INOVANCE

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IR-TS Series
Ceiling-mounted SCARA robot

User Guide - Mechanical

Industrial Automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

Data code PS00008435 A00

Preface

Introduction

Ceiling-mounted SCARA robots feature compact structure, light weight, fast movement speed, high precision, small footprint, and no dead angles in the working space. They can be applied in mechanical or electrical assembly, picking and placement, material distribution, and material dispensing scenarios. They are suitable for industries with high precision requirements such as automotive, medical, semiconductors, food, pharmaceuticals, hard disk drives, and consumer goods. Ceiling-mounted SCARA robots are available in two arm lengths of 350 mm and 550 mm, with a maximum payload of 4 kg or 5 kg, and a Z-axis travel of 150 mm. They can be installed in an overhead mounting configuration.

This guide describes basic specifications, installation, and maintenance of the product.

Intended Audience

Mechanical engineers

Electrical engineers

System engineers

More Documents

Doc Name	Data Code	Description
IRCB500 Series Robot Control Cabinet User Guide	PS00001641	Describes the specifications, installation, and wiring of the IRCB500 series control cabinet
IRP80 Series Teach Pendant User Guide	19012261	Describes the product information, wiring, and operation of the IRTP80 series teach pendant

Revision History

Date	Version	Description
December 2022	A00	First release

Access to the Guide

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

- Visit *www.inovance.com*, go to "Support" > "Download", search by keyword, and then download the PDF file.
- Scan the QR code on the product with your smart phone.

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 (natural disaster, earthquake, and lightning strike)

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

For details, see the Product Warranty Card.

General Safety Precautions

Safety Disclaimer

1. This chapter presents essential safety instructions for proper use of the equipment. Before operating the equipment, read through the user guide and comprehend all the safety precautions. Failure to comply with the safety precautions may result in equipment damage, severe physical injuries, or even death.
2. "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.
3. Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
4. Inovance shall take no responsibility for any physical injury or property damage caused by noncompliance with this user guide or improper use of the equipment.

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.

General Safety Precautions

- Some drawings in this guide show the equipment without covers or protective guards to display more details. Remember to install the covers and protective guards before using the equipment and operate it in accordance with the instructions.
- Drawings in the user guide are for illustration only and may be different from the equipment 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.

- Before unpacking, check the package for any damage, water seepage, dampness, or deformation.
- 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

- 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.

- 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

- 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.

- Read through the user guide and safety precautions 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.

- 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

- Never allow non-skilled personnel to carry out installation, wiring, maintenance, inspection, or part 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 will 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 will result in an electric shock.
- Ensure that the equipment is well grounded. Failure to comply will result in an electric shock.

- 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.

- 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

- 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 will result in an electric shock.

- 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

- 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 will 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

- Never allow non-skilled personnel to carry out installation, wiring, maintenance, inspection, or part replacement.
- Do not maintain the equipment while power is on. Failure to comply will 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 will 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

- Never allow non-skilled personnel to carry out installation, wiring, maintenance, inspection, or part replacement.
- Do not repair the equipment while power is on. Failure to comply will 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
WARNING • 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 Labels

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.

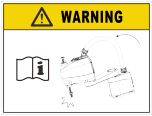
Safety Label	Description
	• Read through the safety instructions and user guide before operating the equipment. Failure to comply may result in equipment damage, physical injuries, or even death. • Do not touch the terminals or remove the cover while power is on or within 10 min after power-off. Failure to comply will result in an electric shock.
	• Secure the robot before removing the fastening screws on the base to prevent the robot from tilting forward due to its center of gravity, which may cause equipment damage or physical injury.
	• Do not touch the energized parts during power-on. Failure to comply may result in an electric shock.
	• Never enter the robot operating area during robot running. Failure to comply may result in collisions with the robot and severe safety issues.

Table of Contents

1 Product Information

1.1 Nameplate and Model Number

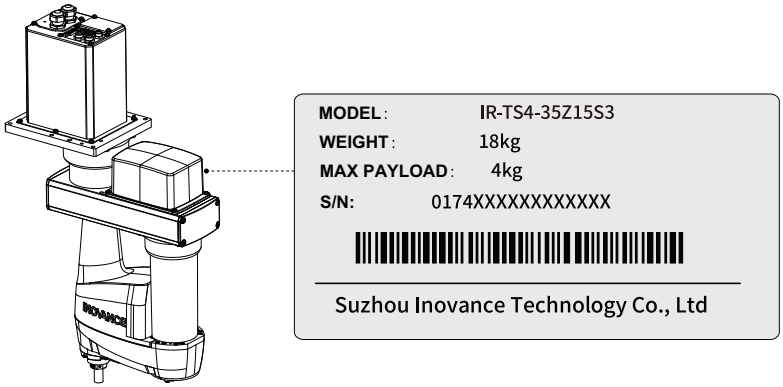


Figure 1-1 Nameplate

Caution

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

IR- TS4 - 35 Z15S3
① ② ③ ④ ⑤ ⑥⑦

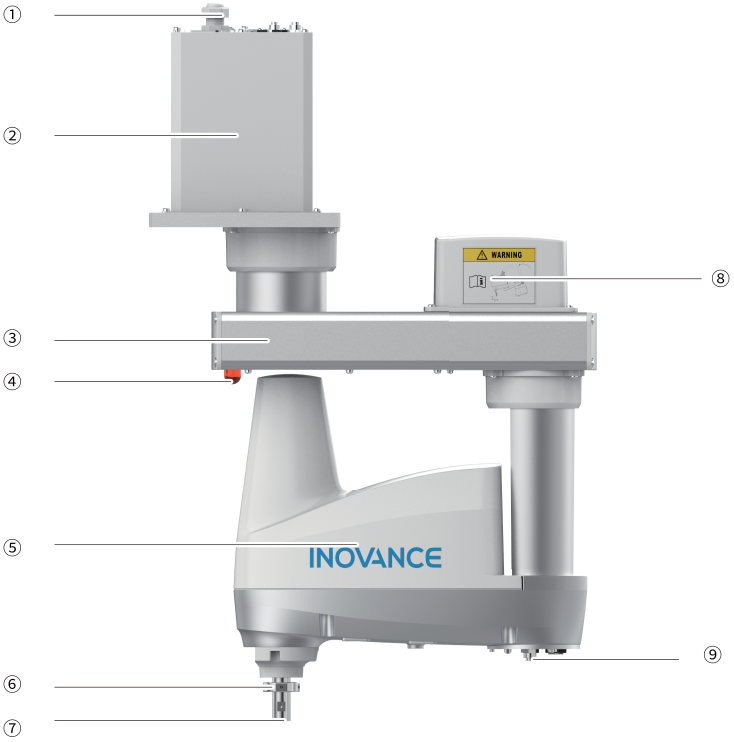
Figure 1-2 Model naming rules

① **Product family** INOVANCE Robot	④ **Arm length** 35: 350 mm 55: 550 mm	⑦ **Cable length** 0: No drag chain cable 3: 3 m standard cable 5: 5 m standard cable G3: 3 m highly-flexible cable
② **Series** TS: Ceiling-mounted SCARA robot S: SCARA robot R: 6-axis robot	⑤ **Maximum travel of Z-axis (empty for models without a lead screw)** Z15: 150 mm	-
③ **Payload** 4: 4 kg 5: 5 kg	⑥ **Installation mode** C: Clean S: Standard P: High-protection	-

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



No.	Description
1	Power cable and encoder cable connectors
2	Base
3	Arm 1
4	State indicator
5	Arm 2
6	Mechanical stop for J3 upper limit
7	J3 lead screw shaft
8	Warning label
9	Air tube connector

1.3 Outline Dimensions

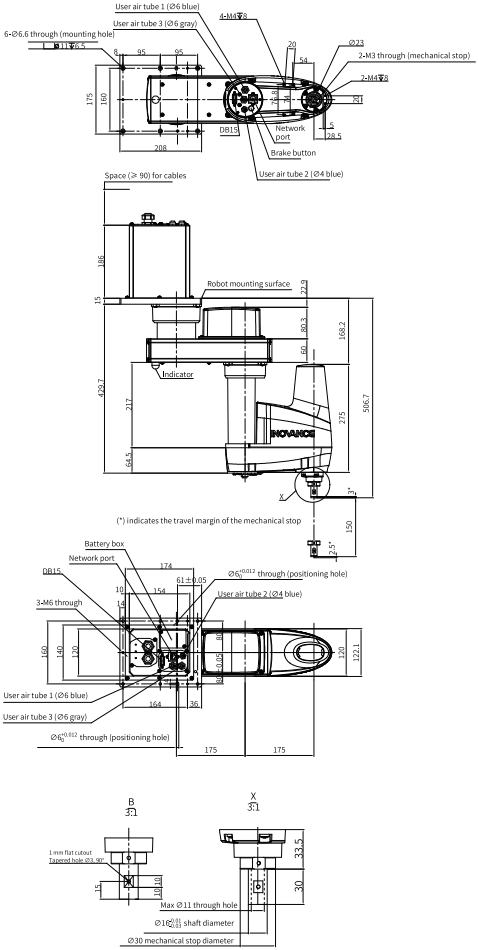


Figure 1-3 IR-TS4-35Z15S3 outline dimensions

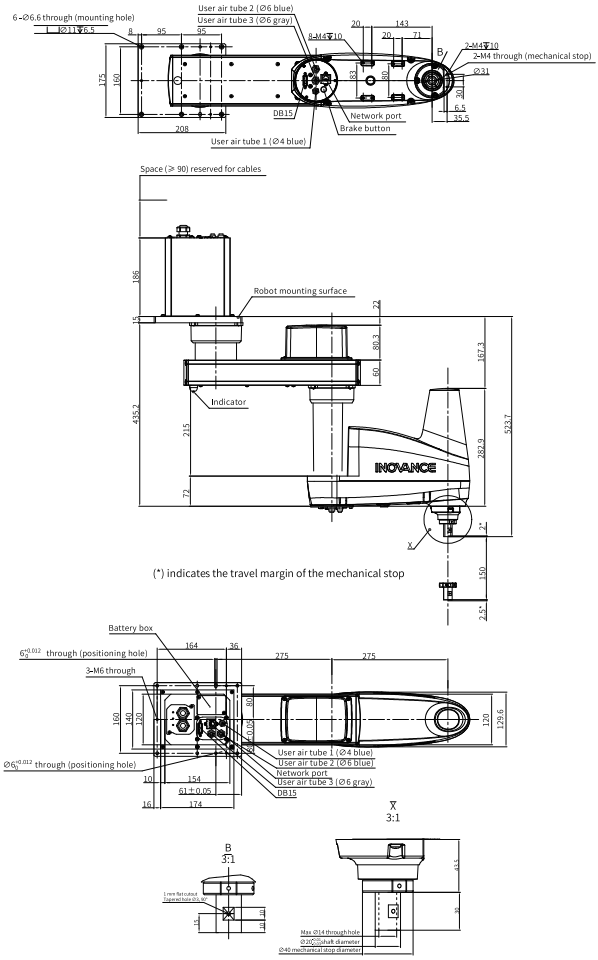


Figure 1-4 IR-TS5-55Z15S3 outline dimensions

1.4 Specifications

Item		IR-TS4-35Z15S3	IR-TS5-55Z15S3
Arm length	Arm 1+Arm 2	350 mm	550 mm
	Arm 1	175 mm	275 mm
	Arm 2	175 mm	275 mm
Maximum motion speed*1	J1+J2	6180 mm/s	9712 mm/s
	J3	1300 mm/s	1300 mm/s
	J4	2600°/s	2000°/s

Item		IR-TS4-35Z15S3	IR-TS5-55Z15S3
Repeat accuracy	J1+J2	±0.01 mm	±0.015 mm
	J3	±0.01 mm	±0.01 mm
	J4	±0.01°	±0.01°
Payload capacity	Rated	2 kg	2 kg
	Max	4 kg	5 kg
Allowable inertia of J4	Rated	0.005 kg.m²	0.01 kg.m²
	Max	0.05 kg.m²	0.12 kg.m²
Mounting hole		95 mm x 95 mm x 160 mm (6-ø6.6 mm)	
Body weight (excluding cables)		18.5 kg	20 kg
Press-in force of J3		100 N	150 N
User wiring		15 (15-pin: D-sub)	
		CAT5E for network port	
User tubing		2 x ø6 mm air tube; pressure resistance: 0.59 Mpa	
		1 x ø4 mm air tube; pressure resistance: 0.59 Mpa	
Ambient conditions	Ambient temperature[1]	5°C to 40°C	
	Relative humidity	10% to 80%	
Noise level[2]		Laeq = 70 dB(A)	
Maximum motion range	J1	±225°	±225°
	J2	±225°	±225°
	J3	150 mm	150 mm
	J4	±720°	±720°
Cycle time*1[3]		0.304s	0.351s

[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] Operating conditions: 4-axis linkage, rated load, 100% speed and acceleration, 50% duty cycle; measurement position: front of the robot, 1000 mm away from the operating area, at least 50 mm above the base mounting surface.

[3] Cycle time: the time required for the robot to move back and forth according to a gantry instruction (300 mm horizontal movement and 25 mm vertical movement) under a load of 1 kg.

2 Preparation Before Installation

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.

Table 2–1 Environmental conditions

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 • Keep away from direct sunlight • Keep away from dust, oil smoke, salt, iron filings • Keep away from flammable and corrosive liquids and gases • Keep away from water • Avoid places with shocks or vibrations • Keep away from sources of electrical interference

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 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.
- Consider the following torques and reaction forces produced by movements of the robot.

Type	IR-TS4-35Z15S3	IR-TS5-55Z15S3
Maximum torque in the horizontal plane	500 N·m	800 N·m
Maximum horizontal reaction force	1200 N	1400 N
Maximum vertical reaction force	1200 N	1300 N

- Use M12 threaded holes on the base table to mount the robot. Use screws with a strength equivalent to Grade 10.9 or 12.9 specified in GB/T 3098.1. For the specific dimensions, see *"1.3 Outline Dimensions" on page 12*.
- To dampen vibrations, use a steel plate with a thickness of over 20 mm and a surface roughness of below 25 μm as the robot mounting surface.
- Fix the base table externally (on the ground or a wall) in a way that prevents displacement.
- Keep the Z-axis of the robot perpendicular to the horizontal plane during installation.
- When using a spirit level for base table height adjustment, use bolts with a diameter larger than M8.

- When cutting cable holes on the base table, make sure that the hole diameters are at least 60 mm.
- Reserve enough space for the robot control cabinet in the base table design. For space requirements of control cabinets, see relevant control cabinet user guides.

2.4 Installation Clearance Requirements

Operating area

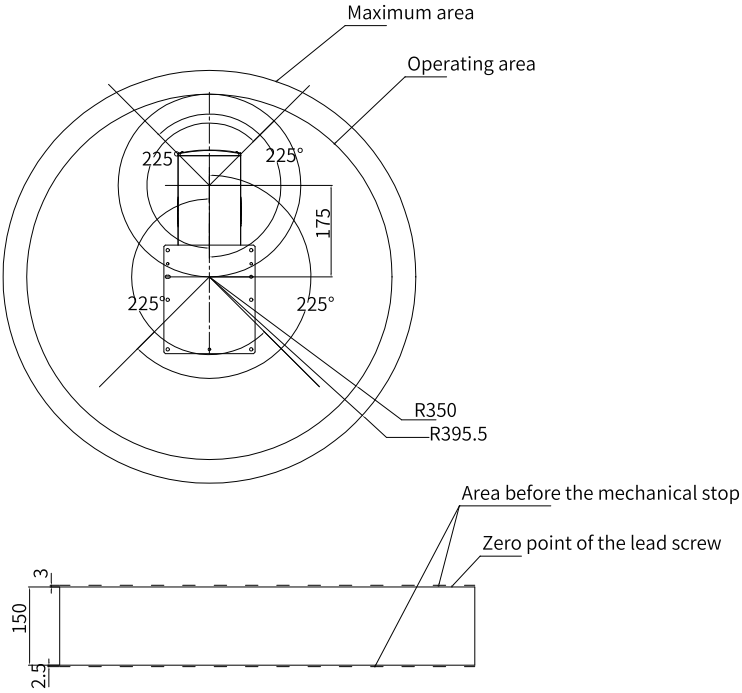


Figure 2-1 Operating area of IR-TS4-35Z15S3 standard model (unit: mm)

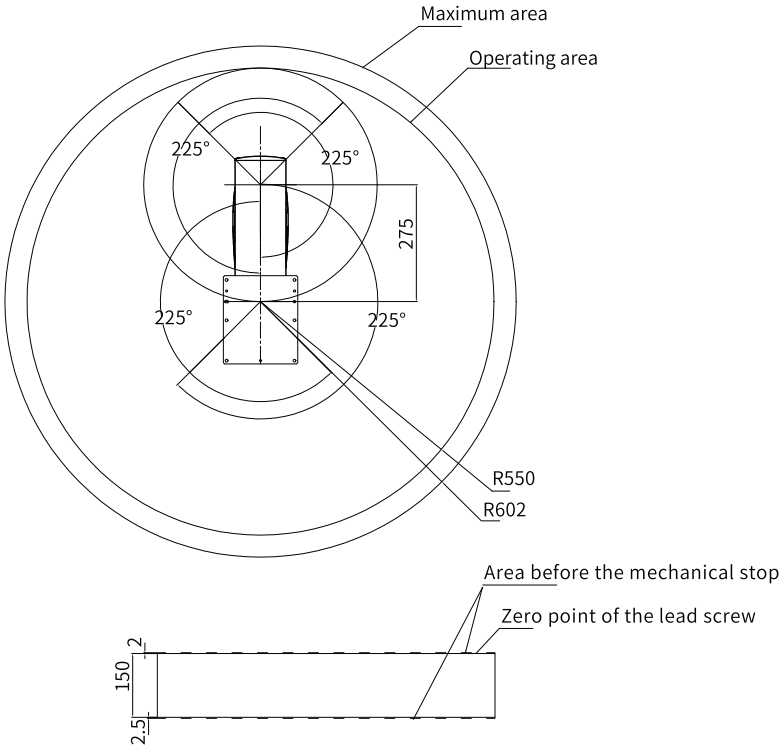
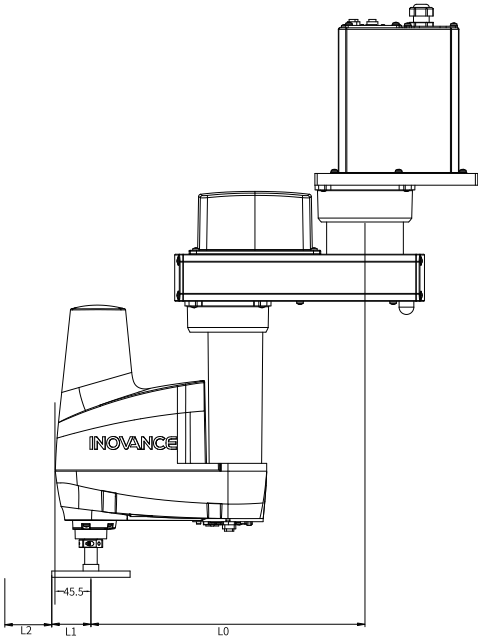


Figure 2-2 Operating area of IR-TS5-55Z15S3 standard model (unit: mm)

Maximum range

The "maximum range" refers to the range in which the robot arm may cause interference. When installing an end effector with a radius exceeding 45.5 mm, set the "upper arm+forearm+end effector radius" as the maximum range.



- L0: Upper arm and forearm length
- L1: Radius of the end effector
- L2: Safety margin

The safety distance should be greater than the sum of L0, L1, and L2.

2.5 Preparation of Installation Tools

Table 2–2 Preparation of tools

Tool	Quantity (pcs)
M6 outer hexagon wrench	1
Scissors or utility knife	1
Claw hammer	1
Straight screwdriver	1
Protective gloves	1
Anti-smash shoes	1
Lifting rope	1
Forklift	1

3 Unpacking and Handling

3.1 Notes

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.

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.

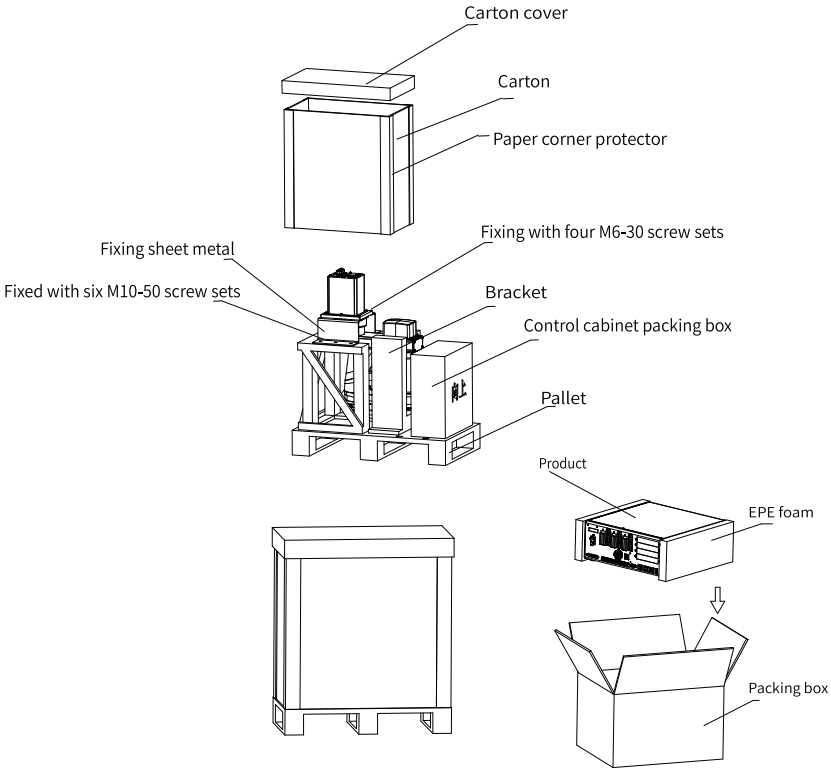
3.2 Unpacking

Unpacking procedure:

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.

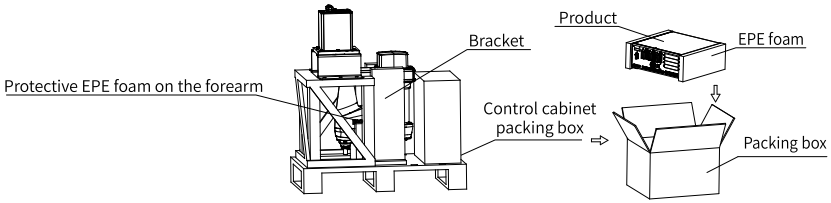
Caution

Wear gloves to prevent scratches.



2. Unpack the control cabinet.

- Cut the packing straps securing the control cabinet packing box with scissors.
- Transfer the control cabinet packing box from the pallet to an open area, ensuring to follow the orientation instructions on the box.
- Open the packing box. 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.



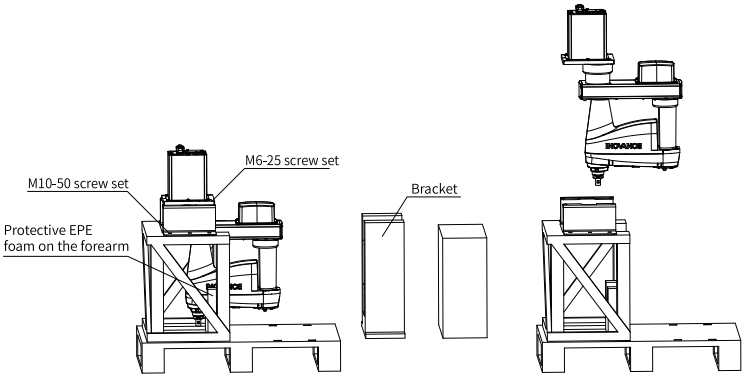
3. Remove the bracket and take out the robot body.

- Remove the outer hexagon self-tapping screws on the bracket with an inner hexagon electric screwdriver.

- Loosen the M6 screws on the pallet (without removing them) with an inner hexagon electric screwdriver.
- Take out the bracket.
- Remove all the M6 screws on the pallet.
- 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.

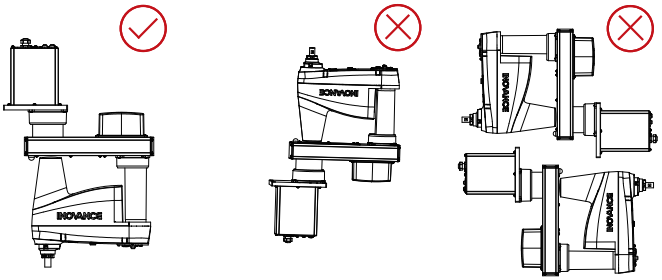
Caution

Be careful when removing the bracket to avoid collisions with the robot.



Caution

Place the robot in the correct manner.



Vertical Inverted Horizontal

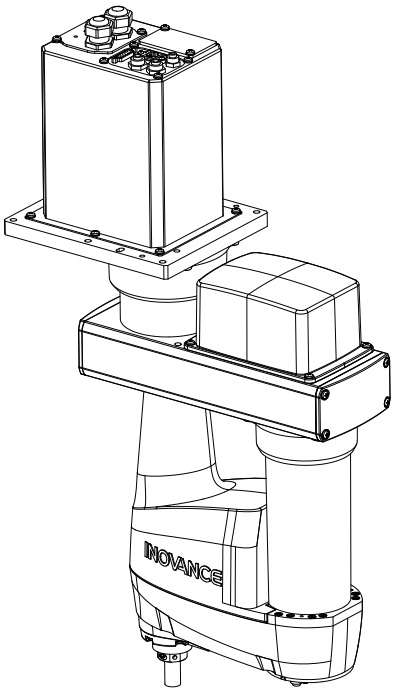
Caution

- 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.
- To repack the robot, reverse the steps above.
- Take out the robot carefully to avoid collision.

3.3 Handling

Preparation before handling

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



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

Handling procedure

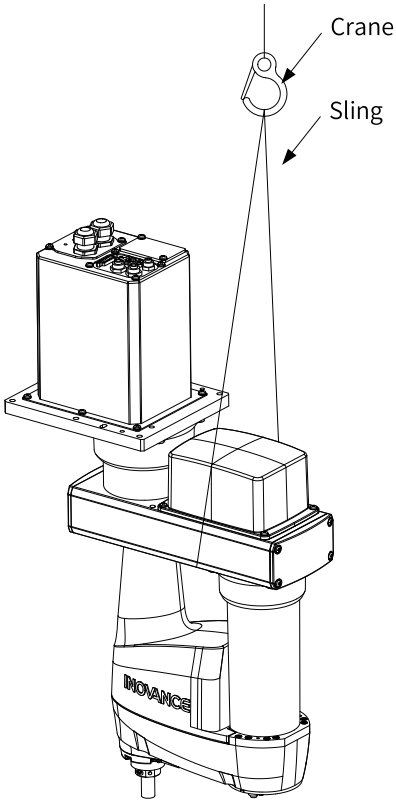
Handling with bare hands

When handling the robot, secure the robot to handling equipment or hold the second arm and the bottom of the base with hands. Be sure to have two or more people carry out the handling operation.

Handling with a crane

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

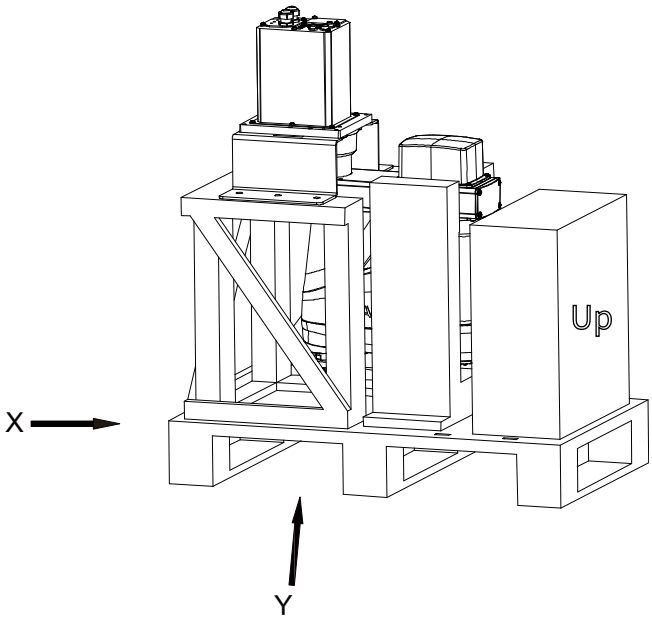
Be sure to use a flat sling to secure the robot in the same posture as it was in the factory. Thread the flat sling through the lower gap so that the sling fits snugly on the robot, as shown below.



Handling with a forklift

When handling the robot using a forklift, secure the robot onto its original pallet or a baseplate with sufficient load-carrying capacity with screws. Insert the fork of the forklift under the pallet or baseplate and lift the robot together with the pallet or baseplate.

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



Note

- The robot is located on one side of the pallet. Therefore, when inserting the fork from the Y direction, pay attention to the counterweight on the other side to prevent the robot from falling over.
- Do not pull the cables of the robot to avoid possible damages.

4 Installation

4.1 Installation Precautions

Danger

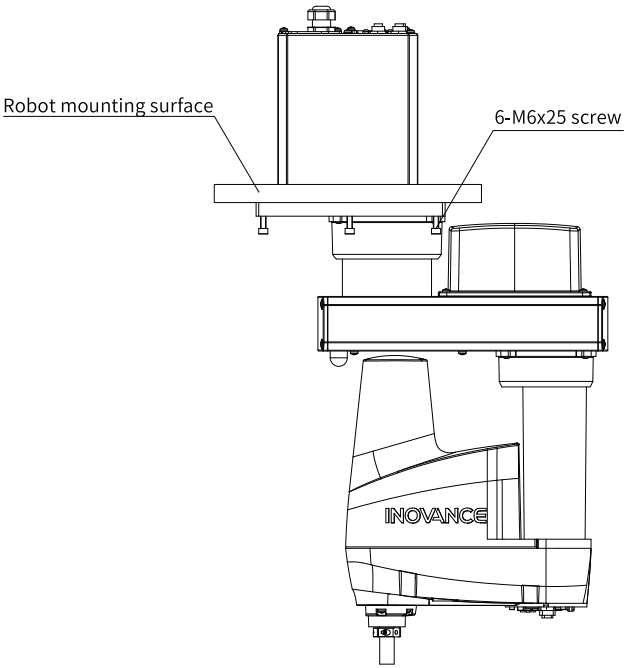
- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Install a safety fence for the system. Failure to comply will result in serious accidents.
- Reserve sufficient space between the equipment and surrounding buildings, structural 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.

Warning

- 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 the Robot Body

Secure the base to the base table with six M6x25 screws, as shown in the following figure. Use screws with a strength equivalent to Grade 10.9 or 12.9 specified in GB/T 3098.1.



Check if the screws are securely fastened according to the following torque recommendations.

Screw Nominal Diameter (Grade 10.9 or Higher Strength)	Installation Torque
M6	12 N·m

4.3 Installing an End Effector

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

Caution

- 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.

Refer to the following dimensions when designing your end effectors and mounting methods.

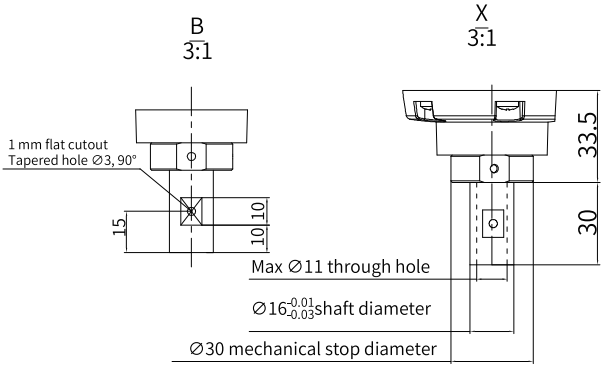


Figure 4-1 Auxiliary tooling installation dimensions for IR-TS4-35Z15S3 (unit: mm)

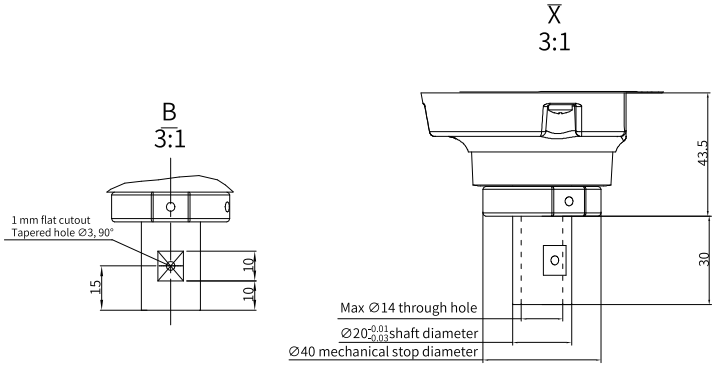


Figure 4-2 Auxiliary tooling installation dimensions for IR-TS5-55Z15S3 (unit: mm)

The weight of any end effector on the ceiling-mounted IR-TS4-35Z15S3 robot must not exceed 4 kg. The weight of any end effector on the ceiling-mounted IR-TS5-35Z15S3 robot must not exceed 5 kg, as shown in the diagram.

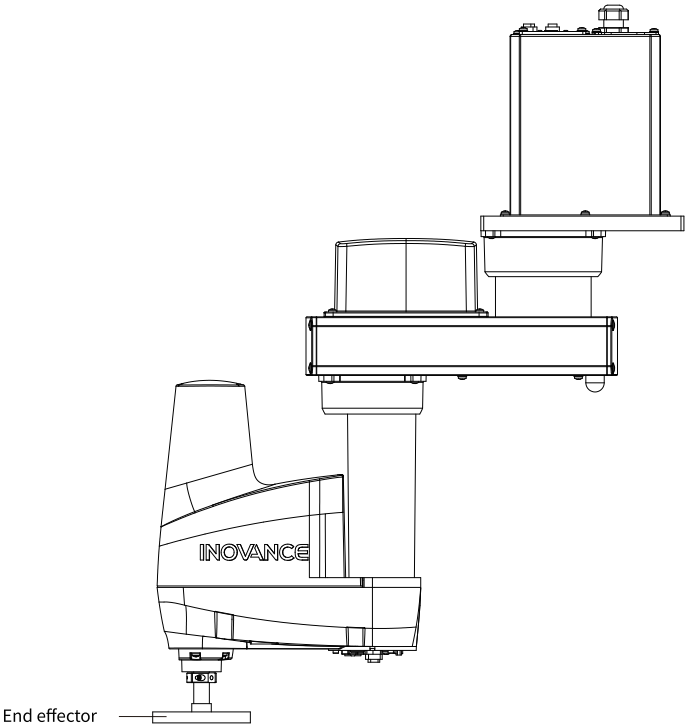


Figure 4-3 Installing an end effector

If you need to move the third axis up or down when installing an end effector, turn on the controller power supply. Press the brake switch while moving the axis up or down or rotating the axis. The brake switch is a momentary switch. It releases the brake only while pressed.

When the brake release switch is pressed, be aware of the potential downward movement or rotation due to the weight of the end effector.

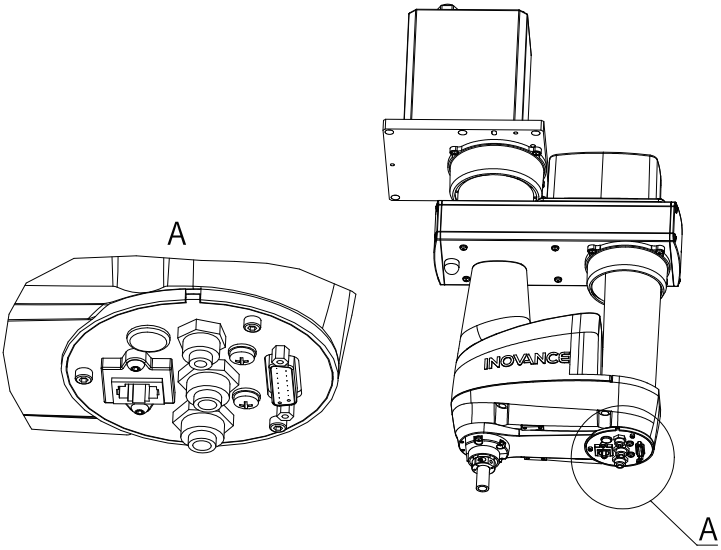


Figure 4-4 Position of the brake release switch

Note

Stop robot movement when installing an end effector to prevent contact between the end effector and the robot body due to the outer diameter of the end effector, workpiece size, or the robot arm position. Pay attention to the interference range of the end effector during system layout design. See the "maximum range" in *"2.4 Installation Clearance Requirements" on page 17*.

4.4 Connecting Cables

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.

Connect the power cable and the signal cable to the control cabinet separately.

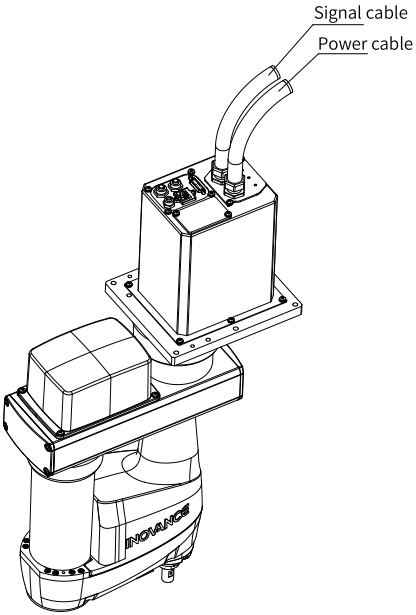
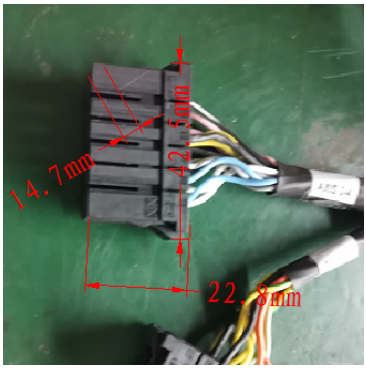
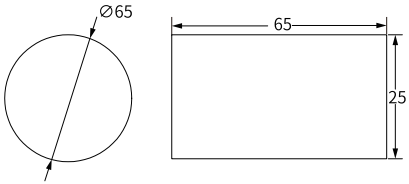
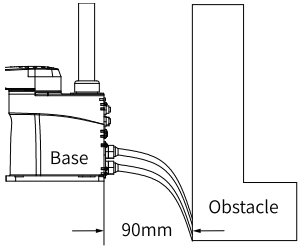


Figure 4-5 Cable connection

Table 4–1 Cable hole dimensions (IRCB500 control cabinet)

Name	Power Cable Connector (Cabinet Side)	Encoder Cable Connector (Cabinet Side)
Dimen-sions	42.5 mm x 22.8 mm x 14.7 mm (W x D x H) 	53 mm x 55 mm x 16.4 mm (W x D x H)

The following table lists recommended minimum hole dimensions and space reservations for cable routing (red box indicates recommended dimensions).

Cable Hole Dimensions (Circular Hole & Square Hole) (mm)	Reserved Space (Connector Size+Cable Bending Radius) for Cables on the Robot Side
	

4.5 User Wiring and Tubing

Danger

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

Wiring (cables)

Warning

Current higher than 0.5 A is not allowed.

Model	Allowable Current	Number of Conductors	Cable Size	Description
DB15	0.5 A	15	24 AWG	Connector included

Note

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

Communication cable requirements

Use Cat5e shielded twisted pair cables for the network port and as the built-in network cable. The cables must support a maximum communication speed of 1000 bps and meet communication requirements of industrial cameras and other devices.

Tubing (air tubes)

Note

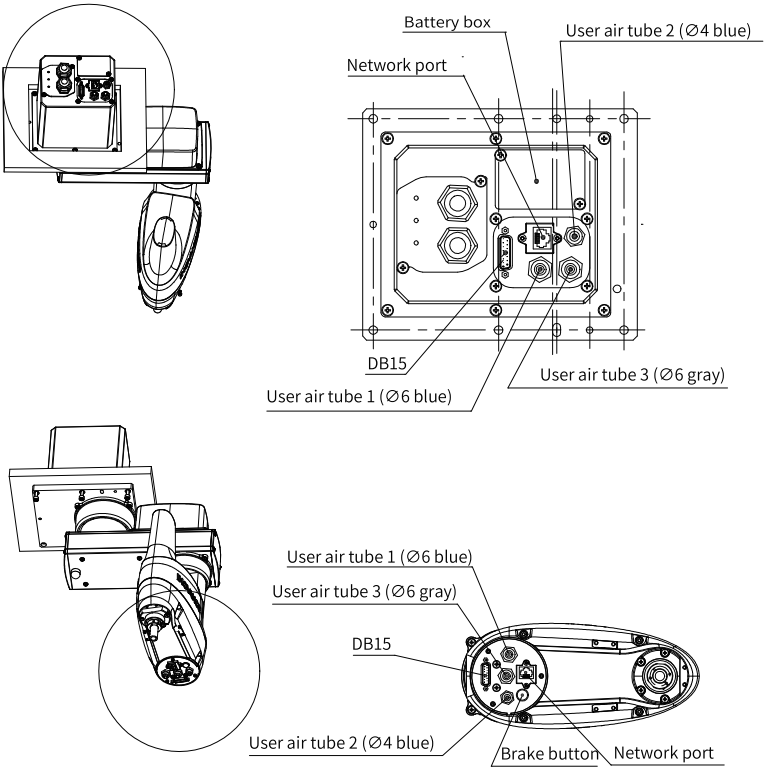
Both ends of the air tubes are equipped with ø6 mm and ø4 mm (outer diameter) fittings.

Pressure Resistance Level	Qty	Specifications (Outer Diameter)
0.59 MPa (6 kgf/cm^2)	2	ø6 mm
0.59 MPa (6 kgf/cm^2)	1	ø4 mm

Two ϕ6 straight-through air tube connectors are provided on the base, and two on the forearm.

One ϕ4 straight-through air tube connector is provided on the base, and one on the forearm.

Air tube connectors are color-coded, as shown in the following figure.


Battery box
User air tube 2 (∅4 blue)
Network port
DB15
User air tube 3 (∅6 gray)
User air tube 1 (∅6 blue)
User air tube 1 (∅6 blue)
User air tube 3 (∅6 gray)
DB15
User air tube 2 (∅4 blue)
Brake button
Network port

5 Operating Area

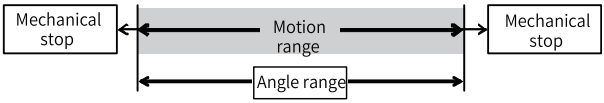
5.1 Method for Setting the Motion Range

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 Setting Operating Area By Using 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.

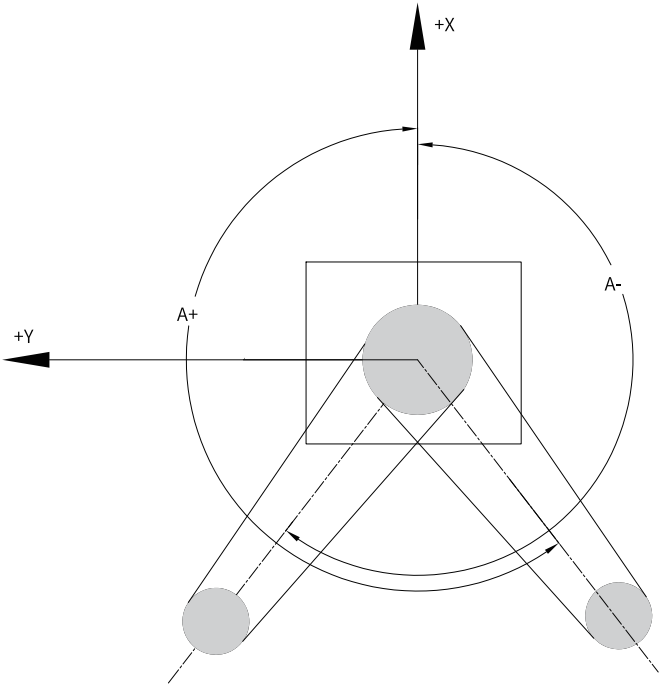
Once the robot receives an operating command, it checks whether the target position specified by the command is within the angle range before operating. If the target position is beyond the set angle range, an error occurs and the robot does not move.

Note

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

5.2.2 Maximum Angle Range of J1

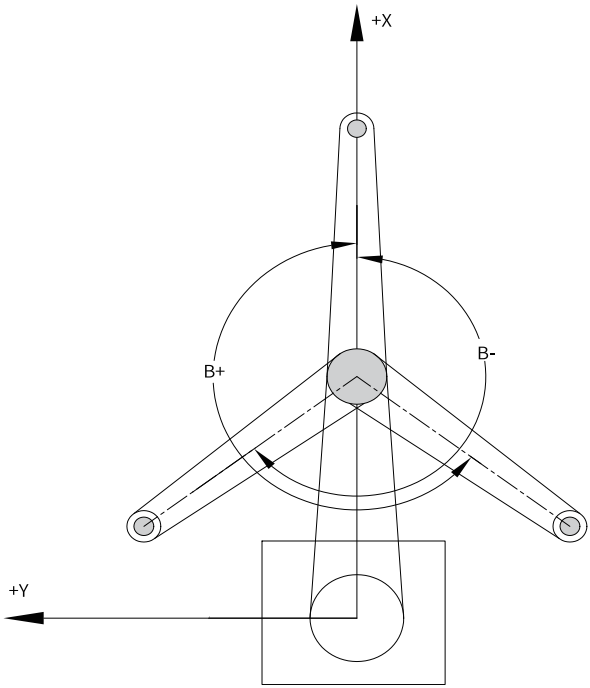
The 0° position of Axis J1 refers to the position where the first robot arm is facing the positive direction of the X-axis. Positive angle values are measured counterclockwise from the 0-pulse position, while negative angle values are measured clockwise.



Model	Maximum Motion Range
IR-TS4-35Z15S3 IR-TS5-55Z15S3	±225°

5.2.3 Maximum Angle Range of J2

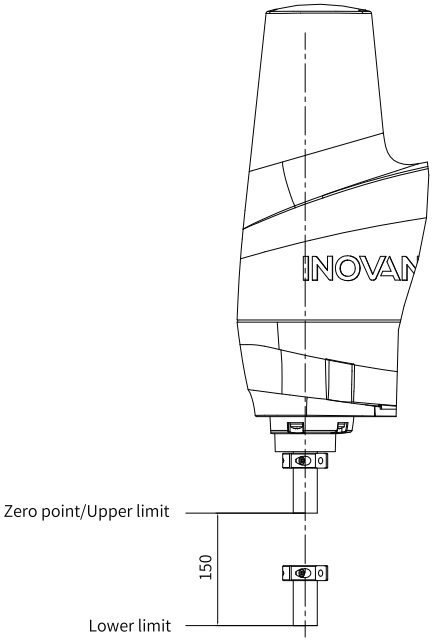
The 0° position of Axis J2 refers to the position where the second robot arm is perpendicular to the first robot arm (regardless of the direction of the first robot arm). Positive angle values are measured counterclockwise from the 0° position, while negative angle values are measured clockwise.



Model	Maximum Motion Range
IR-TS4-35Z15S3 IR-TS5-55Z15S3	±225°

5.2.4 Maximum Travel Range of J3

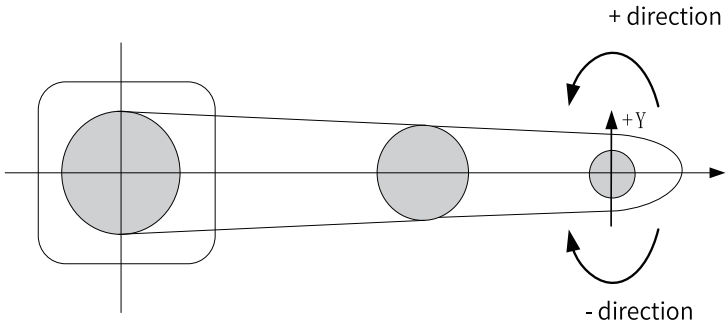
The 0° position of Axis J3 refers to the upper limit position of the axis. When Axis J3 descends from the 0° position, its angle value becomes negative.



Model	J3 Travel
IR-TS4-35Z15S3 IR-TS5-55Z15S3	150 mm

5.2.5 Maximum Angle Range of J4

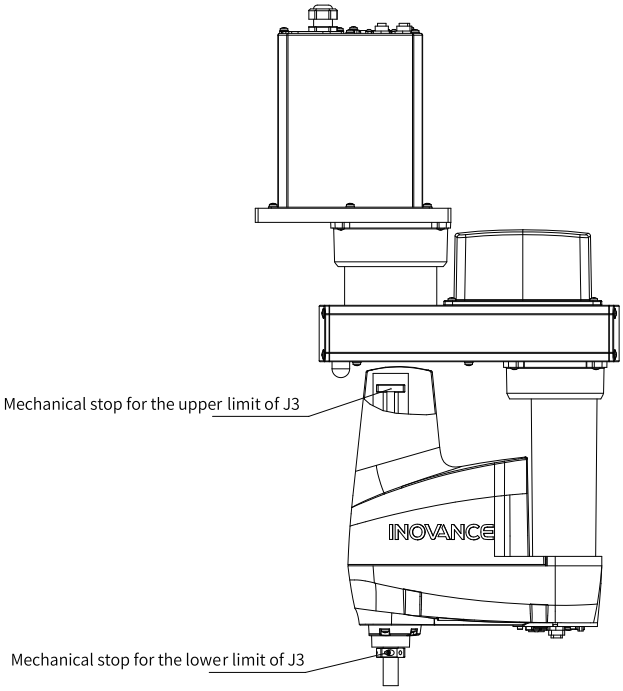
The 0° position of Axis J4 refers to the position where the plane at the top of the axis is facing toward the top of the second robot arm (regardless of the direction of the second robot arm). Positive angle values are measured counterclockwise from the 0° position, while negative angle values are measured clockwise.



Model	Maximum Motion Range
IR-TS4-35Z15S3 IR-TS5-55Z15S3	±720°

5.3 Mechanical Limit Stops

The IR-TS series ceiling-mounted SCARA robot has mechanical limit stops on Axis J3. You can adjust the operating area of Axis J3 as needed, as shown in the following figure.



5.4 Standard Operating Area

The "operating area" is applicable in terms of standard (maximum) specifications. When the motors of the axes are excited, the lower center of Axis J3 moves within the range shown in the figure.

The "range before the mechanical stop" refers to the range in which the lower center of Axis J3 moves when the motors of the axes are not excited. The "mechanical stop" refers to a stopper set mechanically to prevent movement beyond an absolute operating area.

The "maximum range" refers to the range in which the robot arm may cause interference. When installing an end effector with a radius exceeding 45.5 mm, set the "upper arm+forearm+end effector radius" as the maximum range. The following figure shows the operating area.

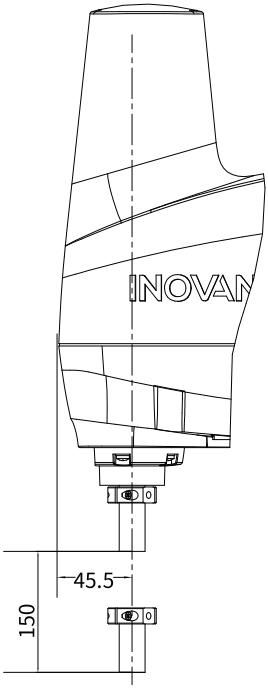


Figure 5-1 Operating area of an end effector (unit: mm)

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)

Inspection Point	Inspection Place	Daily Inspection	Monthly Inspection	Quarterly Inspection	Semi-annual Inspection	Annual Inspection	Maintenance Personnel		
							Professionals	Qualified Personnel	Manufacturer
Check whether the bolts are loose. If yes, tighten them.	End effector mounting screw	✓	✓	✓	✓	✓	✓	✓	✓
	Robot mounting bolts	✓	✓	✓	✓	✓	✓	✓	✓
	Each joint	✓	✓	✓	✓	✓	✓	✓	✓
	Bolts around the axes					✓		✓	✓
	Bolts securing the motor, reducer, etc.					✓		✓	✓
Check whether the connector is loose. If yes, push it securely or tighten it.	External connectors on the robot (on the connector plates etc.)	✓	✓	✓	✓	✓	✓	✓	✓
	Robot cable unit		✓	✓	✓	✓	✓	✓	✓

Inspection Point	Inspection Place	Daily Inspection	Monthly Inspection	Quarterly Inspection	Semi-annual Inspection	Annual Inspection	Maintenance Personnel		
							Professionals	Qualified Personnel	Manufacturer
Check for external defects and remove dust.	Whole	✓	✓	✓	✓	✓	✓	✓	✓
	External cables		✓	✓	✓	✓	✓	✓	✓
Check for bends or improper location. Repair or place it properly if necessary.	Safe guard etc.	✓	✓	✓	✓	✓	✓	✓	✓
Check tension of timing belt. Tighten it if necessary.	Inside arm #2				✓	✓	✓	✓	✓

Inspection Point	Inspection Place	Daily Inspection	Monthly Inspection	Quarterly Inspection	Semi-annual Inspection	Annual Inspection	Maintenance Personnel		
							Professionals	Qualified Personnel	Manufacturer
Check if the lubricating grease is sufficient for lubrication, and add an appropriate amount of lubricating grease as needed.	Ball screw				✓	✓	✓	✓	✓
	Spline				✓	✓	✓	✓	✓
	Polished rod lubrication inspection place				✓	✓	✓	✓	✓

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

Inspection Point	Inspection Place	Daily Inspection	Monthly Inspection	Quarterly Inspection	Semi-annual Inspection	Annual Inspection	Maintenance Personnel		
							Professionals	Qualified Personnel	Manufacturer
Shake the cable gently by hand to check for wire breakage.	External cables (including cable units of the robot)				✓	✓		✓	✓
Press each arm by hand in the enabled state to check whether the arms shake.	Each joint					✓		✓	✓

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

Inspection Point	Inspection Place	Daily Inspection	Monthly Inspection	Quarterly Inspection	Semi-annual Inspection	Annual Inspection	Maintenance Personnel		
							Professionals	Qualified Personnel	Manufacturer
Check the motion range.	Each joint					✓		✓	✓
Check whether unusual sound or vibration occurs.	Whole	✓	✓	✓	✓	✓	✓	✓	✓
Measure the accuracy repeatedly by a gauge.	Whole					✓		✓	✓

6.3 Components Replacement

6.3.1 Note

- Be sure to cut off the power supply before installing or removing the motor connector; otherwise it may cause abnormal action of the robot or electric shock.
- Do not maintain the equipment after power-on. Failure to comply will result in an electric shock.
- Prevent foreign objects from entering the equipment and terminals during maintenance.

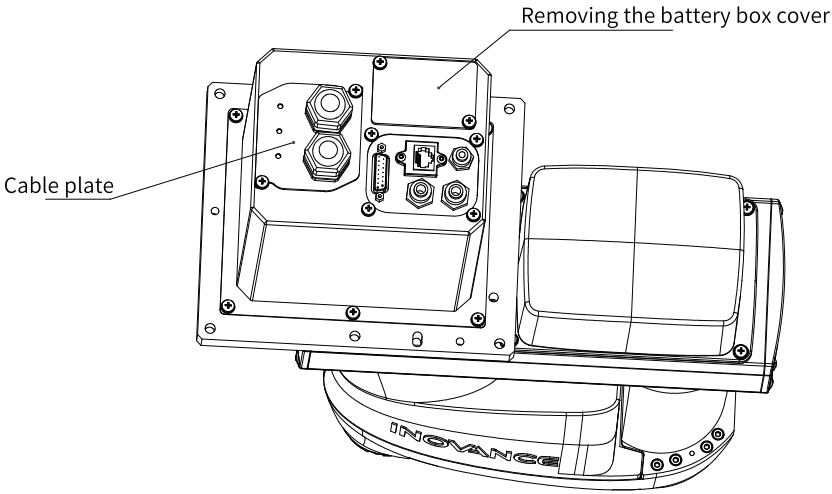
6.3.2 Battery Replacement

Warning

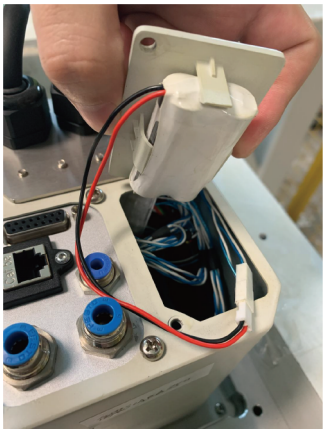
- Do not maintain the equipment after power-on. Failure to comply will result in an electric shock.
- When disposing the battery, consult with the professional disposal services or comply with the local regulation.
- Be sure to use lithium batteries correctly, the wrong way of use may lead to lithium 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 zero points, after removing the battery box cover, first insert a new battery into the white 2P connector. Secure the new battery in the wiring compartment, and then remove the used battery. The replacement steps are as follows.

1. Unscrew the two M4x8 screws on the battery box cover.



2. Connect the terminal of the new battery to the empty white 2P connector.



3. Remove the used battery.
4. Secure the new battery to the battery cover. Use M4x8 screws to fasten the battery cover to the base.

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 53*.

6.3.3 Cable Replacement

1. Loosen the fixing screws with a crosshead wrench. Rotate the cable plate by a certain angle to remove it.
2. Replace the damaged cable.
3. Rotate the cable plate to fit it into the fixing hole, and then tighten the screws.

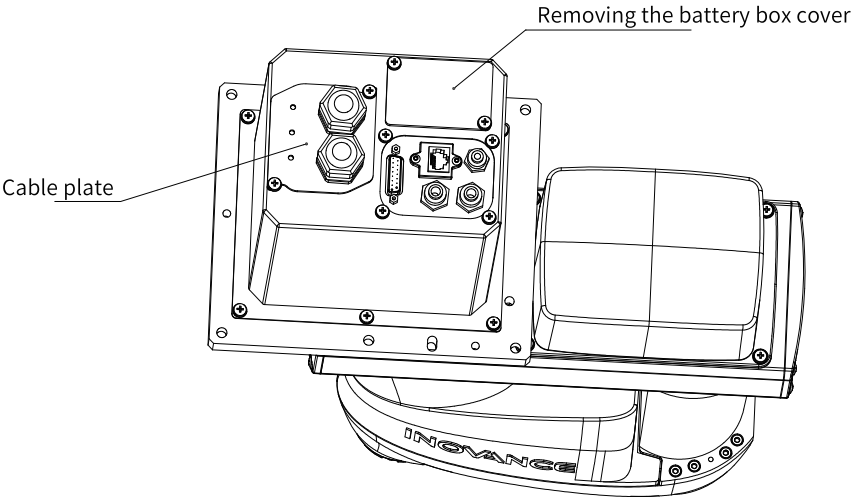


Figure 6-1 Cable plate on the base

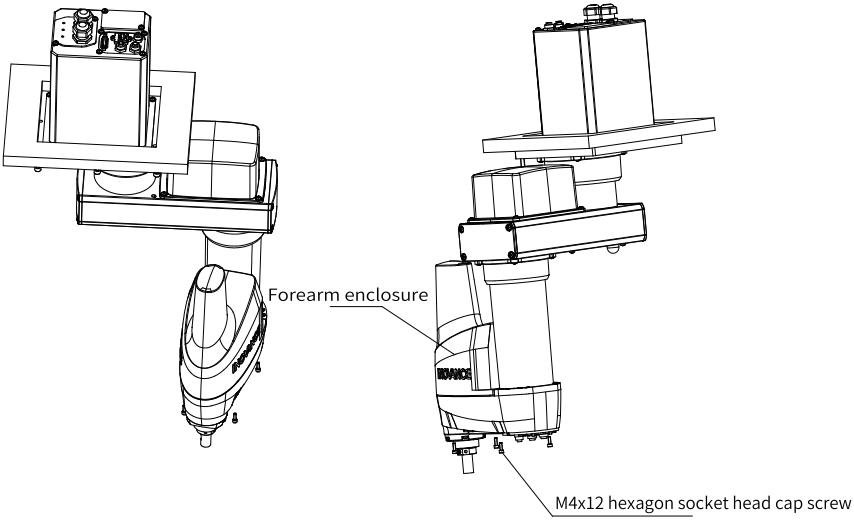
Caution

- 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 Enclosure Replacement

Removing the forearm enclosure

Rotate the forearm to a position greater than 60°. Remove the four M4x12 hexagon socket head cap screws on the forearm, as shown in the following figure. Next, lift the forearm enclosure to remove it.



Installing the forearm enclosure

Rotate the forearm to a position greater than 60°. Install the forearm enclosure onto the forearm. Secure the enclosure to the forearm with the four M4x12 hexagon socket head cap screws under a torque of 0.6 N·m. Make sure that the upper limit mechanical stop does not come into contact with the forearm enclosure.

6.4 Zero Point Adjustment

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.

Warning

- 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 Zero Point of Each Axis

1. The zero point of Axis J1 is shown in the following figure. Axis J2 does not have a zero point slot, and its zero adjustment is embedded in the software.

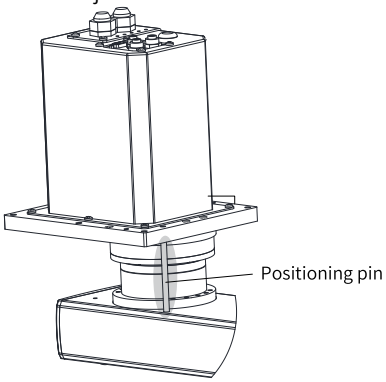


Figure 6-2 Zero points of Axes J1 and J2

2. The zero point of Axis J3 is the upper limit position of the axis.

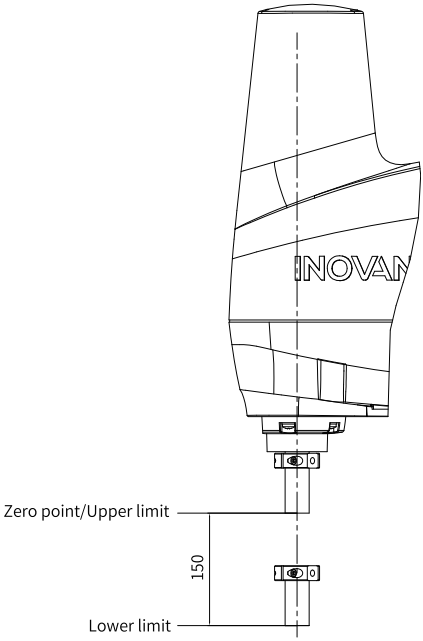


Figure 6-3 Zero point of Axis J3

3. The zero point of Axis J4 is the position where the plane of the axis (or the slot of the upper or lower mechanical limit stop) is facing toward the top of the second robot arm.

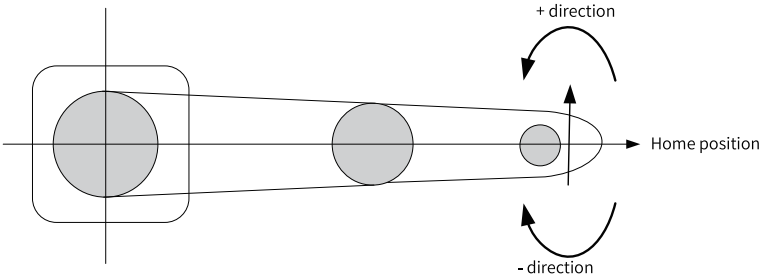


Figure 6-4 Zero point of Axis J4

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