



SYNTEC
TECHNOLOGY CO.,LTD.

LA596-4H Product Manual

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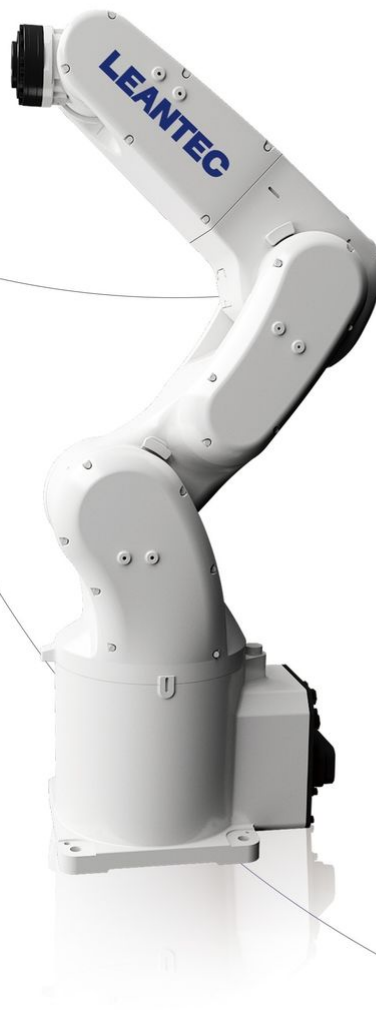


TRUSTED INTELLIGENT MANUFACTURING SERVICE

Product manual
Installation and maintenance

R Series

• LA596-4H



About this user manual

Thank you for buying our robot products.

The manual records the precautions for correct installation and use of the solution.

Please read the manual and other related manuals carefully before install and use the solution.

Please keep properly after reading the manual for future accessible anytime.

Unauthorized copy or reproduction of partial or full contents of this manual is prohibited.

The contents of this manual are subject to change at any time without prior notice.

Please correct us if you found any wrong contents or anything which is needed for improvement.

Except as expressly stated in this manual, any contents in this manual shall not be construed as any warranty or guarantee by the Company for personal loss, damage to property, or specific applicability, etc.

The Company shall not be liable for accidental or consequential injury arising out of the use of this manual and the products described therein.

Manual content

This manual contains the following instructions:

- Installation of robots
- The use of robots
- Maintenance of robots

Reading object

This manual is oriented toward:

- Installers
- Technician

Warranty

The robot and its optional components are delivered after go through the company's strict quality control, testing and inspection, and the performance is confirmed to meet the company's standards.

Within the warranty period of the delivered products, the company will provide free repairs for malfunctions that occurred during normal use. (For warranty period, please consult your regional salesperson.)

However, the customer will be charged for repairs (even within the warranty period) if:

1. Damages or failures caused by improper use and incorrect use without following the manual.
2. Failures caused by the customer's unauthorized disassembly.
3. Damages caused by improper adjustment or unauthorized repair.
4. Damages caused by natural disasters such as earthquake and flood.

Warning

1. If the use of robots or related equipment exceeds the conditions of use and product specifications described in this manual, the warranty will be invalid.
2. The Company shall not be liable for any fault or accident, or even personal injury or death caused by the use of the products.
3. The Company cannot foresee all possible risks and consequences. Therefore, this manual cannot warn the user of all possible risks.

Inquiry

For the repair/inspection/adjustment of the robot, please contact our after-sales department.

If no after-sales department is recorded, please contact your local distributor.

To save your time, please prepare the following items before contacting:

- Controller name/serial number
- Robot name/serial number
- Software name/version
- Problems with the system

The logo for SYNTEC, featuring the word "SYNTEC" in a large, bold, sans-serif font. The letters are white with a subtle drop shadow, giving them a three-dimensional appearance as if they are floating above a light gray background.

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2 Safety

Personal Safety

Basic Principle

There are a few simple principles that must be followed in order to operate a robot safely:

- All of the operating procedures must be professionally evaluated and based on relevant industrial safety regulations.
- Operators who work with robots must wear safety equipment suitable for the working environment before performing operations, such as safety vests, safety shoes and safety helmets.
- When personnel encounter danger or other emergency and abnormal situations due to the robot, please press the emergency stop button for the first time, and use the manual mode to move the robot away from the dangerous situation at low speed.
- A safety area must be set outside the working area of the robot, and appropriate safety devices must be used to prevent unauthorized personnel from entering.
 - The operator must be outside the safe area to operate the robot.
 - When a worker is in the safe area of the robot, the robot can only be operated in manual mode.
 - When you enter the secure area of the robot, you must hold the teach pendant in your hand to ensure that the robot is under your control.
- Keep an eye out for moving tools, such as drills, saws, etc. installed on the robot. Make sure the tools stop working before approaching the robot.
- Be aware of work piece surface or robot body. The temperature of robot motor and outer shell may be very high after working for long time.
- Pay attention to the robot's gripper and the objects it is holding. If the gripper is opened, the workpiece may fall and cause injury to personnel or damage to equipment. In addition, the grippers used by the robot can be very powerful and can cause damage if not used properly.
- Pay attention to the electrical components inside the robot and control cabinet. Even if the power has been cut, the energy retained in the device can be very dangerous.
- Climbing on robot is prohibited.



Warning

- Relevant education training and permission is a must for the person installing the robot.
- In order to protect personal safety, the installation procedures in this manual and related industrial safety regulations must be followed.
- Control box should be away from high voltage and other component that generate electromagnetic field, to prevent the electromagnetic interference which may cause deviation or malfunction of the robot.
- The robot may damage or malfunction if non-original manufacture components used.
- Be careful of the heat source generated by the controller and servo motor.
- Do not excessively bend the power signal cable. Otherwise, it may cause unexpected danger.

- The teach pendant removed from the control cabinet should be properly stored in a safe place away from the robot workstation or control cabinet. The operator should not be misled to think that the teach pendant is still connected to the control cabinet and try to use the unconnected teach pendant to stop the robot when facing dangerous situation.

Precautions for using hydraulic and pneumatic



Danger

- When using hydraulic and pneumatic in operation, the clamped workpiece may fall due to insufficient pressure or gravity.
- The hydraulic and pneumatic systems need to be equipped with safety valves for emergency use.

2.1 Operate the teach pendant

Instruction

The teach pendant equipped with Syntec system is manufactured with advanced electronic components. In order to avoid failure or damage during use, please follow the following requirements.

Handheld teach pendants are developed, manufactured and tested in accordance with relevant industry standards and are intended for use only as described in this manual. If you follow the requirements in this manual, the teach pendant controller will not cause personal injury or damage in normal use.

Operation and cleaning



Danger

The programming must be performed outside the safety fence. If you need to enter the safety fence for operation, you must press the emergency stop button.

- Handle it lightly to avoid falling, throwing or a strong impact on teach pendant. Otherwise, it may cause obstacles.
- If the teach pendant experiences a strong shock, verify that the enable switch and emergency stop button are still in normal working conditions before using again.
- When you do not use the teaching device, please store it properly to avoid accidental dropping.
- Avoid tripping over your own cable when using the teach pendant.
- Do not operate the touch screen with sharp objects, such as a screwdriver, pen tip, etc.. Otherwise, the touch screen may be damaged. Operate with a finger or a stylus on top of the pointer.
- Clean the touch screen often, dust and small particles of impurities may cause the touch screen to malfunction.
- Do not use chemical solvents, detergents or washing surfaces to clean the teach pendant. Use a soft cloth and a small amount of water to scrub.

- When not using the USB interface, the protective adhesive cap must be properly fastened. Otherwise, exposure to dust may cause interface failure.

Pendant cable

- Ensure that the staff does not trip over the teach pendant cable and causes the teach pendant to fall.
- Do not squeeze the teach pendant cable. Otherwise, it may damage the inner core.
- Do not place the teach pendant cable at sharp edges, as this may damage the cable sheath.

2.2 Recovery From Emergency Stop

Instruction

The reset operation must be performed when the system is in an emergency stop state in order to return to the normal state. The reset process is very simple but very important to ensure that the robot system is not put into production operation in a dangerous state.

Reset emergency stop button

All button-type emergency stop devices have a safety lock mechanism that must be manually released after being pressed to reverse the emergency stop state of the device. Most emergency stop buttons are released by rotation, with the direction of rotation marked on the surface of the button. There are also some buttons that support a direct uppull release method.

Reset the external stop device

All external safety devices such as safety gates, safety light curtains, etc. have some type of safety locking mechanism. If your robot workstation uses an external safety device, consult your system integrator for more device reset information.

Recovery from E-Stop

	Operate
1	Confirm that the hazardous condition causing the emergency stop has been addressed and that the hazard source is no longer present.
2	Reset a safety device that causes an emergency stop.
3	Press the "Servo Ready" button on the teach pendant to restore the system from a non-ready state.

2.3 Safety Considerations For Manual Mode

About manual mode

In manual mode, the movement of the robot is under manual control. The robot can be jog or run only if the enable switch is in the middle position.

Manual mode is used for robot program writing and debugging and participating in the commissioning of the workstation.

Bypass external safety signals

In manual mode, signals from external safety devices such as safety doors and safety light curtains will be bypassed. The system will not be in emergency stop state even if the safety door is opened in manual mode to facilitate commissioning.

2.4 Safety Considerations For Automatic Mode

About automatic mode

The automatic mode is used to run the robot program during the formal production process.

The enable switch will be bypassed in automatic mode, so the robot can operate automatically without personnel involved.

Enable external safety signals

External safety signals such as safety gate and safety grating will be enabled in automatic mode, and an emergency stop will be triggered when the safety gate is opened.

Safe fault recovery in processing production

In most cases, robots are part of a production line. Therefore, when robots malfunction, it not only affects the robot workstation itself but also may impact other parts of the production line when issues occur in those areas. Therefore, failures recovery plan should be designed by personnel who is very familiar with the production line to improve safety.

For example, on a production line, the robot needs to grab the workpiece from a conveyor belt. In case of a robot failure, in order to ensure that the production process is not interrupted, the conveyor belt should be kept in operation while the robot is being repaired. At this time, the robot maintenance personnel should consider additional safety measures for working beside the conveyor belt in operation.

Another example, when a welding robot is removed from a production line for routine maintenance, other robots associated with the same process must also be stopped to prevent human injury.

2.5 Emergency Handle

Handling of light fire

In the event of imminent fire danger or fire that has already started but not yet spread, do not panic, remain calm and extinguish the flames with the fire extinguishing equipment provided at the scene. Do not use water to extinguish the fire caused by a short circuit.



Warning

The user shall provide the fire extinguishing device for the robot in the working site. The user shall select the appropriate fire extinguishing device according to the actual situation on the site.

Measures to deal with severe fire

When the fire has spread and is out of control, site staff should not try to put out the fire, but should immediately notify other staff, give up personal belongings, and evacuate from the emergency exit as soon as possible. Elevators are not allowed during an evacuation, and the fire brigade should be called during evacuation.

If a person or clothing is on fire, do not let him/her run away. Instead, let him/her quickly lie down on the ground and put out the fire with clothes or other suitable objects and means.

Handling of electric shock accident

When someone gets an electric shock, don't panic. First, cut off the power as soon as possible.



Warning

Do not contact the electrocuted person directly. Otherwise, the rescue personnel may also be electrocuted!

Appropriate methods and measures should be taken decisively according to the specific conditions on the spot. Generally speaking, there are several methods and measures shown below:

- If the power switch or button is close to the shock point, pull the switch quickly and cut off the power.
- If the power switch or button is far away from the electric shock location, insulated pliers or axes, knives and shovels with dry wooden handle can be used to cut off the power side (i.e., where the electricity is coming from). The cut wire should not touch the human body.

When the wire is attached to or under the body of the electrocute, dry wooden sticks, wooden boards, bamboo poles or other tools with an insulating handle (holding the insulated handle) can be used to quickly remove the wire. Do not use any metal bar or wet things to pick up the wire, so as to avoid the electrocute.

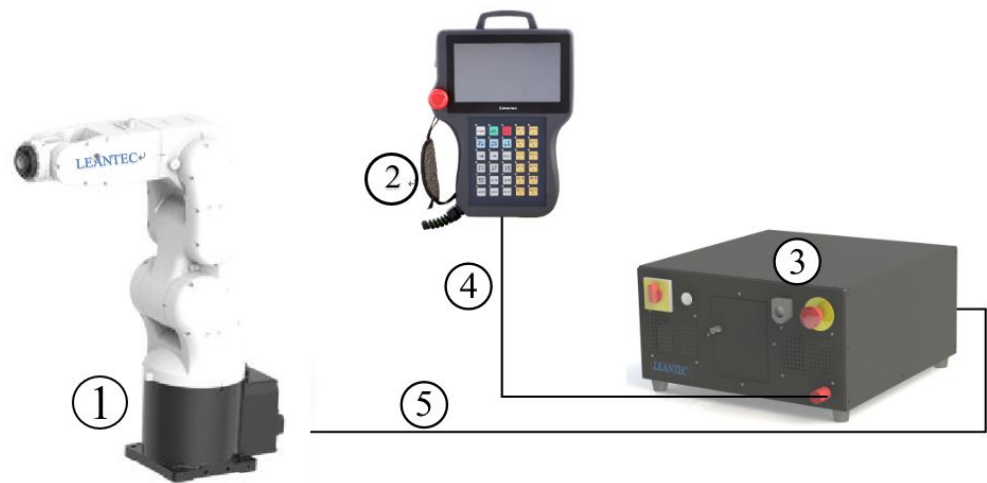
Treatment of electrocuted wounded person

- If the electrocuted victim is conscious, lay him/her on his/her back and watch him/her closely. Do not stand or walk for a while.
- If the contact person is unconscious, lay him/her on his/her back to make sure the airway is clear, and call or pat him/her on the shoulder at a 5-second interval to determine if he/she is unconscious. Do not swing the victim's head to call the victim. Contact the ambulance as soon as possible while rescuing on the spot.
- If the electrocuted victim loses consciousness, the patient's breathing and heartbeat should be judged within 10 seconds. If there is no breathing and no pulsation of the artery, it can be determined that the respiratory heart has stopped, and it should be rescued by cardiopulmonary resuscitation immediately.



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3 Product overview



3.1 Overview of Robot System

System overview

A complete robot system includes the robot body, controller, pendant, connecting cables, software, end effectors and other accessories, as shown in the figure below.

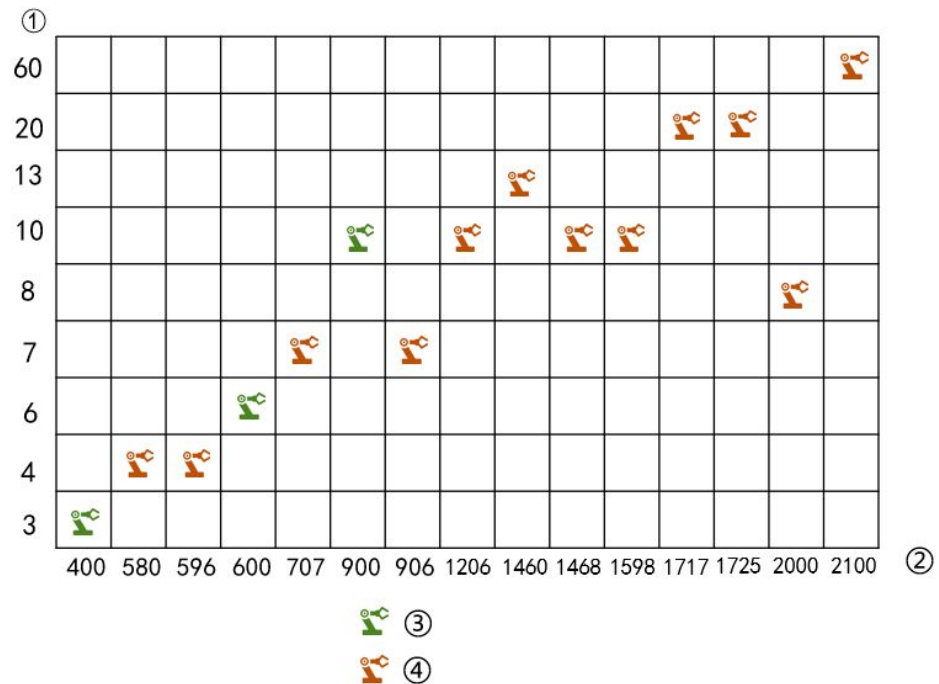
The figures are illustrated below:

- 1 = robot
- 2 = teach pendant
- 3 = control cabinet
- 4 = teach pendant cable
- 5 = cabinet cable

3.2 Load capacity

Load capacity of the joint robot

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Label	Name
①	Load capacity (KG)
②	Work space (mm)
③	Four joints robot
④	Six joints robot

3.3 Function and purpose

Function and purpose

An industrial robot is a mechanical and electronic device that anthropomorphizes arms, wrists and hand functions; it can move any object or tool according to the time-variant requirements of spatial position-pose (position and orientation) to complete the operation requirements of a certain industrial production. Some of the applications of Leantec industrial robot include: To carry out spot welding or arc welding on the body of cars or motorcycles using welding guns or welding torches to carry parts or components formed by die casting or stamping, laser cutting, spray and to assemble mechanical parts and etc.

3.4 Basic principles and main technologies applied

Principles and technologies

The working principle of the Leantec robotic arm consists of three main components: the six-joint arm body, a distribution cabinet, and the 81R handheld controller. The handheld controller sends commands to two new-generation three-in-one drivers, which in turn drive the six motors on the arm body to rotate in a systematic manner. This control enables the movement path of the sixth-axis end rotational center to be managed.

Main technologies:

1. High-speed, high-precision control:

After the user has programmed through the human-machine interface of the teach pendant, the corresponding robot program will be generated. After the program is planned for high speed and high precision offset time, the position command will be transmitted to the Servo Motor Driver through serial communication at each offset time, so that the lower machine does the command planning of the servo motor.

2. Servo motor control:

Upon receiving position commands from the upper-level controller, the driver performs further motor command planning. It sends motor commands for each interpolation time to the servo motors, driving them to operate through the servo motor system.

3. After completing the above, the arm body is driven by the servo motor system to execute the user-edited actions. This fulfills applications such as welding, picking and placing, and other usage scenarios.

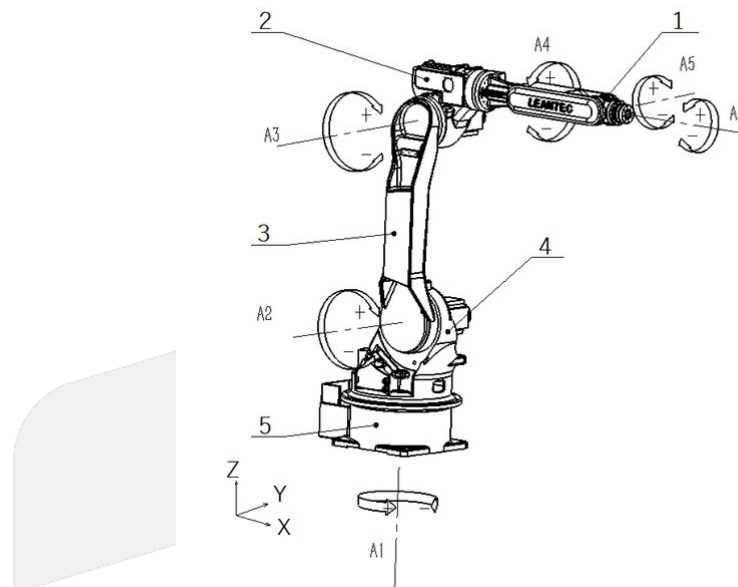
3.5 Overview of Robot Structure

Structure

The main structural parts of the robot body are made of cast aluminum alloy, with a total of 6 degrees of freedom. Each joint motor is equipped with a brake. A mechanism consists of the following parts:

- i. Wrist -- The wrist has three degrees of freedom and is located at the output end of the robot, including axis 4th, axis 5th, and axis 6th.
- ii. Forearm -- The forearm is located between the upper arm and the wrist and is driven by the 3rd motor.
- iii. Upper arm -- The upper arm is located between the lower arm and the lumbar joint and is drive by the 2nd motor.
- iv. Waist -- The waist is located between the upper arm and the base and is driven by the 1st motor.

- v. Base -- The base is the foundation of the robot, with electrical and pneumatics connections for the robot at its rear.



Each axis motion:

- A1 axis: whole mechanical arm rotation
- A2 axis: upper arm pitching
- A3 axis: small arm pitching
- A4 axis: small arm rotation
- A5 axis: wrist swing
- A6 axis: wrist rotation

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4 Technical parameters

4.1 Specification

Performance parameter table

The performance parameters of the robot are shown in the table

Model		LA596-4H
DOF		6
Drive mode		AC servo drive
Maximum arm reach		596mm
Positioning repeatability		±0.02mm
Maximum wrist load		4kg
Range of motion	Axis 1	+170°~-170°
	Axis 2	+144°~-80°
	Axis 3	+54°~-194°
	Axis 4	+170°~-170°
	Axis 5	+119°~-119°
	Axis 6	+360°~-360°
Maximum speed	Axis 1	440°/s
	Axis 2	355°/s
	Axis 3	440°/s
	Axis 4	490°/s
	Axis 5	450°/s

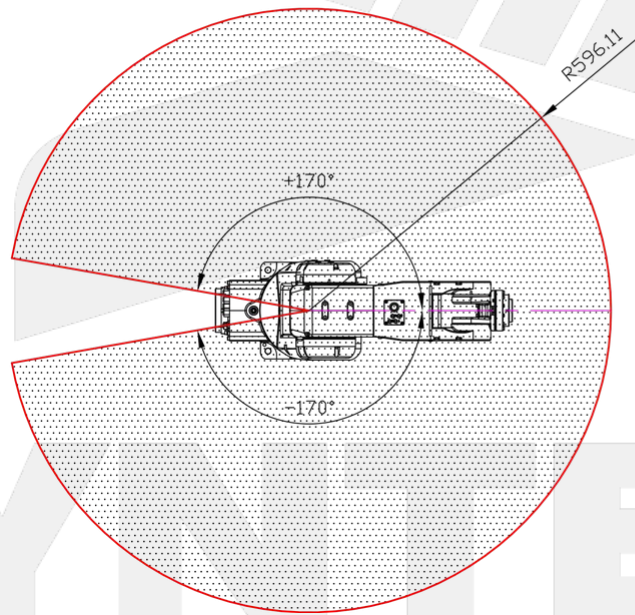
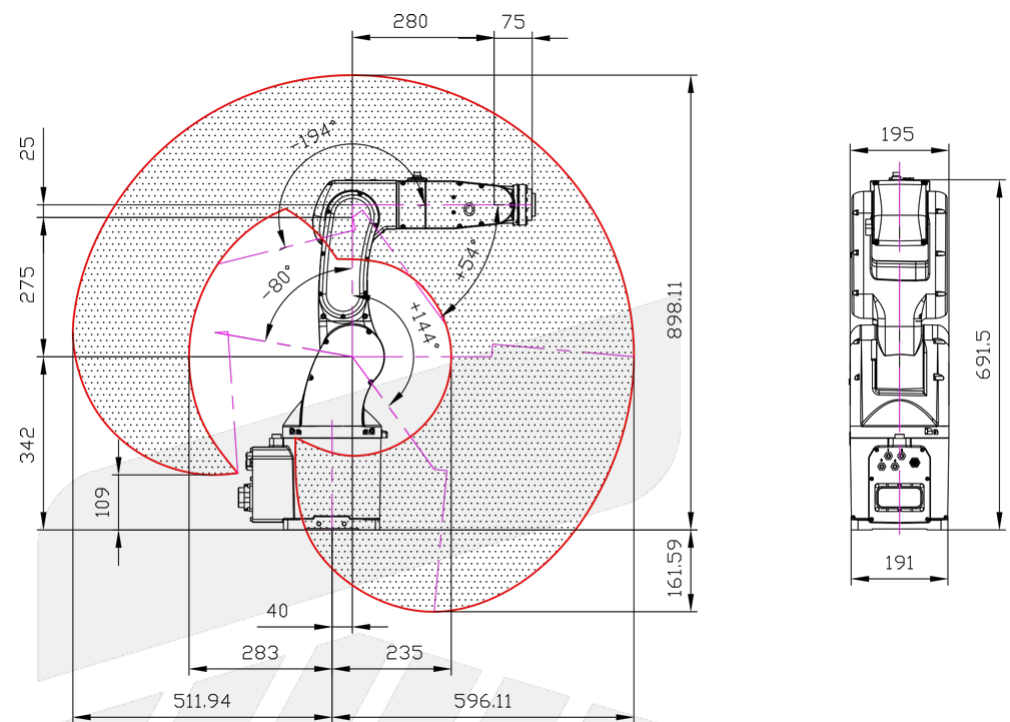
Model		LA596-4H
	Axis 6	948°/s
Operating temperature		0°~+45°
Storage temperature		-10°~+55°
Protection Grade		IP67
Method of Installation		ground, suspension, tilt
Base Dimension		190mm×190mm
Base Mounting Hole		160mm×160mm
Noise Level		≤70dB(A)
Weight		about 32kg

4.2 Robot workspace

Robot workspace

LA596-4H The working space of the robot is shown in the following figure:

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Reminder

In practice, consider the impact of installation on the workspace.

4.3 Output flange

Instructions

Please make the robot end fixture by yourself according to actual needs and connect it to the output flange of the wrist. The size of the output flange is shown below. The strength of the fixed hexangular set screw is grade 12.9. The shape and size of the fixture installed on the output flange may affect the rotation range of the robot shaft. Please pay attention to the interference area at the end of the fixture in the design.

? Unknown Attachment

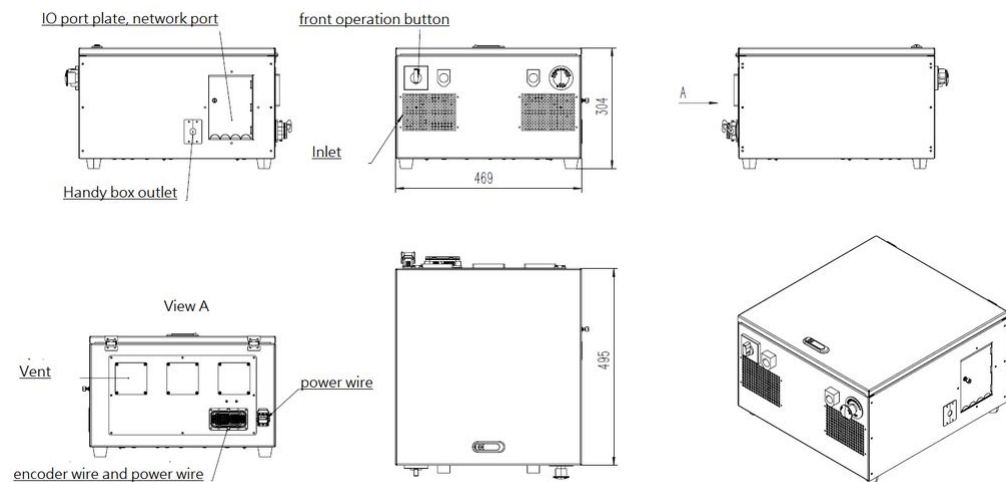
4.4 Electronic Control Box Specification

The standard specifications of the electric control box are listed below.

	Electronic Box R1
Entity diagram of electronic control box	
Corresponding Model	LA596, LA707, LA906, LA1206
Power Supply	Single-phase 200-230VAC, 50Hz/60Hz • LA596: 1.25KW/220V, 10.65A • LA707/906: 2.3KW/220V, 18.41A • LA1206: 2.8kW/220V, 18.45A
Input/Output Signals	16I/16O
Analog Input/Output*	0

	Electronic Box R1
Size	480mm x 500mm x 280mm
Weight (kg)	20
Remarks	*Optional

The dimensions of the electric control box are shown in the following figures.



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5 The installation

5.1 Environmental Conditions

Description

The working environment of the robot shall meet the following conditions:

Item	Conditions
Ambient temperature	Work: 0°C~+45°C Store/transportation: -10°C~+55°C
Ambient humidity	Usually under 75%RH (No frost) short term under 90%RH (in one month)
Allowable height	Altitude below 1000m
Allowable vibration	4.9m/s ² Under 0.5G
Circumstance	• Indoor installation • Avoid sunlight • Keep away from dust, fume, salt, iron filings, etc • Stay away from flammable, corrosive liquids and gases • Do not contact with water • Do not transmit shocks and vibrations • Stay away from electrical interference sources



Reminder

- At lower temperatures (<10°C), the grease (or lubricating oil) in the reducer (or gearbox) is of high viscosity, which may cause shutdown or inefficient operation of the robot.
 - It is recommended that the robot preheat together with other equipment, and also suggested to preheat at a low speed.

It is not allowable to use under the following circumstances



Danger

- A Potentially explosive environment.
- A corrosive environment.
- A flammable environment.

- A radioactive environment.
- An environment without risk assessment.
- Used for the transportation of humans and animals.
- Operation uses non-allowed parameters.

5.2 On-site installation

5.2.1 Transportation

Description

When handling, it is advisable to use lifting equipment such as overhead cranes. In the absence of lifting equipment, manual handling can be considered. The transportation of a piece of equipment requires the coordination of at least two people simultaneously. Attention should be paid to safety, and the equipment should be handled with care to prevent damage and avoid causing harm to the surface of the robot.



Warning

The body of the R-series robot weighs is about 20-60kg. Please use rings with M6×10 threaded lifting eyes and hooks and ropes with a load of over 100kg. Sling or wire rope with protection is recommended to prevent the sling from damaging the body paint. Lifting a robot in any position other than the recommended position may cause the robot to tip over and cause serious damage or injury!



Warning

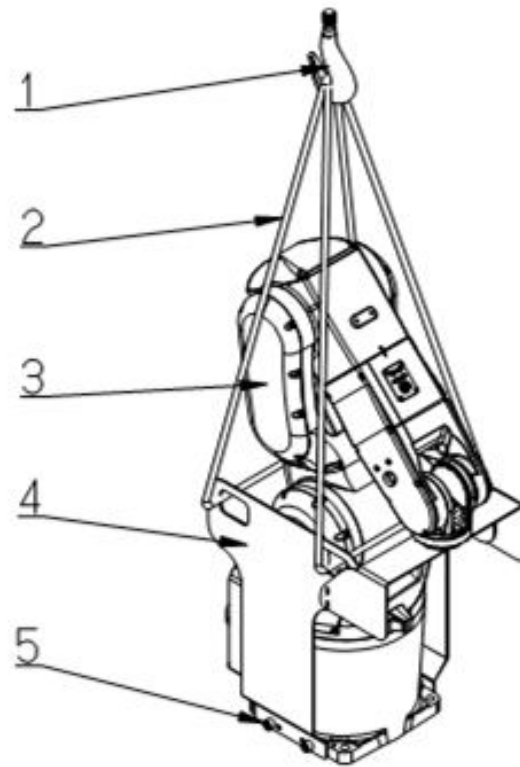
Under any circumstances, no person is allowed to be under the lifting robot.



Danger

Make sure to turn off all power, hydraulic, and air sources of the robot during transportation.

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1 Lifting Equipment 2 Sling 3 Lifting Limit Bracket 4 Lifting Bracket 5 Fixed Screw

5.2.2 Installation



警告

Do not install or operate robots that are damaged or lack parts. Otherwise, accidents such as personal injury and equipment damage may occur.

After the setting is completed, be sure to remove the handling fixture before power on, or the drive part may be damaged.



危险

It is necessary to set up a safety bar, or accidents such as personal injury and equipment damage may occur. Ensure that the safety bar is not inside the working area of the end of the robot and the fixture. Otherwise, accidents such as personal injury and equipment damage may occur.

When the robot is not fixed, it is prohibited to power on and operate, or accidents such as tipping, personal injury, and equipment damage may occur.

Safety Device

According to the safety protection device regulations: "When the industrial robot is running automatically, the operator is in danger of contacting the robot, so safety measures such as a protective bar to prevent the operator from approaching must be

provided."

In order to avoid equipment damage and personal injury of operators and surrounding personnel during the operation of the robot, the necessary safety devices must be installed. Safety devices mainly include safety bars, safety doors, safety pins and slots, and other protective equipment.

Installation Instructions

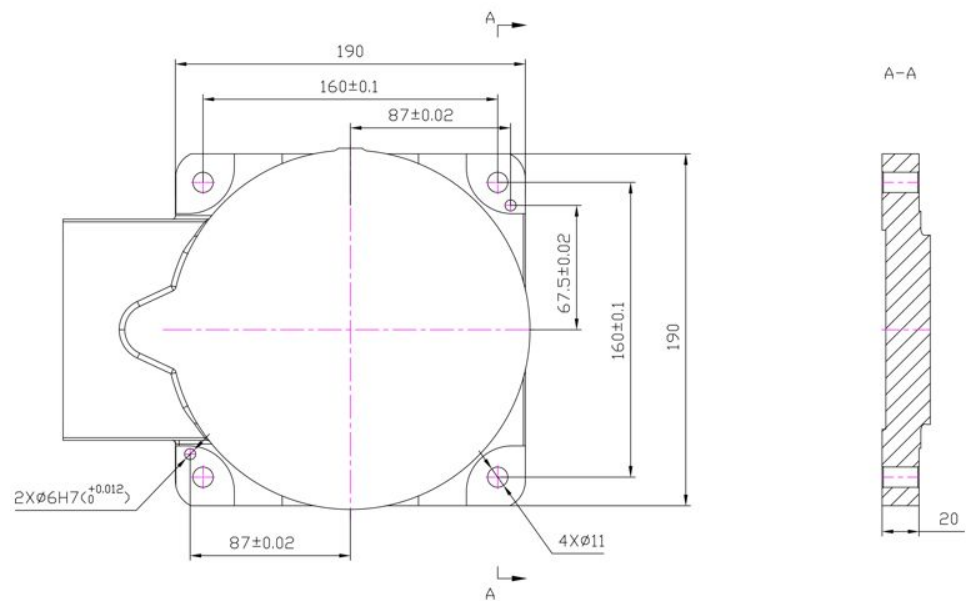
The installation of the robot is very important to its function. It is especially worth noting that the base and the foundation can withstand the dynamic load of the robot during acceleration and deceleration and the static weight of the robot and fixtures. In addition, if the mounting surface of the robot is not flat, the robot may deform and its performance may be affected.

When the robot accelerates or decelerates, a large reaction force will be generated in all directions of the base. Therefore, in the installation of the robot, the foundation must be able to bear the static load and the reaction force during acceleration and deceleration to ensure that the base of the robot is firm and does not move. Robot base by 2 - Φ 6 pin positioning (recommended with the convenient disassembly threaded cylindrical pin, GB/T 120.1 2000), And fasten it with 4-M10 screws (in order to prevent screw loosening, it must be used with flat pad and spring pad). See the table below for screw requirements

Screw	M10×35
Quantity	4
Strength Level	12.9
Tightening torque	45±5Nm

Base hole size

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Reminder

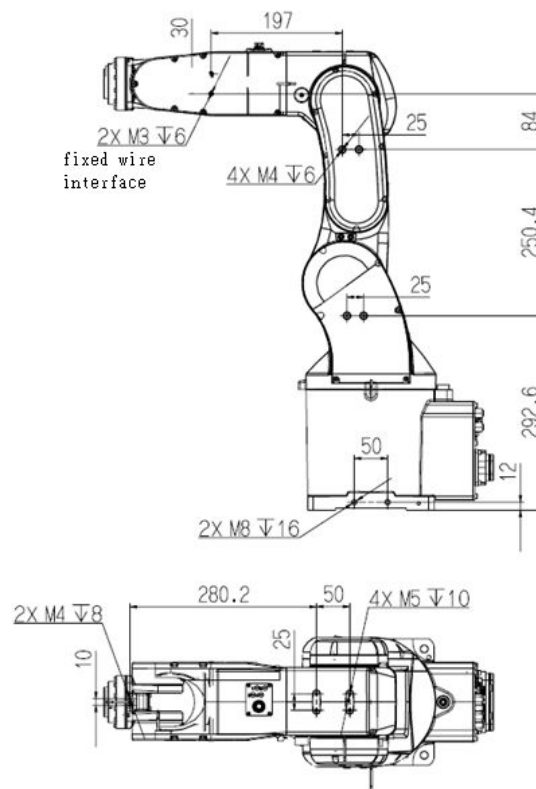
To avoid the deformation of the robot base during installation, please control the flatness of the installation panel within 0.2mm. In addition, the screw hole for the ground wire of the base is M4, and the ground wire connection method is shown in 4.3.3.

5.2.3 Mechanical Interface

Mechanical interface

The LRA596-4-6H-R robot's wrist, upper arm, lower arm, and waist joints can add extra load. The installation interface is shown in the figure below. To ensure the service life of the thread, do not remove the interface mounting screw frequently. The total load of the wrist and forearm should not exceed 4kg. For example, if the wrist load is 3kg, the extra load on the forearm should be controlled within 1kg.

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5.3 Electrical connections

5.3.1 Wiring connection



Warning

- Do not make mistakes on the connection when connecting the robot to the controller. If the wrong connection is made, not only will the robot system not be able to operate normally, but it may also cause safety issues. Please refer to the controller manual for details.
- Only certified technicians or personnel should perform a wiring job. If the wiring job is performed by a person who does not have the relevant knowledge, it may result in injury or malfunction.



Beware of electric shocks

- Please make sure to perform replacement work after turning off the controller and related equipment and unplugging the power plug. If you work with the power on, it may cause electrical shock or malfunction.
- Be sure to connect the AC power cable to the power plug. Do not connect directly to the plant power supply. Turn off the power to the robot system by unplugging it. AC power cables are extremely dangerous to operate when connected to factory power and may cause electrical shock and/or robot system failure

- Be careful not to forcibly bend the cable, etc. to avoid applying the load to the cable. In addition, do not place heavy objects on the cable, forcibly bend or pull the cable. Otherwise, it may cause cable damage, disconnection, or poor contact, resulting in electrical shock or abnormal system operation.
- Before wiring, turn off the power supply of the controller and related devices and put on a warning sign (e.g. never switch on the power). Wiring while energized is extremely dangerous and may cause electrical shock and/or robotic system failure.

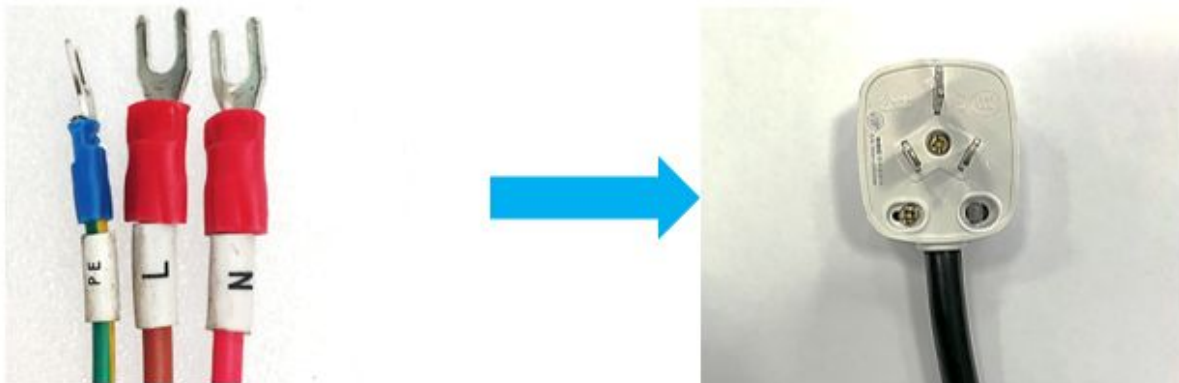
5.3.2 Grounding Instructions

1. Robot main body grounding:

The grounding should be done by the user. Depending on the actual conditions on-site, spatial positioning, and other factors, the user should use terminals to ensure proper grounding of the robot body.

2. electrical cabinet grounding:

electrical cabinet grounding wire 220V



R series electrical cabinet power wire is three-core cable, which is L/N/PE;

L/N : neutral wire/live wire (single phase 220V) PE: ground wire

R series electrical cabinet standard optional with three hole plug. Simply insert the plug into the three-hole socket during use. (Note: Three-hole socket needs to be grounded)

5.3.3 User Wiring

Wiring



Warning

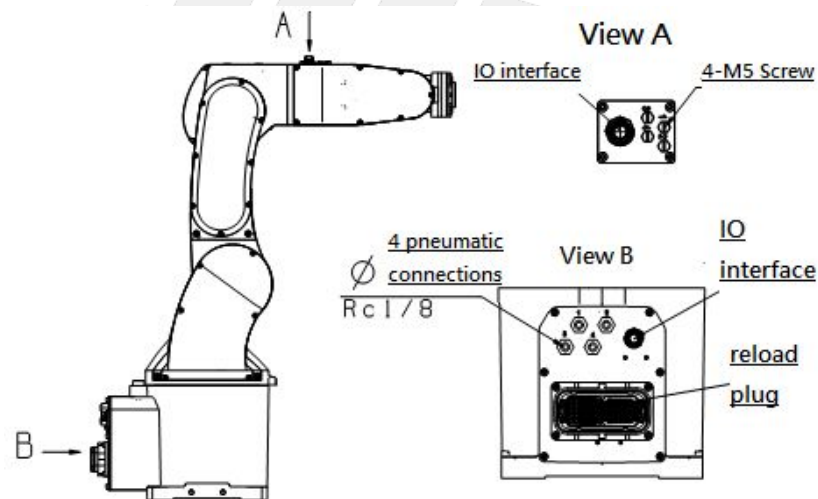
Only certified operators or personnel should perform a wiring job. If the wiring job is performed by a person who does not have the relevant knowledge, it may result in injury or malfunction.



Danger

- The ground terminal must be connected to the ground pole (5.5mm² diameter or above is recommended), otherwise, fire and electric shock may occur.
- Before wiring, turn off the power supply of the controller and related devices and pull up the warning sign (e.g., never switch on the power). Wiring while the power is on is extremely dangerous and may cause electric shock and/or malfunction of the robotic system.

For wiring, please refer to the positions of various connects in the diagram below. The specifications of the IO cable connector and air tube are provided in the table below. When using, replace the M5 plug on side A with an M5 threaded air tube connector (recommended to use SMC's KQ2S04-M5A quick-change connector); when connecting the air tube on side B, remove the plug first and then install the Rc1/8 air tube connector (recommended to use SMC's KQ2H04-01S straight connector). When using the IP67 enhanced function, activate the reserved start interface and use the air source processing component. For details, please consult Leantec.

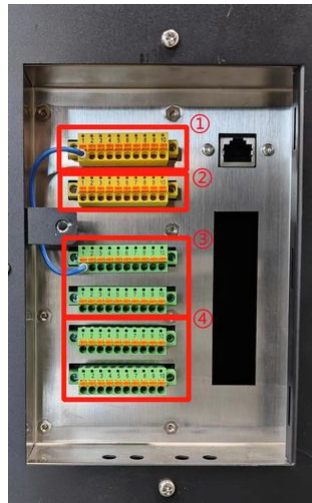


- ①: IO interface
- ②: 4-M5 screw plug
- ③: diameter 4mm pneumatic connections (Rc1/8)
- ④: IO interface
- ⑤: reload plug

5.3.4 IO Wiring Definition

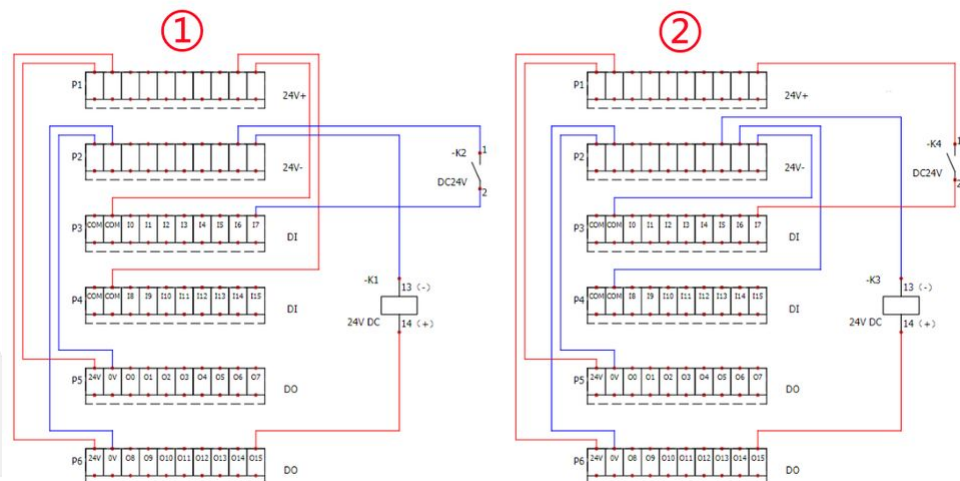
The IO connection method of the electric cabinet of the R-series arm is to transfer 16 I points and 16 O points to the side panel of the electric cabinet. The sheet metal opening is provided with 4 rows of IO external interfaces and two rows of COM port interfaces.

The top row is the 24V COM port and the bottom row is the 0V COM port, as shown in the figure below:



Notice: ①: 24V common terminal ; ②: 0V common terminal ; ③: two COM port and 16 I point ; ④: The first two are 24V and 0V respectively, and the rear is 16 O-points.

The I-board module has two connection methods, one is the PNP connection method, the COM port on the I-board is connected to the power supply 0V, 16 DI ports receive high-level signals as valid signals; the other connection method is NPN connection. The COM port on the I-board is connected to the power supply 24V, and 16 DI ports receive low-level signals as valid signals; Customers can choose the appropriate connection method according to the type of sensor they use. The outgoing connection method of Leantec is NPN connection method;



Note:

Picture ① is NPN wiring method; Picture ② is PNP wiring method;

If you want to replace the PNP connection method, in addition to replacing 24V with 0V to connect to the common point of the I board, you also need to pay attention to

the I15 port of the R series of cabinet emergency stop button, so you also need to change the 0V interface of the emergency stop to a 24V interface (NPN low level is valid, PNP high level is valid) as shown in the following figure:



5.4 Function Test

5.4.1 Check before Power-on

Before powering on, check if the installation environment meets the environmental conditions in chapter 4.1. The items include: Check whether the robot body is firmly fixed, whether the aviation plug of the power cable and the encoder cable is firmly inserted, whether the wiring terminals in the electric cabinet are inserted firmly, and whether the single-phase voltage of the main power cable in the electric cabinet is 220V and the ground wire is connected firmly.

5.4.2 Power-on abnormality check

Power on the electric cabinet after completing pre-power-on check. Observe whether there are any abnormal alarms on the teach pendant controller. If the emergency stop is pressed, the teach pendant controller will display the alarm R44.0. If there are other abnormal alarms, please contact Leantec engineers for analysis and solution.

5.4.3 Check the Mastering position, direction and soft limit of each axis of the robot

JOG each joint according to the direction shown in the figure and check whether the direction of each axis is correct. If the graphic direction is opposite to the actual direction, you can adjust the direction of each axis by modifying parameters 0 or 1 of parameters Pr41~Pr46. Check if the zero point position of each axis is consistent

with the zero point label. If not, reset the zero point of axes base on the zero point label and check the positive and negative software position limit of each axis.

5.4.4 Test procedure of Automatic Mode

Automatically run a random test program, and listen for any abnormal noise from the robot. If there is abnormal noise, stop the robot and test each joint motion separately. The normal joint motion is smooth, no stutter, and the sound fluctuation is minimal. After confirming the abnormal joint, please contact Leantec engineers for assistance. With this, the pre-use inspection of the robot is complete.



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6 Maintenance

6.1 About safety during maintenance

Instruction



Warning

- Please strictly follow the maintenance steps and do not simply disassemble robot parts.
- Maintenance operations should be performed by designated professionals.
- If not trained, stay away from the robot when the power is switched on. Also, do not enter the working area. Even if it appears that the robot stopped moving, a robot in an energized state may still act accidentally and cause a serious safety problem.
- Please confirm the robot action outside the safety enclosure after the replacement of the robot components. Otherwise, the robot may perform unexpected actions before confirmation, potentially causing serious safety issues.
- Before entering normal operation, please confirm that the emergency stop switch and safety guard switch operate normally. If the switch cannot be operated normally, it will be unable to perform the safety function in case of an emergency, which may lead to serious injury or significant damage, which is very dangerous.



Beware of electric shock

Maintenance, replacement, and wiring must be carried out after the power supply of the controller and related devices are turned off and the power plug is unplugged. Otherwise, power contactor failure may occur.

Notice during maintenance



Danger

- If there is a need to perform maintenance procedures not specified by LEANTEC, please contact our company.
- If you need to replace parts not specified by LEANTEC, please contact our company.
- Please perform regular maintenance, otherwise, it will affect the life of the robot or cause other unexpected dangers.
- Before performing overhaul and maintenance, please turn off all power supplies.
- Maintenance or overhaul must be carried out by qualified personnel and with a clear understanding of the installation procedures of the entire system and other possible risks.
- When replacing parts, please avoid other foreign objects from entering the robot.

6.2 Troubleshooting

Instruction

In case of a robot malfunction, do not continue operation. Immediately contact trained personnel to conduct a fault analysis, understand the symptoms, and determine which component is experiencing an issue. If parts need replacement, contact our company's service department. Avoid disassembling the robot without proper authorization.

6.3 Maintenance plan

Instruction

In order for the robot to maintain high performance for a long time, it must be maintained regularly. Maintenance personnel must formulate a maintenance plan and strictly adhere to it.

In addition, the overhaul must be carried out every 20,000 hours or within a shorter period of 4 years. If you have any questions, please contact our after-sales service department.

6.3.1 Check interval

Inspection instructions

Regular maintenance can prevent failures and improve durability and safety. To maintain the robot's long-term efficient performance, regular maintenance is necessary. Maintenance personnel must develop a maintenance plan and strictly adhere to it.

The maintenance can be divided into various stages as shown in the following table and the necessary maintenance items in each stage.

For the setting of the maintenance interval time, please calculate according to the servo power-on time.

The maintenance time in the table is based on arc welding operations. In cases of other applications or specific usage conditions, it is necessary to analyze and draw conclusions separately. It is particularly important to note that for high-frequency operations such as handling tasks, the maintenance interval should be shortened.

The maintenance cycle of the robot can be divided into daily, 1,000 hours, 5,000 hours, 12,000 hours, and 24,000 hours. The details are as follows :

Mainten ance Cycle	Inspection and Maintenance Content	Remarks
Daily	Mastering position marking	Same as robot Mastering position
	Abnormal noise and vibration	

Mainten ance Cycle	Inspection and Maintenance Content	Remarks
	The function of the motor brake	Listen to the sound of each motor when releasing the brake
	Oil leaking inspection	Inspect the installation surface of each gearbox and the external surface of each joint.
	Externally visible screws	Fixing screws on a robot arm body
1000 hr	Screw bolt of the robot base	
	External cable	Check the condition of the cable (cleanliness, damage, etc.)
5000 hr	Remove dust and debris	Especially the ventilation cooling system and electrical box
	Timing belt	Inspect the timing belt condition (Tension, wears down, etc.)
12000 hr	Battery replacement of Robot	In the event of a low battery warning during system startup, or replace the battery annually.
	Checking internal cable	Port connectivity, Wear of metal contact parts
	Surrounding screws of the axis	
	Screws for motors, reducers, etc.	
24000 hr	Internal cable	Replace

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6.3.2 Tightening of hexagon socket screws

Tightening instructions

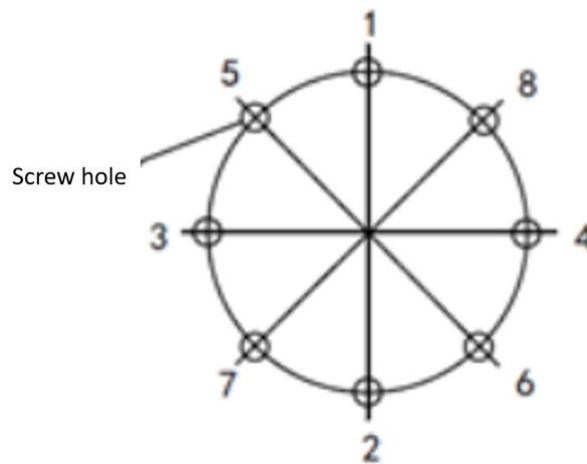
Use hexagon socket head screws (hereinafter referred to as screws, class 12.9) where connection strength is required. When assembling, tighten the screws according to the fastening torque shown in the following table. Unless specified, when refastening these screws in the operations described in this manual, use a torque wrench to tighten the screws by the tightening torque values shown in the table below.

S/N	Hex cylinder head screw	Torque (N·m)
1	M2	0.5
2	M3	2
3	M4	4
4	M5	9
5	M6	15
6	M8	35
7	M10	70
8	M12	125

Please refer to the following table for the torque of the set screw used in belt pulley installation:

S/N	Hex cylinder head screw	Torque (N·m)
1	M4	2
2	M5	3.9

It is recommended to fasten the screws on the circumference in diagonal order as shown in the figure below. Use a hexagon wrench to loosely tighten it 2~3 times and then use a torque wrench to tighten it according to the tightening torque value as shown in the table above.



6.4 The maintenance of synchronous belt

Reminder



Reminder

Synchronous belt adjustment and maintenance require professional staff to use professional tools to operate, after the replacement of the robot to zero calibration! If you have any problem during the adjustment, please call us!

LRA596-4H Robot 2, 3, 4, 5, and 6 axes should be used in synchronous belt transmission, loose when may lead to abnormal sound, precision decline, such as fault, so for every six months inspection on the synchronous belt, prevent synchronous belt loose lead to failure.

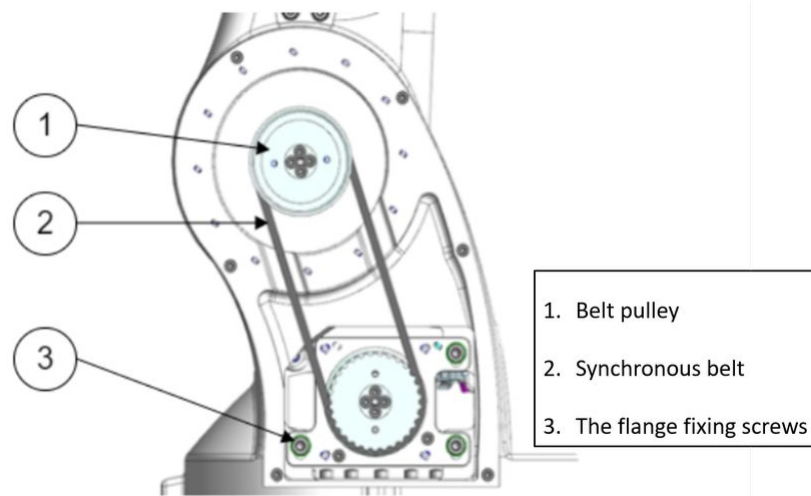
6.4.1 2nd-axis synchronous belt maintenance

Instruction

Remove the left cover of the waist and measure the tension of the belt with a belt tension meter. The standard tension of the timing belt is between $55 \pm 6\text{N}$ (for timing belts that have been in operation for over 20 hours, the tension should be adjusted to the standard tension * 0.7). If the measurement result is not within this range, adjust according to the following steps:

- Loosen the flange fixing screw (3 M5 in total, loosen until the belt wheel can move freely).
- Tighten the belt and measure the tension of the belt until the tension reaches the design requirements.
- Tighten the flange fixing screw (tightening torque: see "**Tightening of hexagon socket screw**").
- Remove tensioning screws and tool screws.
- Install waist right cover.

If the synchronous belt is found to be damaged, please replace it in time. After the replacement, zero calibration of the robot shall be performed again.



6.4.2 3rd-axis synchronous belt maintenance

Instruction

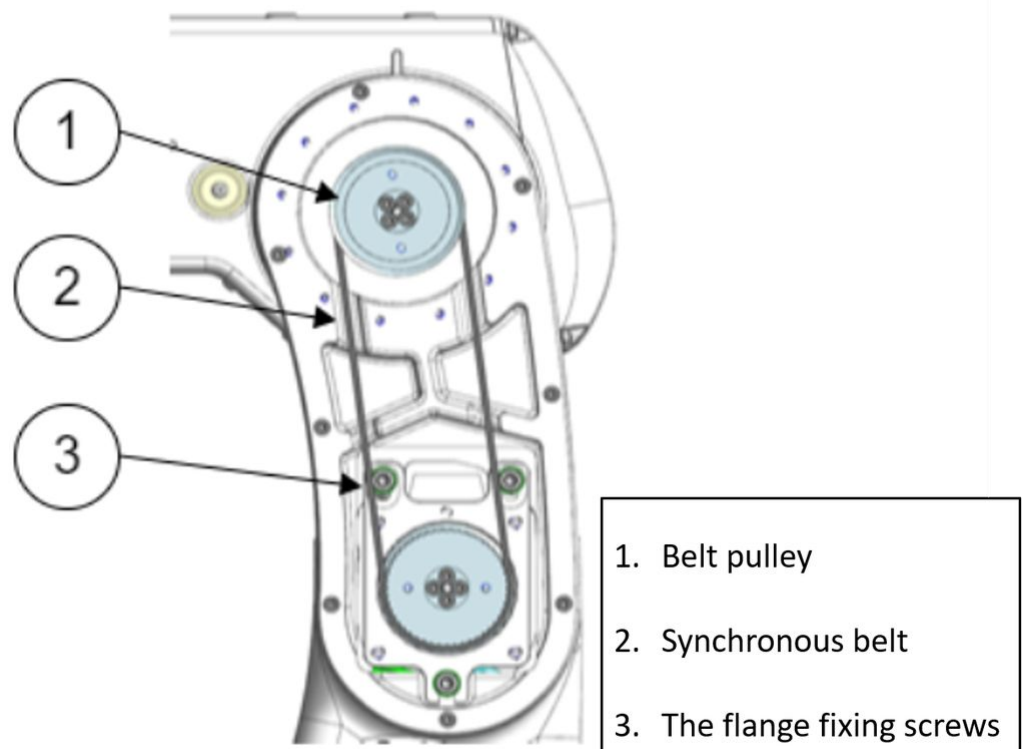
Remove the right cover of the upper arm and measure the tension of the belt with a belt tension meter.

The standard tension of the timing belt is between $44 \pm 5\text{N}$ (for timing belts that have been in operation for over 20 hours, the tension should be adjusted to the standard tension * 0.7). If the measurement result is not within this range, adjust according to the following steps:

- Loosen the flange fixing screw (3 M4 in total, loosen until the belt wheel can move freely).
- Tighten the belt and measure the tension of the belt until the tension reaches the design requirements.
- Tighten the flange fixing screw (tightening torque: see "Tightening of hexagon socket screw").
- Remove tensioning screws and tool screws.
- Install upper arm right cover.

Note: For products with IP67 protection grade, it is necessary to clean the residual glue off the right arm cover and install the right arm cover after using the new sealant between the cover plate and body.

If the synchronous belt is found to be damaged, please replace it in time. After the replacement, zero calibration of the robot shall be performed again.



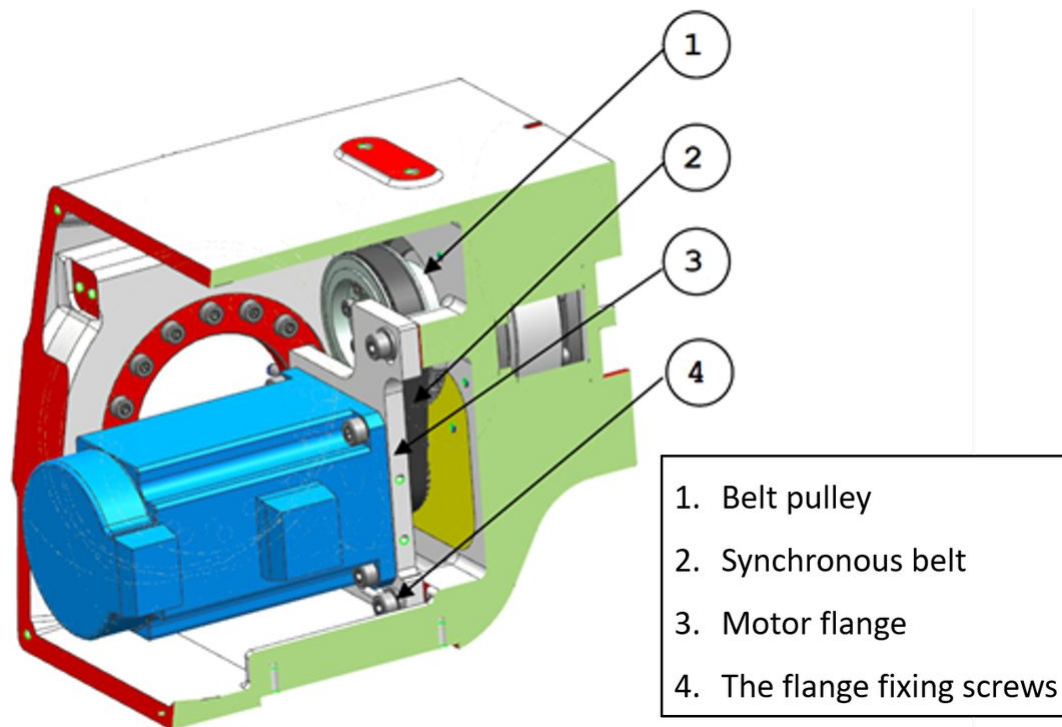
6.4.3 4th axis synchronous belt maintenance

Remove the small cover at the lower part of the forearm, and measure the tension of the belt with a belt tension meter.

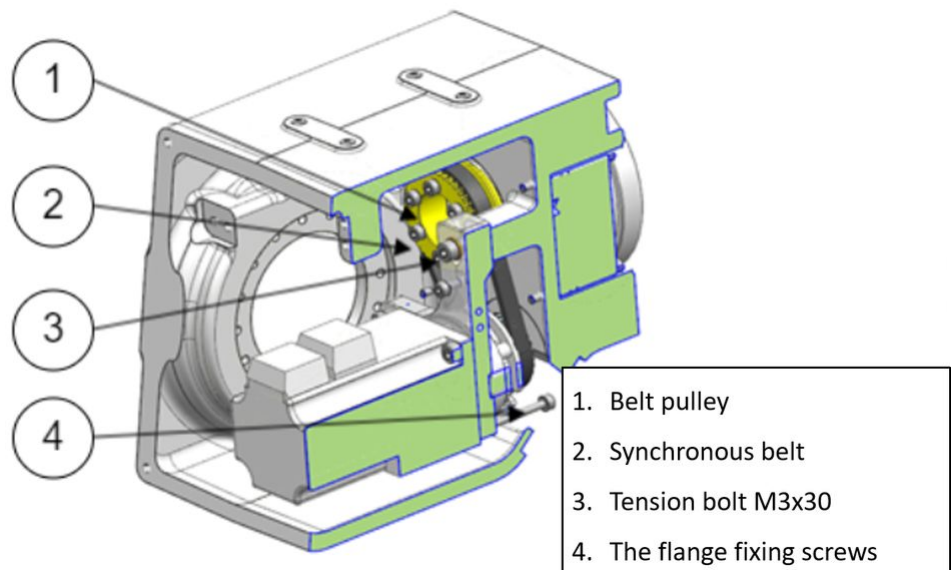
The standard tension of the synchronous belt is $20 \pm 2\text{N}$ (After the timing belt has been in operation for 20 hours, the tension will decrease to around 70% of the recommended value. At this point, please adjust the tension to 70% of the recommended value.). If the measurement result is not within this range, adjust according to the following steps:

- Loosen the flange fixing screws (3 in total, so that the pulley can move freely);
- Use a spring balance (maximum tension 200N) to tighten the motor flange tensioning screws (the lower end of the flange has M3 screw mounting holes), and adjust the tension to the specified value;
- Tighten the flange fixing screws (see "5.2.2 Tightening of Hexagon Socket Screws" for the tightening torque);
- Install the small cover;

Note: For products with IP67 protection grade, it is necessary to clean the residual glue of the right arm cover and install the small cover after using the new sealant between the cover plate and body.



If the synchronous belt is found to be damaged, please replace it in time. After the replacement, zero calibration of the robot shall be performed again



6.4.4 5/6th axis synchronous belt maintenance

Instruction

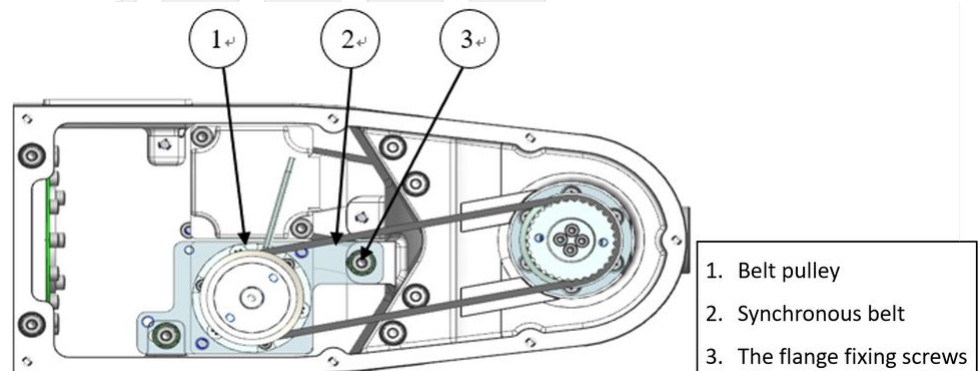
Remove the front cover of the forearm and measure the tension of the belt with a belt tension meter.

The standard tension of the timing belt is between $20 \pm 2\text{N}$ (for timing belts that have been in operation for over 20 hours, the tension should be adjusted to the standard tension * 0.7). If the measurement result is not within this range, adjust according to the following steps:

- Loosen the flange fixing screw (2 in total, loosen until the belt wheel can move freely).
- Tighten the flange fixing screw (tightening torque: see "**Tightening of hexagon socket screw**").
- Install upper arm right cover.

If the synchronous belt is found to be damaged, please replace it in time. After the replacement, zero calibration of the robot shall be performed again.

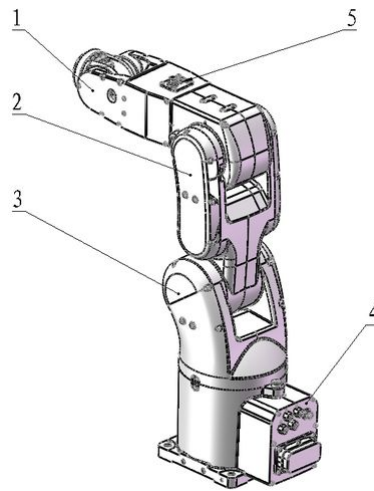
The structure of the 5th-axis and 6th-axis pulley is the same, so the maintenance of the 6th-axis pulley can refer to the 5th-axis.



6.5 Waterproof Sealant Instructions

6.5.1 Corresponding Model

R-series with IP67 protection grade, In the maintenance or repair of the robot, the cover of the robot body and the rear tailstock are disassembled, to maintain its IP67 protection performance, it is necessary to use a flat sealant for sealing; the description of the seal is shown in the following figure:



- 1- When maintaining 5, 6-axis synchronous belt or repairing components, you need to disassemble the left and right covers here, and apply sealant when installing;
- 2- When maintaining the 3-axis synchronous belt or repairing components, you need to disassemble the left and right covers here, and apply sealant when installing;
- 3- When maintaining the 2-axis synchronous belt or repairing components, you need to disassemble the left and right covers here, and apply sealant when installing;
- 4- The rear tailstock needs to be disassembled when replacing the battery with the robot, and sealant should be applied when installing;
- 5- This cover must be disassembled when repairing and maintaining the air pipe, joints, and signal line interfaces, and sealant should be applied during installation

6.5.2 Model of sealant

LEANTEC Automation R series robot cover and tailstock seals recommend using two models of sealants "TONSAN 1596" and "ThreeBond 1211" to solve the problem of sealing and waterproofing. The sealant parameters are shown in the following table:

	TONSAN 1596	ThreeBond 1211	Note
Tack-free time (min)	5-20	90	
Tensile Strength (MPa)	1.8	1	(GB/T528) After soaking in 5W30 engine oil at 150°C for 100h
Operating temperature (°C)	-54~260	-60~200	

	TONSAN 1596	ThreeBond 1211	Note
Elongation at break (%)	300	230	(GB/T528) After soaking in 5W30 engine oil at 150°C for 100h
main component	Silicone Rubber	silicone resin	
Color	Gray	White	

6.5.3 Usage and precautions

Use the cover plate and rear tailstock at the forearm of the robotic arm as an example. The rest of the cover plate can be operated in the same way.

1. Connect the tapered hose to the waterproof sealant (used to ensure that the sealant is squeezed and applied evenly);



2. Apply the waterproof sealant evenly to the connection position of the cover and the tailstock to ensure that the contact surface with the body connection is completely closed and there should be no disconnection or leakage in the middle;

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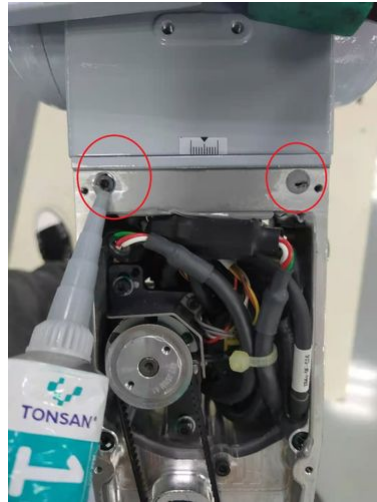


3. Coat all threaded holes for connection with a waterproof sealant to ensure complete sealing and achieve waterproof effect;



4. If there is a countersunk screw on the connecting surface of the robot body side, it needs to be completely filled with sealant to prevent water from penetrating into the inside of the arm, as shown in the following figure:

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⚠ Precautions

After applying the sealant, you should directly connect and lock to ensure that the product is completely sealed. To make the product have good sealing performance, it is recommended that the waiting time is much longer than the surface drying time of the product for more than 3 hours. It is not allowed to operate automatically or manually during the process.

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7 Zero point

7.1 About mechanical home

What is a mechanical home

When designing a robot, a predefined initial posture is established, where the angles of each joint are set to 0 in this posture. From a mechanical perspective, the zero-point posture refers to the position achieved when a specific angle is formed between adjacent links. From a software perspective, as robots use encoders to record joint angles, the zero-point posture refers to the robot's position when the servo motors rotate to a specific encoder value.

Therefore, the mechanical zero point can actually have two interpretations. From the perspective of observers, the mechanical zero point is the posture of the robot corresponding to specific positions reached by each joint of the robot. From the standpoint of the control system, the mechanical zero point comprises values from several encoders. The zero point serves as the reference for the robot's coordinate system. Without a zero point, the robot cannot determine its own position. Hence, in order to achieve the highest possible absolute positioning accuracy, it's necessary to calibrate the robot's zero point, aligning the mechanical zero point as closely as possible with the algorithmic zero point.

Under what circumstances should the mechanical home be calibrated

The situations where recalibrating the zero point is generally necessary include:

- After the replacement of the motor, synchronous belt, reducer, and other mechanical system parts.
- After a violent collision with a workpiece or environment.
- Manually move robot joints without control of the controller.
- Reinstall the entire system.
- Encoder battery after discharge.

7.2 Zero point calibration

Instruction

The purpose of mastering is to make the theoretical zero of the control algorithm coincide with the actual mechanical home so that the mechanical connecting linkage system can correctly respond to the position and speed instructions of the control system.

More generally speaking, mastering is a process in which each joint of the robot is rotated to a specific angle by using some pre-designed positioning devices on the mechanical body, and the control system is informed to record the numerical values of the motor encoder of each joint at this time.

All joints of LRA596-4H series robots are calibrated by key-code plate, and only one axis can be calibrated at a time. During the calibration, the corresponding joint shall be slowly rotated until the two grooves coincide and a special calibration key shall be

inserted (or the standard 3mm wide flat key can be used instead). At this time, the position shall be the zero point position of the axis.

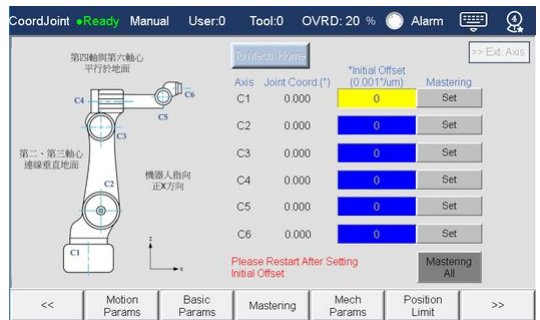
For the six axes, special tools are used to calibrate the zero points as shown in the figure below when leaving the factory. If the user has a high requirement on the path trajectory accuracy and needs to accurately calibrate the zero point of the six-axis, it is suggested that the user leave a keyway of 3(+0.01,+0.03)mm in the end tool flange for use with the standard zero calibration block

? Unknown Attachment

- ①: A1 axis calibrate groove
- ②: A2 axis calibrate groove
- ③: A3 axis calibrate groove
- ④: A4 axis calibrate groove
- ⑤: A5 axis calibrate groove
- ⑥: A6 axis calibrate groove
- ⑦: calibrate piece

7.3 Calibration steps

Calibration steps

	Operate	Description
1	Log in to the system with users above the Expert level and enter the zero-point calibration interface.	Zero calibration can only be done in manual mode with no program running. The zero calibration interface is located in the "calibration" classification.  The screenshot shows the 'Mastering' screen in the robot's control system. It features a diagram of the robot arm with axes C1 through C6 labeled. To the right is a table with columns for 'Axis', 'Joint Coord. (°)', 'Initial Offset (0.001°/um)', and 'Mastering'. All initial offsets are set to 0. Below the table, there is a 'Mastering All' button and a warning: 'Please Restart After Setting Initial Offset'. The top status bar shows 'CoordJoint Ready Manual User:0 Tool:0 OVRD: 20 % Alarm'.
2	In joint coordinate jog mode, please calibrate the robot starting from axis 1.	Different robots have different mastering calibration tool. Please refer to the manual for the corresponding robot.

	Operate	Description
3	When the corresponding axis moves to the zero position, click the "calibration" button of the corresponding joint on the HMI to complete the calibration of the joint, and then move on to the next joint.	It is recommended to wait for the calibration of the previous joint to be completed before calibrating the "calibration" button of the next joint.
4	Repeat step 3 until all joints of the robot have been calibrated.	



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8 Appendix

8.1 Appendix 1: IP67 Reinforcement Kit Installation

8.1.1 1.1 Corresponding Model

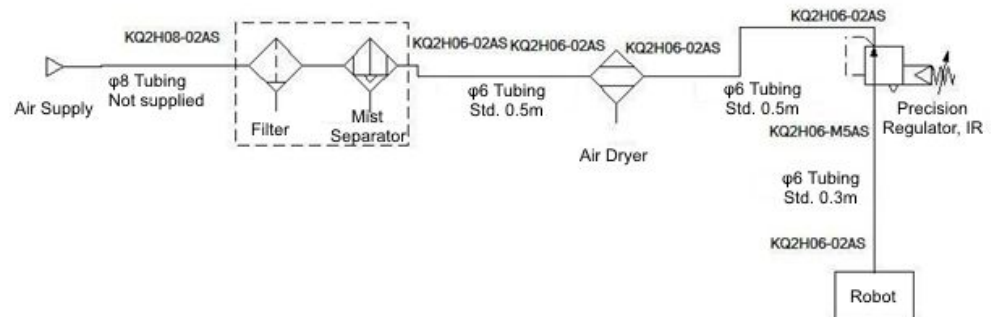
R-series with IP67 protection grade

8.1.2 1.2 Part List

The IP67 reinforcement kit contains the following components. The user must provide air supply (air pressure between 0.3 and 0.85 MPa) and install the IP67 reinforcement kit in a suitable place.

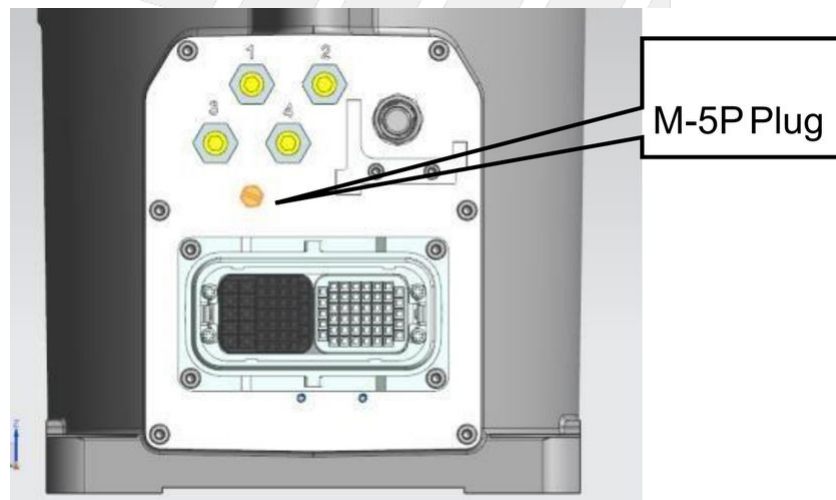
Item	Name	Model	Qty.	Remark
1	Membrane Pneumatic Air Dryer	IDG1	1	
2	Precision Regulator	IR2000	1	
3	Mist Separator	AFM20	1	
4	Spacer with Bracket	Y200T-A	1	For user installation
5	Filter	AF20	1	
6	Connector	KQ2H06-02AS	5	Rc1/4
7	Connector	KQ2H08-02AS	1	for $\phi 8$ air supply
8	Connector	KQ2H06-M5A	1	M5 male thread. Install on robot
9	Tubing	TU0604BU-100	5	5 meter long $\phi 6$ tubing

8.1.3 1.3 Pneumatic Wiring Schematic



8.1.4 1.4 Installation Procedure

1. Connect air supply (φ8 tubing) to the filter of IP67 reinforcement kit
2. Turn on air supply, and adjust the precision regulator to maintain the pressure between 0.03 ± 0.01 MPa
3. Remove the M-5P plug from the robot base and install KQ2H06-M5A connector
4. Connect IP67 reinforcement kit to KQ2H06-M5A connector through φ6 tubing
5. Re-adjust the precision regulator to maintain the pressure between 0.03 ± 0.01 MPa
6. Complete. The robot is now ready for use



Hint

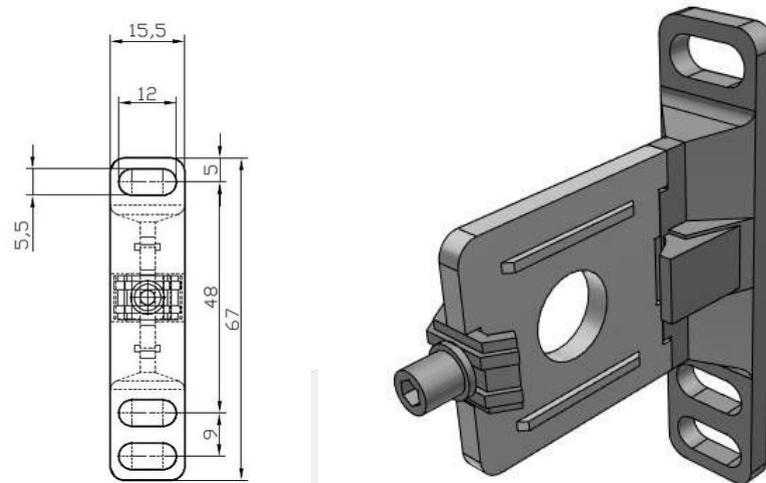
Do not cut off air supply during use.

Fluid level must not exceed a height of 16 cm from the base of the mounting surface.

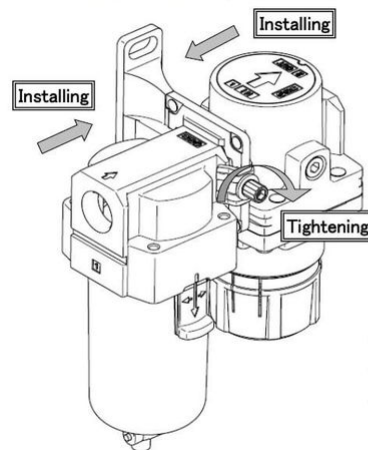
This IP67 reinforcement kit can only supply air to one robot.

8.1.5 1.5 Mounting

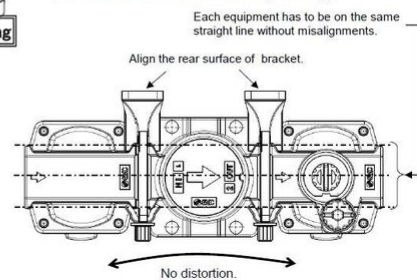
Y200T-A spacer is provided for installation on site. The mounting hole size and installation instruction are as follows:



【Modular connection (Assembly)】



【Precautions for modular connection (Assembly)】



8.1.6 1.6 Maintenance Precautions

The filter and mist separator need to be maintained according to the usage. The waste liquid needs to be removed regularly, and the filter element needs to be replaced according to the usage.

Read more

For more information about the use, programming, and parameter setting of robots, teaching aids and control cabinets, please refer to the Operation Manual of Syntec Robot Control System.

Address: Leantec Intelligence, Xindai Science park, No. 9, Chunhui Road, Suzhou Industrial Park

Leantec Intelligence: <https://www.leantec.com.cn>