



SYNTEC
TECHNOLOGY CO.,LTD.

LS600-6 Product Manual

匯出日期: 2023-12-04

修改日期: 2023-09-04



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



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2 Safety

2.1 About this Chapter

Instruction

This chapter explains the content that must be observed in the safe use of the robot. Please read this chapter and carefully before using the robot system.

This chapter introduces the safety principles and procedures to be considered when using LEANTEC robots.

User Introduction

Users can be divided into 3 types :

Operators :

- Turn on or off the system power
- Start or stop the program
- Restore system alarm state

Programmers :

- In addition to the operator's work
- Teach new robot programs

Technicians :

- In addition to the programmer's work
- Repair and maintain the robot system

⚠ Both programmers and technicians are required to take professional training from the original factory.

2.2 Safety Terms







2.2.1 Safety Identity

About safety identity

When operating the robot in accordance with the contents of this manual, different degrees of danger may be encountered. Therefore, near the operation instructions that may cause danger, there will be a special safety mark prompt box to remind users to pay attention to precautions. The contents of the prompt box include:

- An icon representing the safety level and corresponding name, such as warning, danger, prompt, etc.
- A simple description of what could happen if the operator did not eliminate the hazard
- Instructions on how to eliminate hazards


Safety level







Icon	Name	Description
	Danger	If the content with this logo is not operated in accordance with the regulations, it will cause serious or even fatal to the personnel Life damage, and will/may cause serious damage to the robot. Operations associated with such hazards include contact with high voltage components in the control cabinet and movement during robot operation into its work area, etc.
	Warning	It is suggested that the current operation may have the risk of accidents, causing serious or even fatal injuries.
	Electric Shock	It is suggested that the current operation may have the risk of electrocution, causing serious or even fatal injuries.
	Caution	Content bearing this logo, if not operated in accordance with the regulations, may result in personal injury and damage to the machine itself.
	Anti-static (ESD)	It is suggested that the parts involved in the current operation are sensitive to static electricity and may be damaged during the operation if they are not operated according to the specification.
	Reminder	Used to suggest important information or prerequisites.

2.2.2

Risk

Introduction

Icon	Name	Description
	Pinch	When operators and maintenance personnel enter the robot's movement range during commissioning, maintenance, overhaul and tool clamping, they may cause damage.

Icon	Name	Description
	Clamp hand	There is a risk of a pinch when the maintenance personnel approaches the belt drive during a maintenance operation.
	Collision	When operators and maintenance personnel enter the movement range of the robot during commissioning, maintenance, overhaul and tool clamping, collision or serious injury may occur.
	Friction	When the operator and maintenance personnel enter the movement range of the robot during commissioning, maintenance, overhaul and tool clamping, there may be abrasions
	Parts fly out	Operators and maintenance personnel enter the movement range of the robot during commissioning, maintenance, overhaul and tool clamping, and the tool or workpiece may fly out due to lax clamping, which may cause serious damage.
	Fire	Fire may occur in the event of a short circuit or wirings and devices catching on fire which may cause serious injury.
	High temperature	When maintenance personnel contacts the high-temperature surface of the robot during equipment overhaul and maintenance, it may cause burns.



Warning, any robot in motion can be fatal!




When a robot is running, it may perform undesirable or even unreasonable movements. In addition, the robot will carry a huge amount of energy when moving, and when a collision occurs, it will cause serious injury/damage to the personnel and equipment in its working range

Elimination of danger

	Operate	Reference information
1	Make sure all emergency stop equipment is properly configured and installed before starting the robot.	Emergency stop equipment includes a safety gate, safety grating, safety light blanket, etc.
2	In the process of robot programming, it is necessary to ensure that the teach pendant is held by the person entering the working area of the robot.	Avoid the danger of operating the robot with the teach pendant when the personnel outside the work area do not observe the personnel inside the work area.
3	Before starting to run the robot program, make sure that there are no other personnel in the robot's work area.	

Robot icon description

Icon	Name	Description
	Collision hazard sign	Keep a safe distance when the robotic arm is in operation to avoid a collision.
	Specification label	Label the specifications of the robotic arm and manufacture dates.

Icon	Name	Description
	Grounding sign	The robotic arm must be connected to the ground to prevent electrical shock.
	Electrical Shock Hazard Sign	The robotic arm might have potential electrical shock risks.
	Operate Carefully Sign	Be careful when operating the robotic arm, and predict the movement of the robotic arm.

2.2.3 Safety characteristics

Instruction

PLC is built into the Syntec system to process safety-related signals, and external safety signal interfaces such as safety gate and safety grating are provided.

Signals processed by PLC include :

- Reset signal
- Safety gate signals
- Emergency stop reset signal
- Enable switching signals
- Mode selection signals
- Servo on signal

2.2.4 What is Emergency Stop

Definition of safe stop

The emergency stop is the highest priority function in the robot system. Pressing the emergency stop button will trigger the emergency stop. At this time, all other robot control functions will stop, the robot will stop moving and the motor power of each joint will be cut off. The control system will switch to the emergency stop state, which will be maintained until it is manually reset.

The emergency stop means that all power to the robot will be cut off except for the manual brake release circuit. To restore the system to its normal state, a manual reset operation must be performed, that is, first release the emergency stop button and then manually press the power on the control cabinet.

After triggering the emergency stop, the system may take either of two different stopping modes according to different working conditions:

- STOP 0, immediately cut off the power supply of the motor and make each joint brake, which is the safest way to STOP. However, the robot is in an uncontrolled state during the stopping process, and may deviate from the path after stopping. The emergency STOP in manual mode belongs to STOP 0.
- STOP 1. After the emergency STOP is triggered, the control system will immediately decelerate along the path. Then the safety module will cut off the power supply of the motor and make all the joints lock, no matter whether the robot stops completely or not. In the vast majority of cases, due to a controlled stop, the robot will end up on the programming path, providing the best protection against peripherals. By default, the emergency STOP in automatic mode belongs to STOP 1.



Reminder

An emergency stop is only used to stop the robot immediately in a dangerous situation.



Reminder

The emergency stop should not be stopped as a normal procedure. Otherwise, it will cause extra and unnecessary wear to the brake system and transmission system of the robot, and reduce the service life of the robot.

Emergency stop button

By default, the robot system is equipped with two emergency stop buttons that trigger an emergency stop when pressed. One is mounted on the control cabinet and the other is mounted on the teach pendant.

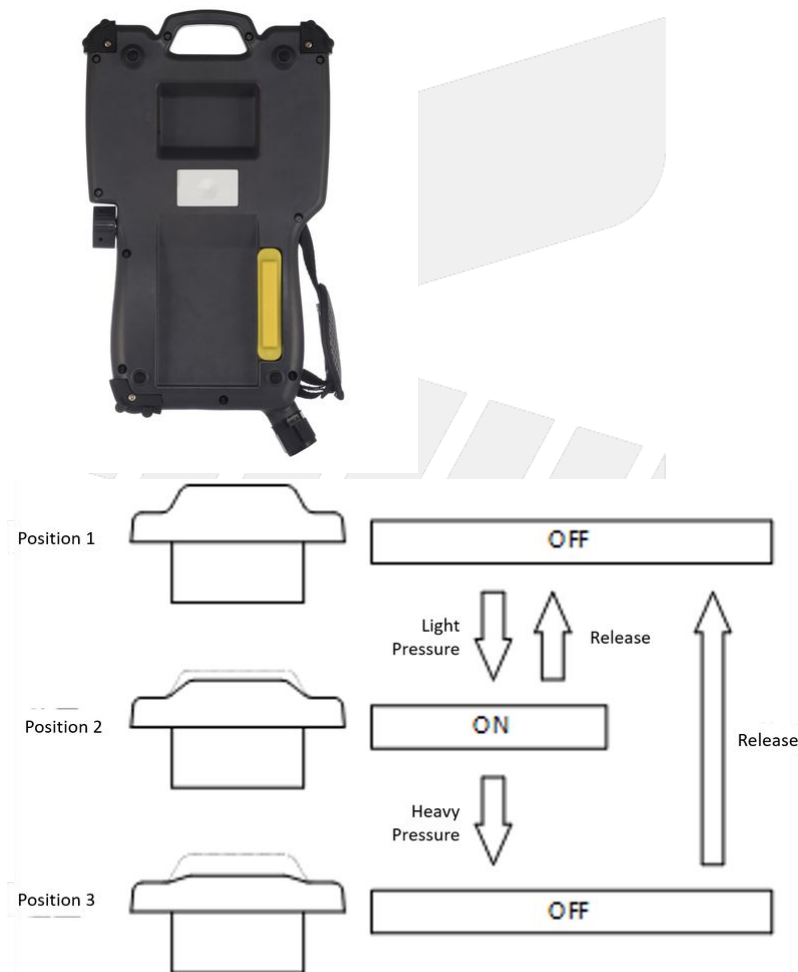


In addition, your system integrator may install additional emergency stop buttons during the robot deployment process. Please contact your system integrator or consult the robot workstation documentation for more information.

2.2.5 Enabling Device

It is a special switch with two presses and three positions, which only works if the enable switch been pressed and kept in the middle position. If the switch is released or fully pressed, the robot movement will be stopped.

It needs to be pressed together with other keys to prevent mistouch.



Reminder

The enabling device is mounted on the back of the teach pendant, and Jog or run programs can only be performed when pressed it to the middle position. The operation is invalid when the switch is released or fully pressed.

For safe use, the following requirements must be observed:

- Enable switches must work properly under all circumstances.
- During programming and commissioning, release the switch when robot movement is not required.

Anyone entering the robot's workspace must carry a teach pendant with them to prevent others from starting the robot without the knowledge of insiders.



Warning
External devices that jam the enabling device in the middle position are strictly prohibited!

2.3 Work Safety Guide

2.3.1 Description

About Robots

No matter how fast they move, industrial robots are potentially dangerous. A pause or wait in a program may be followed by a very fast and dangerous motion command. Even if you are already familiar with the current robot's trajectory and mode, the robot's trajectory in automatic mode can still be changed by external signals without warning.

Therefore, safety regulations must be followed when entering the working area of the robot.

About working area, safe area and danger area

The working area is the range in which the robot can move and should be limited to the minimum necessary size. Appropriate protective measures must be used to protect the work area. The protective devices (such as a safety gate) must be located in a safe area. When it stopped, the robot will be braked and stopped in the danger area. Danger area includes the range of working area and the stopping distance of the robot, it must be protected by physical protective measures to prevent danger to humans or property damage.

About this section

This section will introduce some basic safety regulations for end users. However, due to space limitations, it cannot cover every specific situation.

2.3.2 Self 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.
- Pay attention to the problem of the workpiece surface or robot body. After long working hours, the temperature of robot motor and outer shell may be very high.
- 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.
- Watch for electrical components in the robot and control cabinet. Even when power is lost, the energy stored in the device can be very dangerous.
- Any move of a climbing robot is forbidden.



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.
- Avoid placing the control box near high voltage or other components that generate electromagnetic fields, to prevent the electromagnetic interference which may cause deviation or malfunction of the robot.
- It may cause damage or malfunction of the robot if it uses aftermarket repair parts.
- 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 away from the robot workstation or control cabinet. It is needed to prevent that the operator might 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 danger happened.

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.

2.3.3 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.

Teach pendant controller lecturers 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.

2.3.4 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 emergency stop devices such as safety gates, safety gratings, etc., have some type of safety lock mechanism. If you use external emergency stop devices in your robot workstation, please 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 RESET button on the teach pendant controller to restore the system from the emergency stop.

2.3.5 Safety Considerations For Manual Mode

About manual mode

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

Manual mode is used to write and commission robot programs and participate in the commissioning of the workstation.

Speed limitation under manual mode

In manual mode, the movement speed of the robot end is limited to under 250mm/s, that is, whether it is a Jog robot or running a program and regardless of the speed set in the program, the maximum movement speed of the robot will not exceed 250mm/s.

Bypass external safety signals

In manual mode, signals of external safety devices will be by bypassed, such as safety doors and safety light barriers. This means, to facilitate debugging, the system will not be in an emergency stop state even if the safety door is opened in manual mode.

2.3.6 Safety Considerations For Automatic Mode

About automatic mode

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

In the automatic mode, the enable switch will be bypassed, so the robot can run automatically without human involvement.

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

Most of the time, robots are part of a production line, so robot failures do not only affect the workstation itself but when problems occur in other parts of the production line, the robot workstation may also be affected. Therefore, it is up to those familiar with the entire production line to design fault recovery solutions 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.

2.3.7 Handling When Emergency

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:

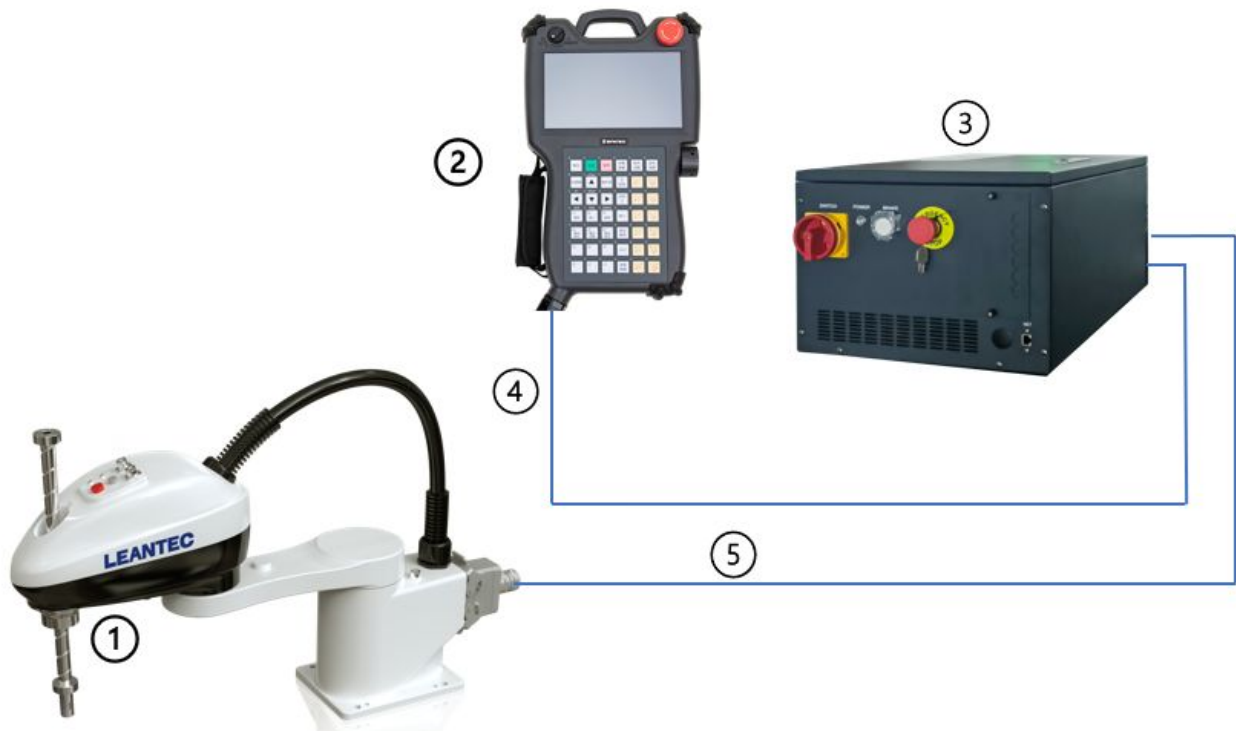
- If the power switch or button is close to the shock point, pull the switch quickly and cut off the power.
- If the power switch or button is far away from the electric shock location, insulated pliers or axes, knives and shovels with dry wooden handle can be used to cut off the power side (i.e., where 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 electrocuted person, 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 electrocuted person.

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.

3 Product overview



3.1 Overview of Robot System

System overview

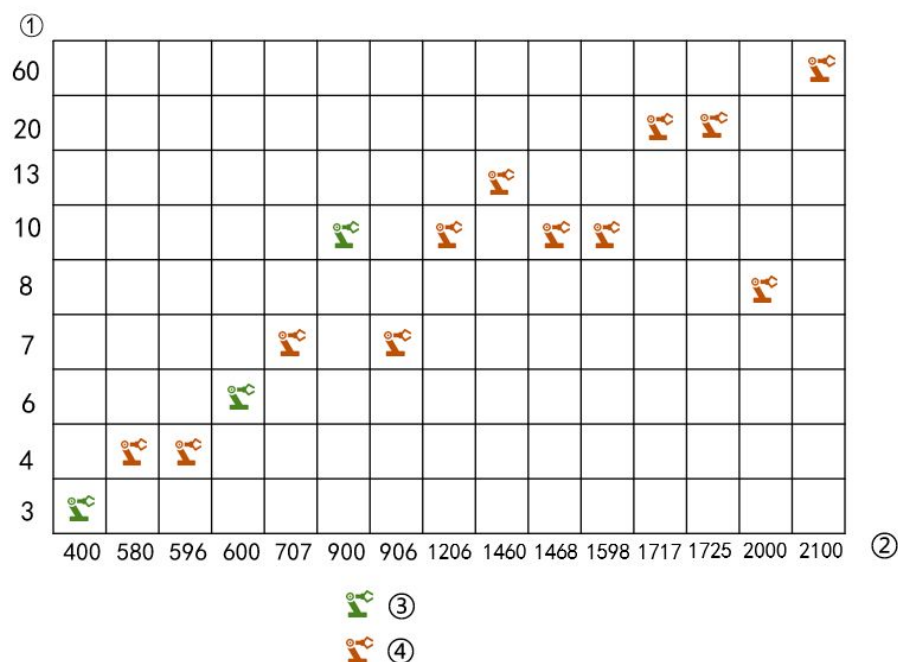
A complete robot system includes the robot body, controller, instructor, connecting cables, software, terminal actuators, and other accessories, as shown in the figure below.

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



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. The use of Leantec industrial robot is as follows: 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

Principles: Leantec robot is composed of a four-joint robot, control cabinet and 81R teach pendant controller. The teach pendant controller gives the command to two SYNTEC three-in-one drivers, and the drivers drive the six motors on the robot to rotate regularly to control the motion path of the center of rotation at the end of the sixth axis.

Main technologies:

1. High speed and high precision advanced:

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:

After receiving the position command from the Controller, the drive will make further motor command planning and send the motor command of each offset time to the servo motor, so that the servo motor could drive the reducer to run.

3. After completing the two points above, the reducer will drive the operation of the robot and completes the action edited by the user to meet application scenarios such as welding, picking, and placing, etc.

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 4 degrees of freedom. Each joint motor is equipped with a brake. A mechanism consists of the following parts:

- Wrist -- The wrist has one degree of freedom and is located at the output end of the robot.
- Forearm -- The forearm is located between the upper arm and the wrist and is driven by a 3rd motor.
- Upper arm -- The upper arm is located between the lower arm and the lumbar joint and is drive by the 2nd motor,
- Waist -- The waist is located between the upper arm and the base and is driven by the 1st motor.
- Base -- The base is the foundation of the robot, with electrical connections for the robot at its rear.

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4 Technical parameters

4.1 Specifications

Performance parameter table

The performance parameters of the robot are shown in the table

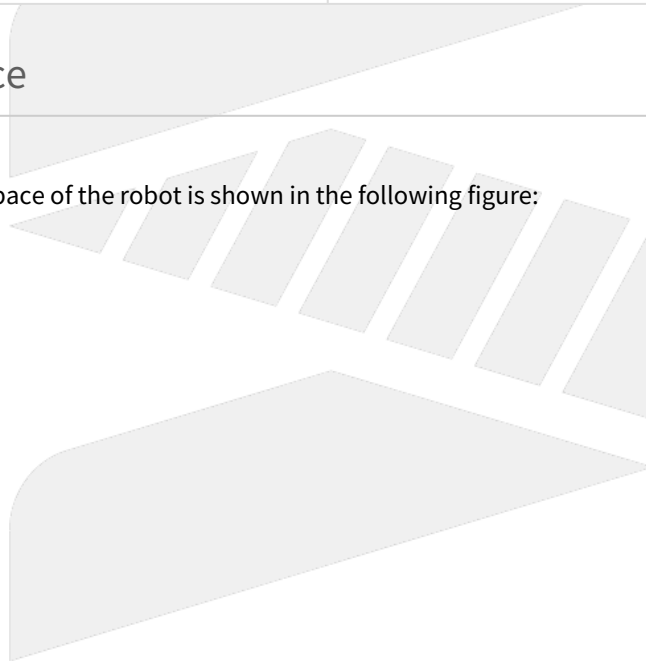
Model		LS600-6
DOF		4
Drive mode		AC servo drive
Max. Reach		600mm
Repeatability		±0.02mm
Max Load Capacity		6kg
Motion Range (°)	Axis 1	+132°~-132°
	Axis 2	+145°~-145°
	Axis 3	0~-130mm (0-220mm)
	Axis 4	+360°~-360°
Max. Speed* (°/s)	Axis 1	450°/s
	Axis 2	720°/s
	Axis 3	1100mm/s
	Axis 4	2000°/s
Operating temperature		0°~+45°C
Storage temperature		-10°~+55°
Level of protection		IP54 (IP20)

Model	LS600-6
Method of Installation	Floor, upside, tilt
Base Dimension	200mm×170mm
Base Mounting Hole	150mm×150mm
Noise Level	≤70dB(A)
Weight	Approx 17kg

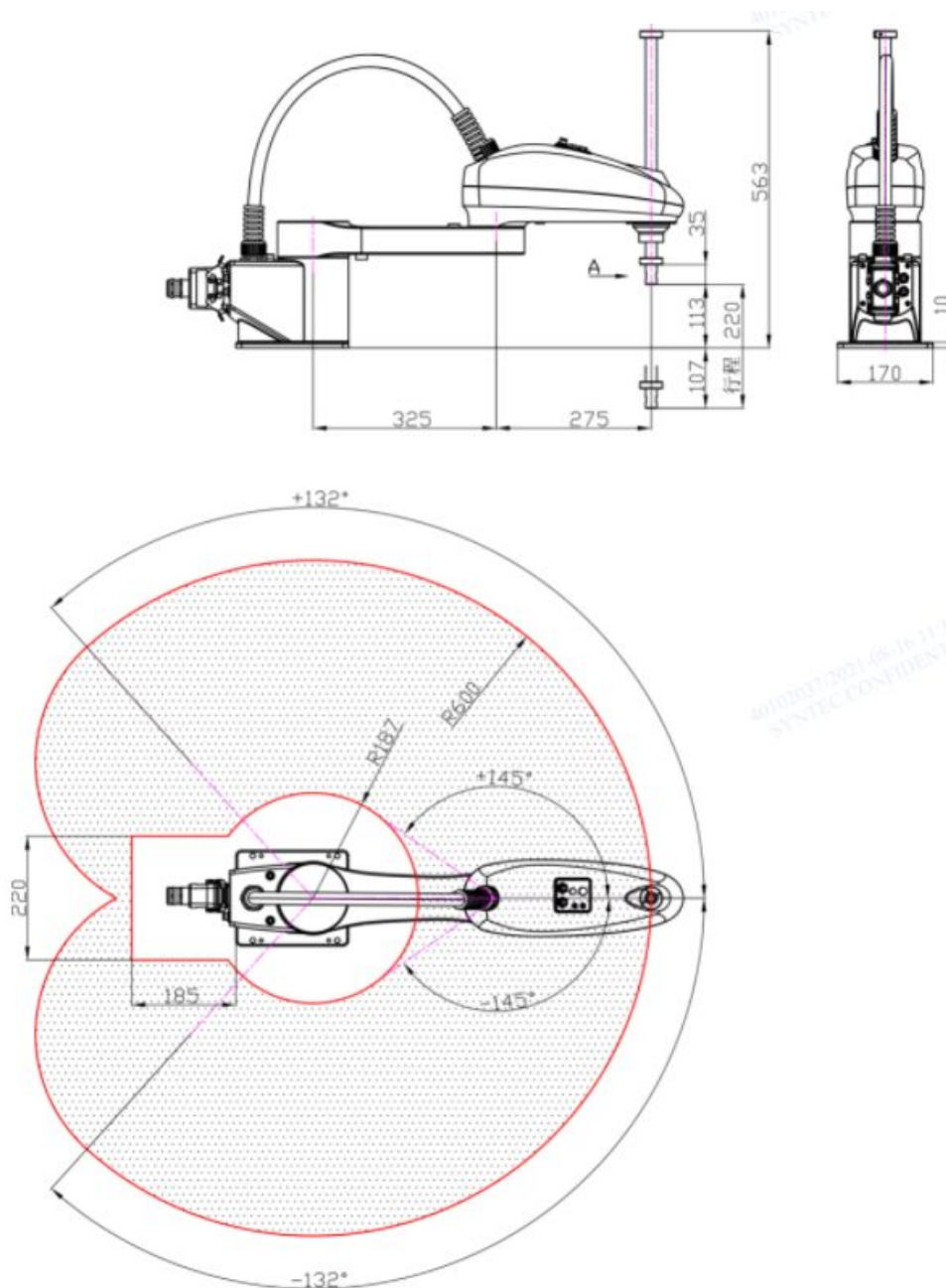
4.2 The workspace

Robot workspace

LS600-6The working space of the robot is shown in the following figure:



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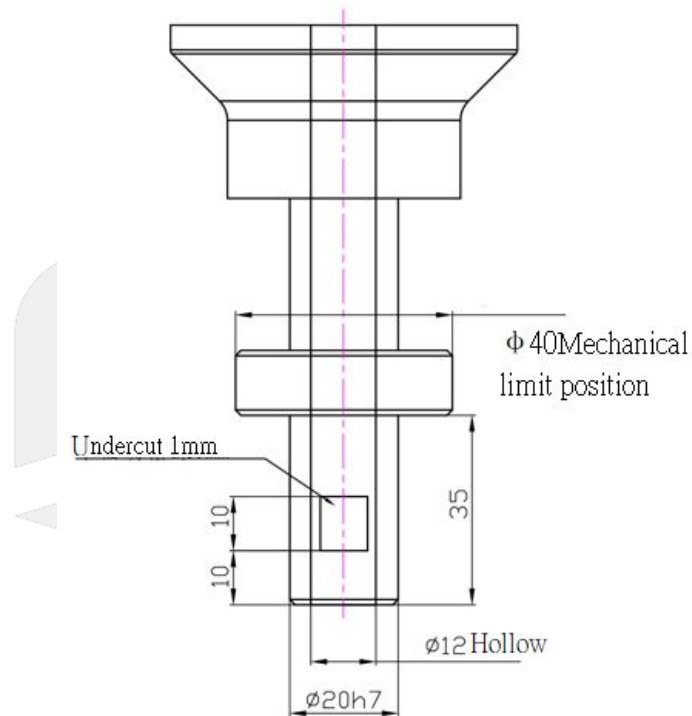
Reminder

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

4.3 Output flange

Instructions


Please make the robot end fixture 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 axes. Please pay attention to the interference area at the end of the fixture in the design.



4.4 Electronic Control Box Specification

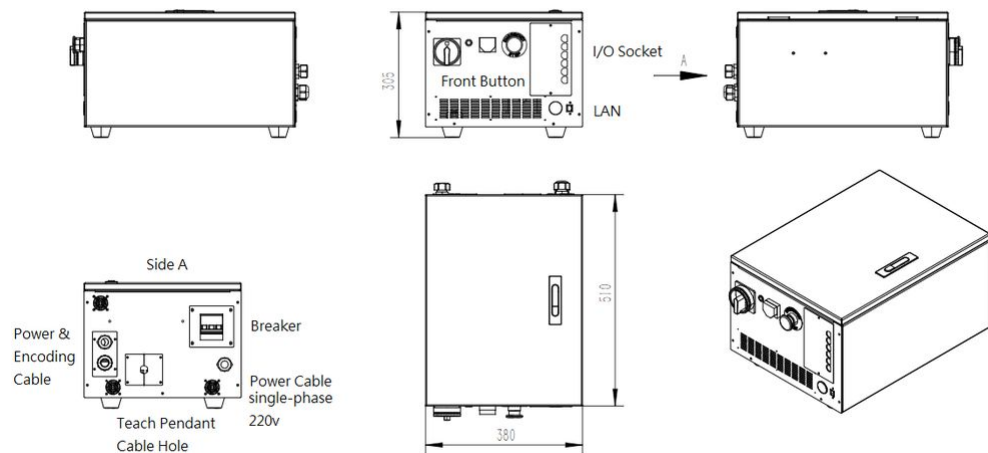
The standard specifications of the electric control box are listed below.

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	Electronic Box D
Entity diagram of electronic control box	
Corresponding Model	LS400、LS600、LA917
Power Supply	Single-phase 200-230VAC, 50Hz/60Hz
Input/Output Signals	16I/16O
Analog Input/Output*	/
Size	380mm x 510mm x 305mm
Weight (kg)	-
Remarks	*Optional

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

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4.5 Specifications of Protective Bellows

The specifications are as follows:

Material	Three proof fabric (Surface rubber elastic fabric)
Levels of protection	IP54
Features	Waterproof, dustproof, unresistant to acid and alkali, not stab-proof, unresistant to high temperature, install the screw protection bellows at the 3.4-axis position, and carried out special treatment for high protection in other parts

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**Example
diagram**



Standard Type (IP20)



Protective Type (IP54)

Notice

1. The projective bellows will wear and tear, please install and use it under suitable environmental conditions. Please check, maintain and replace it regularly;
2. Not suitable for lathe processing and other environments with large machining chips to avoid sharp objects from scratching the protective cover;
3. Not suitable for strong acid and strong alkali environment to avoid corrosion and damage of the protective cover surface;
4. Not suitable for high temperature environment;

4.5.1 Addition: The supplementary description for SCARA protection solution

- The protection type SCARA protection level IP54. It is applied for normal machine put and place environment use. But it is not applied for large particles chips, high temperature, strong acid, strong alkali environment. The damage to the protective cover or main body structure caused by improper user operation is not covered by the warranty.
- The protection cover needs regular inspection and maintenance, and change the dust cover every 6 months. The damage to the protective cover or main body structure caused by improper user operation is not covered by the warranty.
- The protection cover is consumable part. It should be change immediately once be broken. The damage to the protective cover or main body structure caused by not change protection cover in time is not covered by the warranty.



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Danger

- Potentially explosive environment
- Corrosive environment
- Flammable environment
- Radioactive environment
- Environment without risk assessment
- Use for human and animal transportation
- Operation outside of the permitted usage parameters

5.2 On-site installation

5.2.1 Handling

Description

When handling, in principle should use a crane and other lifting equipment, in the absence of lifting equipment can also be considered by manual handling. The handling of a device should be carried out by at least 2 people at the same time. It is necessary to pay attention to safety and handle the device lightly at the same time to avoid damage to the equipment and the surface of the robot.



Warning

The body of the Y-series robot weighs is about 13-60kg. Be sure to use rings with M6×10 threads 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.

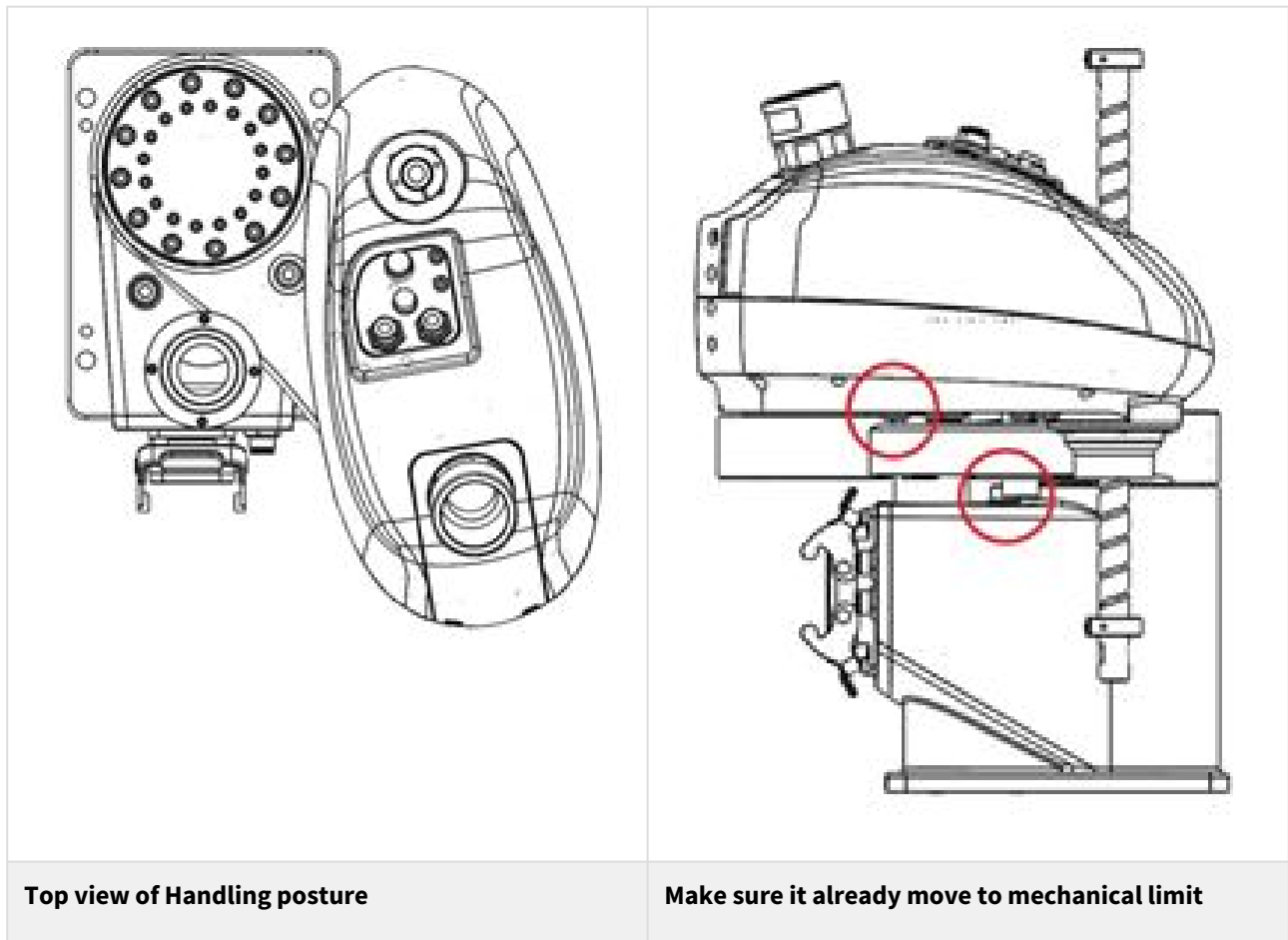


Danger

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

1. Handling posture:

When handling, please confirm that the arm has been adjusted to the following posture.

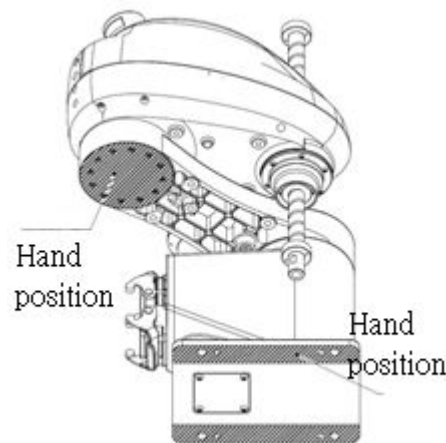


2. Handling method

Please transport the robot by using a trolley . When transporting the robot, please fix the robot on a transport tool (such as a cart), or support the shaded part (under the 1st robotic arm and under the base, refer to the figure) and carry it by more than 2 people;

- When holding the base, please be careful not to pinch fingers;
- When transporting for a long distance, please fix the robot directly on the transporter to prevent it from overturning;
- Please perform the same packaging like it just shipped before handling;

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5.2.2 Installation



Warning

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.



Danger

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

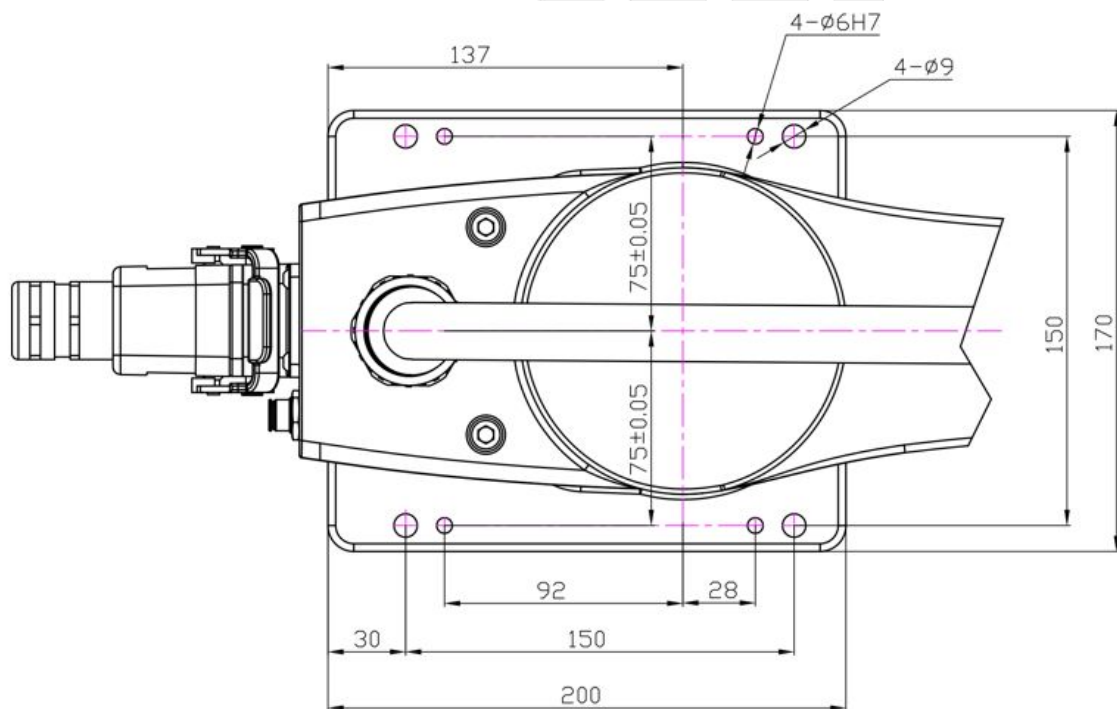
The installation of the robot is very important to its function. It is especially worth noting that the base and the foundation can withstand the dynamic load of the robot during

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 - $\Phi 6$ 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	M8×35
Quantity	4
Strength Level	12.9
Tightening torque	45±5Nm

Base hole size



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.

5.3 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.

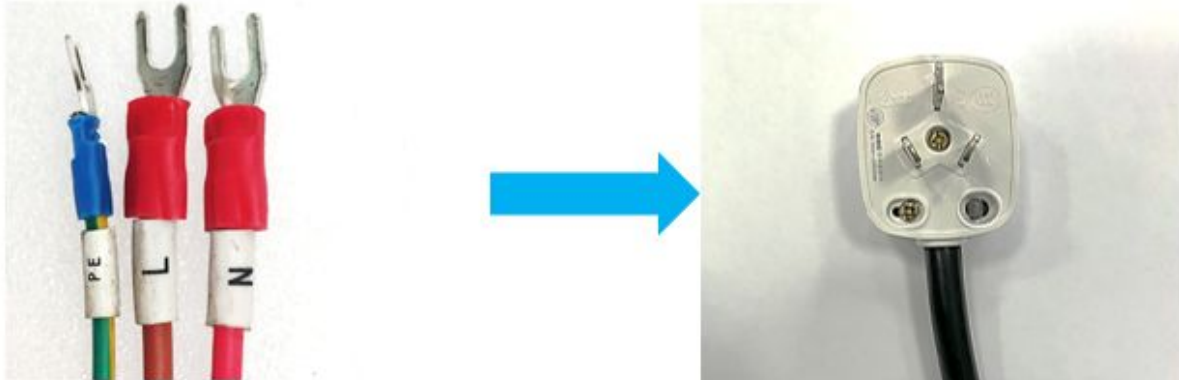
5.3.2 Grounding Instructions

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.

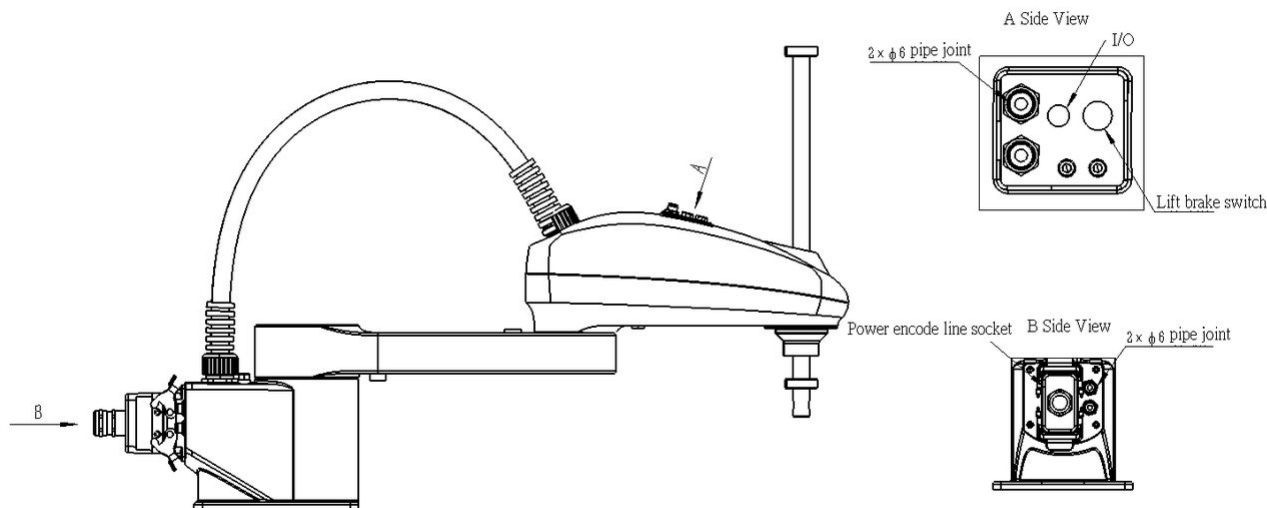


Danger

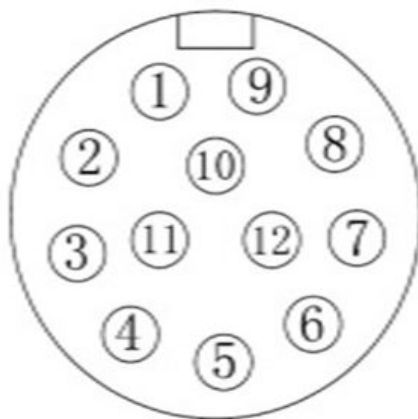
- The ground terminal must be connected to the ground pole (5.5mm² diameter or above is recommended), otherwise, fire and electric shock may occur.
- Before wiring, turn off the power supply of the controller and related devices and pull up the warning sign (e.g., never switch on the power). Wiring while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



LS600-6 robot is built-in with 12 lines of wire directly connected to the end of the power box, which effectively solves the problem of wire twisting during the working process. The definition of specific wires is shown in the table below:



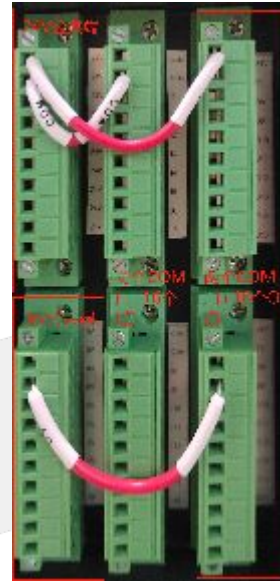
arm plug side			inside electronic box	
pin number	main body wire color	code	wire color	code
1	blue	X1	black 15	X1

arm plug side			inside electronic box	
2	white	X2	black 16	X2
3	yellow	X3	black 17	X3
4	white	X4	black 18	X4
5	red	Y1	black 19	Y1
6	white	Y2	black 20	Y2
7	purple	Y3	black 21	Y3
8	white	Y4	black 22	Y4
9	(empty)	(empty)		
10	(empty)	(empty)		
11	yellow	+24V	black 23	+24V
12	brown	GND	black 24	GND

5.3.4 IO Wiring Definition

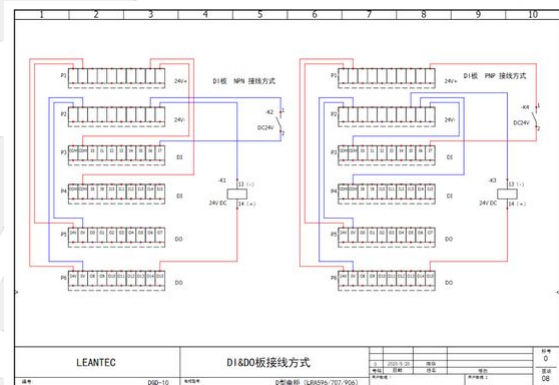
The IO connection method of the electric cabinet of the Y-series arm is to transfer 16 I points and 16 O points to the side panel of the electric cabinet. The sheet metal opening is provided with 3 rows of IO external interfaces and two rows of COM port interfaces. The top row is the 24V COM port and the bottom row is the 0V COM port, as shown in the figure below:

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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;

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5.3.5 Function test

5.3.6 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.

5.3.7 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.

5.3.8 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.

5.3.9 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 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 the robot appears to have stopped moving, a robot in an energized state may still act accidentally and pose a serious safety problem.
- Be sure to confirm the robot action after the replacement of the component outside the safety fence. Otherwise, the robot before action confirmation may perform unexpected actions and may cause serious safety problems.
- 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 you need to perform maintenance procedures other than those specified by LEANTEC, please contact our company.
- If you need to replace parts not specified by LEANTEC, please contact our company.
- Be sure to 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 material from entering the robot.

6.2 Troubleshooting

Instruction

When the robot breaks down, please do not continue to operate. You should immediately contact the technician who has received the required training to carry out the failure analysis and determine which part is abnormal.

If you need to replace parts, please contact our company's service department, do not disassemble the robot at will.

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 shall compile maintenance plans and strictly implement them.

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. In order to enable the robot to maintain high-efficiency performance for a long time, regular maintenance must be carried out. Maintenance personnel must prepare inspection and maintenance plans and strictly implement them.

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 following table is based on the arc welding operation. For other purposes or special conditions, it is necessary to analyze it separately before making a conclusion. Pay attention to the need to shorten the maintenance interval for high-frequency operations such as handling operations.

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 :

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

Maintenance 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	Check the installation surface of each reducer
	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
	Synchronous belt	Inspect the synchronous belt condition (Tension, wears down, etc.)
12000 hr	Battery replacement of Robot	Replace the battery when the battery low voltage alarm pop out during the startup of the system or every year
	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

6.3.2 Tightening of hexagon socket screws

Tighten 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.

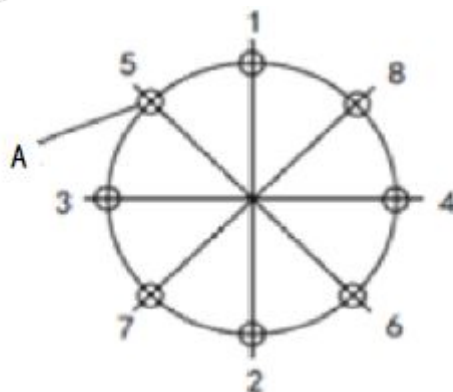


Diagram description

A: Screw hole

6.3.3 Replace Battery

6.3.4 Replace Battery

The batteries of the robot are used to record the encoder data of each axis, hence the batteries are required to replace every 1000 hours. Users should replace the batteries when the battery low voltage alarm appears. The mastering position of the robot will be lost if the user does not replace the battery in time.

Specific steps are as follows:

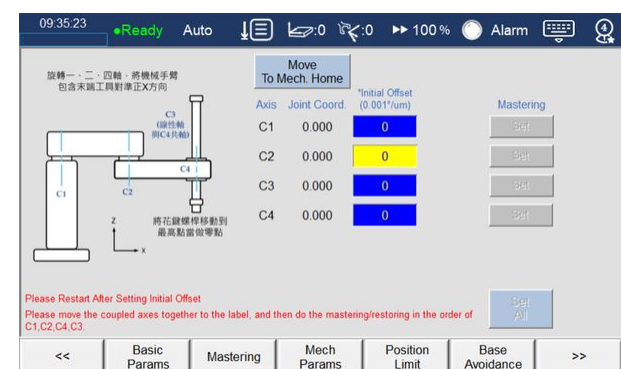
Mastering and power off:

1. Before replacing the battery, start the robot and run the robot to the Mastering position: After starting the robot, make the controller in the state of "Ready", "Permission 4" and "Manual", then open the "Settings" in the controller and enter the "Mastering setting page", Press and hold the "safety switch" on the back of the teach pendant, then press the "Mechanical Home" button until the robot moves back to the Mastering position.
2. Power off and remove the Robot Power Cable.

1. Click to set in the "Ready" "Permission 4" "Manual" state



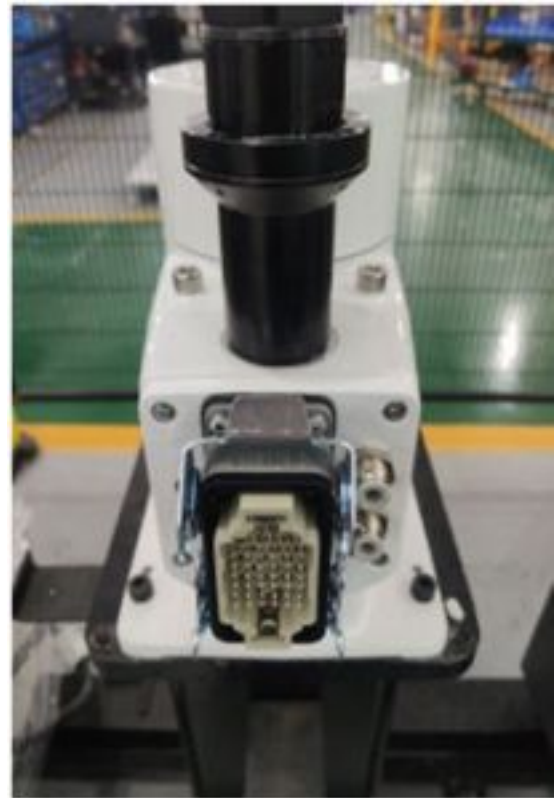
2. Mastering setting page



3. Robot Power Cable

4. Status after Removal

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Remove the battery case

1. Loosen the "4-hexagon socket M4 screw" fastened on the back cover of the robot, and open the back cover.
Note: Do not pull out the back cover, just open it slightly;
2. Pull out the "plug" connected to the battery box;
3. Loosen the "2-hexagon socket M4 screw" fastened by the battery case, and remove the "battery case";

Install the battery case

1. Put the new battery case in the position, and fasten it with "2-hexagon socket M4 screws";
2. Insert back the "plug" connected to the battery box, paying attention to the direction;
3. Connect the back cover to the base and fasten it with "6-hexagon socket M4 screws";

4-Hexagon Socket M4 Screw

Open the back cover

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Plug and 2-Hexagon Socket M4 Screw



Battery Case



Power-on verification

1. Connect the robot's Heavy Duty Connectors down shell and power on;
2. When the robot is not running, open the "Status Monitor" in the controller to check the current coordinates, whether it is C1=0, C2=90, C3=0, C4=0.
3. If it is 0, there is no need to re-record the zero point, then the battery replacement is completed. If the data deviation is too large, it must re-record the zero point, then go to step 5.

Recording zero point method: After replacing the battery, when the robot is not running after power on...

1. Make the controller in the state of "Ready", "Permission 4" and "Manual", open "Settings" - "Origin Setting" in the teach pendant to enter the "Origin Setting" page, and click "Calibrate Origin for All Axes" (It can also mark the origin one by one)
2. After confirming that the zero point recording is completed, long press the "safety switch" on the back of the controller and then press the "return to mechanical origin" button. If the robot does not run, the position of the robot at that moment is the zero point states of the robot.

6.4 The maintenance of Synchronous belt



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!

LS600-6 Robot 2, 3, 4, axis all use synchronous belt transmission. When the synchronous belt is loose, it may cause abnormal sound, decrease in accuracy, etc., so it's necessary for checking synchronous belt every six months to prevent it from causing malfunctions.

6.4.1 3rd/4th Axis Synchronous Belt maintenance

The LS600-6 robot needs to replace the 3rd/4th axis synchronous belts every 3840 hours or 1 year . Please see the table.

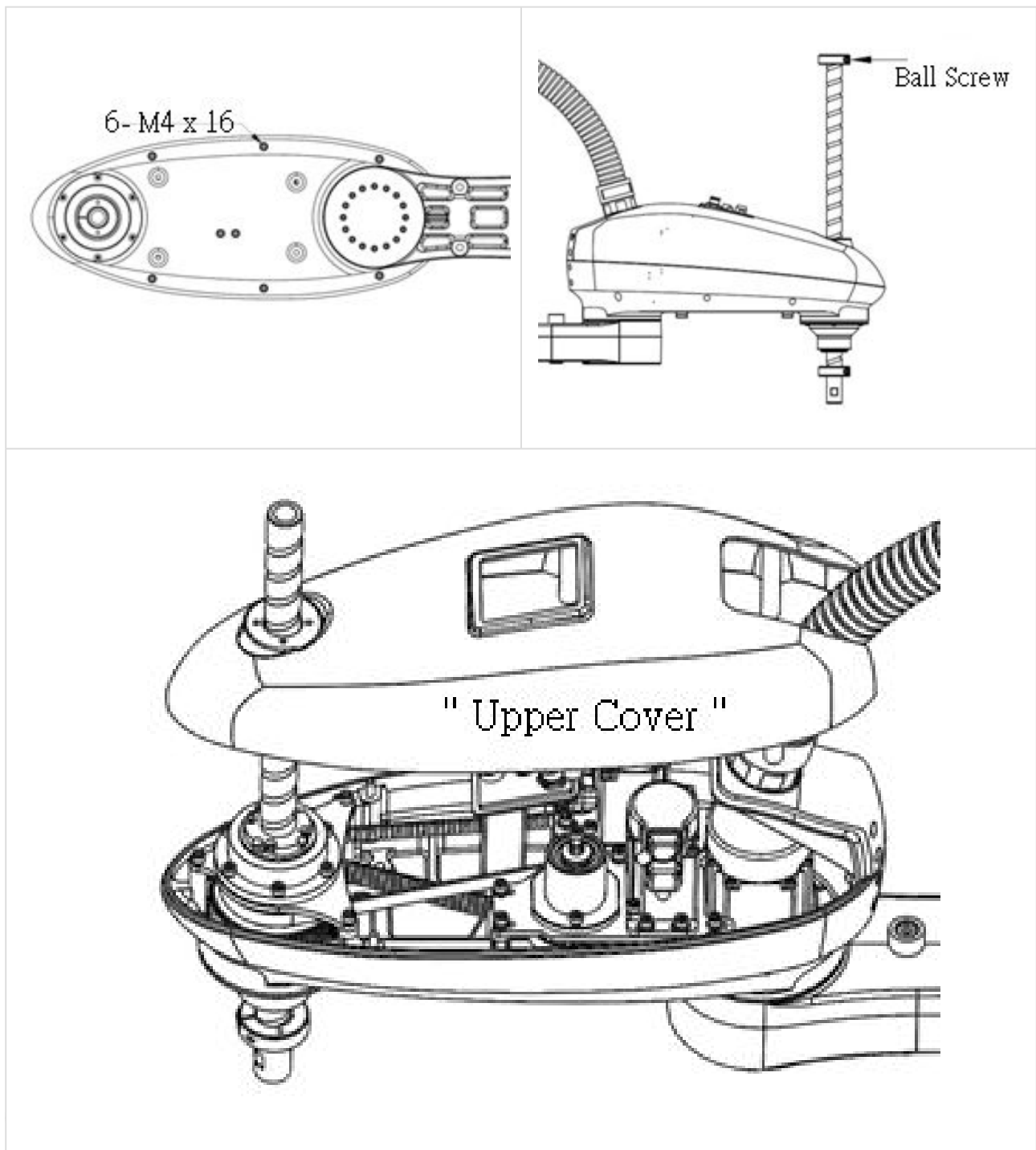
Robot Model	Synchronous Belt position	Synchronous Belt Model
LS600-6	Primary side transmission of C3	Synchronous Belt-2GT Z108 width 9
LS600-6	Secondary side transmission of C3	Synchronous Belt-2GT Z242 width 15
LS600-6	C4	Synchronous Belt-3GT Z186 width 9

Note: whether the C3 secondary side transmission synchronous belt or the C4 synchronous belt is replaced, the 4th axis should be removed first, and then the 3rd axis could be removed.

Before replacing the synchronous belt:

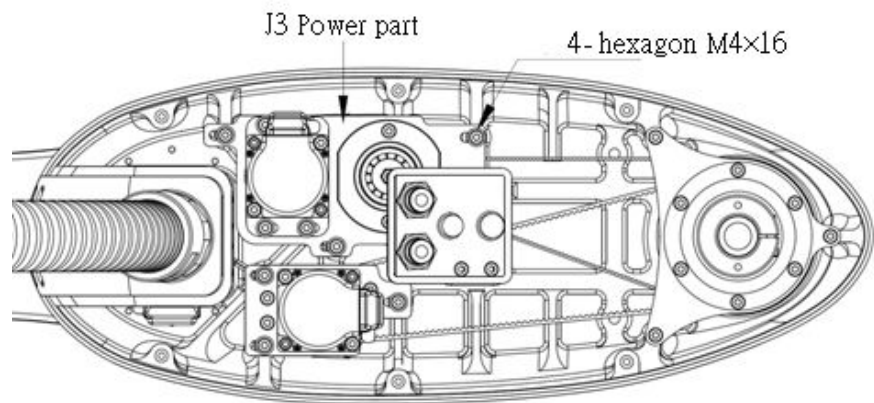
Step 1: Cut off the power supply of the device, and the robot returns to Mastering position.

Step 2: Use an Allen wrench to remove the screw M4×16 that fixed on the mechanical limit position at the upper end of the ball screw and the screw 6-M4×16 on the forearm shell, then remove the upper cover of the forearm, please refer to the picture . Then, re-locked the mechanical limit position fixed at the upper end of the ball screw. To prevent the ball screw shaft from being separated from the rotating nut and the lifting nut.

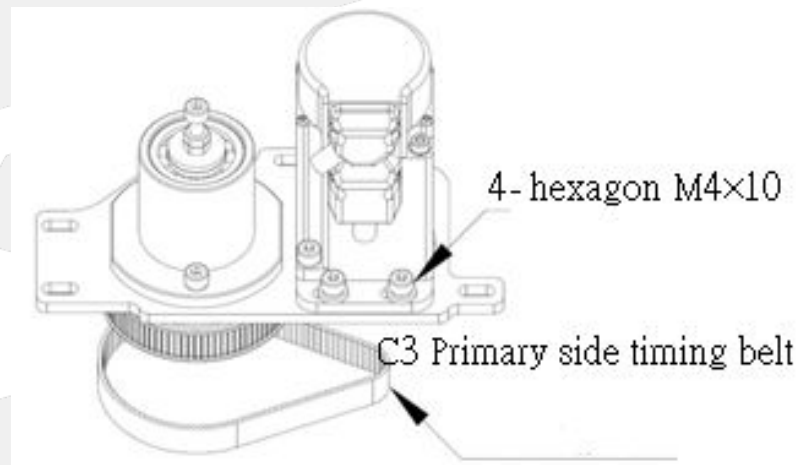


(1) Replace the C3 Primary side transmission synchronous belt.

Step 1: As shown in the picture, first loosen the set screw 4- hexagon M4×16 inside the expanded part, then the C3 power part can be taken out (include Primary side transmission) ;



Step 2: Use an Allen wrench to loosen the screws 4- hexagon M4×10 fixed to the C3 servo motor, and then move the servo motor ;



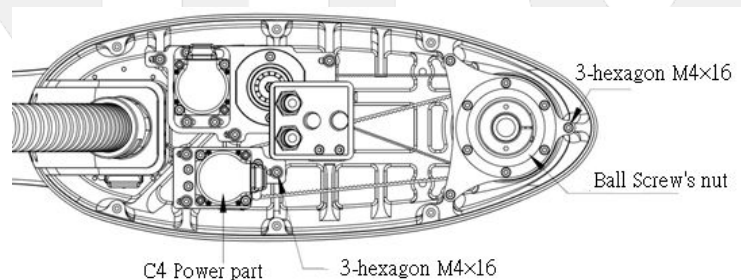
Step 3: Remove the old synchronous belt and replace it with a new one;

Step 4: According to the synchronous belt tensioning parameters, it is recommended to use a tension meter to control the tensioning frequency of the C3 Primary side transmission synchronous belt at about 628Hz. According to the 12.9-level torque standard of DIN267, tighten the set screw 4-hexagon M4×10 for fixing the C3 servo motor;

Step 5: Apply robot Mastering operation.

(2) Replace the C4 transmission synchronous belt.

Step 1: As shown in the picture. Remove the set screw 3-hexagon M4×16 of the power part of the C4 with an Allen wrench, then the C4 power part can be removed;



Step 2: Use an Allen wrench to remove the set screw 3-hexagon M4×16 which fixes the ball screw , so that the nut assembly can move up or down;

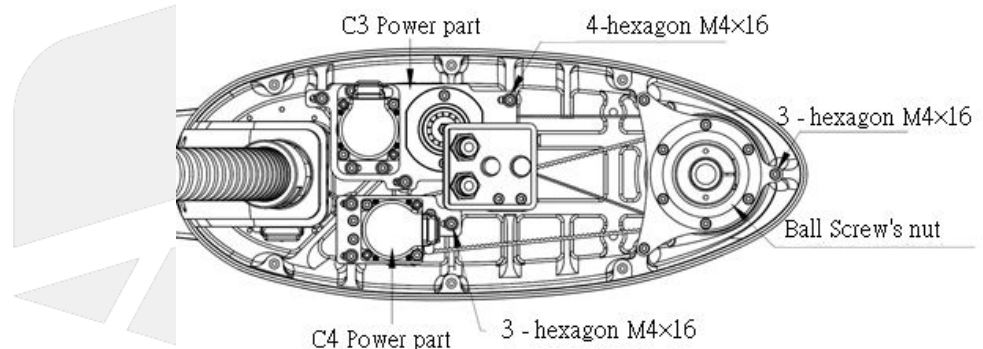
Step 3: Remove the old synchronous belt and replace it with a new one;

Step 4: According to the 8.8-level torque standard of DIN267, firstly tighten the set screw 3-hexagon socket M4×16 to fix the nut of the ballscrew, notice that the ball screw should move swimmingly;

Step 5: According to the synchronous belt tensioning parameters, it is recommended to use a tension meter to control the tensioning frequency of the C4 synchronous belt at about 78Hz, and according to the 8.8-level torque standard of DIN267, tighten the screws 4-hexagon socket M4×10 to fix the power part of the C4;

Step 6: Apply robot Mastering operation.

(3) Replace the C3 secondary transmission synchronous belt.



Step 1: Use an Allen wrench to remove the set screw 3 - hexagon M4×16 of the power part of the C4 , and remove the C4 power part;

Step 2: Use the Allen wrench to remove the set screw 4-hexagon M4×16 of the C3 power part, and remove the C3 power part;

Step 3: Use an Allen wrench to remove the set screw 3-hexagon M4×16 that fixes the elevating screw, so that the elevating screw assembly can move up and down, and the C3 secondary synchronous belt can be replaced;

Step 4: Remove the old synchronous belt and replace it with a new one;

Step 5: According to the 8.8-level torque standard of DIN267, firstly tighten the set screw 3-hexagon socket M4×16 to fix the elevating screw , then the screw can be adjusted;

Step 6: According to the synchronous belt tensioning parameters, it is recommended to use a sonic tension meter to control the tensioning frequency of the three-axis secondary transmission synchronous belt at about 105Hz, and according to the 8.8-level torque standard of DIN267, tighten the screws 4-hexagon socket M4×10 to fix the power part of the C3;

Step 7: Apply robot Mastering operation.

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

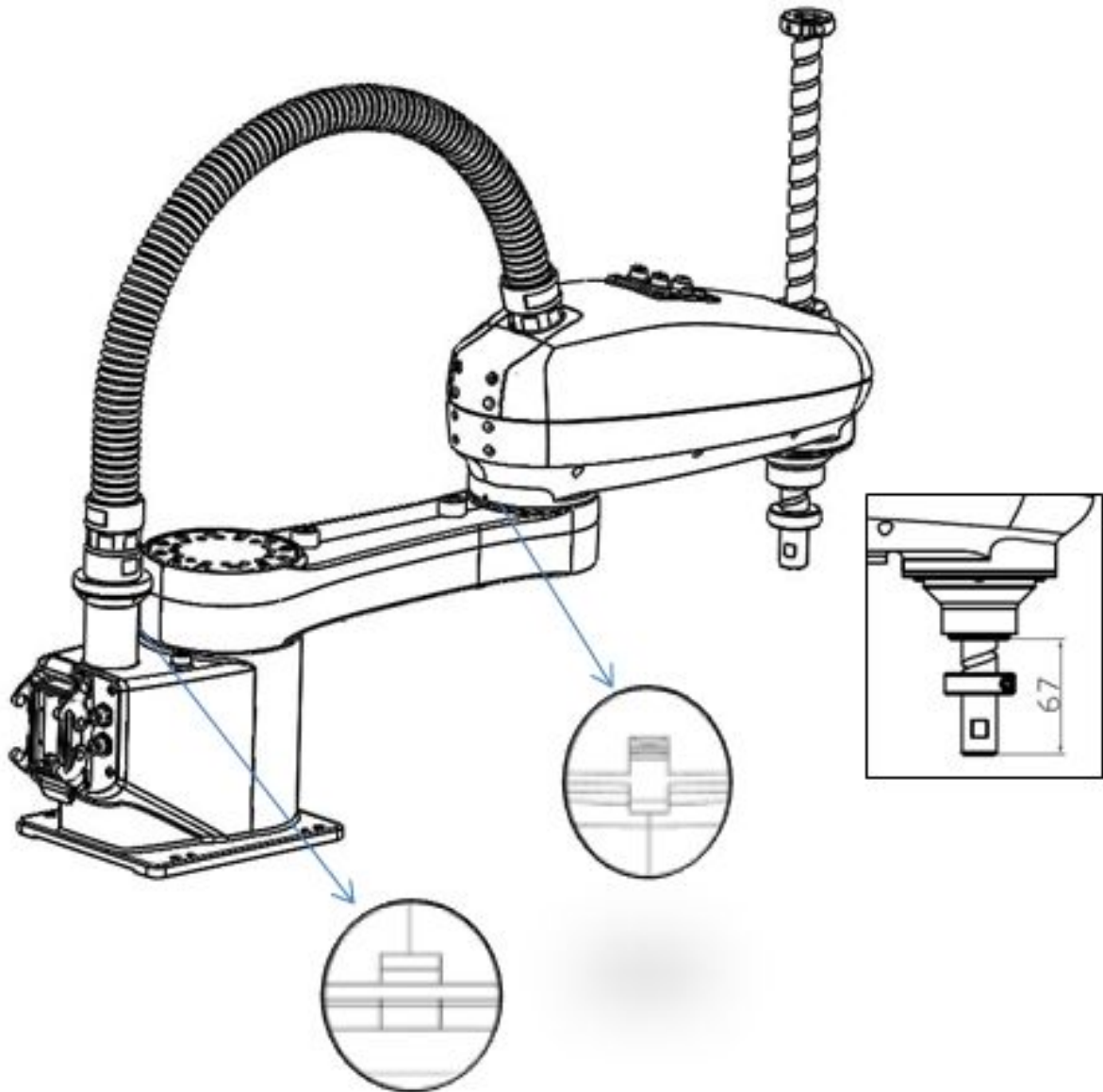
The purpose of mastering is to make the theoretical zero of the control algorithm coincide with the actual mechanical home so that the mechanical connecting linkage system can correctly respond to the position and speed instructions of the control system.

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.

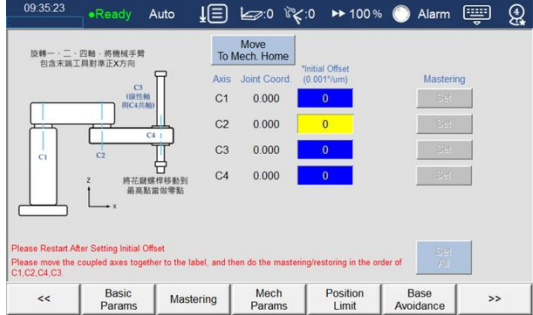
All joints of LS600-6 series robots are calibrated with key-code plate, and only one axis can be calibrated at a time. When calibrating, it is necessary to slowly rotate the corresponding joint until the two grooves overlap and insert a special calibration key (or

a standard 3mm wide flat key instead), and the position at this time is the zero position of the axis.

The calibration position of each axis of the LS600-6 series robot is shown in the figure. When the bottom surface of the spline screw is about 67mm away from the bottom end of the spline, the calibration position is 0; other axes are 0°.



7.3 Calibration steps

	Operate	Description
1	Log in to the system with users above the Expert level and enter the zero-point calibration interface.	<p>Zero calibration can only be done in manual mode with no program running.</p> <p>The zero calibration interface is located in the "calibration" classification.</p> 
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.
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.	

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.

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