

**ELITE ROBOTS EUROPE** by **IMTEC** Ltd.



# EC66 USER MANUAL

WORKING AREA DRAWING

PRODUCT DRAWING

ELECTRICAL DRAWING

[www.eliterobots.eu](http://www.eliterobots.eu)

## **Original Version 4.0.0**

### **Please read this manual carefully before use**

Please see the chapter of version information in this manual for the product version information corresponding to the user manual of this version, and please check the actual product version information carefully before use, as to ensure consistency.

This user manual shall be periodically checked and revised, and the renewed contents will appear in the new version. The contents or information herein is subject to change without prior notice.

Suzhou Elite Robot Co., Ltd. shall assume no liability for any errors which will occur in the manual probably.

Suzhou Elite Robot Co., Ltd. shall assume no liability for the accident or indirect injury as a result of using of this manual and the product mentioned herein.

Please read this manual before installing and using the product.

Please keep this manual so that you can read and use it for reference at any time.

The pictures in the specification shall be used for reference only. The goods received shall prevail.

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# Preface

Thank you for purchasing and using the light 6-degree-of-freedom (DOF) collaborative robot EC66 developed by the company.



The ELITE collaborative robot series takes a joint modular design, and uses a developer-oriented robot system. The user may develop his own robot control system in accordance with an application program interface provided by a ELITE collaborative robot platform. In addition, the ELITE collaborative robot is equipped with a dedicated programmable interface, in this way the user may observe a running state of the robot in real time through the interface, while implementing multiple control settings for the robot and implementing offline simulation. Accordingly, the work efficiency of the practical application may be improved greatly. The EC66, as one of the ELITE modular collaborative robot series, is an intelligent light 6-DOF modular collaborative robot launched by Suzhou Elite Robot Co., Ltd., with a payload of 6kg.

## Product Composition

The detailed outbound list of one set of complete EC66 robot is shown in the table below.

Name	Quantity
Robot body	1
Control box including teach pendant	1
Power cord	1
Base (Optional)	1
User manual (optical disk)	1
Thin-walled wrench	1

## More Information

If you need more information, please visit the website: [www.elibot.cn](http://www.elibot.cn)

# Chapter 1 Safety

## 1.1 Profile

This chapter introduces the safety principles and specifications that should be followed when operating a robot or a robot system. The integrator and the user must read this manual carefully, and need to mainly master and strictly comply with contents with warning labels. As the robot system is complicated and dangerous, the user needs to fully understand the risk of operation, and strictly comply with and implement the specifications and requirements in this manual. The user and the integrator should have sufficient safety awareness and comply with ISO 10218 *Industrial Robots - Safety Specification*

## 1.2 Safety Warning Symbols

The safety-related contents in this manual are illustrated with the following warning symbols. The descriptions related to the warning symbols in this manual represent the important contents, please comply with these symbols.

	This indicates an imminently hazardous electrical situation which, if not avoided, could result in casualties or serious damage of the equipment.
	This indicates a potentially hazardous hot surface which, if touched, could result in the personnel injury.



**SAFETY CAUTION:**

This indicates an imminently hazardous situation which, if not avoided, could result in casualties or serious injury.



This indicates a potentially hazardous electrical situation which, if not avoided, could result in personnel injury or serious damage of the equipment.



This indicates a potentially hazardous situation which, if not avoided, could result in personnel injury or serious damage of the equipment. As for the items marked with this symbol, the major consequence would probably occur sometimes in accordance with the specific situation.



This indicates a situation which, if not avoided, could result in personnel injury or damage of the equipment .

As for the item marked with this symbol, the major consequence would probably occur sometimes in accordance with the specific situation.





## **1.3 Safety Cautions**




### **1.3.1 Overview**

This manual includes the safety measures of protecting the user and preventing the machine from damage. The user needs to read all relevant descriptions in the specification and be fully familiar with the safety cautions. In this manual, we shall try to describe various situations. However, it is impossible to record all the cases that cannot be done because there are so many possibilities.

### **1.3.2 Notice for use**

The following basic information needs to be understood and followed when starting the robot or the robot system for the first time, and other safety-related information shall be introduced in other parts of the manual. However, it is impossible to cover all aspects. In practical application, the concrete problem needs to be analyzed in a concrete way.

	<ol style="list-style-type: none"> <li>1. Please install the robot and all electrical equipments in accordance with the requirements and specification in the manual.</li> <li>2. The preliminary test and inspection should be implemented for the robot and its protective system before using the robot for the first time and putting into production.</li> <li>3. Before starting the system and the equipment for the first time, that whether the equipment and the system are complete, whether the operation may be implemented safely, and whether any damage is detected must be checked. During the detection, that whether it is in line with the effective safety production rules and regulations of the country or the region should be observed, and all safety functions must be tested.</li> <li>4. The user must check and make sure that all safety parameters and user programs are correct and all safety functions run normally. The person qualified to operate the robot should check each safety function. The robot cannot be started until the robot passes comprehensive and careful safety test and reaches the safety level.</li> </ol>
	<ol style="list-style-type: none"> <li>1. The professional staff should install and debug the robot in accordance with the installation standards.</li> <li>2. Upon completion of installation and construction of the robot, the comprehensive risk assessment should be implemented again, with the document records kept.</li> <li>3. The authorized personnel should set and change the safety parameters, and the passwords or the isolation measures should be used to prevent the unauthorized personnel from changing or setting the safety parameters. When the safety factors are revised, the related safety functions need to be analyzed.</li> <li>4. When the robot is trapped in accident or runs abnormally, the emergency stop switch may be pressed to stop the action of the robot.</li> <li>5. The brake is installed in the EC66 joint module, to maintain the pose of the robot arm when the power is switched off. Do not artificially switch the power supply system on and off frequently. It is recommended that the time interval of switching on and off the machine should be more than 10 seconds.</li> <li>6. The EC66 has the collision detection function. When the external force of powering on the robot arm exceeds a normal force of the user's safety setting, the robot arm may stop automatically, as to prevent the robot or the operating personnel from injury due to collision. The function is dedicatedly designed by the EC66 for the safety of man-machine collaborative work. However, the robot system is required to run within the normal range, and the control box of the ELITE collaborative robot series must be used. If the user develops the controller himself, the robot will not have the abovementioned function. Moreover, the user should be responsible for the dangerous consequence brought herefrom.</li> </ol>

	<ol style="list-style-type: none"> <li>1. The robot and the control box may generate heat during running. When the robot is working or just stops working, please do not operate or touch the robot.</li> <li>2. The robot may be cooled down after turning off the power supply and waiting for an hour.</li> <li>3. Do not put your finger to the heating part of the control box.</li> </ol>
	<ol style="list-style-type: none"> <li>1. Make sure that the robot arm and the tool are properly and securely installed in place.</li> <li>2. Make sure that the robot arm has ample space to operate freely.</li> <li>3. Never use the robot if it is damaged.</li> <li>4. Do not connect any safety equipment to normal I/O interface. Use safety-related interface only.</li> <li>5. Make sure to implement the correct installation settings (such as the robot installation angle, mass in TCP, TCP offset, safety configuration). Save and load the installation file into the program.</li> <li>6. The tool and obstacles shall not have sharp angles or pinch points. Make sure that heads and faces of all people are kept outside the reach of the robot.</li> <li>7. Be aware of robot motion when using the teach pendant.</li> <li>8. Any impact will release a lot of kinetic energy, which is much higher than that at high speed and high payload.</li> <li>9. Combination of different machines can increase hazards or create new hazards. Always make an overall risk assessment for the complete installation. When different safety and emergency stop performance levels are needed, always choose the highest performance level. Always read and understand the manuals of all equipments to be used during installation.</li> <li>10. Never modify the robot. A modification might create hazards that are unforeseen by the integrator. The authorized reassembling of the robot shall be done in accordance with all relevant service manuals of the latest versions. If the robot is changed or altered in any way, Suzhou Elite Robot Co., Ltd. shall refuse to take all responsibilities.</li> <li>11. Before transporting the robot, the user needs to check the insulation and the protective measures.</li> <li>12. Comply with the transportation requirements when carrying the robot, as to carry carefully and avoid bumping.</li> </ol>
	<ol style="list-style-type: none"> <li>1. When the robot is combined, or works with the machines capable of damaging the robot, it is highly recommended to test all functions and the robot program separately. It is recommended to use the temporary waypoints outside the workspaces of other machines to detect the robot program.</li> <li>2. Suzhou Elite Robot Co., Ltd. may not be held responsible for the damage of the robot or personal injury due to programming errors or improper operation of the robot.</li> </ol>

	3. Do not expose the robot to permanent magnetic fields all the time. The strong magnetic fields may damage the robot.
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### 1.3.3 Personnel safety

When running the robot system, safety of the operating personnel must be ensured first. The general cautions are listed below, please properly take corresponding measures of ensuring safety of the operating personnel.

1. All operating personnel using the robot system should receive the training through training courses hosted by Suzhou Elite Robot Co., Ltd. The user should ensure to fully grasp the safe and normative operational process and have the qualification of operating the robot. For detailed training, please contact with the company. E-mail: support@elibot.cn.

2. All operating personnel using the robot system should not wear loose clothing or jewellery when working with the robot. Make sure that long hair is tied back when working with the robot.

3. When the equipment runs, the robot is in the state of implementing imminent action probably because the robot is waiting for a starting signal although it seems to have stopped. Even in this state, the robot should be regarded as being in action.

4. The lines should be drawn on the floor to mark the range of action of the robot, in this way the operator may know the range of action of the robot including the clamping tool (the manipulator, the tool and so on).

5. Make sure that the safety measures (for example, guardrails, ropes, or protective screens) are established near an operating area of the robot, as to protect the operator and the surrounding people. The locks should be arranged in accordance with the need so that the person outside the operating personnel in charge of operation cannot touch the power supply of the robot.

6. When using the operation panel and the teach pendant, operations cannot be implemented until the gloves are taken off as there may be operational errors if the gloves are worn.

7. In emergency and abnormal cases, such as a person is clamped or surrounded by a robot, the joint is forced to move by pushing or pulling the robot arm hard (at least 700 N). If there is no electric drive available, the robot arm may be moved manually only in case of emergency, and the joint may be damaged.

## 1.4 Liabilities and Specifications

EC66, which is not complete, may form a complete machine with other equipments. Therefore, the information in this manual neither covers how to design, install and operate one complete robot comprehensively, nor covers all possibilities of affecting safety of the peripheral equipment of the complete system. The installation safety of the complete robot shall depend on how the robot is integrated. The integrator should comply with the laws, regulations, safety specifications and standards of the country where the integrator is located to implement the risk assessment for design and installation of the complete system. The risk assessment is one of the most important tasks that the integrator must complete. The integrator may implement the risk assessment process by using the following standards for reference.

- **ISO 12100:2010 *Safety of machinery - General principles for design - Risk assessment and risk reduction***
- **ISO 10218-2:2011 *Robots and robotic devices - Safety requirements for industrial robots - Part 2: Industrial robot system and integration***
- **RIA TR R15.306-2014 *Technical report of industrial robots and robot systems - Safety requirements and task-based risk assessment method***
- **ANSI B11.0-2010 *Safety of machinery – General requirements and risk assessment***

The ELITE robot integrator should perform, but not limited to, following responsibilities:

- **Make a comprehensive risk assessment for the complete robot system.**
- **Confirm that the whole system is designed and installed accurately.**
- **Provide the user and the staff with training.**
- **Create the operation specification of the complete system and clarify the instructions of using the robot.**
- **Establish appropriate safety measures.**
- **Eliminate the hazards or minimize all hazards to acceptable levels with appropriate methods during the final installation**
- **Pass the remaining risks to the end user.**
- **Mark the logo and contact information of the integrator on the robot**
- **Archive the related technical documents.**

For reference to applicable standards and legal guide, please visit the website: [www.elibot.cn](http://www.elibot.cn).

All safety-related information contained in this manual shall not be regarded as a warranty of

Suzhou Elite Robot Co., Ltd. Even though all safety instructions are followed, the personnel injury or equipment damage caused by the operating personnel may happen as well.

Suzhou Elite Robot Co., Ltd. is committed to continuously improving reliability and performance of the products, and accordingly reserves the right to upgrade the products without prior notice. Suzhou Elite Robot Co., Ltd. strives to ensure accuracy and reliability of the contents in this manual, and takes no responsibility for any errors or missing information herein.

## 1.5 Danger Identification

All potential contacts and foreseeable misoperations between the operating personnel and the robot during normal use should be considered during risk assessment. The neck, face and head of the operating personnel should not be exposed, as to avoid touching. In absence of peripheral safety protective device, the risk assessment should be implemented first before using the robot, as to judge whether the related dangers constitute the unacceptable risk, for example:

- **The probable danger because of use of the sharp end effector or the tool connector.**
- **The probable danger due to handling of the toxic or other harmful substances.**
- **The danger in which a finger of the operating personnel is clamped by the robot base or the joint.**
- **The danger caused by bumping against the robot.**
- **The danger because the robot or the tool connected to the end is not fixed in place.**
- **The danger due to impact between the payload of the robot and the hard surface.**

The integrator must measure this type of risks and the related risk levels thereof through the risk assessment, and confirm and implement the corresponding measures, as to reduce the risks to the acceptable levels. Please note that the specific robot equipment may have other major dangers.

The risk related to collaborative operation of the EC66 may be reduced to a reasonable and feasible level as far as possible by combining the inherent safety design measures applied to the ELITE collaborative robot and the safety specifications or risk assessment implemented by the integrator and the end users. Through this document, any remaining risks of the robot before installation may be passed to the integrator and the end users. If the risk assessment of the integrator measures that there is risk that may constitute the unacceptable risk to the user in its specific application, the integrator must take the appropriate risk reduction measures to eliminate or minimize

the risk until the risk is reduced to the acceptable level. It is unsafe to use before taking the appropriate risk reduction measures (if needed).

If the non-collaborative installation (for example, when using the dangerous tool) is implemented for the robot, the risk assessment may infer that the integrator needs to connect to an additional safety device (for example, a safety starting device) when programming, as to ensure safety of the personnel and equipment.

## 1.6 Intended Use

The ELITE collaborative robot should be used on the general industrial equipment only, for example, operate or fix the tool or the equipment, process or convey the parts and the products. The ELITE robot shall be allowed to use only under the specified condition. For specific information about the relevant operating environment and operating conditions, please refer to the appendix.

The ELITE collaborative robot has the special safety level characteristics and may implement the collaborative operation, namely, the ELITE collaborative robot may be used in absence of the peripheral safety protective device, however, only in the case that no danger occurs in accordance with the risk assessment. Namely, on the premise that no safety protective device and the on-site sensor are used, anticipated or accidental contact between the staff and the ELITE collaborative robot or its end effector or the part would not constitute the unacceptable risk, and the anticipated or accidental contact with other objects (the tool, the equipment, the surface and so on) in the workspace would not constitute the unacceptable risk as well.

The robot controller and the robot should be used on the general industrial equipment only and cannot be applied to the application breaching the intended uses. The prohibited use includes, but are not limited to, the following situations:

- **Use in flammable and explosive environment, and other dangerous environment.**
- **Use on the device of moving or carrying human body or other animals.**
- **Use on the device, such as the medical device involved in the human life.**
- **Use on the device which greatly influences the sociality and the publicity.**
- **Use in the environment subjected to vibration, such as the vehicle and the ship.**



- Use of the climbing tool.

## 1.7 Handling of Emergency Situations

### 1.7.1 Emergency stop device

All motions of the robot may be stopped upon pressing the emergency stop button. The emergency stop cannot be taken as the measure of reducing the risk, however can be taken as the secondary protective device. If multiple emergency stop buttons need to be connected, the emergency stop device must be incorporated into the risk assessment of the robot application. The emergency stop button should be in line with the requirements of IEC 60947-5-5.

The EC66 is equipped with the emergency stop buttons on the control box and the teach pendant. The button should be pressed only when meeting the dangerous situations or emergencies, as shown in following figure. The control box is equipped with the external emergency stop button port, and the integrator or the user can use it in accordance with the actual situations.



Figure 1-1 Emergency stop button



The tool or equipment connecting to the end, if constituting the potential threat, must be integrated into the emergency stop loop of the system. If falling to comply with the caution, death, and even personal injury or serious property damage may be caused.



### 1.7.2 Resuming from the state of emergency

All emergency stop equipments in form of button have "Locking" function. The "Lock" must be unlocked, as to end the emergency stop state of the equipments.

The "Lock" may be unlocked by rotating the emergency stop button.

Resuming from the emergency stop state is a simple and important step which can be operated only when the danger of the robot system is eliminated completely.

### 1.7.3 Forced emergency movement of the joints

In rare cases, one or more robot joints may need to be moved under the emergency situations, namely, the power supply of the robot is trapped in failure or the operating personnel does not want to use the power supply. In this way, the robot joints are forced to move through the following method:

Forced reverse drive: push or pull the robot arm hard (at least 700N), as to force the joints to move.



Forced manual movement of the robot arm should be operated only in case of emergency, and the joints may be damaged.

### 1.7.4 Over-strong-force safety protection of the robot arm

The robot arm has the over-strong-force safety protection function. When the robot arm is powered on statically, and when the operating personnel or other objects bump against the robot arm accidentally and the impact force exceeds a safety threshold, the robot arm may move along with a direction of the impact force. The function may ensure that the damage to the personnel, other objects and the robot arm is reduced when the operating personnel or other objects bump against the robot arm.



The function may reduce the damage as a result of impact, and the risk assessment should be implemented when used for other purposes.

## Chapter 2 Carrying and Cautions

When hoisting the robot, moving parts should be positioned with the appropriate measures, as not to cause the unanticipated motion which may lead to harm accordingly during hoisting and transportation. When packing and transporting, the robot should be packed in accordance with the packing standards, and the needed marks should be printed outside a packing box.

When transporting, the robot should be ensured to be stable and needs to be held and fixed at an appropriate position.

The control box should be raised with a handle

When moving the robot to the installation position from the packing material of the robot, the robot should be supported until all bolts of the robot base are tightened completely.

After fixing, the robot is powered on, and the pose of the robot should be adjusted to the appropriate position with the dragged teaching function of the robot.

An original package should be kept upon completion of transportation. The packaging material should be stored in a dry place, for repackaging and movement of the robot in the future.



1. Make sure that your back or other parts of the body are not overloaded when raising the equipment.
2. All regional and national guides should be followed. Suzhou Elite Robot Co., Ltd. shall not be responsible for damage generating during transportation of the equipment.
3. Make sure that the robot is installed in strict accordance with the installation instructions in the specification.

# Chapter 3 Maintenance, Repair and Disposal

## 3.1 Maintenance and Repair

The maintenance and repair work must be implemented in strict accordance with all safety instructions in this manual.

The maintenance, calibration and repair work must be operated in accordance with the latest service manual which can be searched on the supported website: [www.elibot.cn](http://www.elibot.cn). All dealers of Suzhou Elite Robot Co., Ltd. may visit the website.

After changing the control system, the robot joints or the tool, the robot and the tool zero should be re-calibrated on the spot, and the calibration operation and the result judgment method are introduced in the specification of check for zero. In addition, the parameter settings should be checked. If the parameters are backed up, the backup parameters may be imported; if the parameters are not backed up, the parameters should be set again. If the robot joints or the tool needs to be replaced, the dynamics of the robot needs to be re-identified, with the identification method introduced in the instructions of the control system.

The authorized system integrator or Suzhou Elite Robot Co., Ltd. must implement the maintenance. When the parts are returned to Suzhou Elite Robot Co., Ltd., operation should be implemented in accordance with the provisions in the service manual.

The safety level stipulated by the maintenance and repair work must be ensured, the effective national or regional working safety rules must be followed, and that whether all safety functions run normally must be tested.

The purpose of the maintenance and repair work is to ensure normal running of the system, or to help it return to normal in case of the system failure. The repair work includes the failure diagnosis and practical repair.

The following safety procedure and cautions must be followed when operating the robot arm or the control box:

**Safety procedure:**

1. Remove the mains input cable from the back of the control box to ensure that it is completely powered off. Take necessary precautions to prevent other persons from re-energizing the system during the repair period. When it is powered off, re-check the system to ensure the outage.
2. Please check the earth connection before re-starting the system.
3. Please comply with the electrostatic discharge (ESD) regulations when disassembling the robot arm or the control box.
4. Avoid disassembling the power supply system of the control box. The high voltage can be retained inside the power supply system for several hours when the control box is switched off.
5. Prevent water or dust from entering into the robot arm or the control box.

**Cautions:**

1. Replace the parts trapped in failure with new parts with the identical part number or the corresponding parts approved by Suzhou Elite Robot Co., Ltd.
2. Reactivate all prohibited safety measures immediately upon completion of the work.
3. Record all maintenance operations in written form and save these records in the relevant technical documents of the whole robot system.
4. The control box does not have a part that the end user can repair by himself. If you need maintenance or repair services, please contact with your dealer or Suzhou Elite Robot Co., Ltd.

## **3.2 Disposal**

The ELITE robot must be disposed in accordance with the applicable national laws and regulations and the national standards.

## **3.3 Maintenance**

The safety functions of the robot must be tested at least one time every year, as to ensure that the functions are correct.

# Chapter 4 Quality Assurance

## 4.1 Product Quality Assurance

A limited warranty period of the ELITE collaborative robot is 12 months.

Suzhou Elite Robot Co., Ltd. should provide the necessary spare parts to replace or repair relevant parts if the new equipment and its components are trapped in defects resulting from manufacturing and/or poor materials within 12 months after entry into service (maximum of 15 months from shipment).

Suzhou Elite Robot Co., Ltd. shall possess the ownership of the equipment or components replaced or returned to Suzhou Elite Robot Co., Ltd.

Insofar as no warranty default exists, Suzhou Elite Robot Co., Ltd. shall reserve the right of charging the customer for replacement or repair.

In case of defects of the equipment which is out of warranty, Suzhou Elite Robot Co., Ltd. shall not be responsible for any damage or loss caused therefrom, such as loss of production or damage due to other production equipments.

## 4.2 Disclaimer

If the equipment defect is caused by improper disposal or falling to comply with the relevant information stated in the user manual, the “Product Quality Assurance” should be invalid.

The failure caused by the following circumstances shall not be covered by this warranty:

1. Installation, wiring and connection to other control equipments are not in line with the industrial standards or not implemented in accordance with the requirements of the user manual.
2. Outside the specification or standards shown in the user manual during use.
3. This product is applied to the non-designated purposes.
4. The storage mode and operating environment are outside the specified scope (such as pollution, salt damage and dewing) of the user manual.
5. The product is damaged as a result of improper transportation.
6. Damage due to the accident or impact.
7. The non-original parts and accessories are installed.
8. Damage as a result of modification, debugging or repair of the original parts by the third party outside Suzhou Elite Robot Co., Ltd. or other integrators specified by Suzhou Elite Robot Co., Ltd.
9. Natural disasters, such as fire, earthquake, tsunamis, lightning stroke, gale and flood.
10. Failure outside the abovementioned circumstances and not caused by Suzhou Elite Robot Co., Ltd.

The following circumstances should not be covered by warranty:

1. The date of production or the start date of the warranty cannot be identified.
2. Alteration of the software or internal data.

3. The failure can not be reproduced, or Suzhou Elite Robot Co., Ltd. cannot identify the failure.

4. This product is used on the radioactive equipment, the biological test equipment or in the dangerous use judged by Suzhou Elite Robot Co., Ltd.

In accordance with the product quality assurance agreement, Suzhou Elite Robot Co., Ltd. shall be responsible for making the commitment of quality guarantee for the defects or deficiencies occurring in the products and the parts sold to the dealers.

As for any other explicit or implied warranties or liabilities including, but not limited to, any implied warranty for marketability or specific use, Suzhou Elite Robot Co., Ltd. shall not bear the related liability to guarantee. In addition, Suzhou Elite Robot Co., Ltd. shall not be responsible for the related liabilities in allusion to any form of indirect damage or consequence generated by the related product.

## Chapter 5 Robot Hardware Composition



Figure 5-1 EC66 robot system

As shown in Figure 5-1, the EC66 collaborative robot system mainly consists of the robot body, the control box (multiple modes of the control boxes are optional), the base and the teach pendant. The robot body imitates the arm of human body, and totally has six rotating joints and each representing one degree of freedom. As shown in Figure 5-2, the robot joint includes a substrate (joint 1), a shoulder (joint 2), an elbow (joint 3), a wrist 1 (joint 4), a wrist 2 (joint 5) and a wrist 3 (joint 6). The substrate is used to connect the robot body with the base, and the tool end is used to connect the robot with the tool. The shoulder is connected with the elbow and the elbow is connected with the wrist with the arm tubes. Through the operation interface of the teach pendant or dragged teaching, the user may control each joint to rotate, in this way the end tool of the robot may be moved to the different poses.



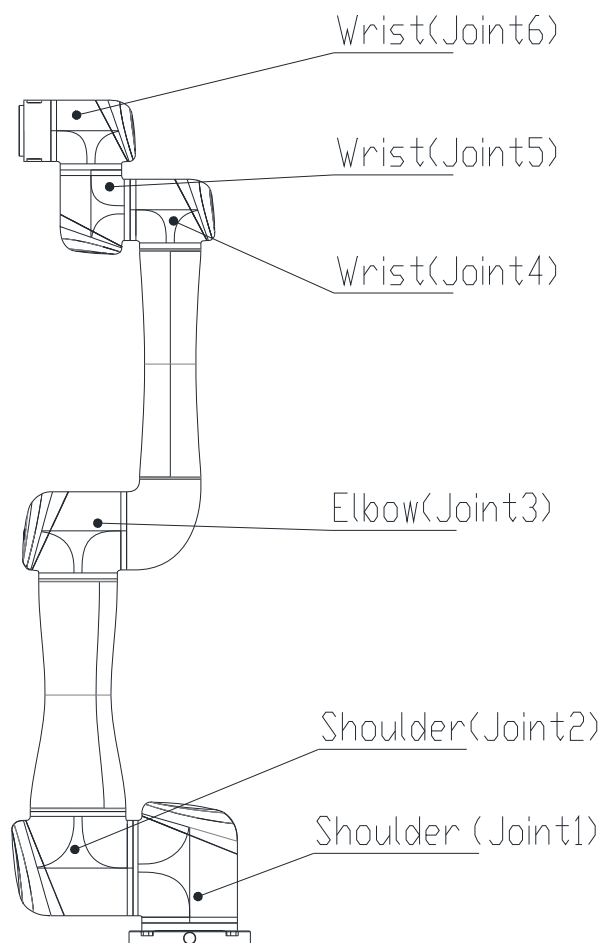


Figure 5-2 Robot joints

The control box is the control body of the EC66 collaborative robot. Please refer to the instructions of the control box in the user manual for the components inside the control box.

The EC66 provides multiple IO interfaces, and the tool flange of the robot end is equipped with four digital input and output interfaces and two analog input and output interfaces. The control box may communicate with the robot arm through the high-speed dedicated bus.

The teach pendant provides the user with a visual operation interface. The user may test, program and simulate the robot through the teach pendant, and operate the robot only through a small amount of programming basics.

# Chapter 6 Robot Installation

## 6.1 Brief Installation Steps

The brief installation steps of the EC66 robot:

1. Confirm the workspace of the robot.
2. Install the robot body on the base.
3. Install the end tool.

## 6.2 Important Safety Instructions

Environmental conditions for installation:

- Without corrosive gas or liquid
- Without dust or metal powder
- Without radioactive material
- Without oil mist
- Without mechanical shock and vibration
- Low humidity
- Less than 1000m above sea level
- Avoid direct sunshine (prevent the robot from being used outdoors)
- Without salt mist
- Without electromagnetic noise
- Without flammable materials

Ambient temperature: at 0°C ~ 45°C

Operating humidity: 5%~90% (without dewing)

Bearing capacity of the floor: the robot is installed on a hard surface. The surface should be able to bear at least ten times of the complete torsion of the base joints and at least five times of the weight of the robot arm. In addition, the surface should be free from vibration. Please refer to the appendix for the specific bearing capacity. The safety assessment must be implemented upon completion of each installation of the robot, and the instructions in Part I (Safety) should be strictly followed.

Description of installation of the additional device: if the additional components, such as the cable which is outside the range that Suzhou Elite Robot Co., Ltd. should provide, are integrated into the industrial robot, it is the user's responsibility to ensure that these components are completely unaffected and the safety functions would not be affected.

## 6.3 Workspace of the Robot

### 6.3.1 Mechanical dimensions of the robot

The mechanical dimensions diagram of the EC66 robot is shown in Figure 6-1. The range of motion of the robot must be considered during installation, as to prevent the surrounding personnel and equipment from being bumped.

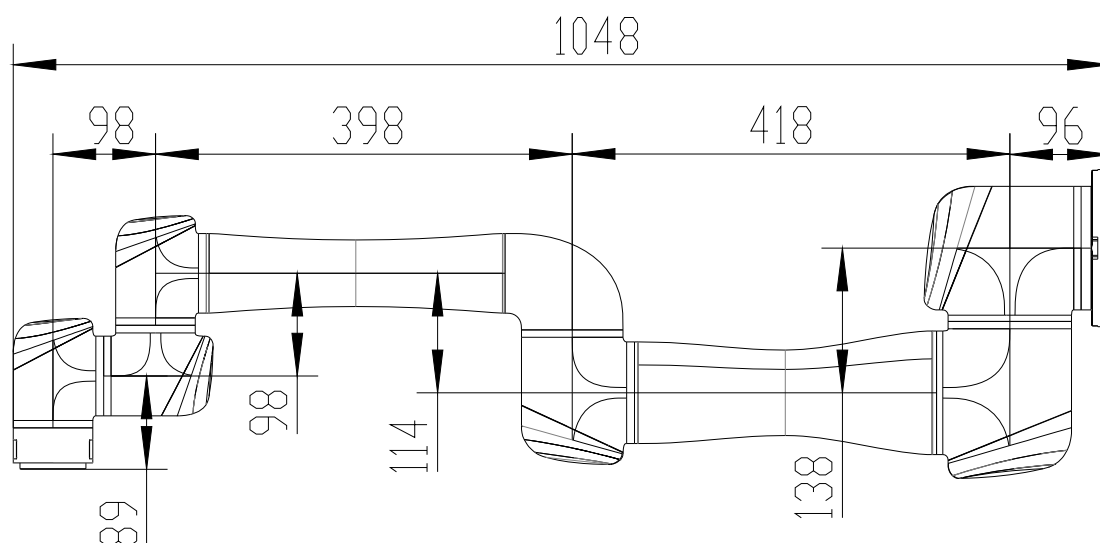


Figure 6-1 Mechanical dimensions diagram of the EC66 robot, with unit of mm

### 6.3.2 Range of motion of the robot

Figure 6-2 shows the range of motion of the EC66, namely, a sphere with a reach of 914mm except the cylindrical space directly above and directly below the base. When choosing the installation position of the robot, the cylindrical space directly above and directly below the robot must be considered, as to avoid the tool from being moved toward the cylindrical space as far as possible. In addition, the rotation angle of the joints 1~6 is  $-175^{\circ}$  to  $+175^{\circ}$  in practical application.



Figure 6-2 Schematic diagram of workspace of the robot

## 6.4 Robot Installation

The robot has the 360° pose self-adaptive function at the installation location, and is compatible with installation, hoisting, wall mounting and other specific installation ways on the base, as shown in Figure 6-3.

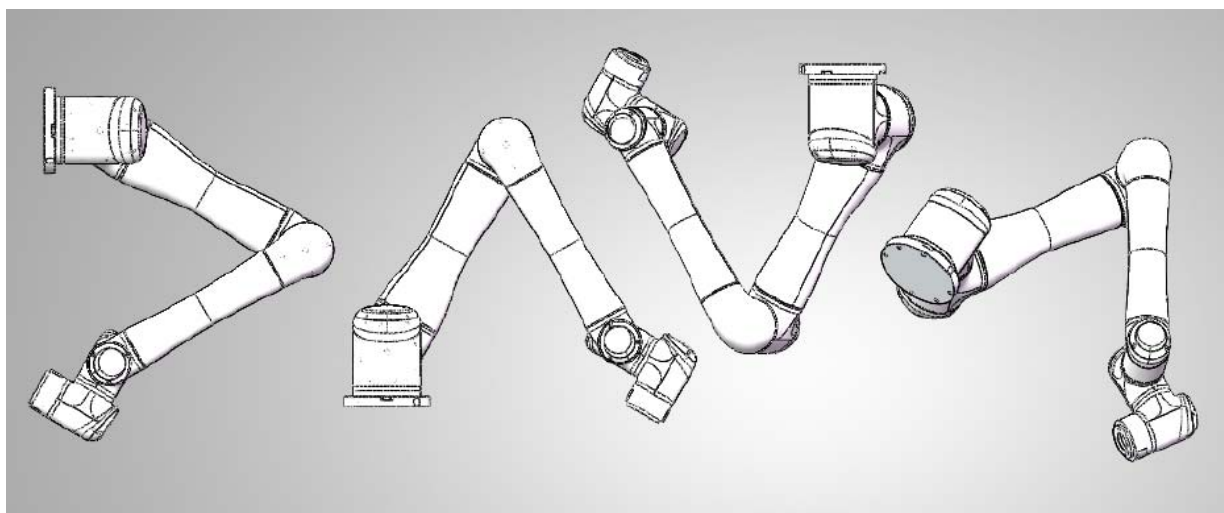


Figure 6-3 Schematic diagram of different installation poses

When installing on the base, the robot body is fixed on the base with four M8 bolts. It is

recommended to install the pins with two holes, as to improve the installation accuracy. The mechanical dimensions are shown in Figure 6-4.

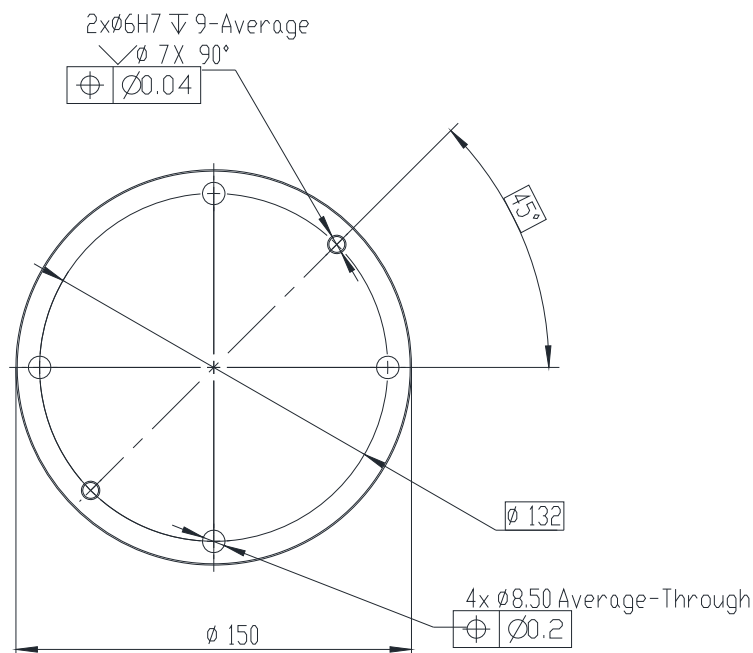


Figure 6-4 Dimensions of installation holes on the base, with unit of mm

1. When installing on the base, the robot should closely contact with a contact surface of the base, and the surface should be sufficient to bear at least 3500Nm torsional force in a selected installation direction of the base joints and a weight of at least 100kg. The surface should be free from vibration. If the robot is installed on a moving platform, an acceleration of the moving platform should be very low, and a high acceleration would trigger the collision stop function of the robot.

2. The user is recommended to use a base contact surface with strong heat dissipation performance, such as all-aluminium material. When the operating temperature is greater than 35°C, the user is strongly recommended to use the material with strong heat dissipation performance.

Make sure the robot arm is correctly and securely installed in place.

If soaked in water for more than a certain period of time, the robot may be damaged. The robot should not be installed in water or the humid place unless IP67 protection class is declared.

Danger of overturning: if not securely placed on the hard surface, the robot may overturn and cause damage.

## 6.5 Installation of the End Tool

The tool flange has four M6 threaded holes and one  $\Phi 6$  positioning hole, in this way the clamp may be conveniently installed and connected to the robot end. The mechanical dimensions of the tool flange are shown in Figure 6-5.

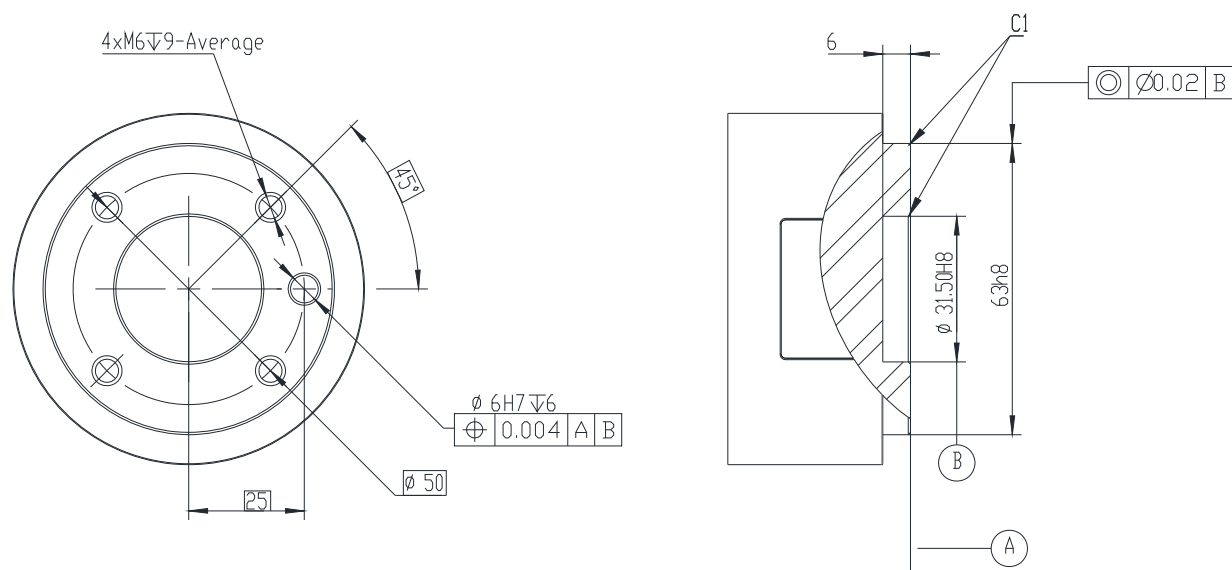


Figure 6-5 Mechanical dimensions diagram of the tool flange of the robot, with unit of mm

1. Make sure the tool is correctly and securely installed in place.
2. Make sure the tool is safely constructed such that it cannot create a hazardous situation by a dropping part unexpectedly.

# Chapter 7 Introduction to Use

## 7.1 Installation

### 7.1.1 Robot installation

Take the ELITE robot out of the packing box and install it on the base. Please refer to Chapter 6 Robot Installation for the specific installation instructions.

#### 【NOTES】

1. The control box should be placed on the ground horizontally. A 50 mm clearance should be reserved on each side of the control box to ensure smooth air circulation.
2. The teach pendant can be hung on the control box. Make sure that the cable will not cause tripping hazard.

#### 【DANGER】

1. Make sure the control box, the teach pendant and the cables do not come into contact with liquids. The wet control box may cause casualties.
2. The control box and the teach pendant should not be exposed to the dust or the humid place exceeding the level of IP54. Pay close attention to the environment of conductive dust.

### 7.1.2 Cable Connection

There are two sockets at the bottom of the control box, and the corresponding cable should be inserted into the socket before use.

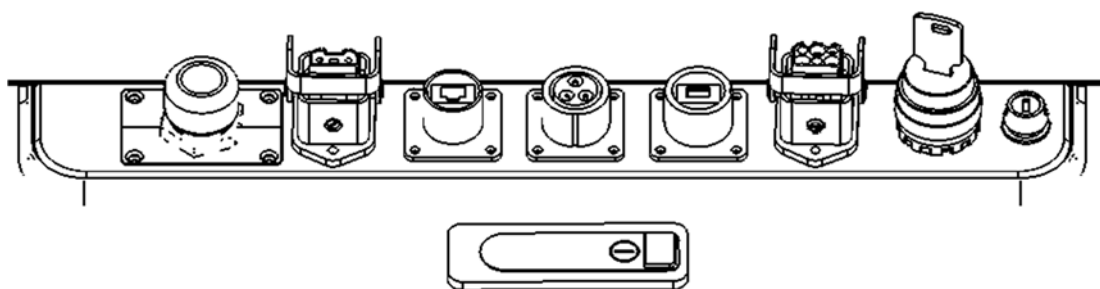


Figure 7-1 Plugs at the bottom of the control box

### 7.1.2.1 Connection of the robot arm to the control box

There is a heavy-load rectangular plug at the end of the robot arm cable. Insert the heavy-load rectangular plug into the control box. Pay attention to the insertion direction, and lock the connector after tight insertion, as shown in the following figure.

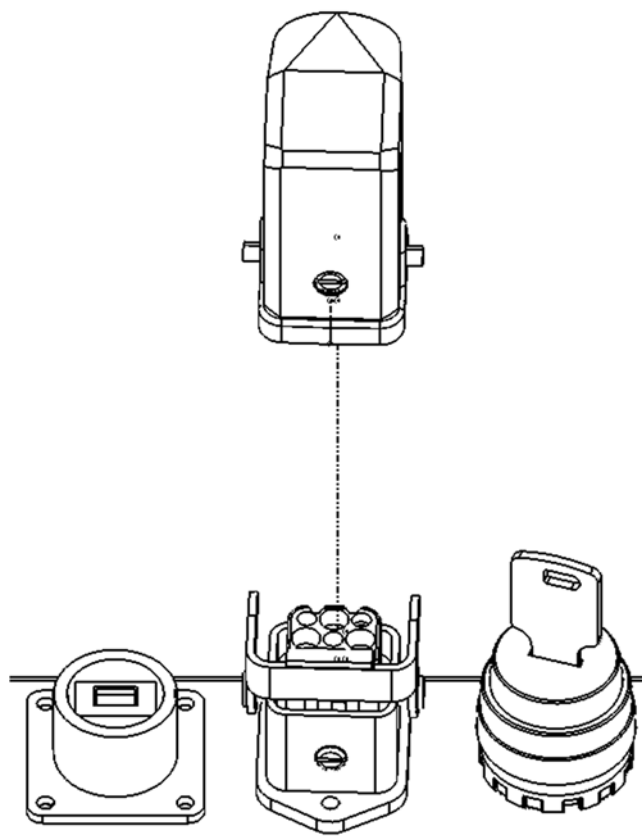


Figure 7-2 Connection of the robot cable to the control box

### 7.1.2.2 Connection of the control box to the mains supply

There is a heavy-load rectangular plug at the end of the mains cable of the control box. Connect the local dedicated mains cable to the heavy-load rectangular plug. Pay attention to the insertion direction, and lock the connector after tight insertion, as shown in the following figure.



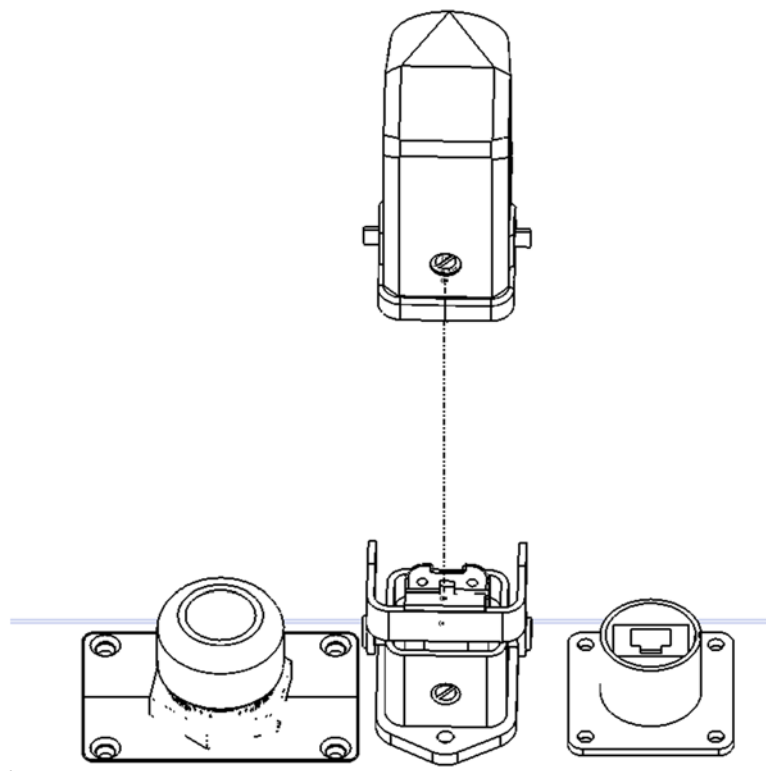


Figure 7-3 Diagram of the power interface of the control box

**【DANGER】**

1. Please make sure that the robot is grounded correctly (electrical connection to ground). The grounding conductor should have at least rated current of the highest current in the system.
2. Please make sure that all cables are correctly connected before the control box is powered on. Always use the original power cord correctly.

**【WARNING】**

1. Do not disconnect the robot cable when the robot arm is turned on
2. Do not extend or modify the original cable.

## 7.2 Robot Power-on

### 7.2.1 Preparations before power-on

- Check whether the robot is well connected with the control box.
- Check whether the teach pendant is well connected with the control box.
- Check whether the power cable of the control box is well connected.
- The power master switch of the control box is OFF when the power supply is turned

off.

- The control box and the emergency stop switch of the teach pendant are in bouncing state.
- The mode selection button is positioned at the correct position.
- Make sure the robot would not come into contact with the surrounding personnel and the equipment.

### 7.2.2 System power-on

## 7.3 Robot Shutdown

**Shutdown sequence:** turn off the power supply of the robot and the teach pendant first; then turn off the power supply of an I-series control box. 1. Turn off the power supply of the robot and the teach pendant.

**Normal exit:** exit the program, and press the software closing button in the upper right corner of the operation interface of the teach pendant.

**Forced shutdown:** long press the starting button in the upper left corner of the teach pendant for about 3 seconds, to turn off a blue light; and turn off the power supply of the teach pendant and the robot. 2. Turn off the power supply of the I-series control box.

**Warning:** shutdown of the system by directly unplugging the power cord from the wall socket may cause damage of the file system of the robot, and accordingly lead to function failure of the robot.

# Chapter 8 Electrical Interface

## 8.1 Overview

This chapter describes all electrical interfaces of the collaborative robot. Examples are given for most types of I/Os. The term “I/O” refers to both digital and analog control signals of an import interface.

- Controller I/O
- Ethernet
- Power supply connection
- Robot connection
- Tool I/O

The warnings and cautions in next section are related to the four groups of interfaces, please comply with these matters.

## 8.2 Electrical Warnings and Cautions

Observe the following warnings and cautions when the robot application is designed and installed. Furthermore, observe these warnings and cautions as well when implementing maintenance.



### **DANGER:**

1. Never connect the safety signals to a PLC which is not a safety-related PLC with the proper safety level. Failure to follow the warning may result in serious injury or even death as certain safety stop function is invalid. Separate the safety interface signal from the general I/O interface signal.
2. All safety-related signals are constructed redundantly (two independent channels). Keep the two channels independent so that a single failure would not lead to loss of the safety function.
3. Some I/Os inside the control box may be configured as the normal I/Os or the safety-related I/Os. Please read through Section 4.3.

**DANGER:**

1. Make sure that all equipments kept far away from water are kept dry. If the water enters into the product, please turn off the power supply and then contact with your provider for assistance.
2. Only use the original cables supplied with the robot. Do not use the robot in applications where the cables are subjected to flexing. If a longer cable or a flexible cable is needed, contact with your provider.
3. A negative connector is defined as the Ground (GND) connector and connected to a shield of the robot and the control box. All GND connectors mentioned in the text are only suitable for powering and signalling. For protective earth (PE), please provide the control box with the reliable GND with the dedicated power supply socket of the control box.
4. Please be careful when installing the interface cable to the robot I/O. A metal plate on the back of the box is intended for the interface cables and connectors. Please remove the metal plate before drilling holes. Make sure that all matte sides are removed before reinstalling the metal plate. Remember to use a gland with a correct size.

**Caution:**

1. The robot has been tested in accordance with international IEC standards for electromagnetic compatibility (EMC). Disturbing signals with levels higher than those defined in the IEC standards may cause unexpected behaviors of the robot. Very high signal level or excessive exposure may damage the robot permanently. The EMC problems happen usually during welding and are usually prompted by the error messages in the log. ELITE shall not be held responsible

for any damages caused by EMC problem.

2. The I/O cable for connecting the control box to other machinery and factory equipments may not be longer than 30m, unless the prolonged test are performed.



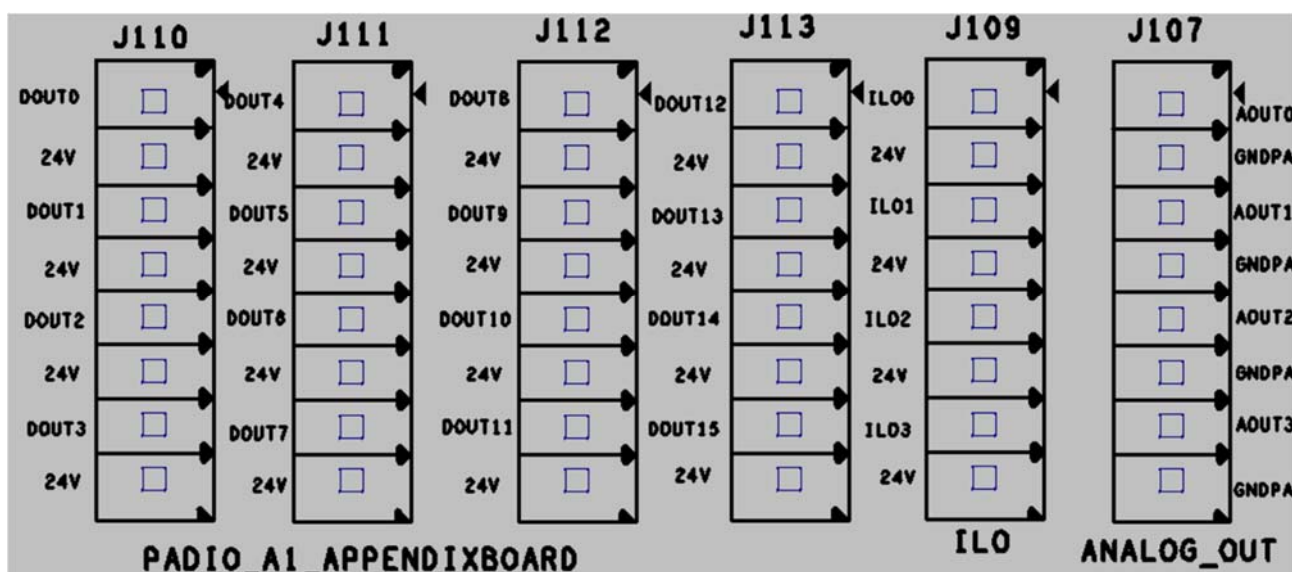
**NOTE:**

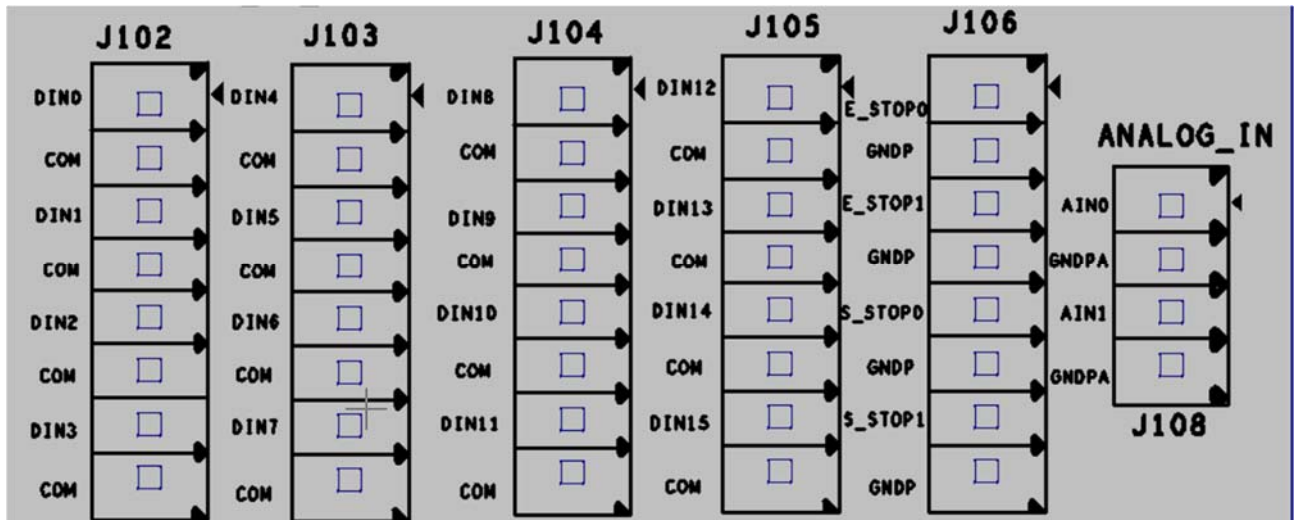
All voltages and currents are in direct current (DC), unless otherwise specified.

## 8.3 Controller I/O

This chapter describes how to connect the equipment to the I/O inside the control box. The I/O is extremely flexible and may be applied to various different equipments, including the pneumatic relay, the PLC and the emergency stop button.

The layout of the electrical interfaces inside the control box is shown in the following figure.





J106	Dedicated safety signals
J102,J103,J104,J105	Configurable digital input DI
J109,J110,J111,J112,J113	General purpose digital DO
J108,J107	General purpose analog I/O

The following chapters shall describe how to use the digital I/O. This section describes the common specifications that must be followed.

### 8.3.1 Common specifications of all digital I/Os

This section defines the electrical specifications of the following 24V digital I/Os of the control box.

- Safety I/O.
- Configurable I/O.
- General purpose I/O.

It is of importance to install the Elite robot in accordance with the electrical specifications, and this point must be done for both two types of inputs. The internal 24V power supply shall be provided to the digital I/O, and access of the power interface shall be implemented through the J14 terminal on the IO plate via the internal 24V power supply.

The configurable I/O is defined that the digital input may be configured to two input modes including NPN and PNP, which may implement selection with J22 on the IO plate. The NPN input is default, namely, J22 short circuit 24V and the intermediate terminal. Furthermore, the



short circuit may be implemented for the GNDP and J22 intermediate terminal with a short circuit cap, as to configure the input as the PNP mode.

The electrical specifications of the internal power supply is shown below.

Terminal	Parameter	Min	Type	Max	Unit
Internal 24V power supply					

[24V - GNDP]	Voltage	22.8	24	26.4	V
[24V - GNDP]	Current	0	--	4	A

The digital I/O should be constructed in compliance with IEC 61131-2. The electrical specifications are shown below.

Terminal	Parameter	Min	Type	Max	Unit
Digital output					
[DOUx/ILOx]	Current	0	-	0.7	A
[DOUx/ILOx]	Voltage drop	0	-	1	V
[DOUx/ILOx]	Leakage current	0	-	0.1	mA
[DOUx/ILOx]	Function	-	PNP	-	Type
[DOUx/ILOx]	IEC 61131-2	-	1A	-	Type
Digital input					
[DINx]	Voltage	-3	-	30	V
[DINx]	OFF region	-2	-	2	V
[DINx]	ON region	8	-	30	V
[DINx]	Current (8-30V)	2	-	8.5	mA
[DINx]	Function	-	PNP	-	Type
[DINx]	IEC 61131-2	-	3	-	Type
Digital input/safety input					
[DINx /x_STOPx]	Voltage	-10	-	26	V
[DINx /x_STOPx]	OFF region	22	-	26	V
[DINx /x_STOPx]	ON region	-10	-	19	V
[DINx /x_STOPx]	Current (-10V-19V)	1	-	10	mA
[DINx /x_STOPx]	Function	-	NPN	-	Type
[DINx /x_STOPx]	IEC 61131-2	-	3	-	Type



#### NOTE:

The word “Configurable” is intended for the input which may be



configured as the NPN input or PNP input.

### 8.3.2 Safety I/O

This section introduces the dedicated safety input. Observe the common specifications in Section 4.3.1.

The safety device and equipment must be installed in accordance with the safety instructions and the risk assessment in Chapter 1.

All safety I/Os are paired (redundant) and two separate branches must be retained. A single failure should not cause loss of the safety function. There are two permanent inputs: emergency stop and safeguard stop.

The emergency stop input should be applied to the emergency stop equipment only. The safeguard stop input should be applied to all types of safety-related protective equipments. The functional differences are shown below.

	Emergency stop	Safeguard stop
Motion stop of the robot	Yes	Yes
Program execution	Stop	Pause
Power supply of the robot	Off	On
Reset	Manual	Automatic or manual
Frequency of use	Infrequent	Once within each cycle
Requires re-initialization	Brake released only	No
Stop category (IEC 60204)	1	2
Performance level (ISO 13849-1)	PLd	PLd

The emergency stop output and other safety I/O functions may be set with the configurable I/O.

Some examples about how to use the safety I/O are given in the section below.

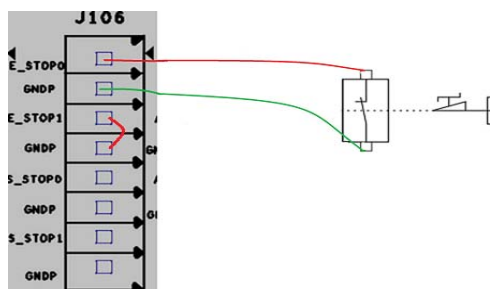


### **DANGER:**

1. Never connect the safety signals to a PLC which is not a safety-related PLC with the improper safety level. Failure to follow the warning may result in serious injury or even death as certain safety stop function is invalid. Separate the safety interface signal from the general I/O interface signal.
2. All safety-related I/Os are constructed redundantly (two independent channels). Keep the two channels independent so that a single failure may not lead to loss of the safety function.
3. Safety functions must be verified before putting the robot into operation. Safety functions must be tested regularly.
4. The robot installation shall conform to these specifications. Failure to do so may result in serious injury or even death as the safety stop device may be invalid.

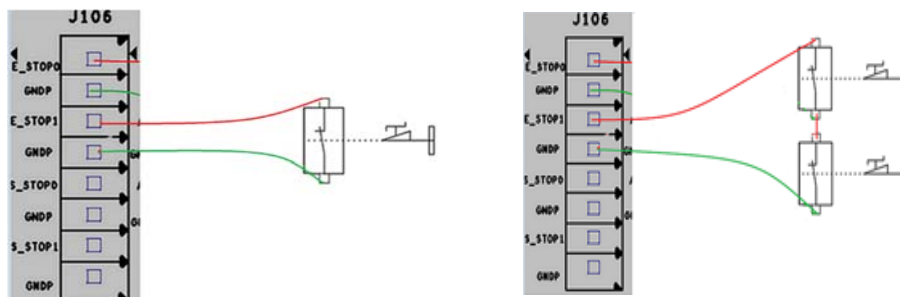
#### **8.3.2.1 Default safety configuration**

The default configuration is implemented for the delivered robot, which may be operated in absence of any additional safety equipment (the teach pendant is equipped with the emergency stop button; the equivalent circuit is shown below; and the short circuit is required to implement for E\_STOP1 and GNDDP when the E\_STOP1 enabling is not configured in the software).



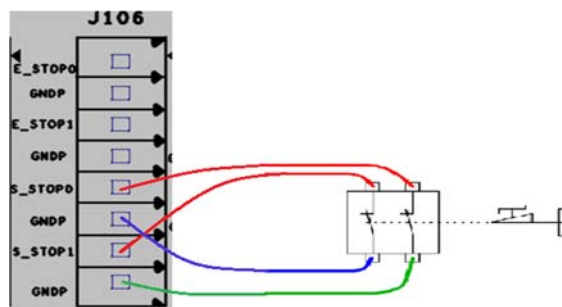
#### **8.3.2.2 Connecting with the emergency stop button**

Most applications require one or more additional emergency stop buttons. The operational principle (the E\_STOP1 function enabling needs to be configured in the software) of the one or more emergency stop buttons is shown in the following figure.



### 8.3.2.3 Safeguard stop with automatic resume

The door switch is an example of the basic safeguard stop equipment. When the door is opened, the robot is stopped. Please refer to the figure below (the software is required to configure the safeguard stop function cooperatively).



This configuration is only intended for application where the operator cannot go through the door and close it behind him. The configurable I/O may be used to set a reset button outside the door, as to reactivate motion of the robot.



#### **DANGER:**

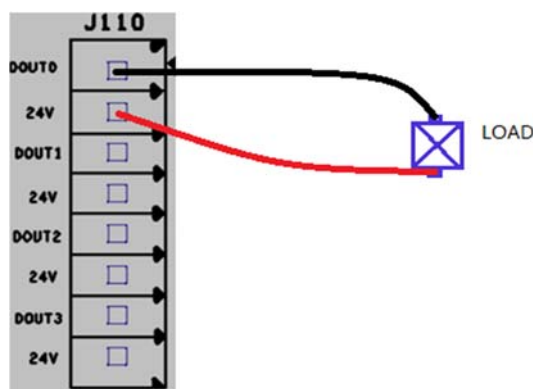
The robot shall resume motion automatically when the safeguard signal is re-established. Do not use this configuration if the signal can be re-established from the inside of the safety perimeter.

### 8.3.3 General purpose digital I/O

This section introduces the general purpose 24V I/O. The common specifications in section 4.3.1 must be followed. The general purpose I/O may be used to directly drive the equipment, such as the pneumatic relay, or to communicate with other PLC systems. All digital outputs may be disabled automatically when program execution is stopped. Refer to Part II for details. In this mode, the output shall be the high level all the time when the program does not run. Several examples are shown in the section below. The regular digital outputs are taken in these examples, however this type of outputs may also be used if the configurable output is not configured to perform the safety function.

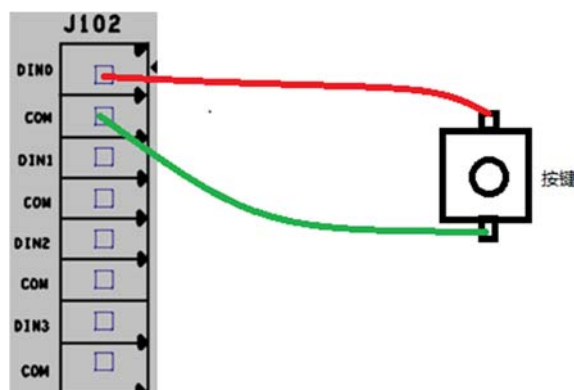
#### Load controlled by the digital output

This example shows a connection way of the load controlled by the digital output. See the figure below.



### 8.3.4 Digital input from a button

This example shows a connection way of a simple button and the digital input.



### 8.3.5 General purpose analog I/O

The analog I/O interface may be used to set or measure the voltage (-10V~10V) to and from other equipments.

In order to acquire a high accuracy, it is recommended to comply with the following instructions:

- Use the GNDPA terminal closest to the I/O. The I/O pair shares a common mode filter.
- Use the same GND (0V) for the equipment and the control box. The analog I/O is not galvanically isolated from the control box.
- Use a shielded cable or twisted pair. Connect the shielded cable to the “GNDP” terminal on the “Power” terminal.

The electrical specifications are shown below.

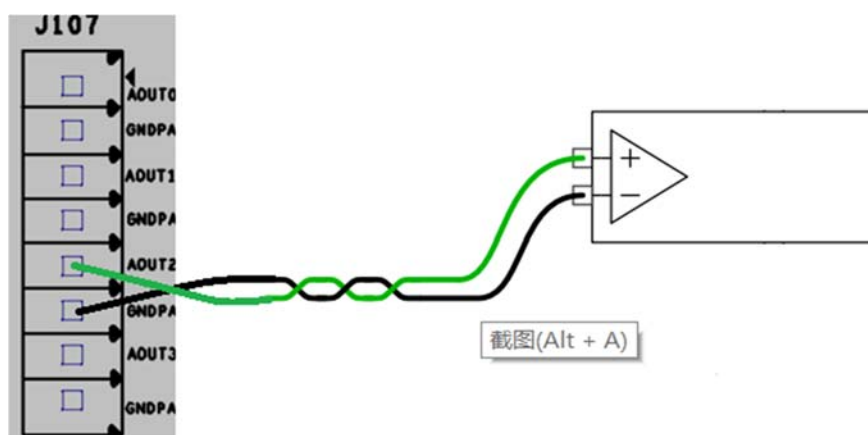
Terminal	Parameter	Min	Type	Max	Unit
Analog input					
[AINx - GNDPA]	Voltage	-10	-	10	V

[AINx - GNDPA]	Resistance	-	100	-	Kohm
[AINx - GNDPA]	Resolution	-	12	-	bit
Analog output					
[AOUTx - GNDPA]	Voltage	-10	-	10	V
[AOUTx - GNDPA]	Resistance	-	10	-	ohm
[AOUTx - GNDPA]	Resolution	-	12	-	bit

The following example shows a way of using the analog I/O.

### 8.3.5.1 General purpose analog output

The following example illustrates how to control a welding current of a welder with an analog input.



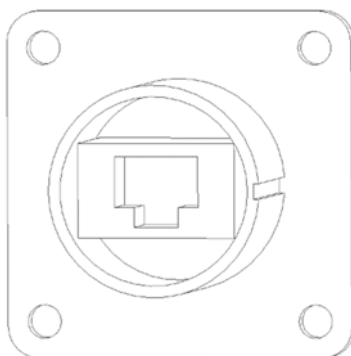
### 8.3.5.2 Using an analog input

This example illustrates how to connect with an analog sensor.



## 8.4 Ethernet

The Ethernet is provided on a top of the control box. Please refer to the figure below.



The Ethernet interface may be applied to the following applications:

- Remote access and control

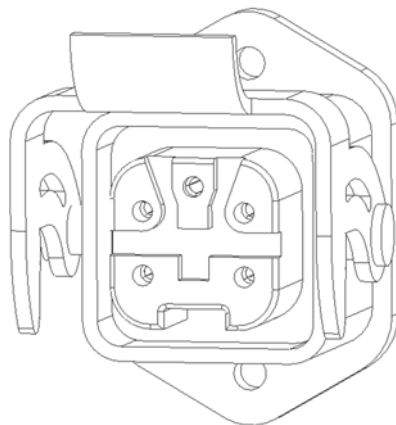
The electrical specifications are shown below.

Parameter	Min	Type	Max	Unit
Communication speed	10	-	100	Mb/s

## 8.5 Mains Connection

The mains cable of the control box has a standard rectangular heavy-load plug at the end. Connect the local dedicated mains socket or cable to the rectangular heavy-load plug.

In order to power on the robot, the control box must be connected to the power supply. This process must be completed by connecting with the rectangular heavy-load plug at the bottom of the control box with the corresponding wire. Please refer to the figure below.



The power supply should be equipped with at least following accessories:

- Connection to ground
- Mains fuse
- Residual current device

It is recommended to install a mains switch to the power supply of all equipments in the robot application, in order to facilitate lockout and tagout during repair.

The electrical specifications are shown in the table below.

Parameter	Min	Type	Max	Unit
Input voltage	90	-	240	VAC
External mains fuse (when the voltage is 90-130V)	16	-	32	A
External mains fuse (when the voltage is 200-240V)	8	-	16	A
Input frequency	47	-	63	Hz
Rated operating power	150	250	1200	W



**NOTE:**

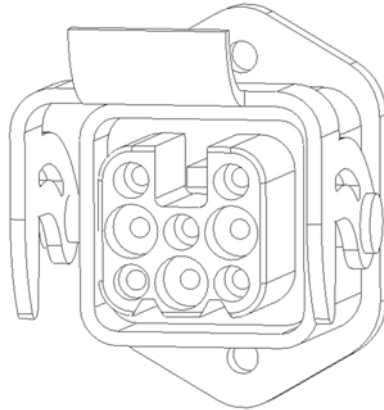
The switch inside the NED-100D switching power needs to be switched to a gear 115V when the external mains supply is 90~130VAC.

**DANGER:**

1. Please make sure that the robot is grounded correctly (electrical connection to ground). Please establish the common grounding for all equipments inside the system with bolts which are unused and connected to the grounding symbols inside the control box. The grounding conductor should have at least the rated current of the highest current in the system.
2. Make sure that the input current of the control box is protected with the residual current device (RCD) and the appropriate fuse.
3. The lockout and tagout should be implemented for all power supplies when the robot needed to complete all services is installed and set. The robot I/O should not be powered by other equipments when the system is locked.
4. Please make sure that all cables are connected correctly before the control box is powered on. Always use the original power cord.
5. The operation of switching the switch inside the NED-100D switching power should be implemented before the box is not connected with the power supply.

## 8.6 Robot Connection

The robot cable must be inserted into the connector on the top of the control box, as shown in the figure below. Appropriately lock the connector when the robot arm is started. The power supply of the robot must be turned off when disconnecting the robot cable.

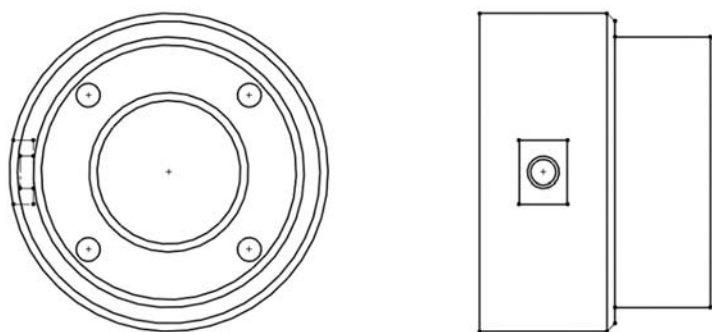


### Caution:

1. Do not disconnect the robot cable when the robot arm is started.
2. Do not extend or modify the original cable.

## 8.7 Tool I/O

A 12-pinned connector is arranged near the tool flange of the collaborative robot end, for providing the different grippers and sensors connected to the robot with the power supply and the control signals.



**NOTE:**

The tool connector must be manually tightened up, with a maximum moment of force of 0.4Nm.



The following figure should be used for reference for a function list of 12 connecting pins of an aviation plug:



Note: the mode of the aviation plug is HR10A-10R-12P of HRS company

Pin No.	Function description
1	Digital ground (GND)
2	Digital output interface 1 (DO1)
3	Digital output interface 2 (DO2)
4	Digital input interface 1 (DI1)

5	Digital input interface 2 (DI2)
6	Analog input interface (AI1)
7	Analog output interface (AO1)
8	RS485+
9	RS485-
10	+24V power output
11	Blank, no connection therein
12	Blank, no connection therein

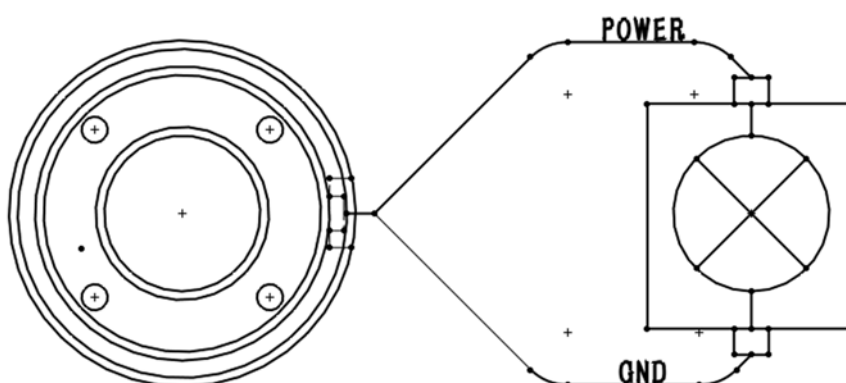
Herein, the electrical specifications of the 24V internal power supply are shown in the table below:

Parameter	Min	Type	Max	Unit
24V supply voltage	23.5	24	24.8	V
24V supply current	-	800	1000*	mA

\*1000 mA for max 1 second. Maximum duty cycle: 10%. Average current must not exceed 600 mA

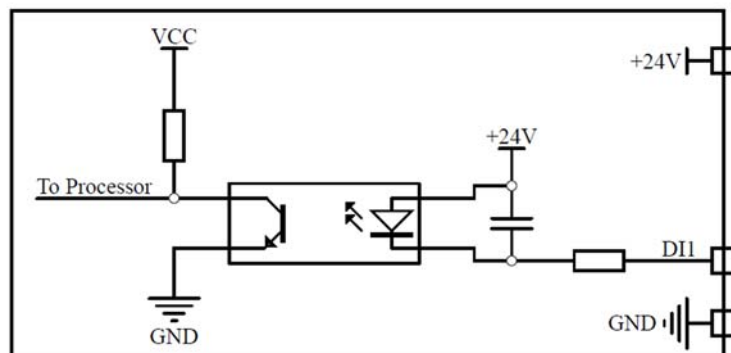
### 8.7.1 Tool power supply

The tool I/O of the Elite collaborative robot may provide the external tool with the 24V power supply.



## 8.7.2 Tool digital input

The implementation mode of the digital input interface is shown in the figure below:

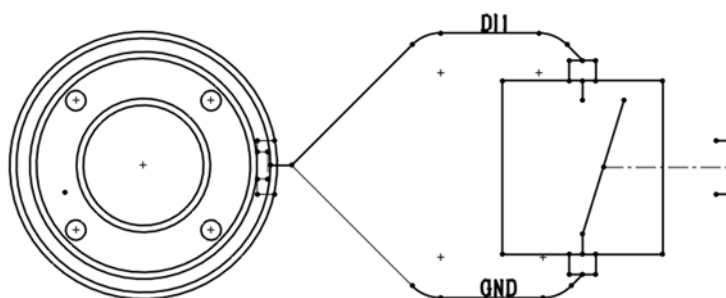


The electrical specifications are shown in the table below:

Parameter	Min	Type	Max	Unit
Input voltage	-0.5	-	26	V
Logical low voltage	-	-	10	V
Logical high voltage	22	-	-	V

### Using the tool digital input:

This example illustrates how to connect with one simple button.



## 8.7.3 Tool digital output

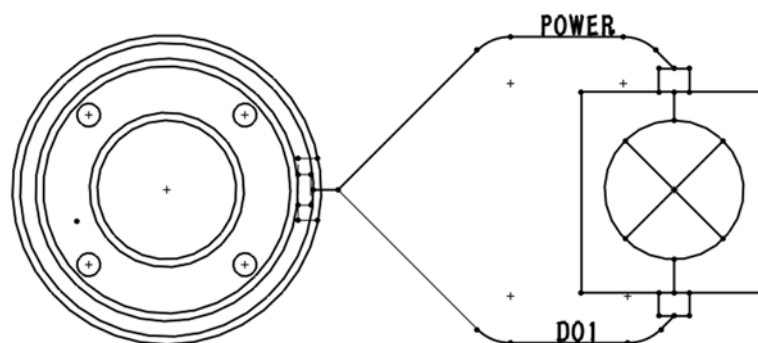
The digital output is compatible with a sinking drive mode (NPN), namely, it is in the low level state when the output port is activated; and the level state is in a high-impedance breaking state when the output port is not activated.

The electrical specifications of the digital output port are shown below:

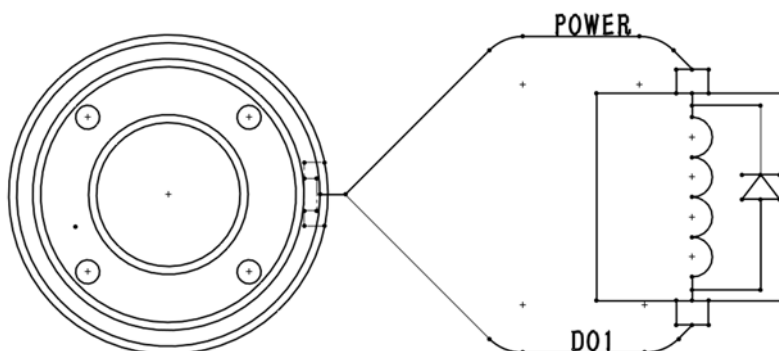
Parameter	Min	Type	Max	Unit
Voltage when open	-0.5	-	26	V
Voltage when sinking 1A at 25 °C	-	0.19	0.24	V
Sinking current	0	600	1000	mA

### Using the tool digital output

This example illustrates how to open and use a load of the internal 24V power supply:



It is recommended to use a protective diode for the inductive load, as shown in the figure below.



### Caution:

There is voltage between the power connector and the shield/ground even when the load is turned off.

### 8.7.4 Tool analog input

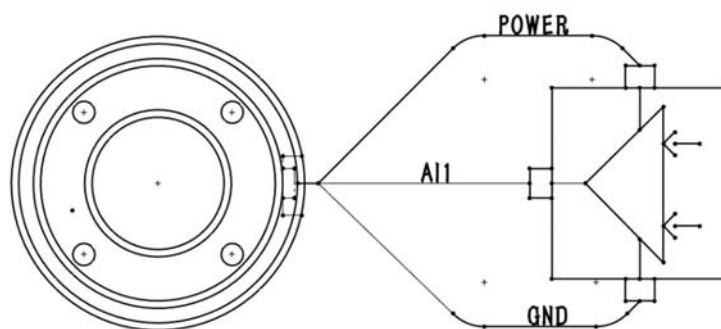
The tool analog input is a non-differential input, with voltage (0-10V). The electrical specifications are shown below.

Parameter	Min	Type	Max	Unit
Input voltage	-0.5	-	24	V
Input resistance	-	-	>100	MΩ
Resolution	-	10	-	Bit

Two examples of how to use the analog input are illustrated in the following section.

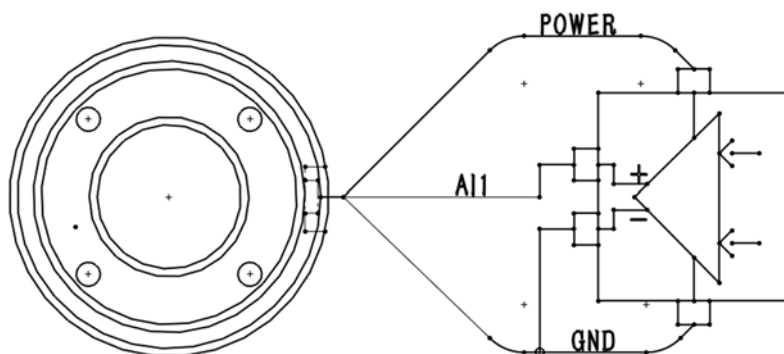
#### Using the tool analog input, non-differential

This example shows an analog sensor connection with a non-differential output.



#### Using the tool analog input, differential

This example shows an analog sensor connection with a differential output. Work in the same way as the non-differential sensor after connecting a negative output end to the GND (0V).



### 8.7.5 Tool analog output

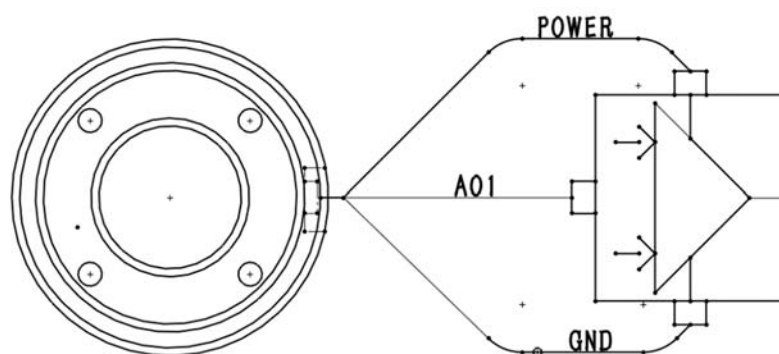
The tool analog output is a non-differential output, with voltage (0-10V). The electrical specifications are shown below.

Parameter	Min	Type	Max	Unit
Output current	-	17	-	mA
Output short circuit current	-	60	-	mA
Resolution	-	10	-	Bit

The examples of how to use the analog output are illustrated in the following section.

#### Using the tool analog output

This example shows a method of connecting to an analog signal with a non-differential output.



### 8.7.6 Tool communication I/O

- Signal requests: RS485 signals use internal fail-safe biasing. If the connected device is not compatible with this fail-safe, the signal biasing must either be done in the connected tool, or added externally by adding a pull-up resistor to RS485+ and a pull-down resistor to RS485-.
- The latency is 2ms to 4ms from writing in data to be sent on a robot controller to the start of sending the data on the RS485. The latency is 2ms to 4ms from the start of receiving the data on the RS485 to receiving of the data by the robot controller and the start of handling.

Baud rate	2.4k, 4.8k, 9.6k, 19.2k, 38.4k, 57.6k, 115.2k
Stop bit	1, 2
Parity bit	None, odd, even



## Chapter 9 Teach Pendant

The teach pendant is an important component of the ELITE robot. Through the teach pendant, the user may read log information of the robot while enabling the robot to move with a teaching way and simply programming the robot.

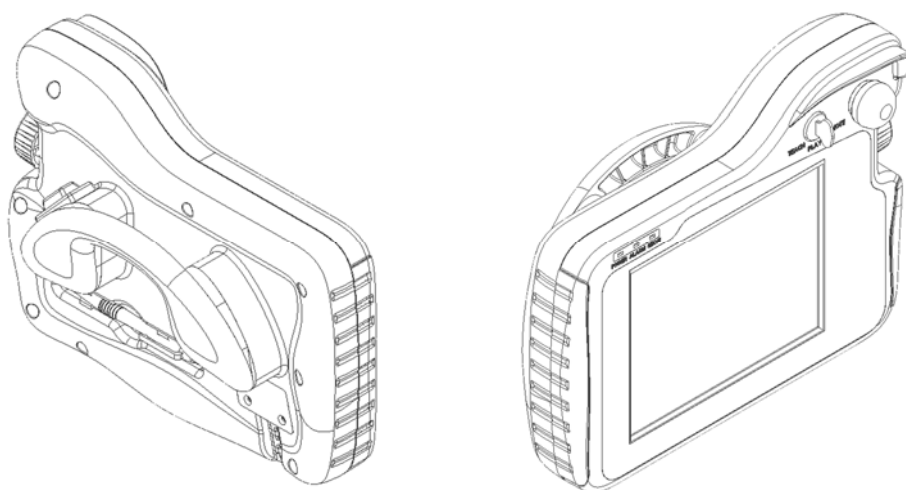


Figure 9-1 Components of the teach pendant

The teach pendant mainly includes a 8.4-inch LCD touch screen, a mains switch, an emergency stop button, a force switch and a socket for a teach pendant connecting line. The touch screen may not only show the detailed motion of the robot to the user clearly, including the position and pose parameters and so on, but facilitate operations of the user. All operations may be completed by directly clicking the screen.

A housing of the teach pendant is designed in combination with aesthetics and ergonomics, and the back thereof is equipped with a nylon rope and two hanging rings. The nylon rope is used to hold the teach pendant, and the teach pendant may be suspended on an electric control cabinet by making use of the hanging rings.

The force switch belongs to the three-position enabling switch which can implement three-position motions of avoiding the danger: OFF (release)  $\Rightarrow$  ON  $\Rightarrow$  OFF (press). When the switch is ON, the teaching operation may be implemented by dragging the robot.

See the detailed instructions of the control system for use of the teach pendant in

“ERC-G200 System Operation Manual”.

# Appendix

## A Glossaries

**Stop Category 0:** the robot motion is stopped immediately when the power supply of the robot is turned off. It is an uncontrolled stop, where the robot may deviate from the programmed path as each joint may brake as fast as possible. This protective stop may be used when a safety-related assessment limit is exceeded, or when a fault occurs in the safety-related assessment part of the control system. For more information, please refer to EN ISO13850:2008 or IEC60204-1:2006.

**Stop Category 1:** the robot motion is stopped with power available for the robot to achieve the stop, and the power supply is turned off when the stop is achieved. It is a controlled stop, where the robot will comply with the programmed path. The power is turned off after one second or once the robot stands still. For more information, please refer to EN ISO13850:2008 or IEC60204-1:2006.

**Stop Category 2:** it is defined as a controlled stop with power available to the robot. The robot stops all motions within one second. Through the operation of the safety-related assessment control system, the robot may stay at the stop position. For more information, please refer to IEC60204-1:2006.

**Diagnostic coverage (DC):** it is used to measure effectiveness of the diagnosis which is implemented to achieve the assessed performance level. For more information, please refer to EN ISO13849-1:2008.

**Integrator:** the integrator is an organization designing the final installation of the robot. The integrator is responsible for implementing the final risk assessment, and must make sure that the final installation comply with the local laws and regulations.

**Mean time to dangerous failure (MTTFd):** the MTTFd is defined as a value acquired by calculation and detection which are implemented to achieve the assessed performance level. For more information, please refer to ENISO13849-1:2008.

**Risk assessment:** The risk assessment is the whole process of identifying all risks and reducing these risks to an appropriate level. The risk assessment should be recorded and archived. please refer to ISO 12100 for details.

**Performance level (PL):** the PL is a discrete level which is used to specify the ability of each safety-related part in the control system to implement the safety function under foreseeable conditions. PLd is a second highest reliability classification, meaning that the safety function is extremely reliable. For more information, please refer to EN ISO13849-1:2008.

## **B Certification and Detection**

Through verification and evaluation of the quality management system and the sample type test of the enterprise by the third party certification organization, the product EC66 of the company is confirmed to be in line with the specific requirements and have the ability of producing the qualified products continuously and steadily, with the written confirmation. The description is as follows:

The EC66 has passed detection and certification of multiple well-known international third party organizations, and has acquired the EU CE certification and Korean KC certification. The product safety has achieved the international leading level.

The EC66 has passed the robot performance test of National Robot Testing and Assessment Center (Headquarters) of China; and the performance indexes have exceeded most of the domestic brands and achieved the standard of the traditional industrial robot, and have been gradually narrowing a gap with the top international brands.

The EC66 robot has passed the EU CE certification, and the product is in line with all relevant requirements of the EU CE directive:

Low-voltage Directive (LVD) 2006/95/EC

Machinery Directive (MD) 2006/42/EC

Electro Magnetic Compatibility Directive (EMC) 2004/108/EC

EN ISO 10218-1:2011

EN ISO 12100: 2010

EN ISO 13849-1: 2008

EN 60204-1: 2006+A1: 2009

The EC66 robot has been certified and tested by the official authority of Korea, has passed Korean KC certification, and is in line with all relevant requirements of the certification standards of Korea.

The EC66 robot has been certified and tested by National Robot Testing and Assessment Center (Headquarters) of China, has passed the CR certification and is in line with all relevant requirements of the CR certification standards regarding the collaborative robot. The test standards are as follows:

GB 5226.1-2008, GB 11291.1-2011

GB/T 15706-2012

GB/T 17799.2-2003, GB 17799.4-2012

The EC66 robot is subjected to the robot performance test implemented by National Robot Testing and Assessment Center (Headquarters) of China, and the test basis and standards are as follows:

GB/T 12642-2013 *Industrial robots -- Performance criteria and related test methods*

## C Stopping Time and Stopping Distance

Stopping distance and stopping time of stop category 0

The table below shows the stopping distance and the stopping time measured when the stop category 0 is triggered. These measuring results correspond to the following configurations of the robot:

- Extension: 100% (the robot arm is completely extended horizontally)
- Speed: 100% (the general speed of the robot is set as 100%, and the robot moves at a joint speed of 180 °/s)
- Payload: a maximum payload (6kg) that can be handled by the robot connected to TCP.

The Joint 0 test was carried out by performing a horizontal movement, where the rotational axis was perpendicular to the ground. During the Joint 1 and Joint 2 tests, the robot followed a vertical trajectory, where the rotational axes were parallel to the ground, and the stop was performed while the robot was moving downward.

	Stopping distance (rad)	Stopping time (ms)
Joint 0 (base)	0.21	210
Joint 1 (shoulder)	0.60	500
Joint 2 (elbow)	0.21	350

## D Reference Standards

The robot is designed by using the following standards for reference:

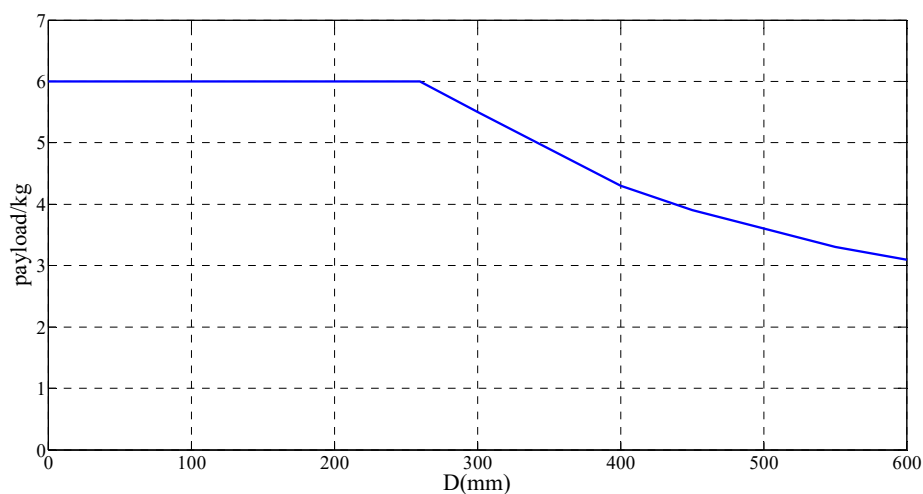
Standard	Definition
2006/42/EC:2006	<p>Machinery Directive:</p> <p>Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)</p>
2004/108/EC:2004	<p>EMC Directive:</p> <p>Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC</p>
EN ISO 13850:2008	<p>Safety of machinery:</p> <p>Emergency stop - Principles for design</p>
EN ISO 13849-1:2008	<p>Safety of machinery:</p> <p>Safety-related parts of control systems - Part 1: General principles of design</p>
EN ISO 13849-2:2012	<p>Safety of machinery:</p> <p>Safety-related parts of control systems - Part 2: Validation</p>
EN ISO 12100:2010	<p>Safety of machinery:</p> <p>General principles of design, risk assessment and risk reduction</p>
EN ISO 10218-1:2011	<p>Industrial robots:</p> <p>Safety</p> <p>Note: Content equivalent to ANSI/RIA R.15.06-2012, Part 1</p>
ISO/TS 15066: 2016	<p>Safety requirements for collaborative industrial robot</p> <p>Robots and robotic devices —Collaborative robots</p>



## E Technical Specifications

Robot type	EC66
Weight	17.5kg
Maximum payload	6kg
Reach	914mm
Joint speed	144°/s to 224°/s
TCP speed	1m/s
Repeated positioning accuracy	0.03mm
Control box IO	16 digital in, 16 digital out, 2 analog in and 4 analog out
Tool IO	2 digital in, 2 digital out, 1 analog in and 1 analog out
IO power supply	The control box is 24V 2A, and the tool end is 24V 0.8A
Communication with control box	TCP/IP 100Mbit, IEEE 802.3u, 100BASE-TX, compatible with Modbus TCP. RS485, compatible with Modbus RTU.
Tool Communication	RS485
Protection class	IP54
Typical power consumption	250W
Temperature	0-50°C
Power supply	85-265VAC, 50-60Hz 18-72VDC
Anticipated service life	25000 hours

## F Payload



A wrist payload diagram is shown above. Herein, the horizontal ordinates  $d$  respectively indicate the offset of the center of gravity. The offset of the center of gravity is a distance from a center of a flange plate of the tool end to the center of gravity of the tool.

### WARNING

1. The load conditions should fall within the scope shown in the chart.
2. The payload shown in the diagram indicates a maximum payload which should not exceed a maximum weight shown in the diagram under any circumstances.
3. The components inside the robot may be damaged early if the payload exceeds an allowable value.

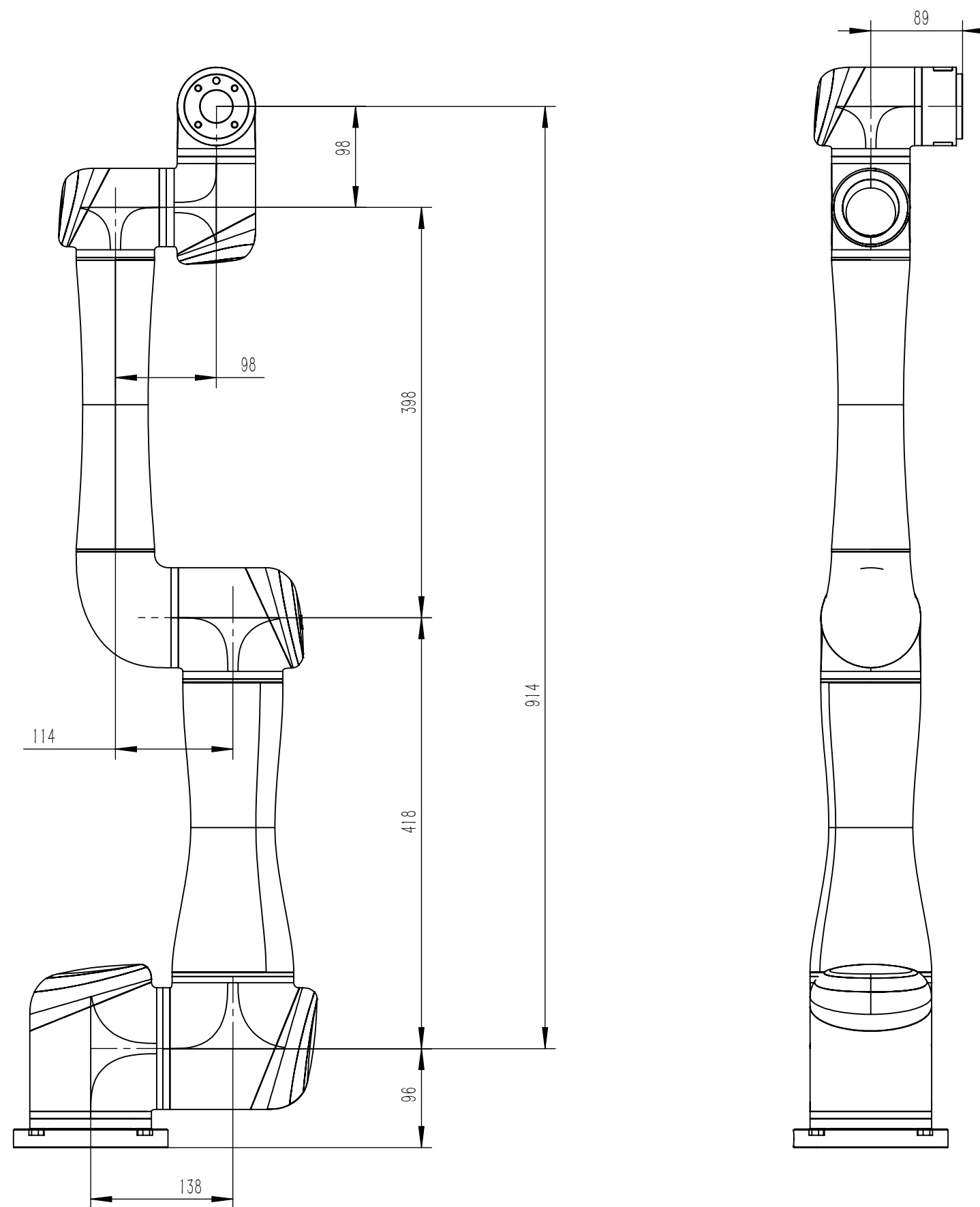
## G Installation Requirements of the Robot Arm

The robot arm having a 6KG load runs normally without bumping against the outside, in which a center of gravity of the load is deviated from a central axis of the tool end for 100mm. Three ways of installation (forward installation, hoisting and vertical installation) are available, and it is recommended that the minimum anti-overturning force should be available at each hole position of fixing the bolt of the robot arm.

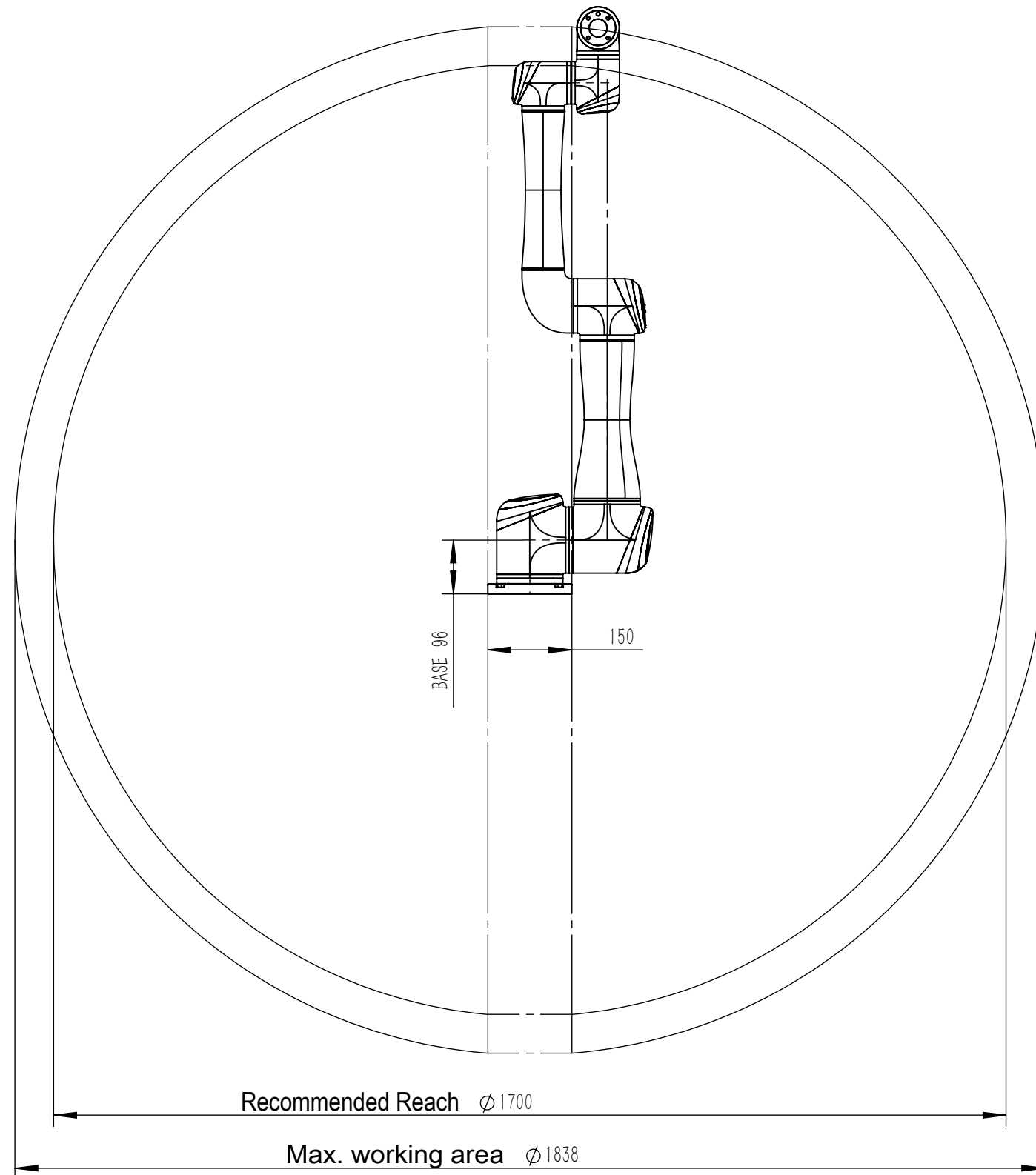
Way of installation	Normal running	Stopping of the equipment in case of emergency
Forward installation	1554N±360N	1554N±2594N
Reverse installation	1754N±360N	1754N±2594N
Vertical installation	1554N±360N	1554N±2594N

## **H Alarm Information and Description of Routine Problems**

See the detailed instructions of the control system for the alarm information.



All dimension is in mm For public use



All dimension is in mm For public use



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