting it from bottom to top, and moving it horizontally. See "3.2.3 Handling Procedure" on page 22.





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

### 3.2 Handling

#### 3.2.1 Cautions for Handling



#### Danger

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



- 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.



- 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 longdistance 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.

## 3.2.2 Pre-Handling Preparation

 For a newly shipped robot, move it in the posture as it was delivered, as shown below.

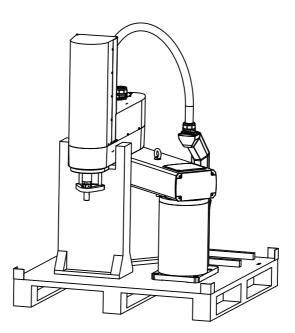


Figure 3-2 Robot posture at delivery

- 2. If you want to relocate a robot that is already in use, do the following before moving it:
  - Disconnect all power supplies of the equipment.
  - Disconnect the power and signal cables from the controller
  - Remove the bolts fixing the robot to the base and then remove the robot from the installation base.
  - Secure the robot to the transportation equipment.

## 3.2.3 Handling Procedure

Move the robot onto the mounting stand by lifting.



- When the robot is shipped, its two arms are adjusted to their extreme positions and are fixed together using Velcro.
- Do not remove the Velcro before the robot is secured to prevent the robot from tipping over when the center of gravity is unstable, which may cause personal injury.
- Do not pull the cables of the robot to avoid possible damages.
- It is recommended to use flat lifting straps with a length of 3 m. Make sure that the straps are intact with a load-bearing capacity of not less than 136 kg.
- Wear protective equipment and ensure that the lifting area is safe enough to avoid collision hazards.
- 1. When the robot is delivered, its forearm is secured by a support.



2. Attach one hook of the hoisting sling to the eyebolt on the robot. Ensure the hooking is reliable.



3. Secure the two arms using a strap ①;Pass the strap ② through the forearm of the robot;Attach the other anti-loosening hook of the hoisting sling to the strap ②.



4. Move the robot by two people, with one stabilizing the robot during transportation, and the other operating the crane to lift the robot and move it to the mounting stand.

## Note

- At least two people are required for handling.
- Wear safety shoes for handling.

#### 4 Installation

#### 4.1 Installation Precautions



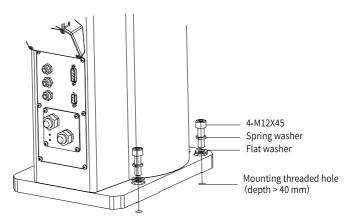
- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Install a safety fence for the system. Failure to comply will result in serious accidents.
- Reserve sufficient space between the equipment and surrounding buildings, structural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



- Do not modify the equipment.
- Do not install this equipment in places with strong electric or magnetic fields.
- When removing the mounting screws of the robot body, hold the robot to prevent it from toppling over.
- For the tabletop mounting, at least two people are required for the operation.

#### 4.2 Installing Manipulator

Secure the robot base to the stand with four M12x45 screws conforming to the strength of GB/T 3098.1 class 10.9 or 12.9, as shown below.



Check that the screws are tightened referring to the following recommended torque.

Nominal Screw Diameter (10.9 or higher)	Installation Torque
M12	30N.m

## 4.3 Installing End Effector

Users need to make their own end effectors. Before attaching an end effector, observe the following guidelines.



- Perform wiring and air tubing of the chuck 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,
  resulting in 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 manipulator 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.

#### To install the end effector:

- 1. Lift the end effector to the lower end of the J4 spline shaft;
- 2. Fix the end effector using auxiliary tooling and clamp the tooling with reverse force to prevent the end effector from rotating while assembling the M16 screws;

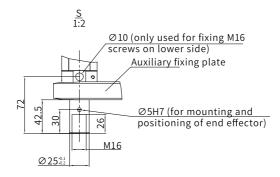


Figure 4-1 Installation position of auxiliary tooling

3. Install the M16 screws from the bottom of the end effector, and tighten the screws using a torque wrench with a torque of 210 N.m. The weight of the end effector should not exceed 50 kg, as shown in the figure below.

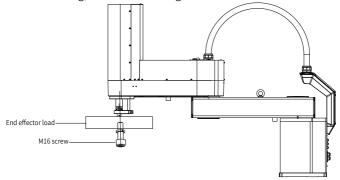


Figure 4-2 Installing the end effector

#### Note

To avoid contact between the end effector and the robot due to the outer diameter of the end effector, the size of the workpiece, or the position of the robot arm, stop operating the robot when installing the end effector. Pay attention to the interference area of the end effector during system layout design. See the maximum area in "2.4 Requirements on Installation Space" on page 15.

### 4.4 Installing Camera and Pneumatic Valve

The IR-S50 series SCARA robot provides mounting holes for the camera and pneumatic valve at the bottom of the second arm, as shown in the following figure.

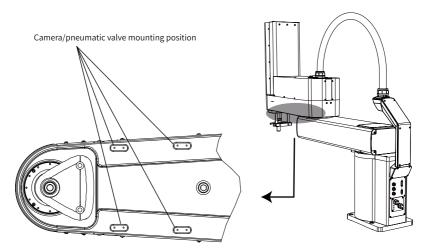


Figure 4-3 Installation position of camera and pneumatic valve

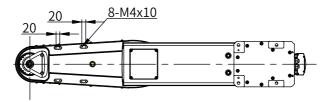


Figure 4-4 Screw size for mounting camera and pneumatic valve

#### 4.5 Cable Connection



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only 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.



- 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.

Connect the power cable and signal cable to the controller.

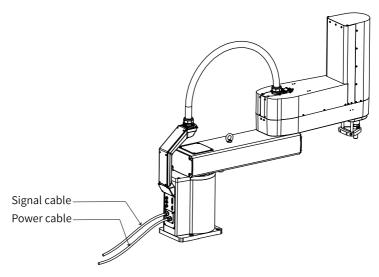
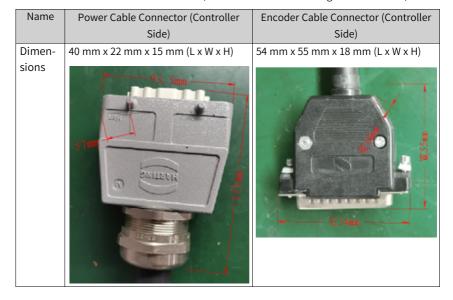


Figure 4-5 Cable connection

Table 4–1 Cable hole dimensions (IRCB500 drive-control integrated controller)



## 4.6 Wiring and Tubing



Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.

#### Wiring (Electrical Wires)



Current higher than 0.5 A is not allowed.

Rated Voltage	Allowable	Wires	Nominal	Remarks
	Current		Sectional Area	
30 VDC/VAC	0.5 A	24	24AWG	Twisted pair

Manufac turer		Cable	Standard
JAE	15-pin	Suitable connector	DA-15PF-N (solder type)
		Fastener	DA-C8-J10-F2-1R (connector fixing screw: # 4-40NC)
	9-pin	Suitable connector	DE-9PE-N (solder type)
		Fastener	DE-C8-J9-F2-1R (connector fixing screw: # 4-40NC)

### Note

Use connectors with the same pin number on both ends of the cable. The robot is shipped with wiring ready for the user.

#### **Tubing (Air Tubes)**

#### Note

Both ends of the air tubes are equipped with quick release couplings (ø6 mm outer diameter) for connecting to the manipulator.

Maximum Operating	Quantity	Dimensions (Outer Diameter
Pressure		x Inner Diameter)
0.59 MPa (6 kgf/cm2)	3	ø6 mm × ø4 mm

- Three air tubes are reserved inside the manipulator, with an outer diameter of 6 mm and an inner diameter of 4 mm.
- The pressure resistance level of the air tubes is ≤0.59 Mpa.
- The manipulator has a total of six φ6 straight-through air tube connectors, 3 at the base and 3 at the forearm.
- The air tube connectors must be distinguished by color or sheet metal with silkscreen. The air tube connectors of the IR-S50 series robots are distinguished by color.

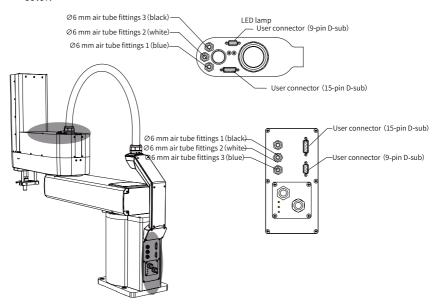


Figure 4-6 Wiring/tubing interfaces

# 5 Motion Range

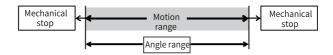
# 5.1 Method for Setting the Motion Range

#### 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:

- Setting by angle range (for all joints)
- Setting by mechanical stops (for J1 to J3)



## 5.2 Motion Range Setting by Angle Range

### 5.2.1 Description of Angle Range

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

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.

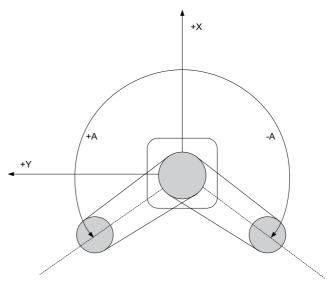
Once the robot receives an operating command, it checks whether the target position specified by the command is within the angle range before operating. If the target position is beyond the set angle range, an error occurs and the robot does not move.

### Note

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

### 5.2.2 Maximum Angle Range of Joint 1

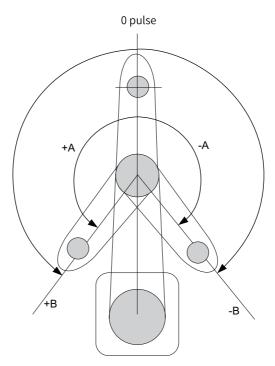
The 0 angle position of J1 refers to the position where the first arm points to the positive direction of the X coordinate axis. From the 0 pulse position, the clockwise angle is positive (+), and the counterclockwise angle is negative (-).



Model	Maximum Motion Range
IR-S50-120Z40S3-B1	±128°

## 5.2.3 Maximum Angle Range of Joint 2

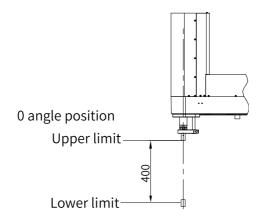
The 0 angle position of J2 refers to the position where the second arm is perpendicular to the first arm. (This is true regardless of the direction of the first arm.) From the 0 angle position,the clockwise angle is positive (+), and the counterclockwise angle is negative (-).



Model	Maximum motion range
IR-S50-120Z40S3-B1	±150°

# 5.2.4 Maximum Travel of Joint 3

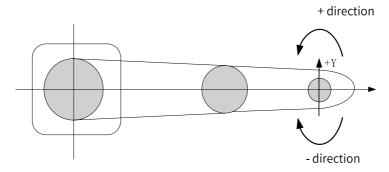
The 0 angle position of J3 is the upper limit position of the axis. When J3 descends from the 0 angle position, it will definitely change to a negative angle value.



Model	Travel of J3
IR-S50-120Z40S3-B1	400 mm

### 5.2.5 Maximum Angle Range of Joint 4

The 0 angle position of J4 is the position where the plane at the top of the axis faces in the direction of the top of the second robot arm. (This is true regardless of the direction of the second arm.) From the 0 angle position, the clockwise angle is positive (+), and the counterclockwise angle is negative (-).

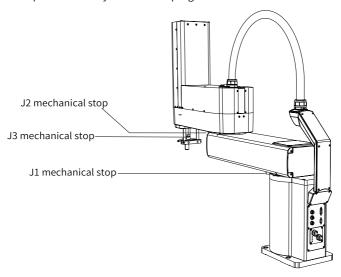


Model	Maximum motion range
IR-S50-120Z40S3-B1	±360°

# 5.3 Description of Mechanical Stops

The IR-S50 series robots have mechanical stops at J1, J2 and J3, and all these mechanical stops are not adjustable. The motion range set by mechanical stops at J1

and J2 is the extreme motion range. The up and down motion range of the mechanical stop at J3 is set by the internal program.



# 5.4 Standard Motion Range

- The "motion range" refers to the situation at the standard (maximum) specifications. When each joint is enabled, the lower center of J4 of the robot moves within the range of motion.
- The "area limited by mechanical stop" refers to the range in which the lower center of J4 can move when each joint is not enabled. The "mechanical stop" is used to mechanically set an absolute motion range beyond which motion is not allowed.
- The "maximum range" is the range where the robot arm may cause interference. When an end effector with a radius of 74.7 mm or more is mounted, set the maximum range to the length of the two robot arms plus the radius of the end effector. The motion range is shown below.

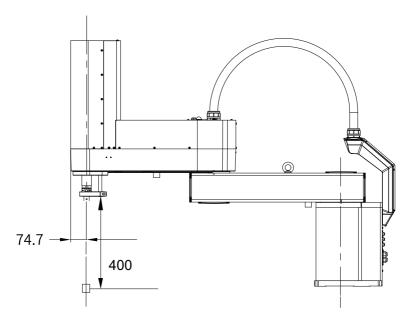


Figure 5-1 Motion range of end effector (unit: mm)

### 6 Maintenance

# 6.1 Safety Instructions for Maintenance and Repair

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



- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only 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.



- 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 Periodic Inspection Items

Perform periodic inspection on items that are difficult to check during operation. Clear the dust especially metal powders on the surface of the drive to prevent the dust from entering the equipment. Clear the greasy dirt from the cooling fan of the equipment.

• Inspection while the power is OFF (robot is not operating)

		Daily	Month	Quarter	Semi-		Mainte	nance Pe	rsonnel
Inspec tion Point	Inspec tion Place	In spec tion	ly Inspec tion	ly Inspec tion	annual Inspec tion	Annual Inspec tion	Profes sionals	Quali fied Person nel	Manu factur er
	End effec tor mount ing screw	✓	✓	✓	✓	✓	✓	✓	✓
Check wheth er the	Robot mount ing bolts	<b>√</b>	✓	<b>√</b>	<b>√</b>	✓	✓	✓	✓
bolts are	Each joint	✓	✓	✓	✓	✓	✓	✓	✓
loose. If yes, tighten them.	Bolts aroun d the axes					✓		<b>√</b>	✓
	Bolts secur ing the motor, reduc er, etc.					✓		✓	✓
Check wheth er the connec tor is loose. If yes, push it secure ly or tighten	Exter nal con nec tors on the robot (on the con nector plates etc.)	✓	✓	✓	✓	✓	✓	✓	✓
it.	Robot cable unit		<b>√</b>	<b>√</b>	<b>√</b>	<b>√</b>	<b>√</b>	<b>√</b>	<b>√</b>

		Daily	Month	Quartor	Semi-		Mainte	nance Pe	rsonnel
Inspec tion Point	Inspec tion Place	In spec tion	ly Inspec tion	Quarter ly Inspec tion	annual Inspec tion	Annual Inspec tion	Profes sionals	Quali fied Person nel	Manu factur er
Check	Whole	✓	✓	✓	✓	✓	✓	✓	✓
for exter nal defects and remove dust.	Exter nal cables		✓	✓	✓	✓	✓	✓	✓
Check for bends or improp er loca tion. Repair or place it proper ly if neces sary.	Safe guard etc.	✓	✓	✓	✓	✓	✓	✓	✓
Check tension of timing belt. Tight en it if neces sary.	Inside arm #2				✓	✓	✓	✓	<b>✓</b>

		Daily	Month	Quarter	Semi-		Mainte	nance Pe	rsonnel
Inspec tion Point	Inspec tion Place	In spec tion	ly Inspec tion	ly Inspec tion	annual Inspec tion	Annual Inspec tion	Profes sionals	Quali fied Person nel	Manu factur er
Check if the	Ball screw				<b>✓</b>	<b>√</b>	<b>√</b>	<b>✓</b>	<b>√</b>
lubri cating	Spline				✓	✓	✓	✓	✓
grease is sufficient for lubrica tion, and add an appro priate amoun t of lubri cating grease as need ed.	Polish ed rod lubri cation inspec tion place				✓	✓	✓	✓	✓

• Inspection while the power is ON (robot is not operating)

Inspec tion Point	Inspec tion Place	Daily Inspec tion	Month ly Inspec tion	Quar terly Inspec tion	Semi- annual Inspec tion	Annual Inspec tion	Mainte Profes sionals	nance Pe Quali fied Person nel	Manu factur er
Shake the cable gently by hand to check for wire break age.	Exter nal cables (includ ing cable units of the robot)				<b>√</b>	✓		<b>√</b>	✓
Press each arm by hand in the ena bled state to check wheth er the arms shake.	Each joint					✓		✓	<b>✓</b>

• Inspection while the power is ON (robot is operating)

			Month	Ouer	Comi		Mainte	nance Pe	rsonnel
Inspec tion Point	Inspec tion Place	Daily Inspec tion	Month ly Inspec tion	Quar terly Inspec tion	Semi- annual Inspec tion	Annual Inspec tion	Profes sionals	Quali fied Person nel	Manu factur er
Check the motion range.	Each joint					<b>✓</b>		<b>√</b>	✓
Check wheth er unusu al sound or vibra tion occurs.	Whole	✓	✓	<b>√</b>	<b>√</b>	<b>√</b>	✓	<b>√</b>	✓
Meas ure the accura cy repeat edly by a gauge.	Whole					<b>√</b>		<b>√</b>	<b>√</b>

### 6.3 Component Replacement

### 6.3.1 Replacing Battery (Lithium Battery)



- Do not maintain the equipment after power-on. Failure to comply will result in an electric shock.
- When disposing the battery, consult with the professional disposal services or comply with the local regulation.
- Be sure to use lithium batteries correctly, the wrong way of use may lead to lithium battery heat, leakage, explosion or even fire, resulting in serious damage to personal and property safety.
  - Do not charge the lithium battery.
  - Do not pressurize or deform the lithium battery.
  - Do not disassemble the lithium battery.
  - Do not short-circuit or misconnect the lithium battery.
  - Do not heat the lithium battery.
  - Do not put the lithium battery into fire.
  - Do not solder the battery terminals.
  - Do not force discharge the lithium battery.

To prevent loss of the home position, when replacing the battery, disassemble the back cover of the manipulator, take out the battery to be replaced, insert the new battery into the white 2P connector, and then pull out the old battery and fix it in the wire chamber. The replacement procedure is as follows:

 Remove the screws of the base extension arm cover and then remove the base tail assembly cover.



Figure 6-1 Battery position

- 2. Cut the binding strap securing the battery to the battery board.
- 3. Tie the new battery to the battery board with a binding strap.
- 4. Fix the battery board to the cable bracket.
- 5. Connect the new battery to the empty white 2P cable end connector.
- 6. Remove the old battery.

### Note

If the home position is lost due to failure to comply with the preceding steps, see "6.4.1 Description of Home Position Calibration" on page 52.

### 6.3.2 Replacing Indicator Lamp

The following shows how to replace the indicator lamp.

1. Remove the arm top cover, as shown in the following figure.

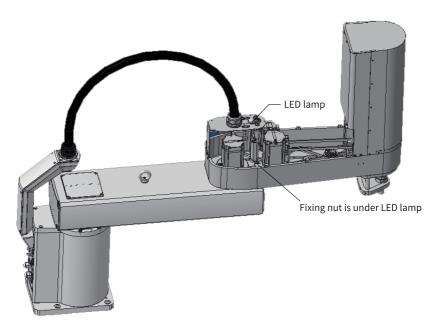


Figure 6-2 Position of indicator lamp

- 2. Remove the connector connected to the indicator lamp.
- 3. Rotate the fixing nut counterclockwise to remove it.
- 4. Remove the indicator lamp from the sheet metal.
- 5. Connect the removed wires to the new indicator lamp, then fix the new lamp onto the mounting bracket and connect it to the connector.

# 6.3.3 Replacing Cable

- Remove the fixing screws of the base cable board, and then remove the cable board.
- 2. Replace the damaged cable.

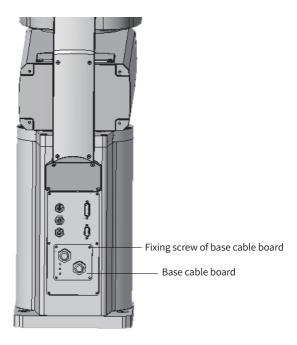


Figure 6-3 Base cable board



- Do not pull the cable board forcibly. Failure to comply will result in cable damage, wire breaking, or poor contact, causing electric shock or system fault.
- After removing the cable board, ensure that the cables are correctly connected during cable maintenance.

## 6.3.4 Replacing Grease

### Note

- Only use original grease.
- Normally, the reducer does not need to be greased. However, under the extreme conditions (duty cycle, speed, load), the grease needs to be replaced regularly.
- Replacing grease by non-professional personnel is not allowed. If maintenance is needed, please contact our after-sales maintenance personnel.

Before maintenance, it is necessary to clarify the parts configuration of the manipulator. The type of lubricating grease used for reducers or screws varies from supplier to supplier. For example, there are two brands of RV reducers, Zhenkang and Nabtesco, for J1 and J2 axes, and two brands of lead screws, IKO and LAIEN, for J3 axis. The specific types of lubricating grease used and their codes are listed in the table below.

Table 6–1 Grease type

Part Name	Grease Type	Grease Code
Zhenkang reducer	Zhenkang reducer grease-ZK- J01-16KG	24060216
Nabtesco RV reducer	Nabtesco reducer grease	24060155
IKO lead screw	Lead screw grease-MUL	24060125
LAIEN lead screw	TEMP LRL No.3	
LAIEN spline screw		
Plain shaft		



Figure 6-4 Zhenkang reducer grease



Figure 6-5 Grease for lead screw, spline screw and plain shaft

After the manipulator is put into service, it is necessary to replace the grease periodically to ensure that the important parts of the manipulator are well lubricated. According to the technical manual of the reducer manufacturer, RV reducers generally require replacement of grease after the first 20000 hours of operation, otherwise the grease may deteriorate. For heavy-duty SCARA robots with a payload of 50 kg, the RV reducer of J2 axis operates at a higher speed. Therefore, the time for the first grease replacement is theoretically shorter than 20000 hours. The specific recommended time for the first grease replacement is as follows.

Part	Replacement Period
RV reducer of J1	2 years (subject to actual operating conditions)
RV reducer of J2	2 years (subject to actual operating conditions)
Lead screw and plain shaft of J3	6 months
Spline screw of J4	6 months

Table 6–2 Recommended first grease replacement time

## Note

- Before maintenance, prepare the necessary tools and fixtures, lubricating grease, screws and other auxiliary materials in advance.
- During the maintenance, if you encounter special problems, you can take photos for record and contact us for help.
- For special operating conditions, such as those with fast operating rhythms, regular lubrication is required. Please consult us for specific maintenance cycles.



If grease gets into your eyes, mouth, or on your skin, follow the instructions below.

- If the grease gets into your eyes, flush them thoroughly with clean water, and then see a doctor immediately;
- If the grease gets into your mouth, wash out your mouth with water thoroughly; if swallowed, see a doctor immediately;
- If the grease gets on your skin, wash the area thoroughly with soap and water.

#### 6.4 Home Position Calibration

#### 6.4.1 Description of Home Position Calibration

The home position is the reference point and base point for the robot. After parts (motors, reducer, timing belt, and cables etc.) have been replaced, the robot cannot execute the positioning properly because a mismatch exists between the home position stored in the motors and its corresponding home position stored in the controller. Therefore, home position calibration is required after the part replacement.

#### Note

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



- Install a safety fence for the system to prevent people from entering the action area of the system. Failure to comply will result in serious accidents.
- Before operation, check that there is no person inside the safety fence. Do not
  enter the action area during system running. Failure to comply will result in
  serious safety problems.
- Operating the robot system in teaching 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.

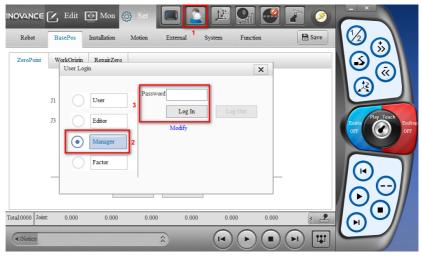
#### 6.4.2 Home Position Calibration Procedure

Both the teaching software on PCs and the hand-held teach pendant provide an operation interface for home position calibration. The following takes the teaching software on PC as an example. The operations on the hand-held teach pendant are similar.

Due to the strong correlation between the coordinates of the robot's work points and the accuracy of J2, it is necessary to complete the home position calibration of J2 before calculating the robot coordinates. The teach pendant provides a right/left wrist rule wizard. Follow the wizard to calibrate the home position. For the adjustment method, see "6.4.4 Home Position Calibration of Joint 2" on page 58.

When calibrating the home position using the teach pendant, adjust J3 and J4 at the same time.

- 1. Log in to the user account.
  - a. Click the shortcut key of user settings on the main interface of the PC teaching software or the hand-held teach pendant to open the user settings interface.
  - b. Enter the password in the password input box and click the **log In** button.

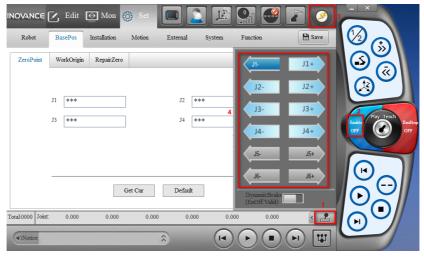


2. Switch to the absolute zero setting interface.

Choose **Set** > **BasePos** > **ZeroPoint** on the main interface of the teaching software or the hand-held teach pendant.

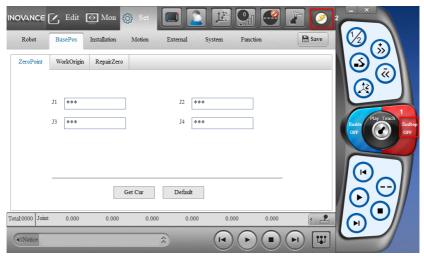


- 3. Move each joint of the robot to the home position.
  - a. Move the robot near the home position by using the joystick on the hand-held teach pendant or on the operation interface on the teaching software. For details, see the Teaching Software Guide/Programming Guide.
  - b. Also, you can manually push the robot to the home position when the motor is not enabled.

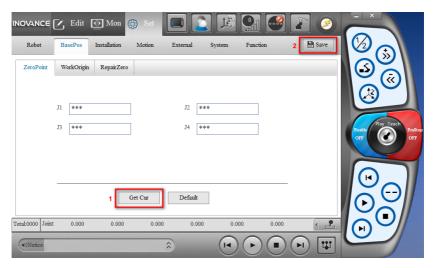


- 4. Switch to the emergency stop state.
  - a. Click the virtual emergency stop button on the PC teaching software or press the red emergency stop button on the hand-held teach pendant.

b. The status indicator on the upper right corner of the teaching software (or the display of the hand-held teach pendant) shows the emergency stop state (in red).



- 5. Obtain and save the home position information.
  - a. Click the **Get Cur** button when the robot moves to the home position to obtain the encoder pulses at the home position.
  - b. Click the **Save** button to complete the home position calibration.



### 6.4.3 Home Position of Each Joint

1. Home position of J1: The position that overlaps with the Y-axis of the robot coordinate system.

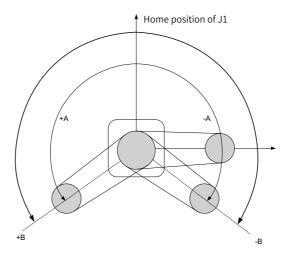


Figure 6-6 Home position of J1

2. Home position of J2: The position that overlaps with the Y-axis of the robot coordinate system.

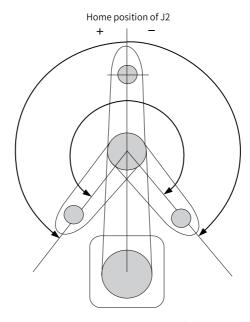


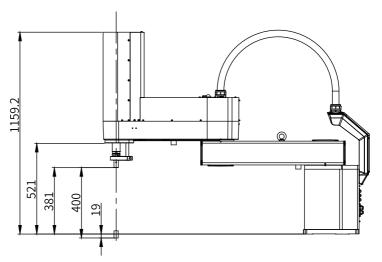
Figure 6-7 Home position of J2

3. Home position of J3: The upper limit position of the J3.

Home position
Upper limit
Lower limit

Figure 6-8 Home position of J3

The upper limit position of the motion range of J3 is shown in the following figure:



4. Home position of J4: The position where the plane of the axis (or the slots of the upper and lower mechanical stops) faces the direction of the top of the second robot arm.

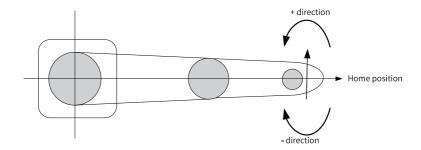


Figure 6-9 Home position of J4

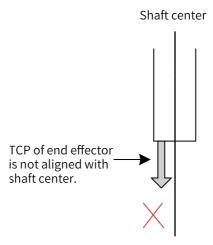
#### 6.4.4 Home Position Calibration of Joint 2

Due to the strong correlation between the coordinates of the robot's work points and the accuracy of J2, it is necessary to complete the home position calibration of J2 before calculating the robot coordinates. To calibrate the home position of J2, follow the wizard provided on the teach pendant for home position calibration using right/left wrist rule.

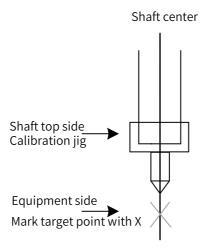
#### Calibration procedure

1. The reference point for home position calibration is the center of the ball screw spline shaft.

When the center of the end effector deviates from the center of the ball screw spline shaft, it is necessary to remove the end effector and perform home position calibration.



2. Make a home position calibration jig (example) on the top side of the shaft to clarify the center of the shaft, as shown in the figure below. Make the position that can be easily recognized when changing the right/left wrist pose the target point, and mark it with X.



- 3. Perform home position calibration using the left/right wrist.
  - a. Adjust the robot end to the target point position using the right wrist (or left wrist) pose. On the teach pendant, go to Set > BasePos > ZeroPoint, click the Get Cur button and record the degree of J2 in current state as Enc1.

- b. Manually adjust the robot end to the target point position using the left wrist (or right wrist) pose. On the teach pendant, go to Set > BasePos > ZeroPoint, click the Get Cur button and record the degree of J2 in current state as Enc2.
- c. On the teach pendant, go to **Set** > **BasePos** > **ZeroPoint**, click the **Default** button and get the currently saved home position info. Calculate (Enc1+Enc2)/2 and fill in the calculation result into the input box of J2, and then click the **Save** button. The home position calibration of J2 is complete.
- 4. After removing the end effector and executing the calibration, install the end effector and move the robot to the teaching point to verify whether is a positional gap. If there is a positional gap, fine-tune the installation position of the end effector and teach the point again.



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