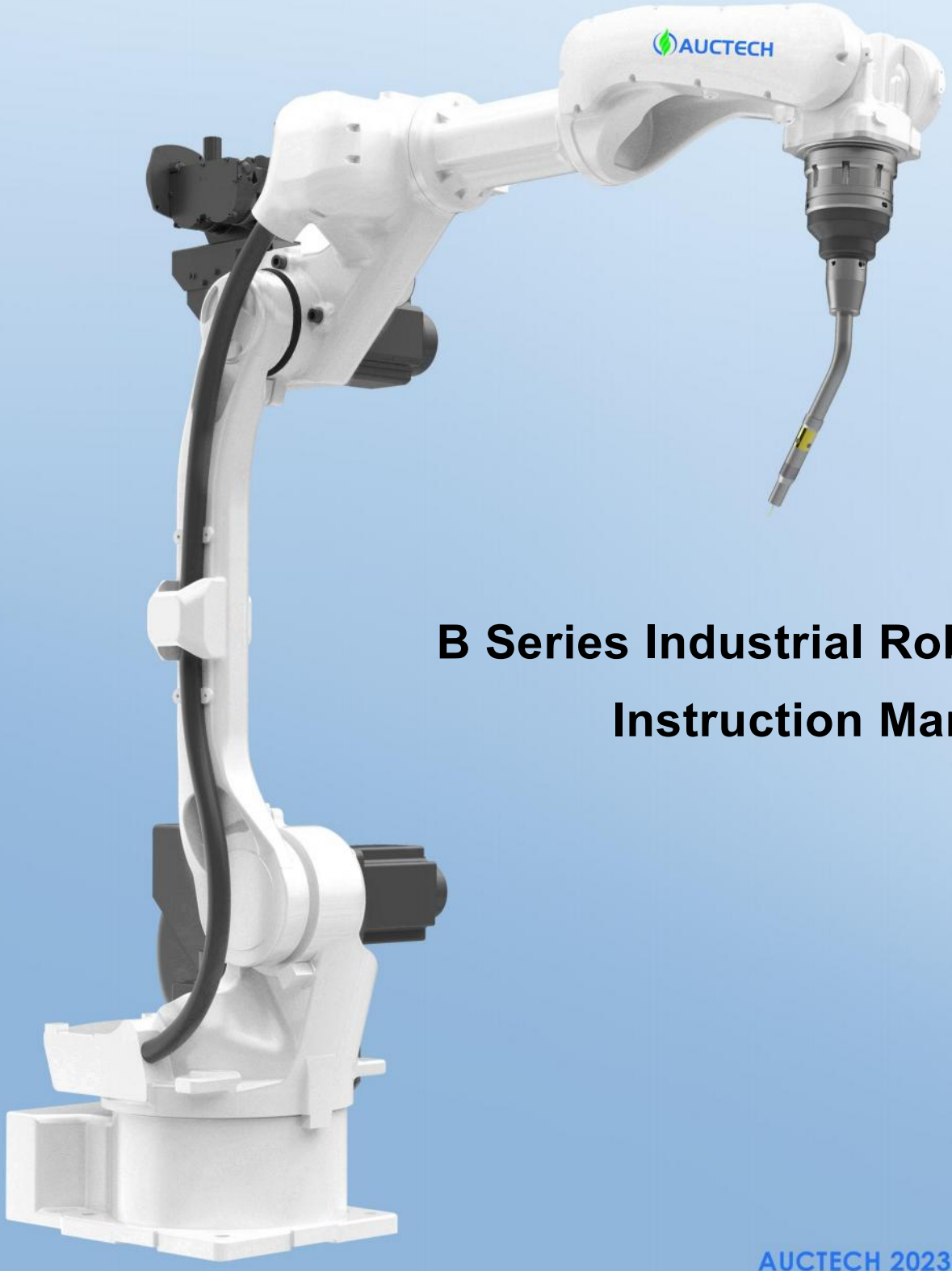
AUCTECH



B Series Industrial Robots
Instruction Manual

AUCTECH 2023-V2.0

Statement

- Thank you for using the AUCTECH 6-axis welding robot products. To ensure proper setting of the product, please read this manual carefully before using the product. The contents mentioned in this manual concern your personal and property safety. If you operate without following or complying with the instructions and warnings in this manual, it may cause personal injury to you and the people around you or may damage the robot and its surrounding objects.
- This manual is intended only as a guide to the normal operation of the product. During the use of the robot at the production site, the user, as the actual manager of the robot at the time of use, must take full responsibility for the product that is used. This Company does not assume responsibility for personal injury or property loss caused by reasons other than product defects.
- All contents of this manual have been carefully considered and checked, but are not guaranteed to be completely correct and are subject to change without notice. All rights to this manual and the information contained herein are reserved by AUCTECH ROBOTICS It is strictly forbidden to reproduce or redistribute this manual or to disclose its contents to third parties without express permission.

Brief Introduction

◆ Manual description:

For the safe and accurate use of AUCTECH general-purpose 6-axis welding robots, this manual contains information on safe handling, installation, operation, repair and maintenance.

◆ Equipment description:

1. Overview:

This series of welding robots mainly consist of robot body, robot electronic control cabinet, welding power supply, welding torch and wire feeder. This model of welding robot can achieve the conventional welding work of carbon steel, stainless steel, galvanized plate and aluminum, with ultra-low spattering, standard single pulse, ultra-short arc pulse, constant penetration, fast spot welding and other functions.

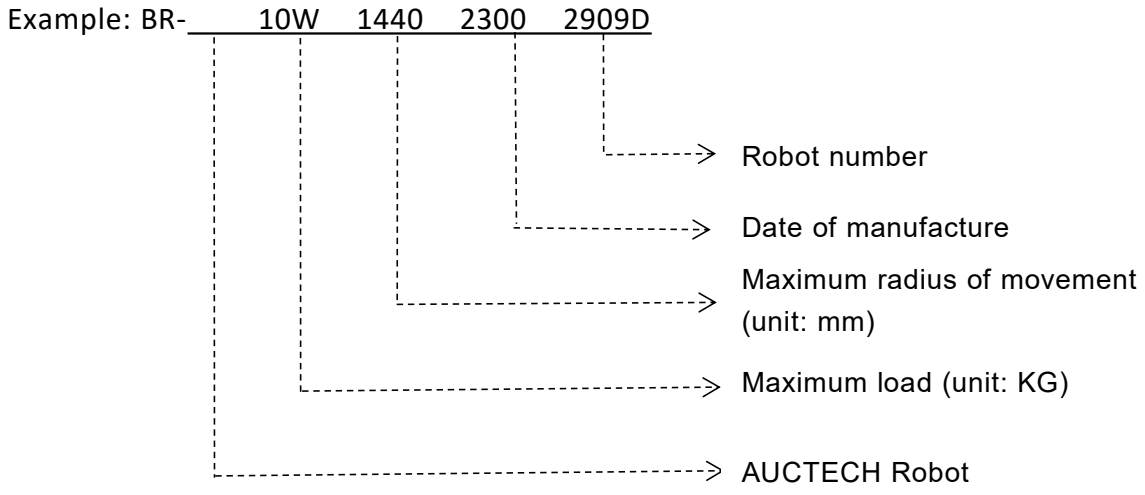
2. Performance characteristics:

① High speed: Continuous and stable high-speed work to improve productivity.
② High precision: Precise control of movements and reduction of human error.
③ Highly flexible: Minimal spattering during the welding process and beautifully shaped weld seams.
④ Digitalization: Full digital control system for precise control of the welding process and stable arc length.
⑤ Expert database: The system has a built-in database of welding experts with automatic and intelligent parameter combinations.
⑥ Ease of use: The control system has a simple interface and is easy to operate.

3. Fields of application:

Welding in agricultural machinery industry, welding in coal machinery industry, welding in engineering apparatus, welding in furniture industry, welding in machine tool accessories, welding in window guardrails, welding in high and low bed frames, welding in automobile and spare parts industry, welding in (bicycle, electric bicycle and tricycle) industry.

◆ Robot serial umber description:



FOREWORD

This instruction manual applies to the robot body models listed below:

Type of robot	Model name	Effective load	Robot weight
General-purpose handling and loading/unloading robot	BR-10W-1440	10KG	210KG
	BR-12-2010	12KG	313KG

WARRANTY

This series of models are shipped and delivered after rigorous test by this Company. For detailed information on warranty terms, please contact the distributor at the place of purchase.

❖ **Warranty period:** The warranty period is within 1 year from the date of delivery of this product to the customer, if the customer needs to extend the warranty period and other services, please contact the distributor at the place of purchase to deal with relevant matters.

❖ **Warranty object:** Products delivered by this Company with the original packing.

❖ **Conditions resulting in a malfunction not covered by the warranty:**

1. Failure to transport and install the products; to wire, connect other auxiliary control equipment; to overhaul and maintain the products in strict accordance with manual requirements or industry standards;
2. Serious collisions or other accidents while in use;
3. In use, beyond the parameters of product use or performance criteria shown in this manual;
4. The placement environment, working conditions and application purpose do not comply with the specified range or limit range of the product in the instruction manual;
5. Unauthorized modification of original product parts or structure, which results in abnormal operation or functional failure of the product;
6. Damage to products caused by natural disasters such as fire, earthquakes, floods, and lightning strikes;
7. Failures other than those mentioned above that are not caused by the product itself and are not caused by the responsibility of AUCTECH Company;

In accordance with the above description or the relevant provisions, warranty of this Company is limited to flaws, defects, and failures in the products and parts delivered directly shipped or delivered by this Company or sold to the distributors. In addition, AUCTECH Company does not assume any responsibility for any form of indirect damage or other consequences arising from the product (as described in detail in section 2.4-Limitation of Liability of this instruction manual**).**

GENERAL SAFETY INSTRUCTIONS BEFORE USE

I. Preamble

Thank you for purchasing and using our robot products. Before using the products, please read the contents of the manual carefully and use them with caution based on your understanding of the contents. For detailed functions and precautions regarding the robot, please read this manual to fully understand them.

II. Description of safety markings in the instruction manual

In this manual, when introducing the product information and operation content, the following markings are attached for additional explanation to assist the user to clearly understand the precautions for the use of the product and quickly get started with the operation and use of the company's products. Please read the contents carefully before installing and using the product, as omission of important safety precautions and solutions may result in safety accidents such as injury or equipment damage.

 **Danger**	**If operated incorrectly, it may result in serious injury or death.**
 **Warning**	**If operated incorrectly, there is a risk of minor injuries to the operator, other operators, or damage to the equipment.**
 **Reminder**	**Remind you of some precautions or quick operation methods, etc.**
 **Note**	**Annotate or emphasize particular elements**

III. Precautions

1. When handling and installation the robot, be sure to follow the methods shown in this manual, otherwise the robot may tip over and an accident may occur.
2. There shall be no heavy hanging objects above the robot to prevent from falling, from damaging equipment such as the robot or from injuring the operator.
3. Be sure to demarcate a safe area prior to robot installation to prevent injuries caused by uninvited persons.

4. It is prohibited to use this product under the place where there are water vapor, corrosive gas, flammable gas and other substances; otherwise it will cause electric shock or fire and other accidents.
5. Before starting the machine, check whether the emergency stop device can be activated at any time or not.
6. When operating the robot for the first time, be sure to start at a low speed and then accelerate gradually, and check for any abnormalities.
7. When the robot is in operation, it is prohibited to be within the working range of the robot to avoid injury to personnel.
8. All peripheral equipment shall be connected to an appropriate ground wires.
9. It is strictly prohibited to move the robot axes at will, as this may cause personal injury and equipment damage.
10. Do not lean on the control cabinet or touch the buttons in order to prevent the robot from generating unintended actions that could cause personal injury or equipment damage.
11. Do not touch the controller and manipulator during operation, otherwise it may cause burns or bumps.
12. It is prohibited to open the door of the electrical cabinet when the power supply is activated.
13. Do not touch the wire ends within 10 minutes after the power is switched off to avoid electric shock.
14. Do not change the wiring when the power is on, as this may cause an electric shock accident.
15. Do not switch the power on and off frequently, if you need to switch the power on and off continuously, please control it to once a minute.
16. Have an operator who is qualified to fulfill the operational requirements carry out the relevant operations.
17. Emergency stop can only be used to stop the robot in an emergency, is not for normally stopping programs, shutting down the robot, etc.
18. When disassembling the robot, be aware of parts that may fall from the robot to avoid injury to personnel.
19. When using the teach pendant, wearing gloves may lead to operating errors, always remove gloves and operate the teach pendant.
20. Protective measures shall be taken when wiring and piping between electrical control cabinets and robots and peripheral equipment, such as passing pipes, wires or cables through pits or covering them with protective covers to prevent them from being stepped on by people or run over by forklift trucks.
21. Any working robot may have unforeseen manoeuvres that could cause serious injury to persons in the working area or damage to equipment. Before preparing the robot for work, test the reliability of the safety measures (fence gates, band-type brakes, safety indicators). Before switching on the robot, make sure that there are no other persons within the working range of the robot.
22. The operating range and load conditions set by the software must not exceed the values specified in the product specification sheet, as improper settings may result in injury to personnel or damage to the machine.
23. If the work has to be carried out within the working range of the robot, the following rules are to be followed:
    - When the robot is in manual mode, the speed must be limited to less than 250 mm/s; when the robot needs to be set to manual full speed, only professionals with a full understanding of the risks shall operate it;

- Pay attention to the rotating joints of the robot to prevent hair and clothing from being caught in the joints; also pay attention to other dangers that may be caused by the movement of the robot or other attached equipment;
- Test whether the motor band-type brake properly operates or not to prevent personal injury from robot abnormality;
- Consider the contingency plan when the robot suddenly moves toward your own direction.

Warning

Any one shall do not stand under the robot arm to prevent personal injury due to abnormal operation of the machine.

Reminder

Please set up fire extinguisher equipment near the robot's operating area to avoid personal injury or property damage caused by an accidental robot fire.

IV. Robot stop function

1. Stop by power failure

This is a robot stopping method, namely disconnecting the servo power supply and stopping the robot's motion in a split second. Since the servo power is disconnected while the robot is moving, the trajectory of the deceleration motion is not controlled. The following processing is performed by the power-off to stop operation:

• After an alarm is given, disconnect the servo power supply. The robot's movement stops in an instant.

• Suspension of program execution.

For robots in motion, frequent power-off operations via the emergency stop button, etc., can lead to robot malfunction. System configurations for power-off stops in daily situations shall be avoided.

2. Alarm stop

This is a robot stopping method, namely decelerating and stopping the robot's movement by a control command after an alarm (other than a power failure alarm) is given by the robot system. The following processing is executed for control stop:

• Robot system alarms due to overload, malfunction, etc. (except for power failure alarms).

• The servo system sends a "control stop" command to decelerate and stop the robot's movement, the program execution is paused.

• Disconnect the servo power supply.

3. Keeping

This is a robot stopping method, namely decelerating and stopping robot movements by maintaining servo power.

By keeping, the following processing is performed:

• Decelerates and stops the robot's movement, pauses the program execution.

Contents

I. PRODUCT SPECIFICATION AND PERFORMANCE

1.1 Robot body model

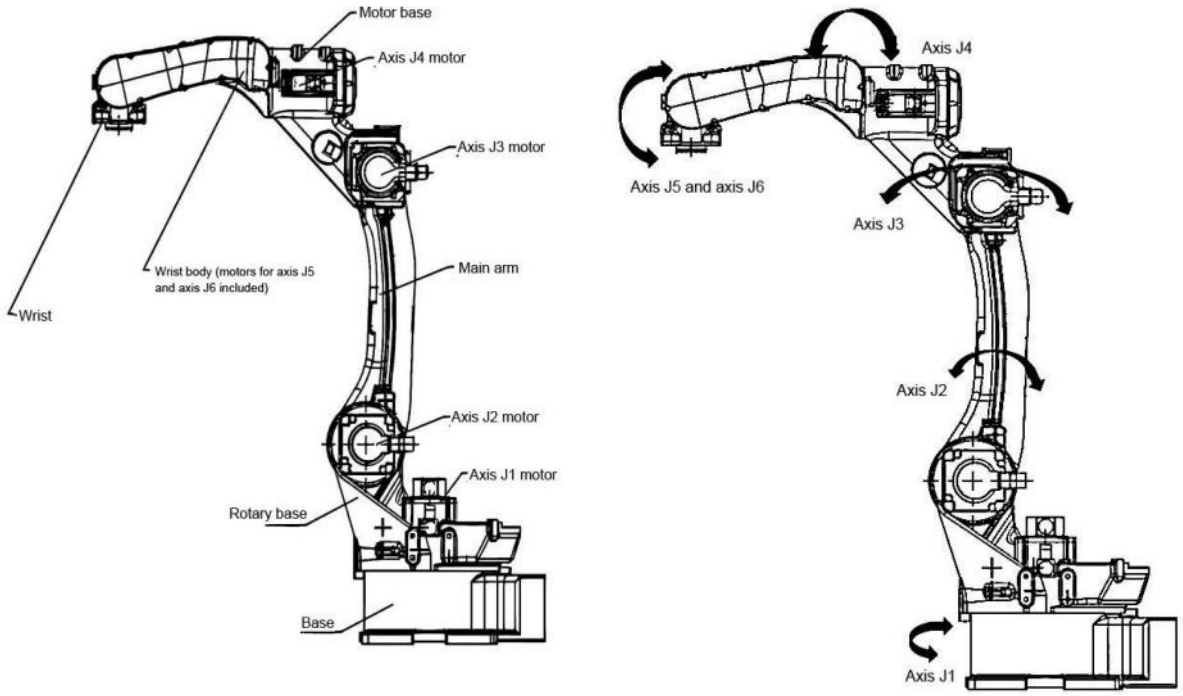
- BR-10W-1440 robot model

- BR-12-2010 robot model

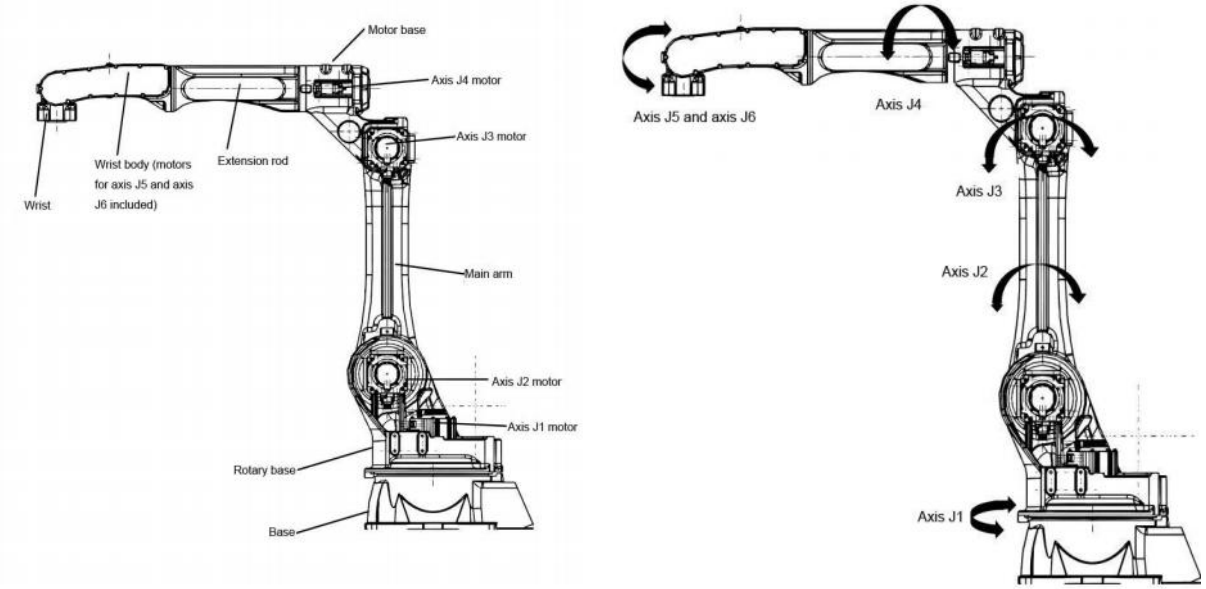
1.2 Robot body composition and motion orientation

The robot body is the mechanism used to grasp or move tools and workpieces in the robot system. This series of welding robot products are six DOF serial robots, and the names of their individual structures (main parts) and the motion orientations are shown in the following figures:

- Schematic diagram of composition and motion orientation of BR-10W-1440 robot

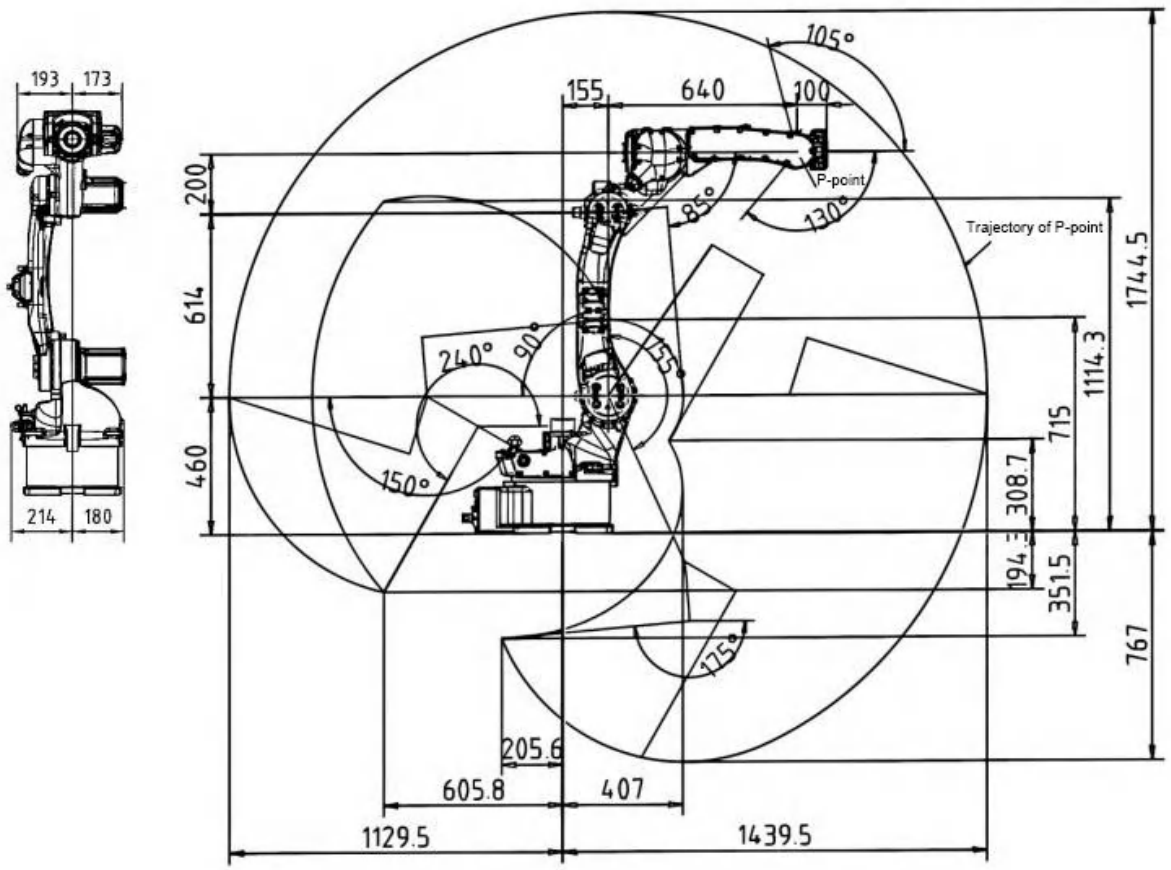


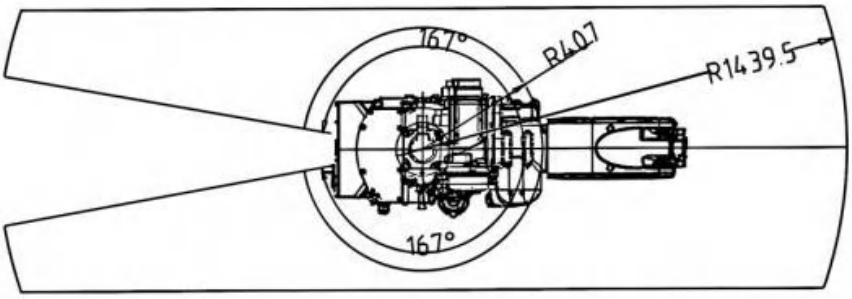
- Schematic diagram of composition and motion orientation of BR-12-2010 robot



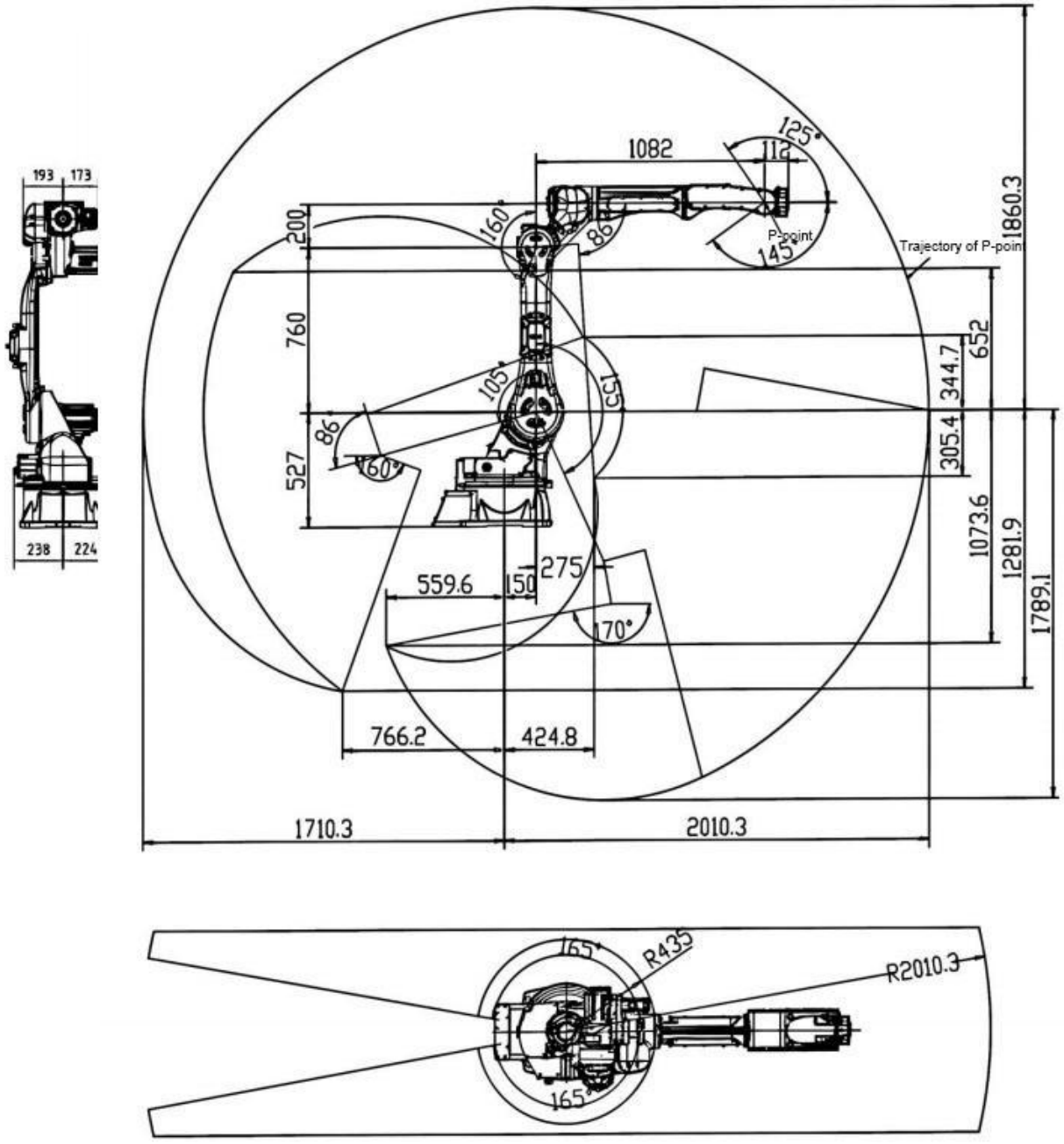
1.3 External dimensions and range of motion of the robot

- External dimensions and motion range of BR-10W-1440 robot (Unit: mm; shaded area: range of motion of p-point)



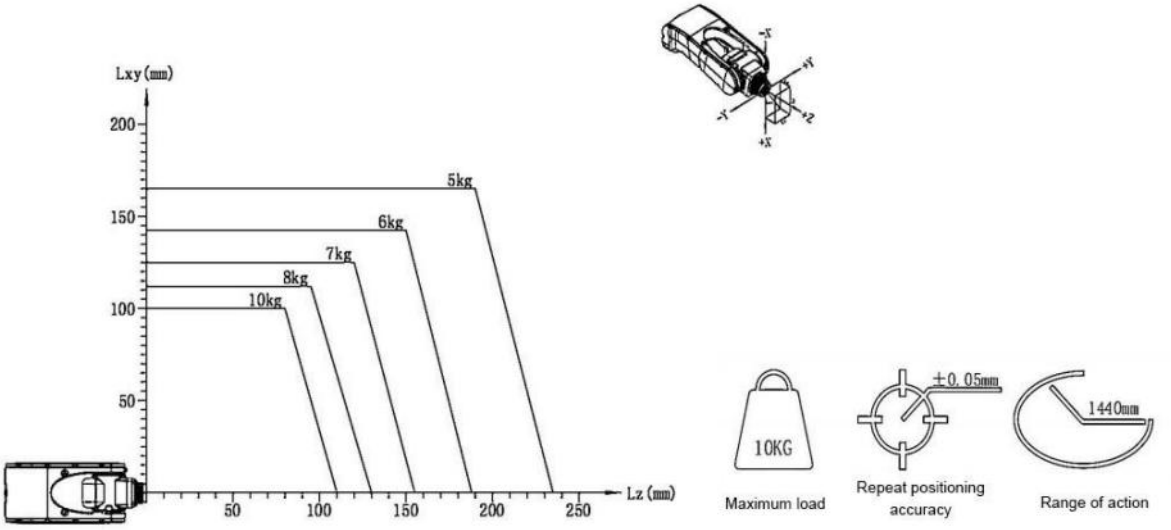


- External dimensions and motion range of BR-12-2010 Robot
  (Unit: mm; shaded area: range of motion of p-point)

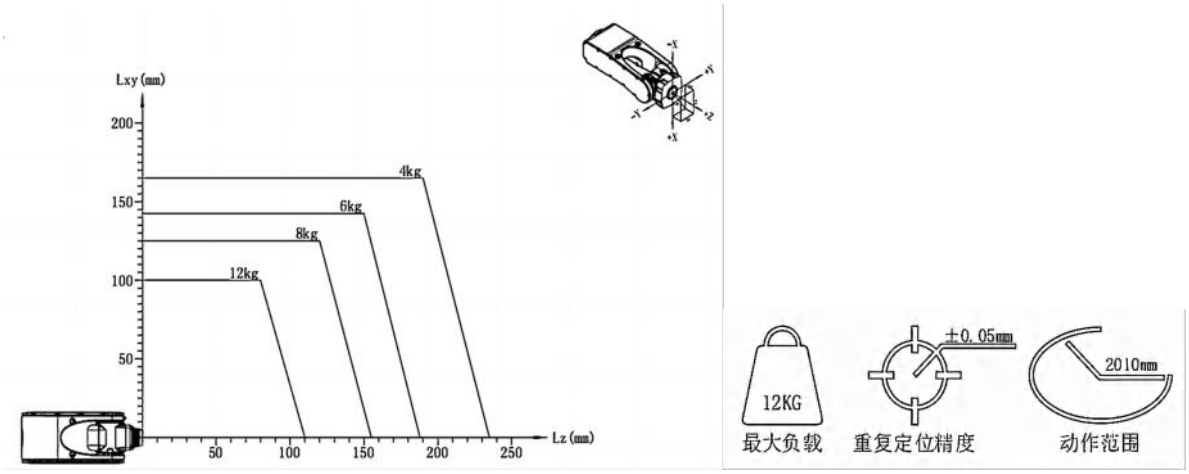


1.4 Loading conditions of the wrist

The load capacity of the robot (including the mass of hand grips, welding torches, etc.) varies with the robot model. Please strictly observe the limitations on the load moment and load inertia of the robot, and the load conditions shall be within the ranges shown in the table and/or figure.



- Figure of wrist load of BR-10W-1440 robot



- Figure of wrist load of BR-12-2010 robot

1.4 Equipment specification and parameters

1.4.1 Robot body specification and parameters

Model	BR-10W-1440	BR-12-2010
Number of axes	6-axis	6-axis
Radius of movement	1440mm	2010mm
Limited load	10KG	12KG
Level of protection	J1, J2 axes TP56 (J3, J4, J5, J6 axes TP67)	J1, J2 axes TP56 (J3, J4, J5, J6 axes TP67)
Installation mode	Floor mounted/bracket mounted/hang upside down	Floor mounted/bracket mounted/hang upside down
Power capacity	4.5KW	6KW
Input/output signals	Standard 16-input/16-output 24VDC	Standard 16-input/16-output 24VDC
Robot weight	210KG	313KG
Repeat positioning accuracy	±0.05	±0.05
Range of motion		
Axis 1 S	±167°	±165°
Axis 2 L	+80° to -145°	+80° to -145°
Axis 3 U	+145° to -75°	+145° to -75°
Axis 4 R	±190°	±190°
Axis 5 B	+50° to -210°	+50° to -210°
Axis 6 T	±220°	±220°
Movement speed		
Axis 1 S	285°/s	203°/s
Axis 2 L	247°/s	203°/s
Axis 3 U	285°/s	214°/s
Axis 4 R	392°/s	392°/s
Axis 5 B	272°/s	276°/s
Axis 6 T	1353°/s	1356°/s
Fields of application	Welding-specific (gas shielded welding, argon arc, laser, aluminum, stainless steel, carbon steel)	Welding-specific (gas shielded, argon arc, laser, aluminum, stainless steel, carbon steel)
Torque		
Axis 4 (N-m)	103.5	88.5
Axis 5 S (N-m)	51.84	45.52
Axis 6 T (N-m)	32.64	32.64
Built-in air tube	Ø10	Ø10
Installation mode	Ground, wall installed, tilted, hang upside down	Ground, wall installed, tilted, hang upside down
Installation environment	Temperature 0-45°C Humidity: 20~80%RH (no condensation) Vibration acceleration (0.5G) or less Altitude below 1000m	
	No igniting or corrosive gases or liquids, no splashing water, less oil or dust, stay away from electromagnetic sources and magnetic fields	

1.4.2 Control cabinet specification and parameters

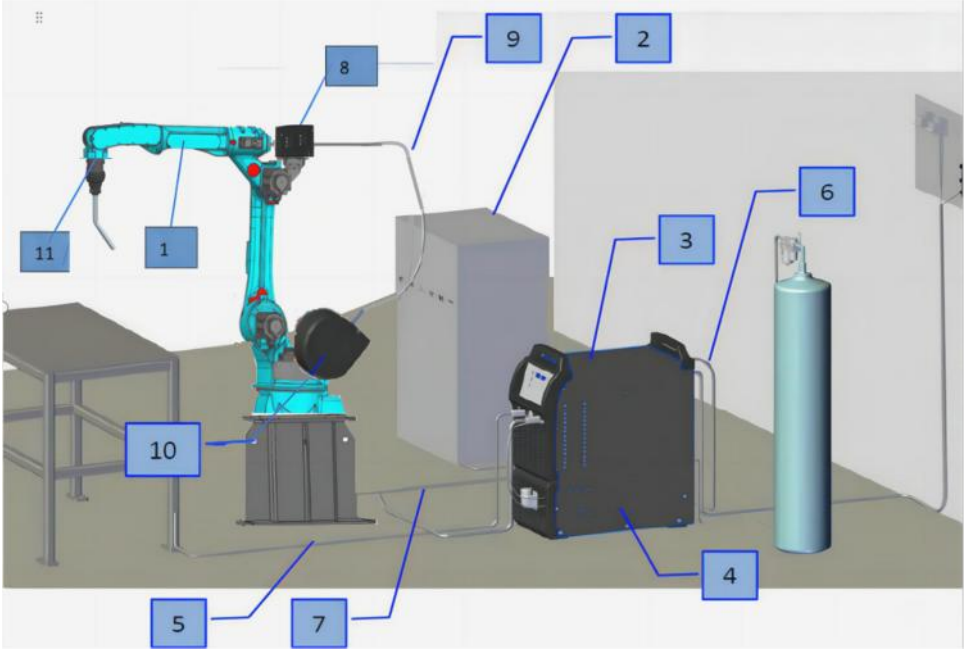
Item	BR-10-1440	BR-12-2010
Overall dimensions	650(W)*495(D)*580(H)mm (including protrusions)	
Approximate mass	60kg	
Cooling method	Direct cooling	
Power supply specifications	AC220V50/60HZ	
Grounding	Industrial grounding (specialized grounding with an grounding resistance of 100Ω or less)	
Input and output signals	General-purpose signal: Input: ; Output: 16 (16 inputs and 16 outputs)	
Position control method	Serial communication method EtherCAT.TCP/IP	
Memory capacity	JOB:200000 steps, 10000 robot commands (200M in total)	
LAN (host link)	Ethercat (1) TCP/IP (1)	
Serial port I/F	RS485(1) RS422(1) R232(1) CAN interface(1) USB interface(1)	
Control method	Software servo <position control>	
Drive unit	Servo package for AC servo (total IN 6 axes); external axes can be added	
Ambient temperature	When energized: 0~+45°C, when stored: -20~+60°C	
Relative humidity	10 to 90% (no condensation)	
Altitude condition	Altitude below 1000m Over 1000m, the maximum ambient temperature is reduced by 1% for every increased 100m increase; it can be used up to 2000m.	
Vibration condition	Below 0.5G	
Other requirements	No igniting or corrosive gases and liquids	
	No dust, chip fluid (including coolant), organic solvents, oily fumes, water, salts, pharmaceuticals, anti-rust oils	
	No exposure to strong microwaves, ultraviolet rays, X-rays and radioactive rays	

1.4.3 Specification and parameters of teach programming pendant

Overall dimensions	280(W)×220(D)×120(H)mm (including protrusions)
Gross weight	0.6KG
Material	Reinforced plastic
Manipulator	Selection key, axis operation key, value/application key, switch mode key with key/(teaching mode, reproduction mode, remote mode), emergency stop key, activation key, 1 USB port
Display screen	8-inch color LCD, touch screen 640X480 pixels
Level of protection	IP54
Cable length	Standard: 5m; Optional: 15m

1.5 Connection of the whole machine and description

1.5.1 Description of handling robot system components

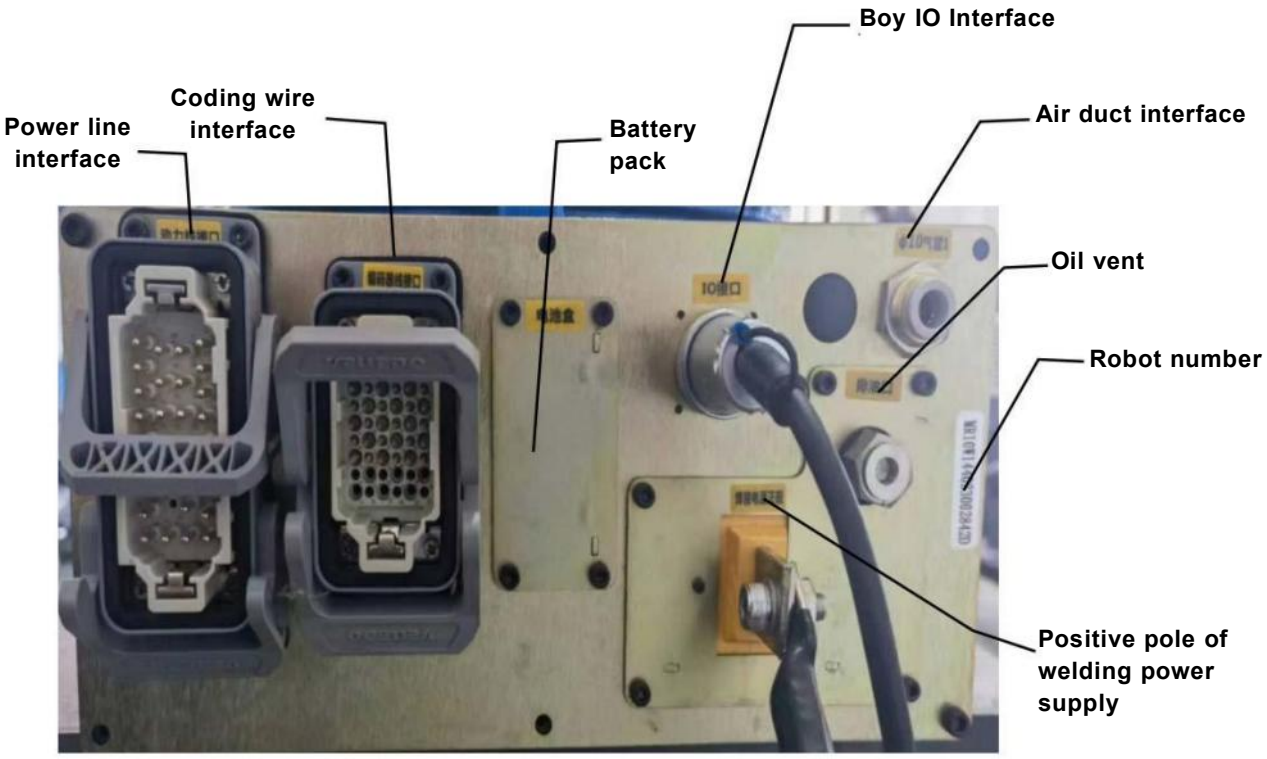


Note

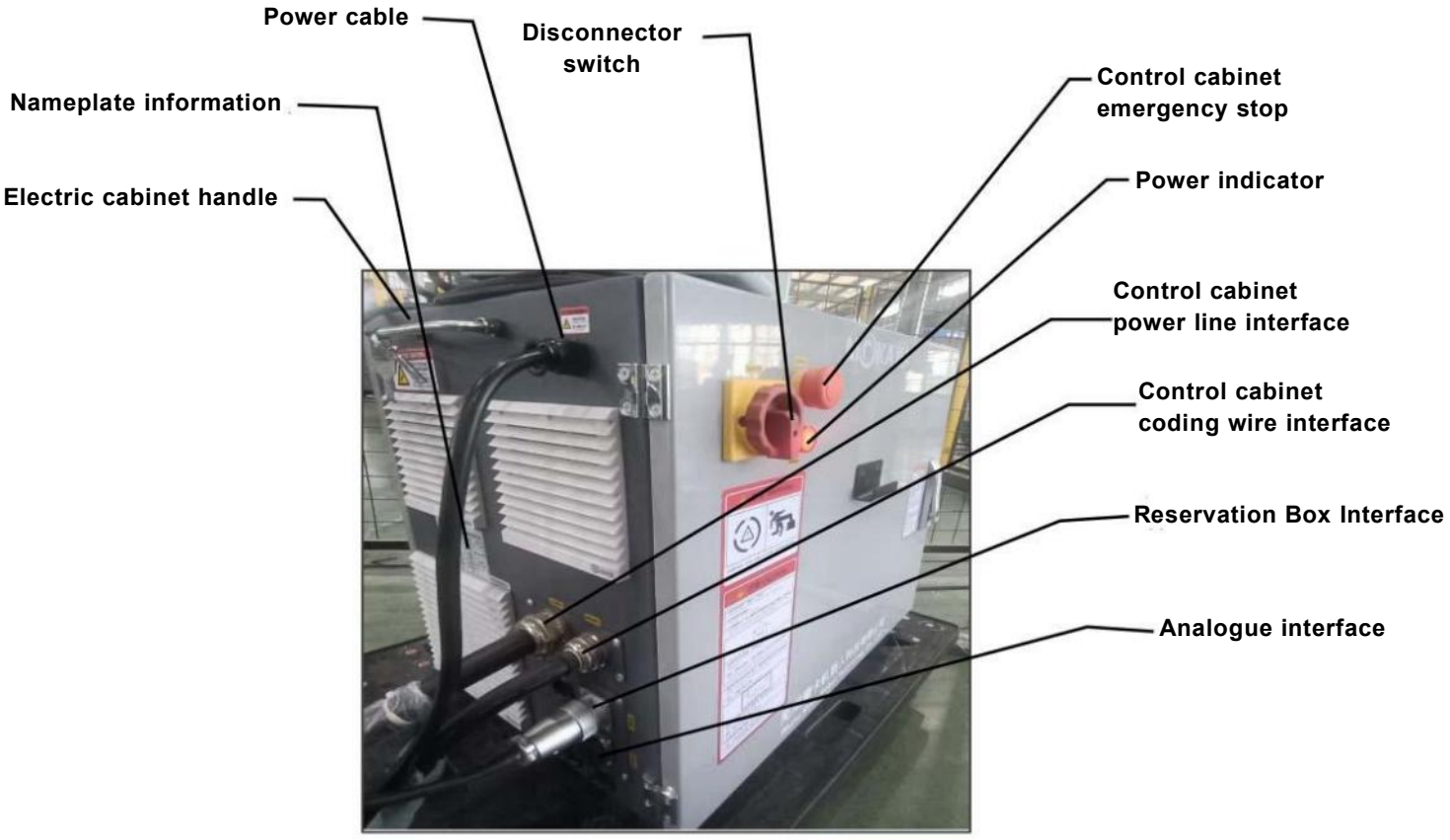
Please refer to the appendix for the robot control cabinet schematic diagram, IO interface schematic diagram and robot body wiring harness connection diagram.

1	Robot body
2	Robot control cabinet
3	Welding power supply
4	Water cooler (optional)
5	Welding cable
6	Robot control cable (control cabinet-welding machine)
7	Robot control cable (welding machine-body)
8	Wire feeder
9	Wire guide tube
10	Wire feeding tray component
11	Robot-specific welding torch (external or internal)

1.5.2 Connections between the robot body and the base and description



1.5.3 Schematic diagram of the robot control cabinet



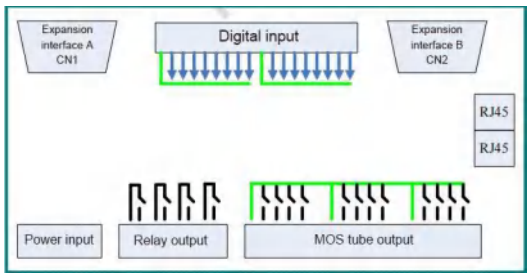
Reminder

- **The serial number of the robot body must match the serial number of the control cabinet; incorrect matching of serial numbers will result in deviations in robot accuracy.**
- **Before turning on the power to the control unit, connect the robot and the control unit via the earth wire. There is a risk of electric shock if the earth wire is not connected.**
- **The grounding position of the robot has a small amount of antirust oil, please clean it well before grounding.**

1.5.4 Description of R4C-IO and R4A-IO interface board

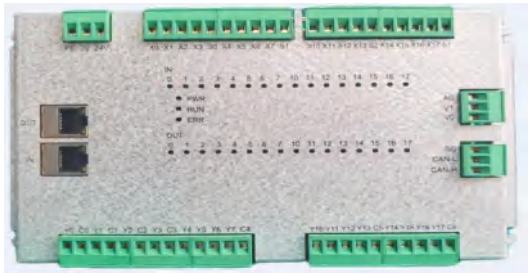
Please refer to Appendices XI and XII for a detailed description of the contents of this subsection.

Physical figure

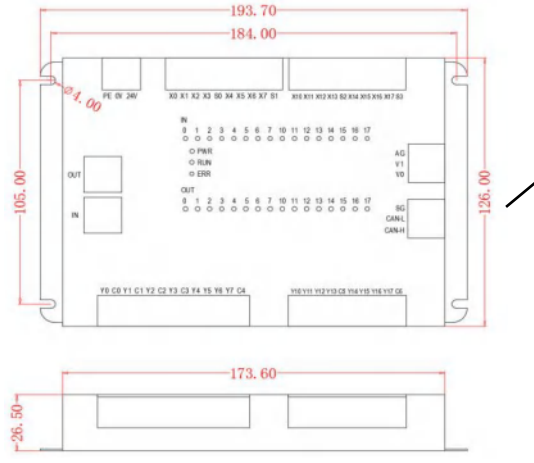


Layout plan

- Schematic Diagram of R4C-IO Interface Board



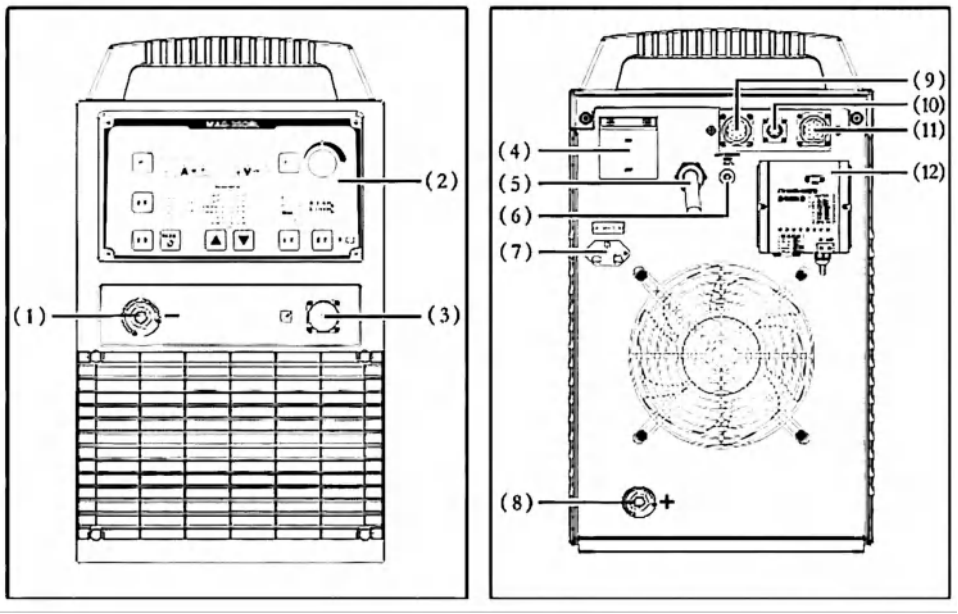
Physical figure



Layout plan

- Schematic diagram of R4A-IO interface board

1.5.5 welding machine Interface Connection and Description



Number	Name	Function
1	Output socket (-)	Connection to the workpiece to be welded is made by means of a grounding cable before welding.
2	Control panel	For function selection and setting for some parameters. The control panel consists of a digital display window, adjustment knobs, keys, and light-emitting diode indicators.
3	Arc Pressure Feedback Line Connection Socket	Connected to the workpiece to be welded by means of an arc pressure feedback line.
4	Automatic Air Switch	The main function is to protect the equipment by automatically disconnecting the power in case of overload or fault.
5	Power input cable	Supply power to the welding power source.
6	Wire Feeder Overload Protectors	Protect the wire feed motor.
7	Heating power output socket (AC 3 6V)	Supply power to the gas meter heating unit.
8	Output Socket (+)	Connection to the wire feeder input socket is made via the wire feeder welding cable.
9	Analogue interface connection socket X5	Used to connect the analogue control line, the interface is low in cost and highly reliable, basic welding tasks can be completed through the robot; but it does not have the function of calling the expert database
10	Digital interface connection socket X6	Used to connect to a communication controller. The digital interface requires the robot to have a digital communication module. The corresponding communication controller is supplied by the factory on request.
11	Wire feed mechanism control line socket X7	Connected to the robot wire feed mechanism via the wire feed mechanism control line
12	Communication Controller	For digital communication with the robot.

II. SAFETY PRECAUTIONS FOR USE

2.1 Safety overview

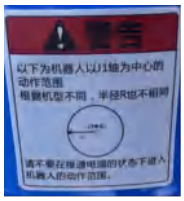
This product is an industrial robot with a great degree of freedom of movement in operation, so safe use is important.

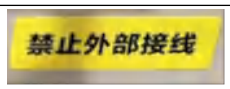
This section focuses on safety precautions necessary to understand during use. For the personal safety of the operator and other related personnel, please be sure to understand and follow the safety notes and precautions described in this manual (this manual does not cover all safety precautions, so the operator shall have a certain degree of common sense and judgment in safety) before use. Failure to observe important or necessary safety warnings may result in injury/death of the user, or other major safety incidents, as well as malfunction or damage to the robot.

2.2 Warning labels

Warning

- Do not remove warning labels from the robot body or attached equipment at will, as this may result in damage to the robot or injury to personnel due to operation negligence or mishandling.
- Make sure that the markings and text on the warning sticker are clearly visible from outside the safety barrier.

 **Marking for removal or replacement**	**Care shall be taken for the place where this label is affixed, it shall replace the filter cotton regularly to prevent blockage of the air ducts.**
 **Marking for no access**	**It is prohibited for the operator to enter the working range of the robot while the robot is powered on, and it shall keep a suitable distance and plan an escape route from unexpected situations, otherwise it may cause personal injury or death.**
 **Marking for Range of Motion Warning Signs**	**The robot joint range of motion shall be carefully understood at the place where this label is affixed, and it is prohibited to enter the range of motion while the robot is powered on, otherwise it may result in injury to the operator.**
	**This label indicates the corresponding handling and placement requirements for the robot body of different models, control cabinet and other peripheral equipment for operation and maintenance, please operate in strict accordance with the label content, otherwise it may cause damage to the equipment or personal injury or death.**

Marking for Handling and Placement Warning	
 **Marking for Electric Shock Warning**	**Danger of electric shock exists at the place where this label is affixed. Non-professional operation is prohibited, private modification of the product is prohibited, please switch off the power first when carrying out the relevant operation, and do not touch the electrically charged parts within one minute after switching off the power, so as not to cause fatal electric shock or scorching injury.**
 **Marking for No Wiring**	**External axle wiring is prohibited at the place where this label is affixed, as it may cause equipment damage or other accidents.**

2.3 Installation of safety barriers

To prevent injuries to the operator or other related personnel from contacting the movable part of the robot, be sure to install safety barrier to prevent personnel from entering the movable range of the robot.

(1) It is prohibited to enter the safety barrier while the robot is in automatic running action.
(2) Press the emergency stop button when entering the safety barrier.
(3) Refer to the robot's range of motion in the first section for the scope of installing the safety barrier.
(4) Please put a 'No Personnel Allowed in Operation' sign on the safety barrier and post it in a conspicuous place.
(5) Before preparing to run the operating robot, have the operator ensure that no one is inside the safety barrier.
(6) Do not place too many bulky items next to the safety barrier to avoid tipping over and damaging the robot or preventing people from taking cover in the event of an accident.

2.4 Operational general safety

(1) Before operating the robot system, please read the General Safety Instructions before Use and this section of the manual carefully. Failure to understand the contents of this section may result in accidents due to faulty operation.
(2) Do not enter the robot's range of motion after the power is turned on. Even if the robot appears to have stopped, it may still perform the next action, which may cause a serious safety accident.
(3) Before operating the robot for other actions, make sure that the emergency stop switch can be used normally.
(4) Before operating the robot system, make sure that no one is on the inside of the safety barrier and run the robot at a low rate and low power in the teaching mode first to ensure operator safety.
(5) If the robot moves abnormally during operation, press the emergency stop switch immediately and do not continue operation, otherwise a safety accident or damage to the equipment may occur.
(6) Be sure to perform replacement work after turning off and unplugging the controller and related equipment, and wait 3 to 5 minutes before performing the work. Working with the power on may result in electric shock or high temperature burns.
(7) Continuous vibration may occur when the robot moves at low speeds depending on the combination of the manipulator direction and the load at the end of the fixture. The vibration is

caused by the natural vibration frequency of the manipulator and can be adjusted and controlled by the following measures.

- ❖ Changing robot speed
- ❖ Change of teaching point
- ❖ Changing fixture end loads

(8) In principle, one person operates the system. If more than one person is required to operate the system, please keep communicating with each other.

(9) Be careful not to touch the screw axis and its grease directly with your hand during lubrication, drag teaching and other operations; frequent contact with the screw axis will cause it to rust.

(10) When the robot operates at high loads and high speeds, high temperature may be generated on the surface of the robot body, so do not operate the robot until the body has cooled down.

2.5 Electrical safety

(1) In order to comply with national regulations, an input power supply must be installed. Fully integrate the robot's power wiring and, if necessary, the power cord must be manually disconnected from the main power cord.

(2) When working in the control cabinet, the main switch and the main power supply must be disconnected and the robot is switched off, locks and labeling shall be considered.

(3) The harness between the controller and the manipulator shall be secured to avoid tripping and fraying.

(4) Whenever possible, switching on or off the power or restarting the robot controller shall be done with all personnel in the safe zone.

(5) When connecting grounding and other cable units, strictly observe the safety regulations for electricity at the place of use.

(6) The waveform of single-phase AC220V power supply shall be a standard sine wave with effective value of +7%, -10% and frequency of 50Hz. The waveform of three-phase AC380V power supply shall be a standard sine wave with effective value of 380V±7% and frequency of 50Hz, and the imbalance of the three-phase voltage shall be ≤5 %.

- ❖ The power inputs are shown in the table below:

Item	BR-10W/BR-12 Robot Control Cabinet	MAG-350RL welding machine
Input Power	Single phase AC220V	Three-phase AC380V
Frequency	50HZ	50HZ
Input cable	≥4mm 2	≥4 mm2
Output cable	/	≥50mm2
Grounding wire	≥4mm 2	≥4mm2

Carbon dioxide extinguishing agent shall be used in case of fire in the robot!

Reminder

2.6 Safety of maintenance and repair

2.6.1 Operational requirements

- ❖ Only personnel who have received training about the robot shall perform troubleshooting.
- ❖ All electrical, pneumatic and hydraulic power must be switched off during maintenance or repairs to ensure that there are no other hazards.
- ❖ Before performing maintenance or repairs, it is important to consider the possible hazards posed by the mechanical energy stored in the manipulator to balance the axis.
- ❖ Never use the robot as a ladder, and do not climb on parts such as controllers, mechanical arms, including motors. Otherwise, you may slip and fall, possibly damaging the robot.

- ❖ After completing robot repair work, inspect whether screws, connectors, and other parts have looseness or missing parts or not.
- ❖ Once the robot repair work is complete, you need to verify whether the safety features are functioning properly or not.

2.6.2 Battery hazard protection

The electrode material and liquid electrolyte in the battery are sealed and not exposed under rated conditions.

- ❖ If abuse occurs (mechanical, thermal, electrical devices), it will result in activation of the safety valve or rupture of the battery box. Consequently, in some cases, there may be a consequent leakage of electrolyte, reaction of the electrode material with moisture, or explosion of the battery ventilation resulting in a fire.
- ❖ Do not short-circuit, charge, puncture, incinerate, crush, immerse, forcibly discharge, or place the battery under temperature exceeding the specified operating temperature range of the product, which may create a fire or explosion hazard.

2.6.3 Gearbox lubrication treatment protection

Reminder	Overview	Safety protection
Lubricant overheating	Gearbox lubricant may need to be changed at up to 90°C	Ensure that protective gear, such as protective goggles and gloves, are worn at all times during work
Allergic reaction	Risk of allergy when handling lubricants	Ensure that protective gear, such as protective goggles and gloves, are worn at all times during work
Gear lubricant overflow	Spillage of gear lubricant can lead to high pressure inside the gearbox, which in turn can lead to damage to seals and gaskets, restricting the robot's freedom of movement.	Make sure there is no spillage when filling the gears with lubricant and check whether the oil level is correct or not after filling.
Possible pressure in the gearbox	When the lubricant plug is opened, there may be some pressure in the gearbox, which can cause lubricant to spray out of the opening.	Carefully open the plug and keep it away from the opening, prevent spillage when filling the gearbox lubricant.
Do not mix different types of lubricants	Mixing different lubricants can cause serious damage to the gearbox.	When filling gearbox oil, do not mix different types, always use the type specified in the product.
Oil residue	Oil residue may be present in the drained gearbox and may spill out when separating the motor and gearbox during maintenance.	Make sure that you always wear protective equipment, such as protective goggles, protective mask, etc., when working; and place the suction device in a suitable position to catch the oil residue.
Heating oil	Hot oil discharges faster than cold oil	It shall run the robot before changing the gearbox oil
Gearbox Contaminated Oil Treatment	If the contaminated oil in the gearbox is not treated in time, it will reduce the life of the gearbox.	To ensure long service life, drain as much oil as possible from the gearbox each time. The magnetic oil plug will remove all residual metal chips.

2.6.4 Unexpected shaking of the manipulator

Accidental movement of the manipulator may result in serious injury to the operator or damage to the equipment, the danger caused by the use of brake release device or manipulator weigh shall be considered.

Danger

In an emergency, the brake on the robot axis can be released manually by pressing the brake release button. When releasing the brake, the robot axis may move quickly and sometimes in an unpredictable manner. Make sure that no one is next to or below the robot.

2.6.5 Brake test

Normal wear of the brakes on each axis motor occurs during operation. A test can be performed to determine if the brakes can still perform its function. The test method is as follows:

① Run each axis to the position where the total weight of the manipulator and any load is greatest (maximum static load).

② The robot motor switches to the enable-off state.

③ Check and verify that the axis position remains the same.

If the arm does not change position when the motor is switched off, the braking function is available.

2.7 Troubleshooting safety

Special consideration must be given when it is necessary to switch on the power supply for troubleshooting:

- ❖ Safety circuits may be silenced or disconnected.
- ❖ Electrical components must be considered to be energized.
- ❖ The manipulator can move unexpectedly at any time.

There is a risk of high surface temperatures that may cause burns.

2.8 Limitation of liability

Any reference to safety in this manual is not to be regarded as a warranty that" the industrial robot will not cause injury or damage if all safety instructions are followed".

In particular, we cannot be held responsible for injury or damage caused by any of the following:

- Failure to use the robot as required;
- Improper operation or maintenance;
- Operate the robot with defective safety devices, not in the designated position or not working properly in any case;
- Operating instructions are not followed;
- Unauthorized changes to the robot structure;
- Repairs to the robot and its parts are performed by inexperienced or unqualified personnel;
- External objects;
- Force majeure;
- The installation and/or use of non-original spare parts and equipment negatively affects the safety, function, performance and structural properties of the robot.

III. HANDLING, INSTALLATION AND COMMISSIONING

Danger

- **Caution during handling, and do not allow people to stand or stay around the handling route, as dropping the robot and injuring a person may result in serious injury.**
- **Do not stand within the working range of the robot before installation and commissioning.**

3.1 Equipment handling

3.1.1 Robotic handling steps

① Before moving the robot, the robot joints are moved to the transport posture to ensure that the robot remains motionless and fixed in the transport posture during transport;

② Disconnect power to all units;

③ Unplug the power and signal cables connected to the control cabinet;

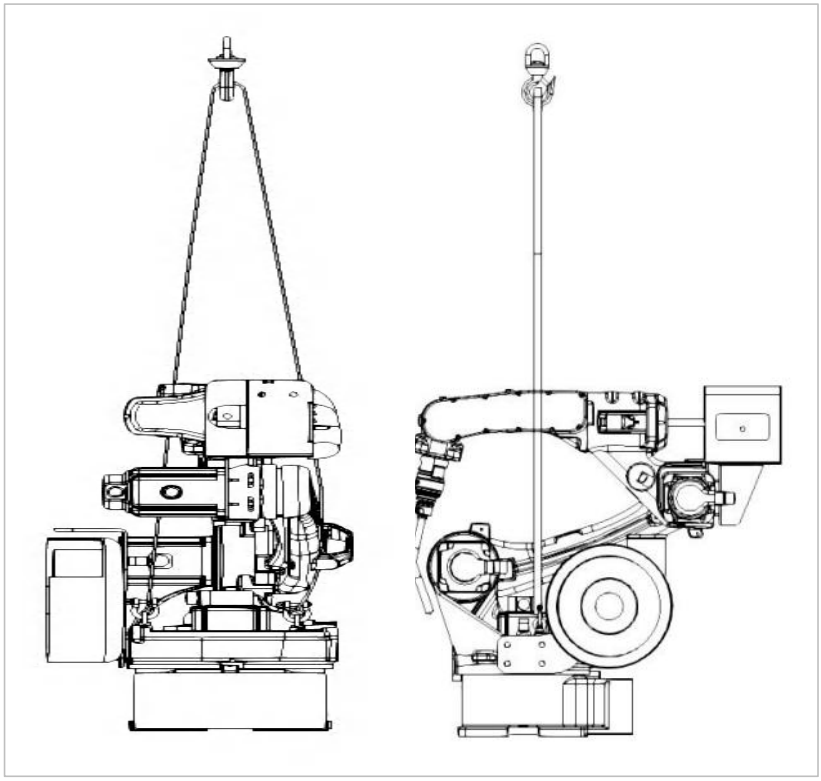
④ Remove the robot from the installation table by unscrewing the base installation fixing screws;

⑤ Secure the robot to the handling apparatus;

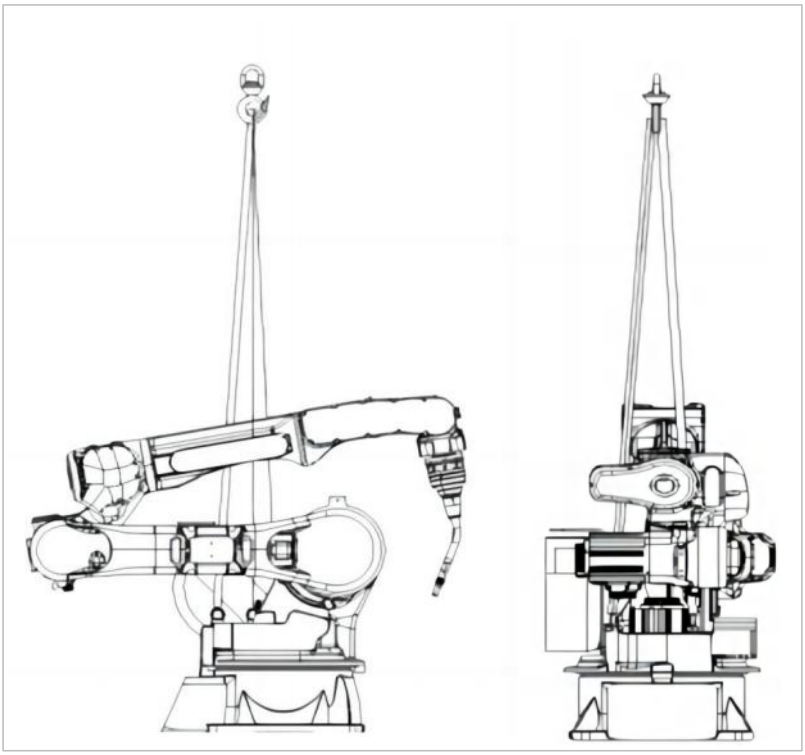
⑥ Lifting of the robot body onto the installation platform by means of a hoist.

Reminder

1. **Do not pull the eyebolt to the side;**
2. **Do not use the jaws of forklift trucks, cranes, etc., to apply impact forces to the transported components;**
3. **Do not hang chains, etc., on transported components.**



- Schematic diagram of BR-10W-1440 Robot Lifting

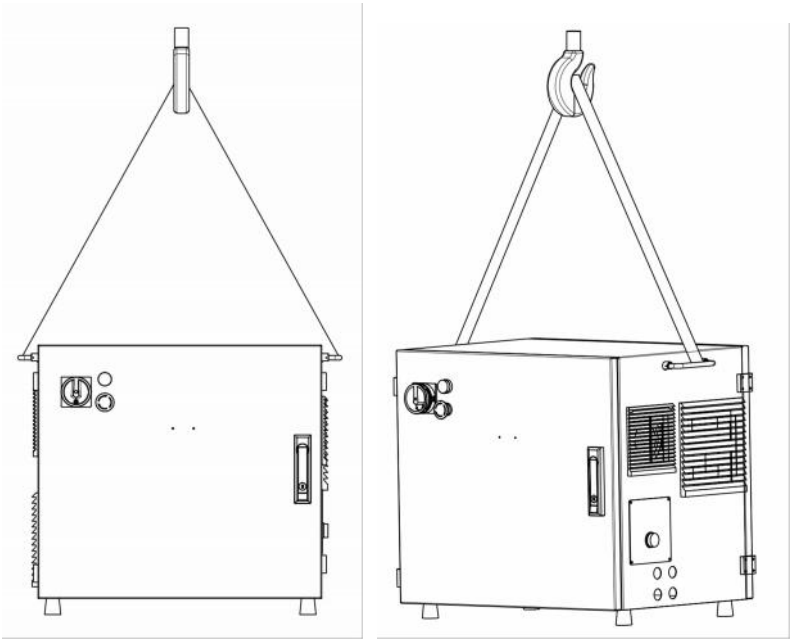


Schematic diagram of BR-12-2010 Robot Lifting

- Angle of each joint for robot transport

Joint	Robot	J1	J2	J3	J4	J5	J6
Angle	BR-10W-1440	0°	74°	-74°	0°	-15°	0°
	BR-12-2010	0°	74°	-74°	0°	12°	0°

3.1.2 Control cabinet handling and placement



Schematic diagram of electric control cabinet lifting

Note

Please refer to Appendix III for the electrical layout of the main board in the electric cabinet.

When handling the robot control cabinet, the following shall be observed to ensure personal safety and equipment stability:

(1) Overhead cranes shall be used.

(2) Check the weight of the control cabinet of the corresponding model by searching section 1.4.2 of the instruction manual and make sure that the lifting ropes have a suitable loading capacity and are fitted with a shackle.

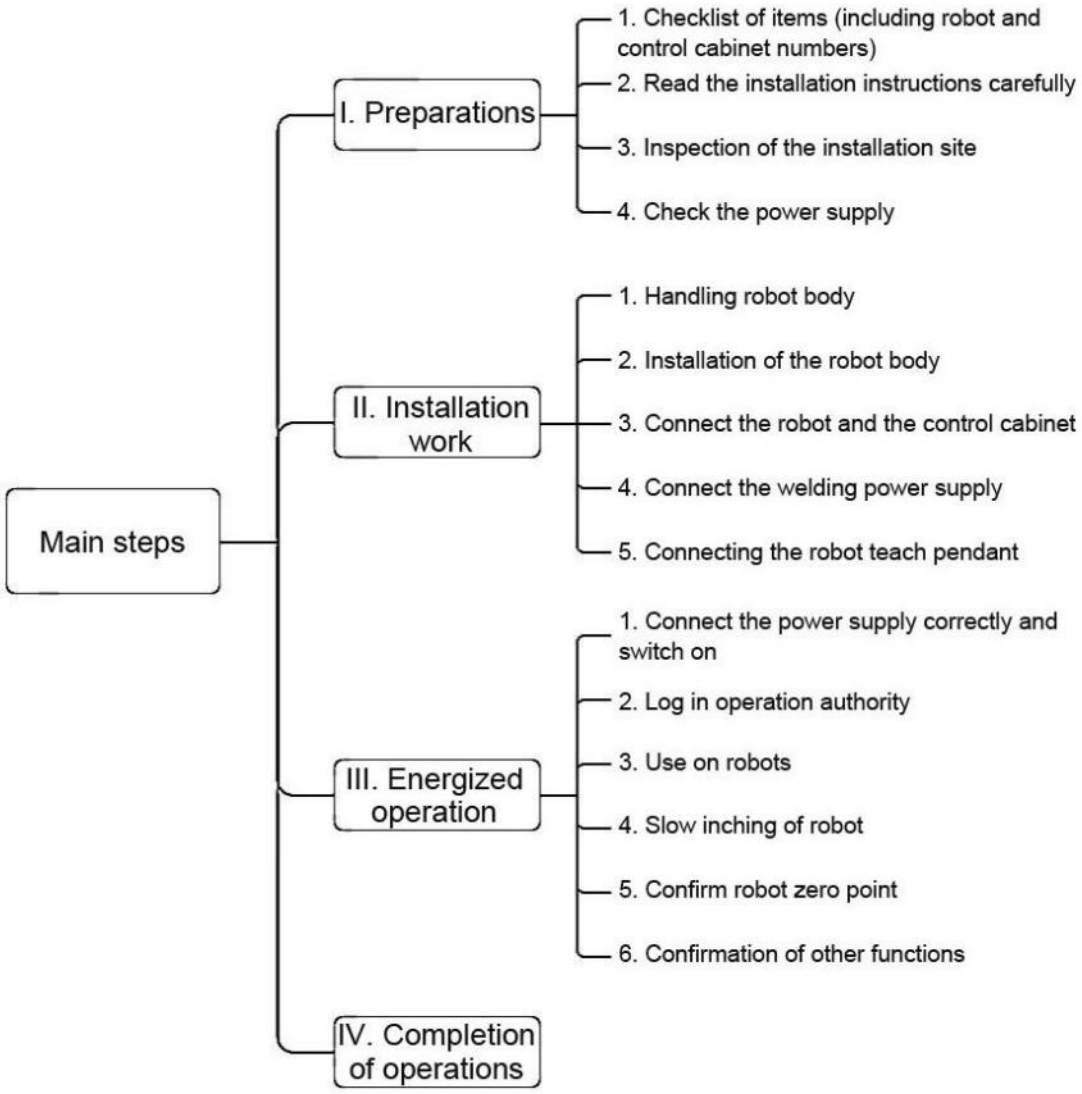
(3) Use ring bolts when handling and make sure they are tightened.

(4) Ensure that there is enough space for robots, control cabinets and other peripheral equipment for operation and maintenance.

(5) Keep the control cabinet in a place where it can be seen clearly and is safe to operate.

(6) Place the control cabinet outside the robot's safety barrier.

3.2 Installation process



3.3 Unpacking and inspection

3.3.1 Unpacking and inspection matters

- Visually inspect the package for damage and remove the package if there is no visible damage.
- Check for any visible shipping collision damage and stop unpacking and contact us if there is visible damage.
- Try to use a lint-free cloth when cleaning.
- Ensure that the installation environment meets the requirements of this product.
- Before moving the robot, please test to check the stability of the robot and whether there is any risk of tilting and tipping over or not.

Once the above requirements are met, the product can be transported to the installation site and the required equipment can be installed (in accordance with the requirements for adaptation of this product).

3.3.2 Checking the product list

After opening the box, please confirm the status, number and type of products according to the packing list.

◆ BR-10W-1440 Robot Packing List

No.	Product name	Unit	Quantity
1	Robot body	Set	1
2	Electronic control cabinet	Set	1
3	Teaching pendant	Unit	1
4	IO plug/12-pole	Pcs	1
5	Cabinet-to-Welding machine plug/20-pole	Pcs	1
6	Wire Feeder, Wire Feeder Box, Welding Torch	Unit	1
7	Wire feed hose	Pcs	1
8	Cabinet key	Pcs	2
9	Certificate of conformity	Copy	1
10	System User's Manual	Copy	1
11	Driver Manual	Copy	1

◆ BR-12-2010 Robot Packing List

No.	Product name	Unit	Quantity
1	Robot body	Set	1
2	Electronic control cabinet	Set	1
3	Teaching pendant	Unit	1
4	IO plug/12-pole	Pcs	1
5	Cabinet-to-Welding machine plug/20-pole	Pcs	1
6	Wire Feeder, Wire Feeder Box, Welding torch, 2-procedure Reservation Box Kit	Unit	1
7	Wire feed hose	Pcs	1
8	Cabinet key	Pcs	2
9	Certificate of conformity	Copy	1
10	System User's Manual	Copy	1
11	Driver Manual	Copy	1

3.4 Robot body installation

Warning

If the robot is connected to a power source, ensure that the robot earth wire is earthed when starting any installation work; there is a risk of electric shock if the earth wire is not already connected.

Before installing the robot, you need to read the following rules and follow them:

- ❖ Ensure that you have read and understood the information in the instructions for safe use;
- ❖ Ensure that the robot is installed by a qualified installer and that the installation protocol must comply with local legal rules;
- ❖ Ensure that when the robot is installed, the handling equipment can support the weight of the robot parts being handled.

3.4.1 Installation conditions

- Installation base requirements

Installation base requirements	
Maximum surface unevenness	0.5mm
Maximum tilt angle for installation	5°

- Chemical and solvent resistance of the robot body

(1) The following liquids may cause deterioration or corrosion of rubber parts (seals, oil seals, O-rings, etc.) on the robot. (Except for products approved by this Company)

a. organic solvent

b. Chlorine and petrol based cutting fluids

c. Amine cleaners

d. Acid, alkali and other corrosive liquids, liquids or aqueous solutions that cause robots to rust

e. Other non-resistant liquids or aqueous solutions such as Nitrile Rubber (NBR-).

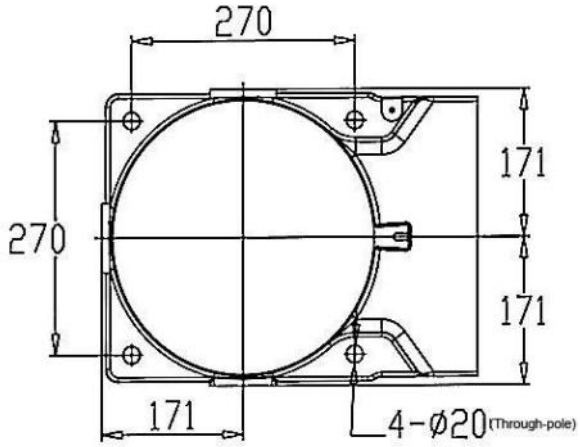
(2) When using the robot in an environment where liquids, such as water, are splashed on the robot, pay sufficient attention to the drainage of the base. Inadequate drainage of the water and frequent submersion of the base will cause the robot to malfunction.

(3) Do not use cutting and cleaning fluids with unknown properties.

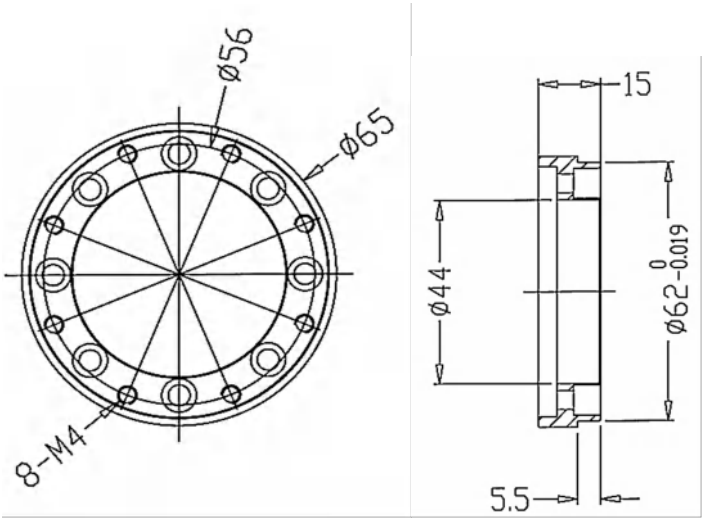
(4) Robots shall not be immersed in water for long periods of time or used in environments where they are susceptible to getting wet. For example, if a motor is exposed, liquid can soak into the motor and cause a malfunction if the motor is wet.

3.5 Robot installation dimensions

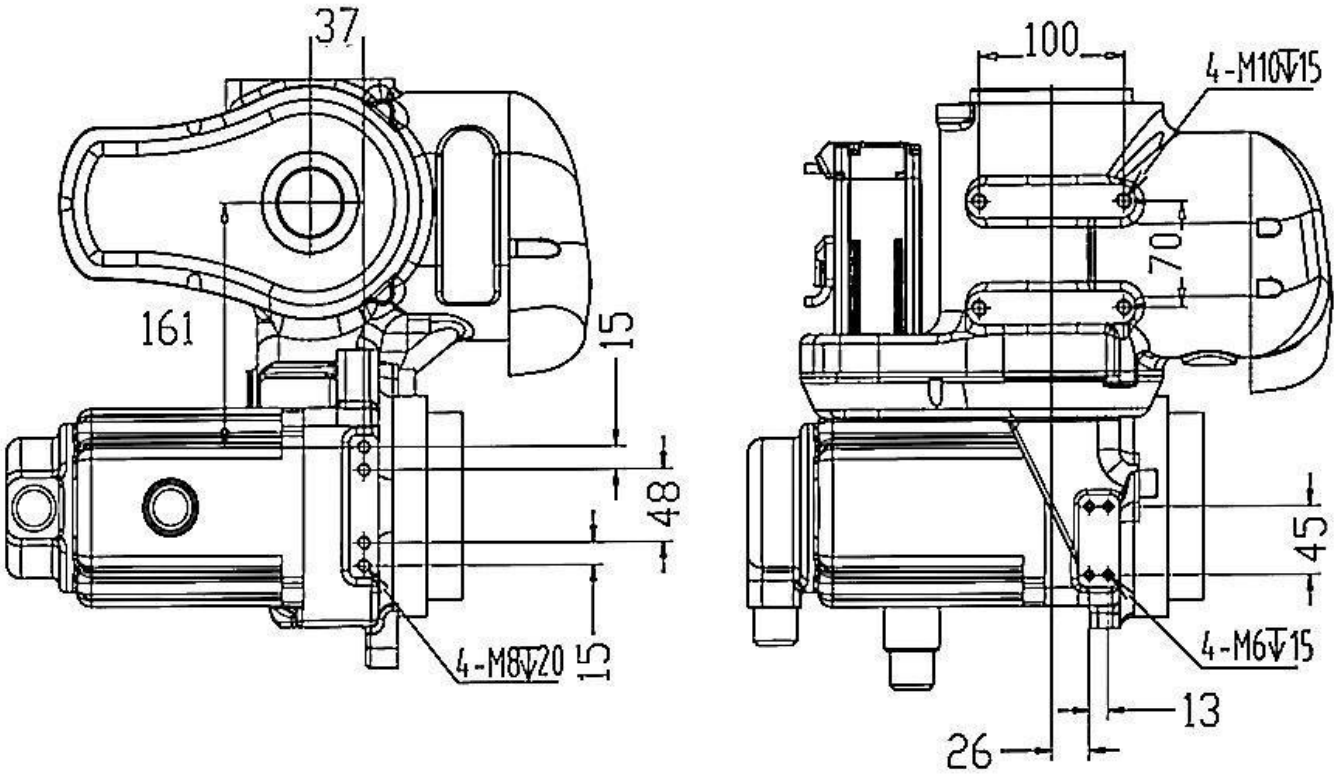
Some of the installation dimensions for robot installation and fixing are shown in the following diagrams.



Base Mounting Size

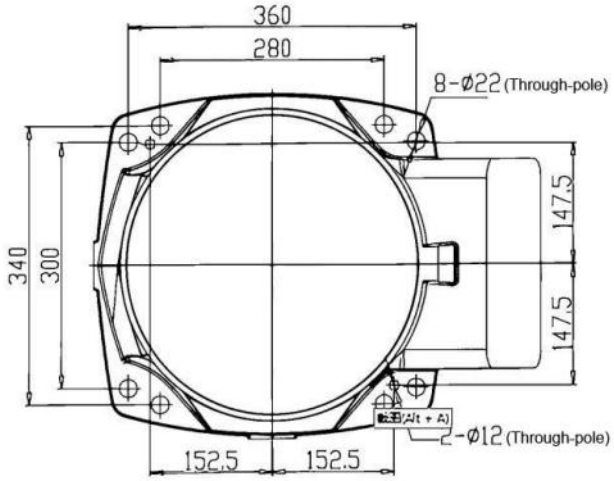


End Mounting Flange Size

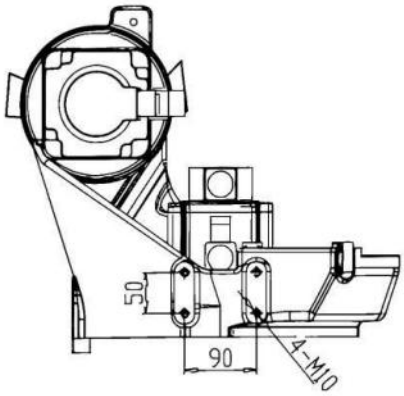


Four-axis mounting size

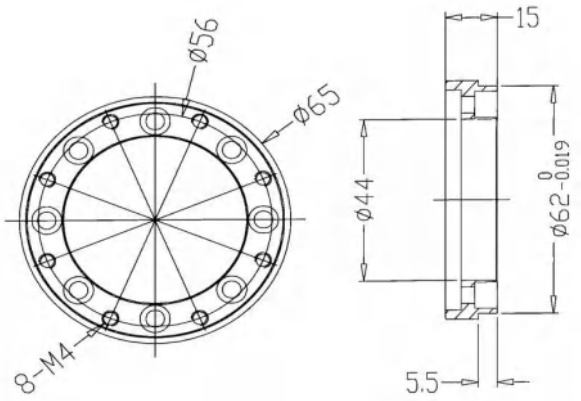
- BR-10W-1440 Robot Mounting Dimension Drawing



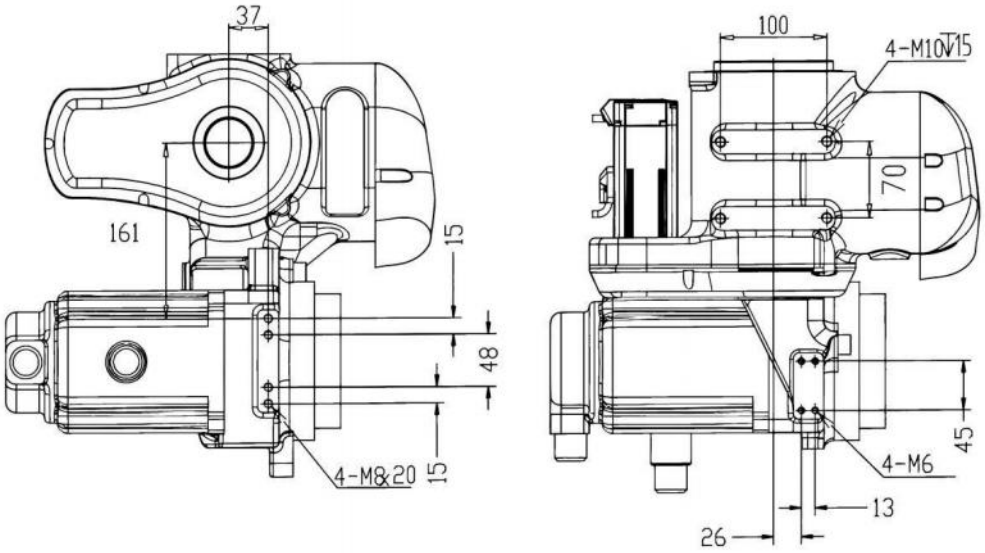
Base Mounting Size



Rotary Base Mounting Size



End Mounting Flange Size



Four-axis mounting size

- BR-12-2010 Robot Mounting Dimension

3.6 Robot fixing

The robot supports three types of installation postures: Floor mounted/bracket mounted/upside down. There are differences in the fixing method on the installation contact surface of different materials, and the specific fixing method shall be selected appropriately according to the conditions of the scene used; the strength of chemical bolts is affected by the strength of concrete, and the construction of chemical bolts shall be used with reference to the design guidelines of each manufacturer and with full consideration of safety.

◆ Components required for robot fixing

Part number	Number of parts	Note
Robot installation base	1	Height can be customized
Movement expansion bolts M20*200mm (not less than grade 4.8)	12	Secure the base to the floor
Fixing screw M16 x 55 (Grade 12.9)	4	Secure the robot to the base

◆ Base fixing

① Fix 1 robot base (height can be customized) to the ground using twelve M20 x 200mm movement expansion bolts (strength class 12.9).

② Install the robot on the robot fixing base (height can be customized) using four M6×55 bolts (strength class 12.9).

Reminder

- **There shall be no insulating material between the robot fixing plate and mounting bracket and the operating machine and concrete.**
- **Brackets need to be securely mounted on the floor**
- **The length of fixing screw M20 shall not be shorter than 40mm, too short length will cause poor fixing and other accidents.**

IV. ZERO CALIBR-ATION

4.1 Overview of calibration

Zero calibration is an operation that correlates the angle of each robot joint with the pulse count value. The purpose of the zero calibration operation is to obtain the pulse count value corresponding to the zero position. "Zero calibration" is done at the factory. It is not necessary to perform the zero calibration operation in daily operation. However, the zero calibration operation is required in the following cases:

1. Motor replacement
2. Pulse encoder replacement
3. Reducer replacement
4. Cable replacement
5. The battery in the machine body for pulse counting backup is exhausted.

Reminder

Data including zero calibration data and pulse encoder data are stored in their respective backup batteries. If the batteries run out, data will be lost. The batteries of the control unit and the robot shall be changed regularly. If the battery voltage drops, the system will notify the user with an alarm.

4.2 Zero calibration of the machinery

When robot zero data is lost due to mechanical disassembly or maintenance, it is necessary to jog all six axes to the zero position at the same time, and calibrate the zero position of each axis by aligning each zero mark hole position or zero mark scale line.

The zero calibration of this device is mainly done by visually inspecting each joint's scale line and the middle scale line of the zero marking patch. Take the J1 axis as an example for the zero calibration of this joint: adjust the robot to align the visually indicated scale lines in the illustration. As shown in the figure, there is a marking line on each of the base and the rotary base, please follow the steps below to calibrate it.

① Turn the J1 axis using the teach box so that the two scale plates are aligned in the middle scale.

② This position is set as the zero position of the J1 axis by means of the teach box.

At this point, the calibration of J1 axis has been completed. Users can refer to the above steps to complete the calibration of other axes, or find the zero position of all the joints and then set the zero position of all the joints at one time through the teach box. Other diagrams in this section will help users in the calibration operation.

- **The following pictures show the actual calibration of the mechanical zero point of each axis (the following picture shows only the BR-10W-1440 model, other models of the same series will not be shown separately).**

J1 axis calibration diagram

J2 axis calibration schematic

J3 axis calibration schematic

J4 axis calibration schematic

J5 axis andJ6 axis calibration diagram

V. ROBOT CONTROL SYSTEM

This chapter covers the basic use of the robot teach pendant. Before operating the robot, be sure to read the robot instruction manual carefully, strictly follow the robot safety operating procedures, and ensure that the operator has been professionally trained before operating the robot.

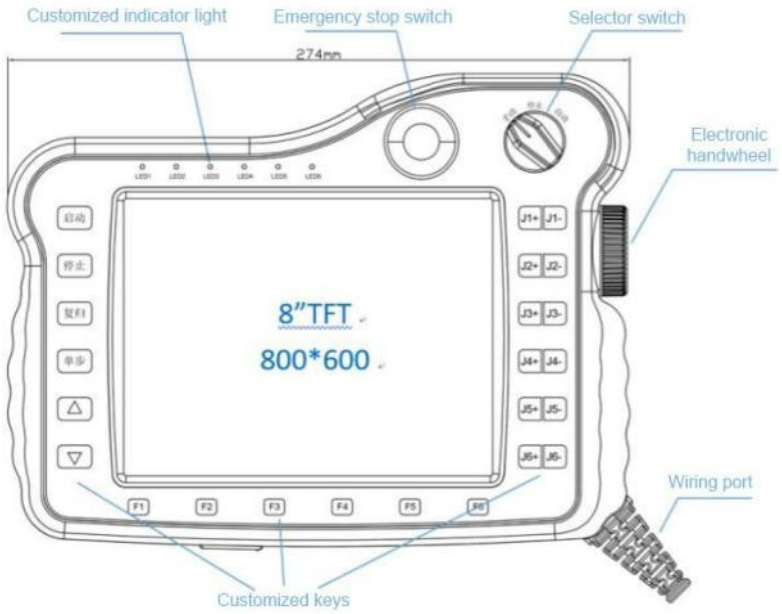
5.1 Robot quick operation getting started guide

This chapter briefly describes the manual operation of the robot axes by means of a teach pendant, in order to enable the user to become familiar with the most basic operation of the robot in a simple and quick manner, to establish an intuitive understanding of the use of the teach pendant and the whole robot system, and to minimize the time required for on-site commissioning and application.

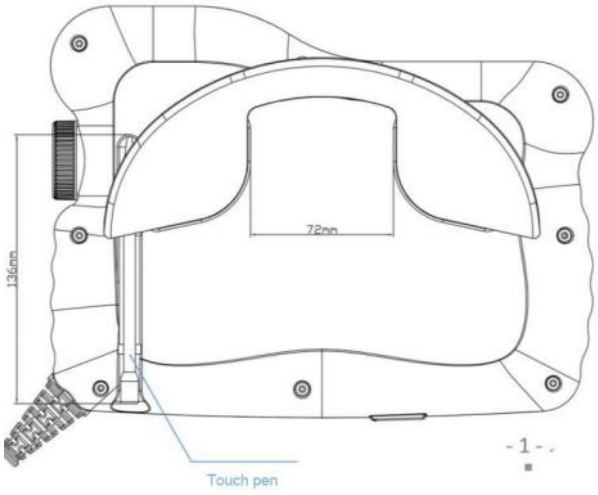
5.1.1 Safe operating procedures

1. **Situations in which the use of robots is not recommended**
   - ❖ Environment with combustion
   - ❖ Environments with explosion risk
   - ❖ Environment with serious electromagnetic interference (EMI)
   - ❖ In water or other liquids
   - ❖ Environment with serious oil, steam and dust
   - ❖ Other hazardous environment
2. **Safety operating procedures**
   - ❖ The operator must not wear gloves while operating the teach pendant and operation panel;
   - ❖ The operator stands outside the workspace where the robot is operating;
   - ❖ When the operator maintains a frontal view of the robot, a safe retreat shall be ensured in the event of an emergency;
   - ❖ Ensure that there are no people within the robot's operating range before the action, pre-consider the trajectory of the avoidance robot, and confirm that the route is not interfered with;
   - ❖ Check the robot for alarms before action, if there are alarms, please clear them before running;
   - ❖ Check whether the robot's mechanical zero position matches the position of each axis of the teach pendant or not before moving;
   - ❖ Confirm the robot speed before powering up the servo and confirm the currently selected coordinate system;
   - ❖ Use a lower speed multiplier when inching to operate the robot to increase the chance of controlling the robot;
   - ❖ Before starting to run the program, it is important to know all the tasks that the robot will perform according to the programmed program;
   - ❖ The location and status of all switches, sensors and control signals that would affect the robot's movement must be known;
   - ❖ The location of the emergency stop button on the robot control cabinet and peripheral control equipment must be known for use in an emergency;
   - ❖ Don't assume that the procedure has been complete when the robot does not move; the robot may be waiting for the command that will allow it to continue moving;
   - ❖ The robot's "Emergency Stop" or "Pause" button must be pressed before you are allowed to enter the robot's operating range.

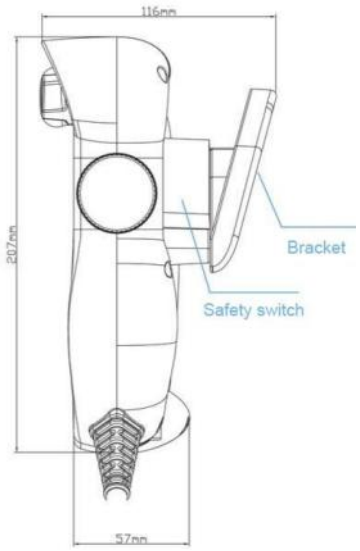
5.1.2 Sketch of the composition of the teach pendant



Front side



Back side



Lateral side

- Illustration Sketch of Robot Teach Pendant

5.1.3 Description of the physical keys of the teach pendant

Left buttons		Right buttons	
	Switching the current servo state		Pausing the program in run mode
	Switching the current robot (only available in multi-robot mode)		Starting the program in run mode
	Switching between the current robot and an external axis (only available if there is an external axis)		Run in negative direction of the corresponding axis during teach
	Zero Return Button		Run in positive direction of the corresponding axis during teach
	Reset Return Button		Rotary switch: left, switches to teaching mode
	Error clearing after servo error reporting (only available in teaching mode)		Rotary switch: center, switches to run mode
	Reserve		Rotary switch: right, switch to remote mode
Lower button		**Three-segment key**	
	Switching between sequential and inverse execution when running a program in single-step in the teaching mode		Press to central position to control robot to be powered on
	Run the program in a single step in teaching mode		Press the button to bottom to power down the robot.
	Reduce teach or running speed		Release the button to control the robot to power down
	Increase teach or running speed	**Rest buttons**	
	Switch tool hand		Emergency stop button
	Switching coordinate systems		Knob with roller

5.1.4 Operate the robot with the teach pendant

The steps to prepare for the operation are as follows:

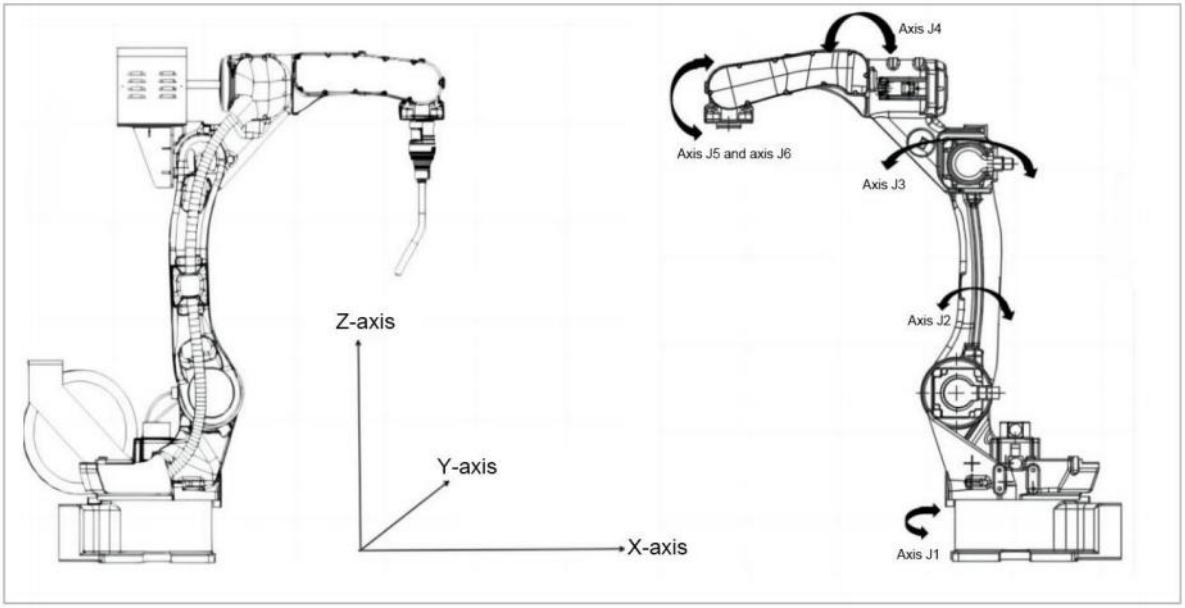
① Connect the cables between the robot teach pendant, the body and the control cabinet correspondingly.

② Confirm that the robot power supply AC220V voltage is correct and that the rotary control cabinet power switch is ON.

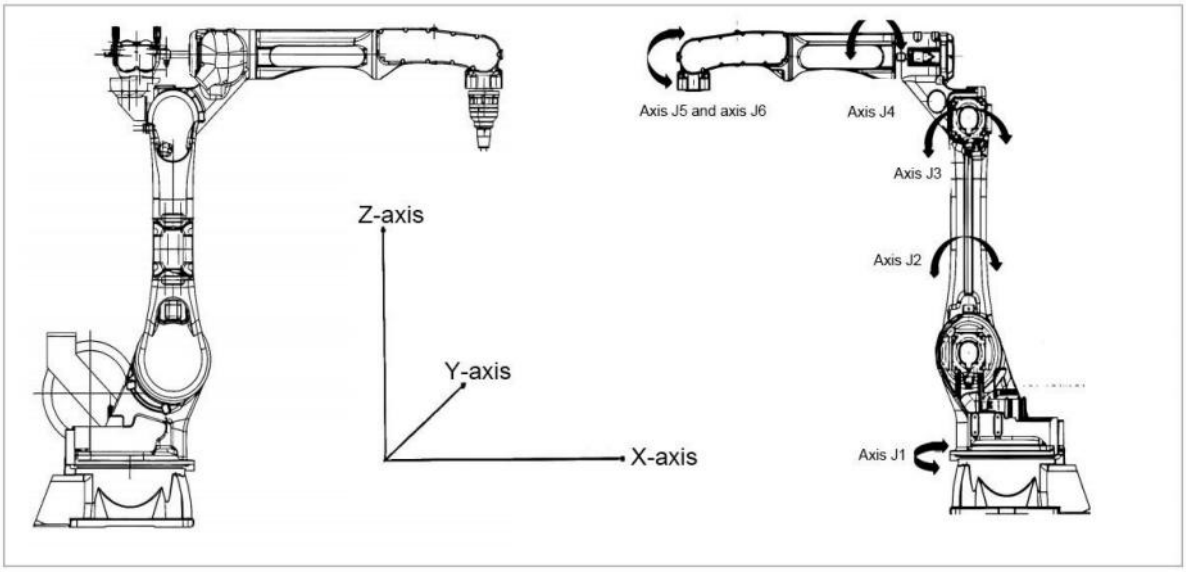
③ The control cabinet power indicator lights up, wait for the teach pendant to be successfully connected to the controller.

- Real photo of robot teach pendant

- Schematic diagram of robot coordinate system operation orientation



- BR-10W-1440 Robot



● BR-12-2010 robot

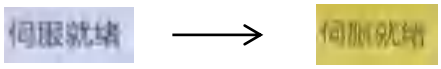
I. Inching operation (teaching mode)

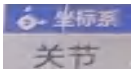
The robot is made to move by means of the inching buttons "-" and "+" on the right side of the teach pendant panel, this operation is only allowed in the teaching mode. After the servo is enabled, the robot's coordinate system type and motion rate need to be set before electric operation.

The operation steps are as follows:

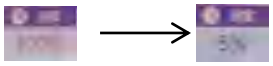
(1) Turn the rotary switch on the teach pendant to the left side 

(2) Login technician authority initial password: 123456

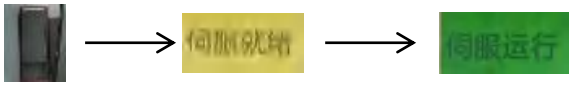
(3) Turn on the servo-ready 

(4) Select the desired coordinate system: joint coordinate, right-angle coordinate, tool coordinate, user coordinate system, here 

select joint coordinate

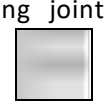
(5) Adjust speed to 5% 

(It is not recommended to set the robot speed too fast in the teaching mode)

(6) Press the 3-speed enable switch 

At the same time, the sound of opening the robot body motor band-type brake will be heard, and the J1~J6 icons will be displayed next to the right button.

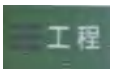
(7) Press the  button on the right side of the corresponding joint 

, the corresponding axis run in the positive direction in teaching mode;Press the  button on the

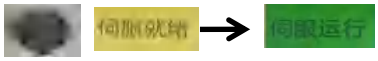
right side of the corresponding joint 

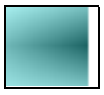
, the corresponding axis run in the negative direction in teaching mode.

II. Auto mode

(1) Log in to technician authority and click on Project Options on the main screen 

(2) Select the desired program and click 

(3) Turn the rotary switch on the teach pendant to the center position 

(4) Press the start button  and the robot starts to run the program automatically. 

(5) At the bottom, you can set the number of runs, choose a single run or a cycle run.

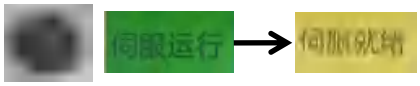
(6) Press the button 

, the robot will pause the program.

III. Robot is powered down

(1) Press the button 

in automatic mode to pause the robot program.

(2) Turn the rotary switch on the teach pendant to the left side 

At the same time, the sound of opening the robot body motor band-type brake is heard.

(3) Manually move the robot to a safe posture

(4) Press any emergency stop button on the control cabinet or teach pendant

(5) Hooking up the teach pendant to the fixing bracket

(6) Rotate the power switch of the control cabinet to OFF state, the power indicator of the control cabinet goes out.

(7) Disconnect the power supply switch or circuit breaker

5.2 Introduction to coordinate systems

A coordinate system is a system of position indicators that serves to determine the position of an industrial robot in space and its posture. Robots use the following four coordinate systems depending on the reference object.

- **Joint coordinate system**

The joint coordinate system is a coordinate system set in the joints of an industrial robot. In the joint coordinate system, the position and posture of the industrial robot are based on the angle of

the origin on the base side of each joint, and the values in the joint coordinate system are the angular values of the joints that rotate in the positive and negative directions.

- **Rectangular coordinate system**

The front end of the robot in the Rectangular coordinate system moves in parallel along the X-axis, Y-axis and Z-axis of the base. A, B and C rotate around the X, Y and Z axes respectively. The Euler angle sequence used in this system is X'Y'Z' and fixed angle sequence ZYX.

- **Tool Coordinate System**

The effective direction of the robot wrist tool is taken as the Z-axis in the tool coordinate system, and the origin of the coordinate system is defined at the tip point of the tool, and the tip point of the body moves in parallel according to the coordinates. TA, TB, and TC rotate around the TX, TY, and TZ axes, respectively. The origin and direction of the tool coordinate system are constantly changing with the end position and angle, and this coordinate system is actually derived from the rectangular coordinate system by rotation and displacement transformation.

- **User coordinate system**

The user coordinate system, i.e. the user-defined coordinate system, is a user-defined rectangular coordinate system for each workspace, which is actually derived from the base coordinate system by axial deflection angle transformation, and the tip point of the body moves in parallel according to the coordinates.

5.3 Controller settings-system settings

This chapter introduces the system settings of the controller, including but not limited to the setting methods of version upgrade and file upload, time settings, IP settings, to import/export procedures, the one-key backup system, modification of the teach pendant configuration, to import/export controller configuration, to export logs, and automatic backup and restoring.

- Tech pendant system setting interface

5.3.1 Making a FAT32-formatted USB memory stick

Upgrading programs, importing/exporting parameters and programs in this system requires a FAT32 format USB memory stick. The steps to make a FAT32 format USB memory stick are as follows:

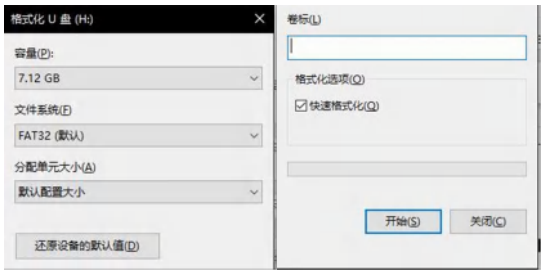
① Prepare a computer, a USB stick, please note that the production process will clear contents of the USB stick and this will not be reverse, please backup the contents of the USB stick;

② Plug the flash drive into the USB port of your computer and open the "My Computer" or "This Computer" interface of Win10 system;

③ At this time, there shall be a driver letter of USB memory stick, if such drive letter does not appear, please re-plug the USB memory stick, if it still does not appear, please try to replace with the other USB memory stick;

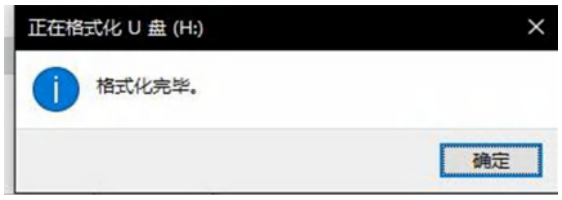
④ Right-click on the USB drive letter and click "Format" in the menu that appears;

⑤ In the pop-up screen, set the settings as shown in the figure below



⑥ Click the Start button and click the [OK] button in the pop-up confirmation box;

⑦ When the "Formatting Completed" window pops up, the FAT32 format USB stick is formatted.



5.3.2 Version upgrade and upload Files

You can view the software version of the teach pendant and controller in the interface of Setting-System Setting-Version Upgrade View, and you can perform the upgrade operation of the teach pendant software.

❖ **Software upgrades for the teach pendant**

① Put the upgrade file (Zip format, no need to decompress, and no special characters such as brackets in the file name) into the root directory of the USB stick, (the USB stick must be in FAT32 format) and insert the USB stick into the USB port of the teach pendant;

② Click the [Detect Upgrade] option under [Settings]-[System Settings]-[Versions and Upgrades] on the robot teach pendant;

③ Select the automatically detected upgrade file in the list;

④ Click the [OK] option;

⑤ The teach pendant will restart automatically after the upgrade is successful, and the upgrade will be successful after the restart.

❖ **Uploading files**

To upload a file such as an ENI file to the controller, follow the steps below:

① Prepare a computer and a USB stick;

② Create a new folder on the USB memory stick called upgrade.

③ The files to be uploaded are placed in the upgrades folder;

④ Insert the USB stick into the USB port of the teach pendant;

⑤ Click [Settings]-[System Settings]-[Version Upgrade] screen on the robot teach pendant;

⑥ Click the Upload File button;

⑦ Select the file to upload from the detected files that pop up, and click the [OK] option.

5.3.3 System time settings

You can set the system date and time in the system setting screen.

The steps are as follows:

① Open the System Settings screen;

② Click the [Modify] option;

③ Just select the year, month, day, hour and minute in the date setting and time setting.

④ Click the [Save] option.

5.3.4 IP Settings

In [Setting]-[System Setting]-[IP Setting] interface, you can modify the controller IP, the teach pendant and the IP connected to the teach pendant.

Reminder

- Please do not change the IP address unless it is necessary to do so, in order to avoid malfunction.
- If you change the controller IP to be not the default value (192.168.1.13), please record the IP of this controller by yourself
- The IP connection is used for switching between multiple controllers connected to a single teach pendant at the same time.

❖ **Modify the current connection IP**

① Click [System Settings]-[IP Settings];
② Click the [Modify] option for "Connection IP";
③ Modify it to the desired IP address for instant effect.

❖ **Modify the current controller IP**

① Click [System Settings]-[IP Settings];
② Click the [Modify] option that corresponds to "Modify controller IP";
③ Modify it to the desired IP address for instant effect.

❖ **Modify the IP of the teach pendant itself**

① Click [System Settings]-[IP Settings];
② Click the [Modify] option for "teach pendant IP";
③ Modify it to the desired IP address for instant effect.

5.3.5 Import/export program settings

❖ **Importing Controller Configurations**

Click the [Import Configuration Parameters] button at the bottom of the system setting interface to import the local configuration parameters into the teach pendant.

① Insert the USB stick into the USB port of the teach pendant.
② Click the [Settings]-[Import Configuration Parameters] button
③ The system pops up all the relevant files in the USB stick (other format files are not displayed), select the program that needs to be imported, click [OK] button
④ Waiting for import.

❖ **Exporting Controller Configurations**

Click the [Export Configuration Parameters] button at the bottom of the system setting interface to export the controller configuration parameters to a USB memory stick.
The controller configuration parameters are saved for the robot, IO, external axes, process parameters and other configuration parameters.

① Insert the USB stick into the USB port of the teach pendant.
② Click the [Settings]-[Export Configuration Parameters] button.
③ Click the [OK] button.
④ Waiting for export.

5.3.6 Log export

Logs can be imported to a USB stick by clicking the [Export Logs] button within the System Settings screen / [Export] button on the Logs screen. Controller logs are most commonly used when we are looking for the cause of robot errors.

① Insert a FAT32-formatted USB memory stick into the USB port of the teach pendant;
② Enter the "Settings-System Settings" screen/"Log" screen of the teach pendant;
③ You can choose to export 5/30/100/500 logs by clicking the [Export Controller Logs] button in the System Settings screen/[Export] button in the Log screen;
④ The export is completed and the controller's logs will be saved on a USB stick.

5.3.7 Language switching

The commands and interface of this system can be switched between Chinese and English languages respectively. To switch the language, follow the steps below:

① Go to Settings-System Settings-Modify Teach pendant Configuration;
② Click the Modify button;
③ Select the desired command language or interface language;
④ Click Save. After saving, the command language takes effect immediately, and the interface language requires a restart to take effect.

5.3.8 Clear the program

The Clear Programs function removes all programs from the system at once, and is used in situations where there are very many programs and they are not useful.

The removal steps are as follows:

① Go to Settings-System Settings-Other Settings screen;
② Click the Clear program button;
③ Click the OK button in the pop-up dialogue box.

5.3.9 Restore factory settings

Restoring the factory settings will clear all robot parameters, programs, etc., so please operate with caution! Be sure to back up all parameters and program files before performing this operation!

The steps are as follows:

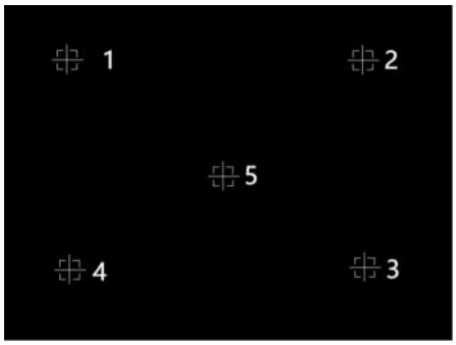
① Go to Settings-System Settings-Other Settings screen;
② Click the [Restore Factory Settings] button;
③ Click the [OK] button in the pop-up dialogue box.

5.3.10 Screen calibration

The steps are as follows:

① In the boot state, simultaneously press the left [O] + middle [Coordinate] + right [STOP] physical keys, the teach pendant pops up prompt "calibration file has been deleted, restart the teach pendant to take effect", manually restart the teach pendant, and then enter the calibration interface

② Calibration can be completed by clicking the center of the cross of 1-5 points respectively with the touch pen as per the example.



5.3.11 Controller automatic backup and restoring function

❖ **automatic backup**

① Backup contents: program, parameters, software (nrc.out);

② Number of backups: up to 10, with the newest replacing the oldest;

③ Backup naming: by premise, version, and time;

Example: Parameters were modified at 13:10 on 10 September 2020, backup name "Parameter-20.04-3.3.7-202009101310", prerequisites for triggering the backup: start-up, modify parameters, modify the program, upgrade;

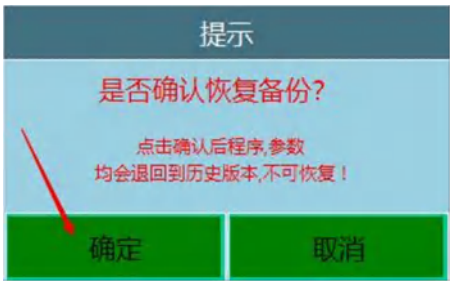
④ Backup frequency: one backup after confirming the version and parameters are normal at power on; one backup if the parameters are not modified again within 5 minutes after modifying the parameters; one backup if the program is not modified again within 5 minutes after modifying the program (inserting commands, modifying commands); one backup before upgrading.

❖ **Restore Backup**

① Select the backup you want to restore and the cursor will be displayed when it is selected;

② Click the "Restore Backup" button;

③ A pop-up box prompts, click and confirm;



④ Do not disconnect the power during the restoration process.

5.4 Connection between robot and welding machine (example of an Aotai-brand Welding machine)

5.4.1 Ethercat communication connection

❖ **Environment building**

① Nabote Robot Control System
② Robot body, control cabinet and its external equipment
③ Altai digital Welding machine
④ Altai Ethercat Communication Controller

❖ **Connection method**

① Connection of the Nabote control system, the servo drive and the Altai digital welding machine via a network cable according to the Ethercat protocol.

② Teach pendant--Setting--Robot Parameters--Slave Configuration, check whether the order of slave reading is correct or not, if the corresponding slave is not recognized, please check whether the network cable and the corresponding servo are normal or not. If the slave is recognized correctly, it will be prompted that the corresponding ENI communication file is missing, so upload the corresponding ENI communication file and restart the controller. Uploading steps (Prepare a USB stick in FAT32 format, create a new folder named upgrade in the root directory of the USB stick, put the ENI communication file into it, and then plug it into the USB connector at the bottom of the teach pendant, click to upload file in Teach pendant-Settings-System Settings-Version Upgrade, and then restart the controller after successful uploading).

③ In the setting--Welding process--Welding machine setting--Welding machine control mode--Digital control, select Ethercat for the communication mode, and select Altai for the power supply manufacturer of the welding machine, after saving the settings, the green light of the communication status of the welding machine will turn on, and this indicates successful communication.

5.4.2 Can communication connections

❖ **Environment building**

① Nabote Robot Control Systems
② Robot body, control cabinet and its external equipment
③ Aotai digital volume Welding machine
④ Aotai Communication Controller

❖ **Connection method**

① Connect the expansion interface A (CN1) of the Nabote IO communication module to the corresponding interface of the Can communication controller of the AOTAI welding machine with a twisted pair cable.

② The Nabote IO module already has 24V and does not require a welding machine to power it; a 120 ohm resistor needs to be connected to the positive end of Can connector and the negative end of Can connector.

③ In the setting-welding process-welding machine setting-welding machine control mode-digital control, selection Can for communication mode, select Aotai for welding machine power supply manufacturer, save the settings, the welding machine communication status green light is on and this means communication is successful.

5.4.3 Analogue connections

① Nabote Robot Control Systems
② Robot body, control cabinet and its external equipment
③ Aotai Analogue Welding machine

❖ **Connection method**

① In Setting-Welding Process-Welding IO Setting, set the DOUT port corresponding to Arc Start, Wire Feed, Wire Retract and Air Feed for Welding Output (corresponding to the four relay outputs on the IO module), set the DIN port (any input port) for Success Arc Starting Signal

for Welding Input, and set the AOUT port corresponding to the given current and voltage for Analogue Output. (IO communication module expansion interface A (CN1).

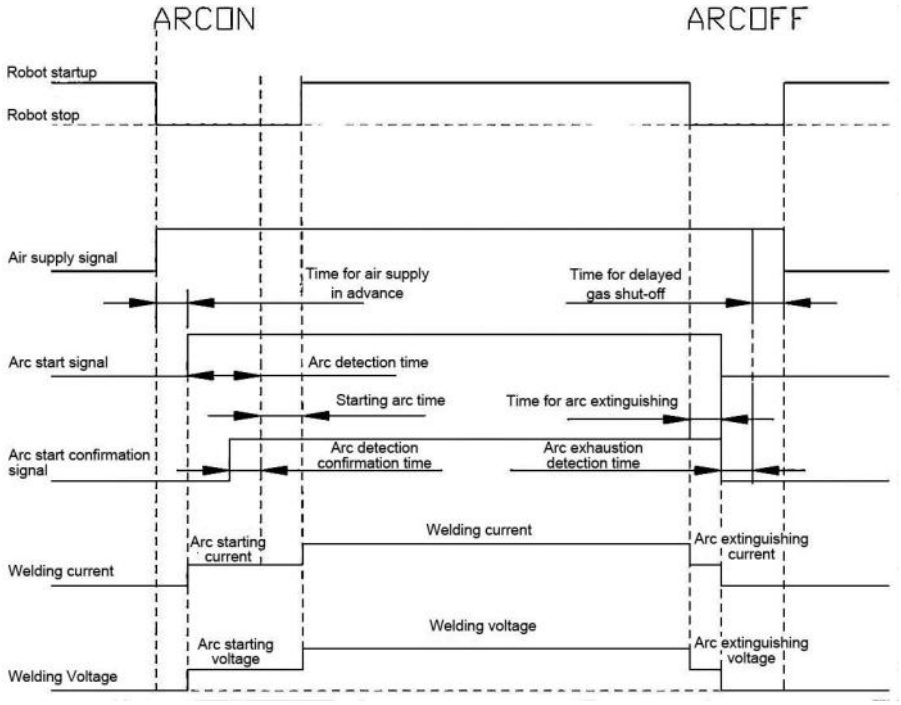
② In Settings-Welding Process-welding machine Settings-welding machine Control Method-Analogue Control.

③ In Setting--Welding Process--Current and Voltage Matching, match the current and voltage, and after the configuration is completed, test whether the current and voltage given by the controller and the display of the welding machine are the same or not.

5.5 Introduction to welding processes

This section mainly introduces the welding process setting instructions on the control system and welding cases, including but not limited to description of welding equipment settings, welding parameter settings, current and voltage matching, manual operation, pendulum welding parameters, welding IO settings, welding machine selection settings.

5.5.1 Welding timing diagram



5.5.2 Welding equipment setting

① To set up the welding equipment, go to "Process / Welding Process / Welding Equipment Settings" and make modification.

② Enter the "Process/Welding Settings/Welding Equipment Settings" screen.

③ Click on "Modify", and in the selection box under Function Selection, select the function you want to modify.

④ Note: If the input boxes below the function settings are whiten, you can enter values after the respective function.

Welding equipment setting interface

Description of welding equipment setting	
Arc detection time:	Welding is started and an arc start signal is sent, it needs to detect whether the arc is signaled or not;
Arc detection confirmation time:	Prevent that there is dust and other obstacles that occur to disrupt the signal, so the delay certain time to ensure that the arc has signal transmission; in this period of time, if it can continuously detect the success of the arc signal, it will start welding;
Arc depletion detection time:	At the end of a weld, the time between giving an arc extinguishing signal and actually extinguishing the arc;
Early air supply time:	For welding, in order to prevent the welding wire by air oxidation, it need to supply protective gas, it can not supply such gas until the welding, so it need to supply the gas in advance;
Delayed gas shut-off time:	After welding is completed, arc extinguishing signal is given, the wire has not yet cooled, if at this time, it stops supplying protective gas, oxidation will still occur, so the gas needs to be delayed to be shut down, but also it has the function of cooling the welding torch.
Retracting function after welding completion:	At the end of the welding, the torch receives a signal and the wire is retracted to prevent collision with the workpiece when going to the next welding point.
Retracting function after in case of arc break:	The welding current exceeds the rated load rate of the welding machine, the welding machine is briefly protected, an arc break occurs, and the wire is retracted to prevent adhesion to the workpiece;
Zeroing of the arc closing analogue:	The analogue voltage and current signals are zeroed at the end of welding;
Restart action:	After turning on, the weld process breaks at the point, and it can retract a distance when running again.
Restart distance:	The retracted distance for the restart action.
Restart speed:	The retraction speed for the restart action.
Anti-collision enable:	Switch on the enable to detect anti-collision signal.
Anti-collision IO:	Anti-collision input signal.
Anti-collision trigger level:	1/0 corresponds to high level/low level.
Anti-collision quick stop time:	The time it takes for anti-collision to be triggered until the robot stops.
Anti-collision status output port:	Outputs a signal from the numerical output port specified when anti-collision is triggered.
Anti-collision status output level:	1/0 corresponds to high level/low level.
Shield anti-collisions:	The shielding anti-collision enable, if it is switched on, the anti-collision signal is no longer detected during the shielding time; the anti-collision signal is released, and the shielding anti-collision enable is switched off immediately.
Shield time:	Time parameter for shielding anti-collision.

5.5.3 Welding parameter settings

① To set up the welding device, go to "Process / Welding Process / Welding Parameter Settings" and make modification.

② Enter the "Process/Weld Setting/Weld Parameter Setting" screen.

③ Selection of the appropriate welding parameter label

④ Click on "Modify", and in the selection box under Function Selection, select the function you want to modify.

Note: If the input boxes below the function settings are whiten, you can enter values after the respective function.

Welding parameter setting interface

Description of welding parameter setting	
Welding parameter labeling:	You can set 1-10 different parameters and just call them as needed;
Arc starting voltage, current time:	The voltage, current, and time applied when heating the wire;
Welding voltage, current:	Voltage and current applied during welding;
Anti-sticking wire voltage, current and time:	At the end of welding, after the controller gives the welding machine an arc extinguishing signal, to prevent the wire from cooling and sticking, it gives a strong pulse to melt the wire;
Arc closing voltage:	The maximum power frequency voltage allowed to be applied to the lightning arrester under the condition of ensuring that the lightning arrester can extinguish the arc when the power frequency continuous current first exceeds the zero value. The arc extinguishing voltage shall be greater than the highest power frequency voltage that may occur on the working busbar of the lightning arrester, otherwise the lightning arrester may explode due to its inability to extinguish the arc.
Arc closing current:	The current given by an arc extinguisher when arc extinguishing is required in welding;
Closing arc time:	Depending on the arc extinguishing medium, extinguishing time is different, generally in millisecond level.
Flight Arc Start:	During the movement from other points to the weld start point, the air is fed in , so that the robot can start the arc when it reaches the weld start point.

5.5.4 Welding voltage and current matching (analogue)

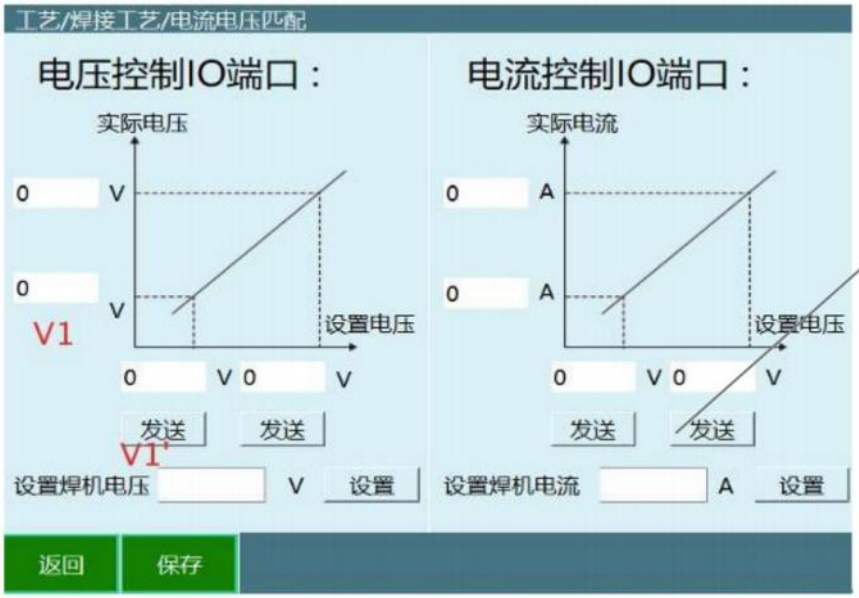
① Go to "Process/Welding Process/Welding Voltage and Current Matching". At this point, the current and voltage input boxes are grey and no values can be entered. After clicking on Modify, the Modify button changes to Save, the current and voltage input boxes become white, and values can be entered after the respective parameters.

② The voltage and current sent to the welding machine by the controller is proportional to the actual voltage and current of the welding machine, connect the controller to the welding machine, open the interface of the teach pendant as shown in the figure, set a voltage parameter at V1, click on Send, you can see that the welding machine will correspond to the

emergence of a voltage, fill in the voltage into the V1' place, so that you can set the voltage on the controller. Similarly, you can operate to set the current.

③ Setting the current: Enter a value for the current in the input box, click Set, and the welding machine will display the corresponding value. For example: enter 200 in the input box, click Set, the welding machine will display 200A;

④ Set Voltage: Enter a voltage value in the input box, click Set, and the welding machine will display the corresponding value. For example: enter 30 in the input box, click set, the welding machine will display 30V.



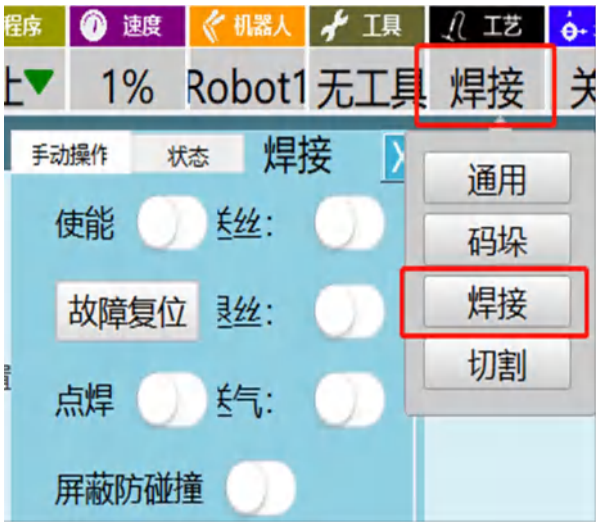
Current-voltage matching interface

5.5.5 Manual operation

① To set up manual operation, go to "Process/Welding Process/Manual Operation" and make modification.

② In order to make welding easier to use, we have added "Process/Welding" to the status bar. Clicking on "Welding" will bring up a manual welding window, which is same as some of functional effects of manual operations in the welding process.

Manual operation



Status bar-Welding window

Description of manual operation	
Welding Enable	When switched on, the robot performs the welding function, otherwise it simply walks the trajectory.
Manual Arc Start Mode	When opened, to allow manual arc starting.
Manual spot welding:	Click and modify to set Spot welding Current, Spot welding Voltage, Maximum Time, Save to take effect. Press and hold the manual spot welding button (press and hold to take effect, release not to take effect), the robot performs welding, release the button, the robot stops welding;
Maximum time:	Maximum time under the manual spot welding button is allowed to be held down.
Spot welding current:	Spot welding output current
Spot welding voltage:	Spot Welding Output Voltage
Wire feed, wire retraction	Press to activate, release to deactivate
Fault reset:	Valid when using a digital Welding machine, and can be used to reset welding machine faults.

5.5.6 Pendulum welding parameters

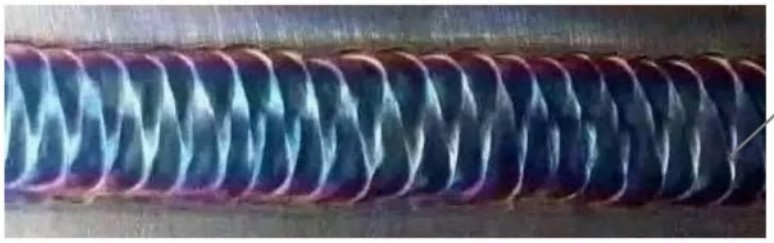
① To set the pendulum welding parameters, go to "Process/Welding Process/Pendulum Welding Parameters" and make modification.

② Pendulum welding: It is a welding operation in which the heat source of the weld seam is swinging on the weldment in a regular transverse direction during welding. Pendulum welding has two types of oscillation, sinusoidal and Z-shaped; oscillation frequency, oscillation amplitude, starting direction, horizontal declination, vertical declination and other parameters can be adjusted, according to the actual needs of industrial site settings.

③ Up to 9 of these pendulum welding files can be saved;

④ Click the Modify button at the bottom, select the pendulum welding file that needs to be modified, click the Modify button at the bottom, and all the input boxes will become available for input; click the Save button when the input is complete.

Pendulum Welding Parameter Interface



Pendulum welding effect diagram

5.5.7 Welding IO settings

① Welding IO settings can be modified in "Process/Welding Process/Welding IO Settings".

② The welding robot is factory set.

Welding IO Setting Interface

5.5.8 Weld selection settings

① The welding machine selection settings can be modified in "Process/Welding Process/Welding machine Selection Settings".

② There are two ways of controlling the welding machine: analogue control and digital control, which is changed according to actual needs.

Welder Selection Setting Interface

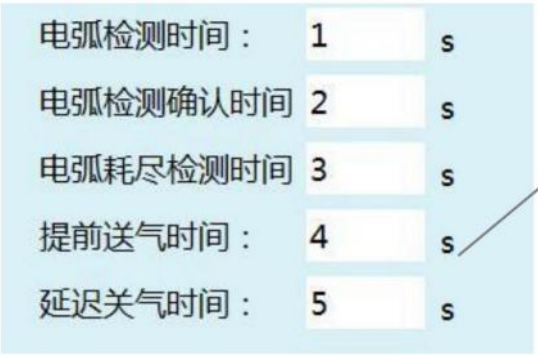
5.6 Welding procedure example

5.6.1 Welding process settings before programming

① Enter the "Process/Welding Settings/Welding Device Settings" screen and make the settings.

Welding device setting interface

② Enter the "Process/Welding Settings/Welding Parameter Settings" page and make settings.



Welding parameter setting interface

③ Enter the "Process/Welding Settings/Welding IO Settings" page and make the settings.

功能	DI端口
起弧成功信号	1-1
寻位成功信号	无
预留参数	无
预留参数	无
预留参数	无
预留参数	无

功能	DO端口
起弧信号	1-1
点动送丝信号	1-2
反向送丝信号	1-3
气体检测信号	1-4
寻位模式	无
预留参数	无

➢ Note: All parameter value settings in this chapter are for example only

5.6.2 Program cases

```
0  NOP
1  MOVL P001 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
2  ARCON #1
3  MOVL P002 V = 10 mm/s  PL = 0 ACC = 1 DEC = 1
4  ARCOFF
5  END
```

Explanation of the above procedure in conjunction with the welding process setting prior to programming under 5.6.1

First line: the robot moves to the starting point P001 of the weld;

The second line: ARCON # 1 (including 4s for time of gas supply in advance and 1s for time of arc detection) to start the arc, the implementation of the welding parameters labels for 10~4s, 4s for advance gas supply time (0s, the start of the gas supply, gas is detected, the gas detection signal output is high, that is, the DO port 1-4 light is lit; after 4s, to provide the arc start signal, that is, at 4s, the DO port 1-1 light is lit), 4~5s, 1s for arc detection time (if the arc success signal is detected within 1s as a high level, i.e., DI port 1-1 lights up, the program will continue to run, if it is not detected, it will report error of "waiting for welding arc success signal is timeout");
The third line: the robot moves to the end point of welding P002, in this process, the robot starts welding function, arc starting voltage 100V, arc starting current 10A, arc starting time 10s, welding voltage 200V, welding current 20A, arc extinguishing voltage 300V, arc extinguishing current 30A, arc extinguishing time 30s (All values correspond to the actual voltage and actual current of the "current-voltage matching", not the set voltage and set current);
The fourth line: ARCOFF (including 3s for arc exhaustion detection time and 5s for delayed gas shutdown time) 0~3s, 3s for arc exhaustion detection time (at 0s, the arc signal output low level, that is, the DO port 1-1 lights out; if the arc success signal is detected within 3s, the level is low, that is, the DI port 1-1 lights out, the program continues to run, if not detected, then it will report error "Waiting for welding arc extinguishing success signal timeout")
3~8s,5s for delayed gas shut-off time (at 8s, gas feeding is stopped and gas detection signal output is low level, i.e. DO port 1-4 light is off);
Line 5: End of program.

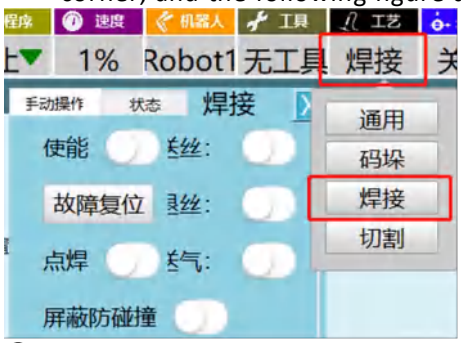
5.6.3 Operational steps

I. Programming:

① Click "Project", click "New", enter the name of the program and click "OK";
② Move the robot to the starting point of the weld, click "Insert", select "Motion Control Class", select "straight line", click "OK". "Modify the speed value and click "OK";
③ Click "Insert", select "Welding Control Class", select "Welding Start", click "OK". Enter the file number (the file number corresponds to the value in the welding parameter setting interface), click "OK";
④ Move the robot to the end of the weld, click "Insert", select "Motion Control Class", select "straight line", click "OK". "Modify the speed value and click "OK";
⑤ Click "Insert", select "Weld Control Class", select "End of Welding", and click "OK".

II. Trajectory confirmation:

① After programming, turn the key, switch the teaching box from teaching mode to running mode, click "Start", and make pilot run at a slow speed to confirm whether the trajectory of the robot is correct or not and meets the needs or not;
② Welding: After confirming that the trajectory is correct, the robot can perform the welding function only if the welding enable is switched on;
③ The teach box switches to teaching mode and clicks on Process/Welding in the upper right corner, and the following figure appears;



④ Select "Enable" and click Open.

➢ Note: When the program is in the running mode, after pressing "Start" and then "Stop", the welding function will not be performed after the program is restarted.

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VI. FAILURE AND REPAIR

6.1 General operations

6.1.1 Leakage test

❖ Test time: After reinstalling any motor and gearbox, the seal integrity of all enclosed gearboxes must be tested. This is done through leak test. Before conducting a leak test, the oil in the gearbox must be drained first.

❖ Leak test operations:

① Complete the relevant motor or gear modification procedure, but do not refill the gearbox with oil prior to the leak test procedure.

② Remove the upper oil plug from the gear and replace it with a leak tester, a regulator may be required, the regulator is included in the leak test.

③ It is to use compressed air and raise the pressure with a ball shank until the correct value is shown in the manometer, please proceed with caution. Note that the pressure shall not be higher than (20~25kpa) under any circumstances.

④ Disconnect the compressed air source.

⑤ Wait about 8 to 10 minutes to make sure no pressure drop has occurred.

⑥ If a pressure drop occurs, locate the leak point as described in steps. If no pressure drop occurs, remove the leak tester and reinstall the ink and the test is complete.

⑦ Spray any suspected leak area with a leak detection spray; bubbles indicate the presence of a leak.

⑧ Once the leak has been located, take the relevant measures to deal with the leak.

6.1.2 Replacement of damaged parts

❖ Description: Whenever the robot's paint is damaged during part replacement, follow these steps.

❖ Tools: cleaner, knife, lint-free cloth, touch-up paint

❖ Disassembly operation: 1. Use a knife to cut the paint layer at the joints between the disassembled parts and the structure, and one side of the paint layer is cracked in a large area.
2. Carefully sand the residual paint layer burrs on the structure and polish it.

6.1.3 Stuck brake release button

❖ The brake release device has push buttons for releasing the brake for each axis motor. Performing maintenance work in the SMB recess, the operation involves disassembling and reassembling the brake release device, after reassembling, the brake release button may become stuck;

Warning

If the brake release button is stuck in the pressed position, once powered on, the affected motor brake may be released, which may cause serious personal injury and machine damage.

❖ Follow the steps below to eliminate the risk of stuck brake release that may occur after maintenance;

No.	Operation
1	Make sure the power is turned off
2	Remove button protection if necessary
3	Verify the buttons of the brake release device by pressing them one by one to ensure that none of such buttons are stuck in the tube

4	If the buttons are stuck in the pressed position, the alignment of the brake release unit must be adjusted so that the buttons move smoothly within their tubes.

6.2 Common faults and solutions (machinery)

Robot malfunctions are sometimes caused by a combination of different reasons, and it is often difficult to identify the cause thoroughly. If the wrong treatment is used, the malfunction may deteriorate further, so it is very important to analyze the malfunction situation in detail to find out the real cause.

Switch off the power before carrying out any maintenance operation to avoid personal injury or equipment damage!

Warning

Position	Description	Possible causes	Troubleshooting
Clattering or vibrating noise	The bottom surface is not securely attached to the floor	Loosening due to frequent vibrations during robot operation	Retighten the robot's connection to the ground
	Loose connections in robot joints	The joint connection bolts do not have the required preload and the bolts are not equipped with appropriate anti-loosening measures (shims).	Reinstallation and retightening of bolts
	If the robot exceeds certain speed and vibrates significantly	The procedure followed by the robot is more laborious for the robot to run.	Improvement of robot program running route
	The robot's vibrations are particularly pronounced in one particular location.	Excessive load on the robot	Reducing robot load
	Reducer damage	Joint reducer has not been replaced for a long time	Replacement of reducer
	Robot collision or vibration due to prolonged overload	Damage to the joint structure or reducer due to collision or overload	Replacement of the reducer at the vibration place or repair of the structure
	Robot vibration related to other operating robots	Resonance between robots	Changing the distance between robots
	Triggering the robot by hand when switching it off, causing it to wobble	Loose bolts on robot joints due to overload and collision	Check whether the joint bolts are loose or not and tighten them.
Motor overheating	The temperature of the robot's working environment rises or the servomotor is covered by an object.	Increase in ambient temperature or increase in temperature due to lack of heat dissipation from the motor.	Reduce ambient temperature, increase heat dissipation, remove motor coverings
	Robot control program or load changes	Program or load exceeds robot's bearing range	Adjusting the program to reduce the load
	Parameters imported into the controller have changed, causing the motor to overheat	Imported parameters do not fit the robot model	Import the right parameters
Gearbox oil leakage	Oil leaks at joints	The robot has been in use for too long, leading to the deterioration of the sealing rubber parts	Replace oil seal or O-ring
		Damage to seals due to inadvertent disassembly and reassembly.	Replace oil seal or O-ring
Gearbox oil leakage	Oil leaks at joints	Broken oil seals may be caused by scratches on the lip of the oil seal due to the intrusion of foreign objects such as dust.	According to the oil leakage location, if the oil seal at the reducer location is broken and it needs to replace the reducer; if the oil seal at the

			motor end is broken, and it needs to replace with new oil seal.
		Gaps in sealing surfaces	Retighten the installation screws so that the bonding surfaces are tight.
		Motor or gearbox installation surface sealant has failure	Reapply sealant
		Problems with the fuel nozzle or plug screw	Replacement with new fuel nozzle or plug screw
		Cracked castings and broken oil chambers due to collisions, etc.	Replacement with new components
Joint cannot be locked	The robot can not stop accurately in a certain position, or after stopping for a period of time, the joints rotate under gravity	Problems with servo motor band-type brake	Replacement of servo motor

6.3 Common faults and solutions (system)

6.3.1 Disconnections displayed in the upper left corner of the teach pendant (red)

❖ **Phenomenon 1**: The red "Connection Disconnected" is always displayed in the upper left corner of the teach pendant after switching on the robot, and there is no change.

Solution:

① Switch off the control cabinet, wait 1 minute and restart to see whether the connection is successful or not;

② Check the wiring between the controller and the teach pendant, whether it is correct or not, the network cable of the adapter box of the teach pendant needs to be connected to the network port of the controller labeled "teach pendant", and the other network port of the controller needs to be connected to the servo's "IN" network port;

③ Switch the authority of the teach pendant as manager, enter the interface of "Setting-System Setting-IP Setting", and check whether the item of "Connection IP" is the same as the IP of the controller or not;

④ Check whether the IP of the teach pendant in the IP Setting interface is in the same network segment as the IP of the Controller, i.e. the IPs of both the Controller and the teach pendant are 192.168.1.xxx or both are 192.168.0.xxx;

⑤ Plug a monitor into the VGA port of the controller to see if the controller powers on normally, if it does not power on normally, please restart the controller, if it still does not power on normally, please go to www.inexbot.com/service/download/ to download the debugging software, and replace the controller program through the debugging software.

❖ **Phenomenon 2:** The upper left corner of the teach pendant keeps displaying a red "Connection Disconnected" after switching on the robot, but it will be connected automatically after a while.

Solution:

① Plug and unplug the teach pendant again to ensure that there is no poor contact in the aviation plug;

② Replace the network cable connecting the teach pendant to the controller, please use a super category 6 shielded network cable.

6.3.2 Unable to upgrade program

❖ **Phenomenon 1:** After the USB stick is inserted into the teach pendant, click the [Detect Upgrade] button in the interface of "Version Upgrade", and a pop-up message "No upgrade file found" appears.

Solution:

① Plug and unplug the USB memory stick again to make sure it is inserted properly;

② Make sure the upgrade file in ".zip" format is on the USB memory stick;

③ Make sure that the upgrade file copied to the USB memory stick is in ".zip" format and has no special characters in the file name;
④ Plug the USB stick into the computer, right-click the USB stick in the file manager, click "Properties" and check whether the "File System Format is FAT32" in the Properties box, if it is NTFS or other formats, please format the USB stick to FAT32 format;
⑤ Make sure the interface of the USB memory stick is intact, if it is loose, please replace the USB memory stick.

❖ **Phenomenon 2:** After selecting the upgrade file and clicking the [OK] button, the interface of being upgraded pops up, but it disappears after flashing for a while, and neither the teach pendant nor the controller restarts automatically.

Solution:

① Make sure that the file name of the selected upgrade file does not have special characters, such as "", (), &, %, and so on;
② Determine whether the controller is properly connected to the teach pendant. Is the word "Connection Disconnected" displayed in the upper left corner of the teach pendant? If the current connection has been disconnected, the upgrade cannot be made;
③ Plug the USB stick into your computer, use winrar or other decompression software to open the ".zip" upgrade file, check its content, whether there are two documents namely Qt-tp and nrc.out or not, if not, please check whether you have copied the wrong file or not.

❖ **Phenomenon 3:** After popping up the interface of being upgraded, the message of "Waiting for timeout" appeared in the interface, and the interface disappeared and did not restart automatically.

Solution:

① Determine if the controller is properly connected to the teach pendant.
② Does the upper left corner of the teach pendant display the words "Connection Disconnected", if the current connection has been disconnected, the upgrade cannot be made;

❖ **Phenomenon 4:** After popping up the interface of being upgraded, the message "Failed to copy the upgrade file" appeared in the interface, and the interface disappeared and did not restart automatically.

Solution:

① Enter the "Status-System Status" interface to check the remaining space of each directory.
② If there is a directory whose storage space has reached 0.0M, it is not possible to upgrade the program, please contact a technician.

6.3.3 Displaying that the servo is not connected

❖ **Phenomenon 1:** After the teach pendant is switched on, the message "Servo not connected" pops up in the lower right corner, and the message "Servo not connected " also pops up when the clear button is pressed, but the message "Corresponding ENI not found" does not pop up.

Solution:

① Check if the network cable connecting the controller to the servo is correct. One end of the network cable connecting to the servo needs to be connected to the network port marked "servo" on the controller, and the other end needs to be connected to the "IN" network port of the servo;
② Check whether the network cable between the servo and the servo is well connected, the two ends of the network cable from the first servo to the second servo shall be connected to the "OUT" port of the first servo and the "IN" port of the second servo, and so on;
③ Check whether the network cable between the servo and the EtherCAT IO board is properly connected, the two ends of the cable shall be connected to the "OUT" port of the servo and the "IN" port of the EtherCAT IO respectively;
④ Check whether the number of robots, robot type, servo for each axis, number of IO boards, IO board model, etc. in the "Setting-Robot Parameters-Robot Configuration" and "Setting-IO-IO Configuration" interfaces are filled in strictly according to the actual wiring or not. After determining the servo model and IO board model, contact the manufacturer for the EIN file.

❖ **Phenomenon 2:** After the teach pendant is switched on, the message "No corresponding ENI found" and "Servo not connected" pop up in the lower right corner.

Solution:

① Check whether the number of robots, robot type, servo for each axis, number of IO boards, IO board model, etc. in the interface of "Setting-Robot Parameters-Robot Configuration" and

"Setting-IO-IO Configuration" are strictly in accordance with the actual wiring or not. After determining the servo model and IO board model, contact the manufacturer for the EIN file.

② After getting the ENI file, please prepare a USB stick in FAT32 format. To determine the format of the USB stick, plug the USB stick into your computer, right-click on the USB stick drive letter in "My Computer", click "Properties", and then there is a line "File System: xxxx" in the pop-up dialogue box. In the pop-up dialogue box, there is a line "File System: xxxx", if it is FAT32, then you can use it, if it is NTFS, please format the USB stick, and choose "FAT32" as the file system when formatting;

③ Create a new folder named "upgrade" in the USB memory stick, and put the obtained ENI file (with .xml extension) into this folder;

④ Insert the USB stick into the teach pendant, make sure the teach pendant is connected to the controller (no red "Connection Disconnected" in the status bar of the teach pendant), switch the authority of the teach pendant to "Manager", click "Settings-System Settings-Version Upgrade" interface, click the "Upload File" button at the bottom, select the .xml file to upload, restart and take effect after uploading successfully.

6.3.4 At startup, it displays version mismatch

❖ **Phenomenon 1:** "Controller(xxx)-teach pendant(xxx), version mismatch" is displayed after power on.

Solution:

① Record the numbers in the Controller (xxx)-teach pendant (xxx) and provide them to the manufacturer for an upgrade package;

② Prepare a FAT32 formatted USB memory stick, please refer to the section "Servo not connected" for the FAT32 format USB memory stick checking and how to get it;

③ Place the upgrade package (.zip file) in the root directory of the USB memory stick;

④ Under the premise of ensuring that the controller and the teach pendant are connected (there is no "Connection Disconnected" in the status bar on the top of the teach pendant), switch the authority of the teach pendant to "Manager", and then click and enter "Settings-System Settings-Version Upgrade" interface of the teach pendant, click "Check Upgrade" button, select the .zip file, click OK, and it will take effect after automatic restart.

6.3.5 Teach pendant is not switched on

❖ **Phenomenon 1:** When the teach pendant is switched on, it is stuck in the interface of running progress bar, and the progress bar has finished but does not enter the program.

Solution: If there is a USB stick inserted in the teach pendant at this time, please unplug the USB stick and restart after power off.

❖ **Phenomenon 2:** A USB stick is not inserted into the teach pendant, and when the teach pendent is switched on, it is stuck in the interface of the progress bar and does not enter the program.

Solution:

① Please find a USB stick and create a new folder named "app" inside the USB stick;

② Unzip the program upgrade.zip file, copy the Qt-tp file from it into that folder, and plug the USB stick into the teach pendant to restart the teach pendant;

③ When the teach pendant restarts to the end of the progress bar, it will restart again automatically, then unplug the USB stick and wait for that the teach pendant is switched on automatically.

❖ **Phenomenon 3:** All the above methods have been tried, but the teach pendent cannot be switched on.

Solution: Contact the manufacturer to resolve the problem.

6.3.6 Red servo error displayed in upper part of the teach pendant

❖ **Phenomenon 1:** "Servo Error" is displayed in red in the servo status of the status bar at the upper part of the teach pendant.

Solution:

① Switch to the teaching mode, check that the emergency stop buttons on the teach pendant and control cabinet and reservation box are pressed, and pull them up if they are pressed.

② Press the "Clear Error" button on the teach pendant, if the "Servo Error" at the upper part of the teach pendant disappears, the servo error is cleared and you can continue to use it;

③ If the error is still reported after pressing "Clear Error", record the servo error information, i.e. the error code of each axis;

④ Insert a FAT32-formatted USB stick into the teach pendant (please refer to the section "Servo Not Connected" for the FAT32-formatted USB stick checking and creation method);

⑤ Enter "Settings-System Settings" interface, click "Export Controller Log".

⑥ Pack and compress the "controllerLog (date-time)" just exported to the USB stick;

⑦ Submit the zip file and the servo error code to the manufacturer, who will analyze the cause;

Note

See appendix for details of servo alarms and treatment solutions

6.3.7 Unable to enable after pressing the three-position push switch of the teach pendant

❖ **Phenomenon 1:** "Servo not ready" is prompted after pressing the three-position push switch of the teach pendant.

Solution:

Press the "Servo" button on the teach pendant, or click the servo status column on the status bar at the upper part of the teach pendant, click the "Servo Ready" button, and the servo status at the upper part of the teach pendant will show "Servo Ready" in flashing manner, at this time, it can enable by pressing the three-position push switch in "teaching mode".

❖ **Phenomenon 2:**

Solution:

① Determine if you are currently in "teaching mode", if not, turn the key switch or click on the Mode column in the upper status bar.

② Check whether the servo alarm indicator in the control cabinet is on, if the indicator is on, please clear the servo error and restart the electric cabinet.

③ If the servo drive and teaching mode are correct, and it still cannot enable after pressing the three-position push switch, please check the teach pendant adapter board, and whether the common terminal on the terminal board is connected in series with +24V, as shown in the figure.

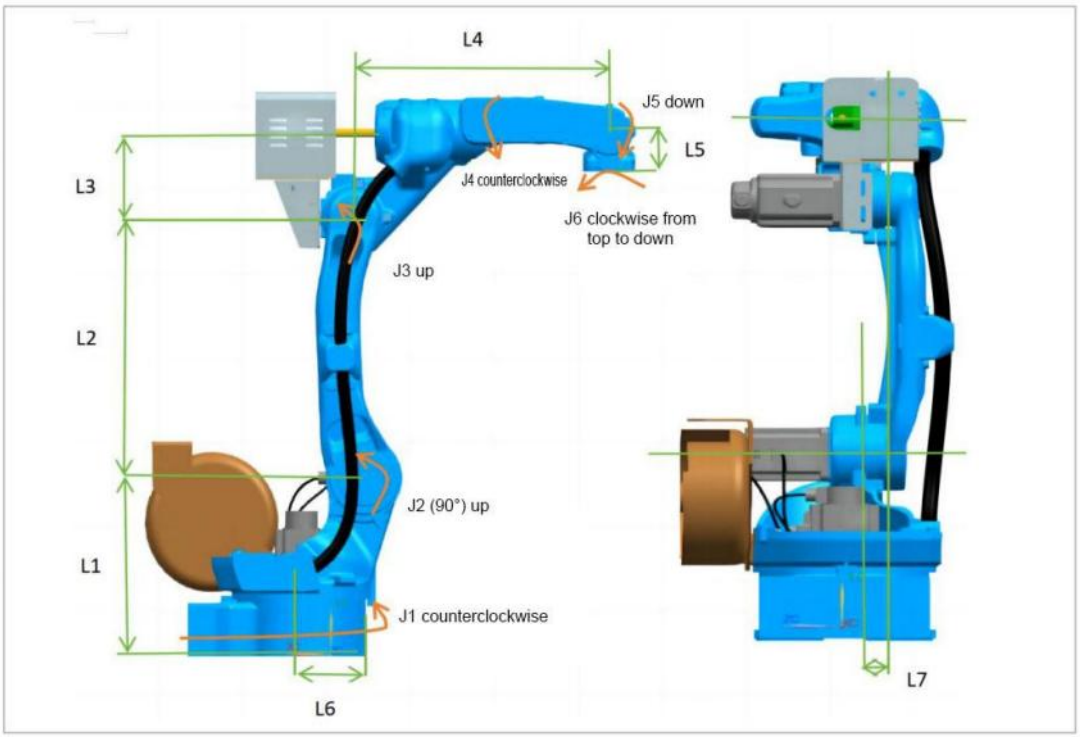
6.3.8 Robot DH parameter filling

❖ **Phenomenon 1:** Don't know the meaning of each parameter of DH parameters

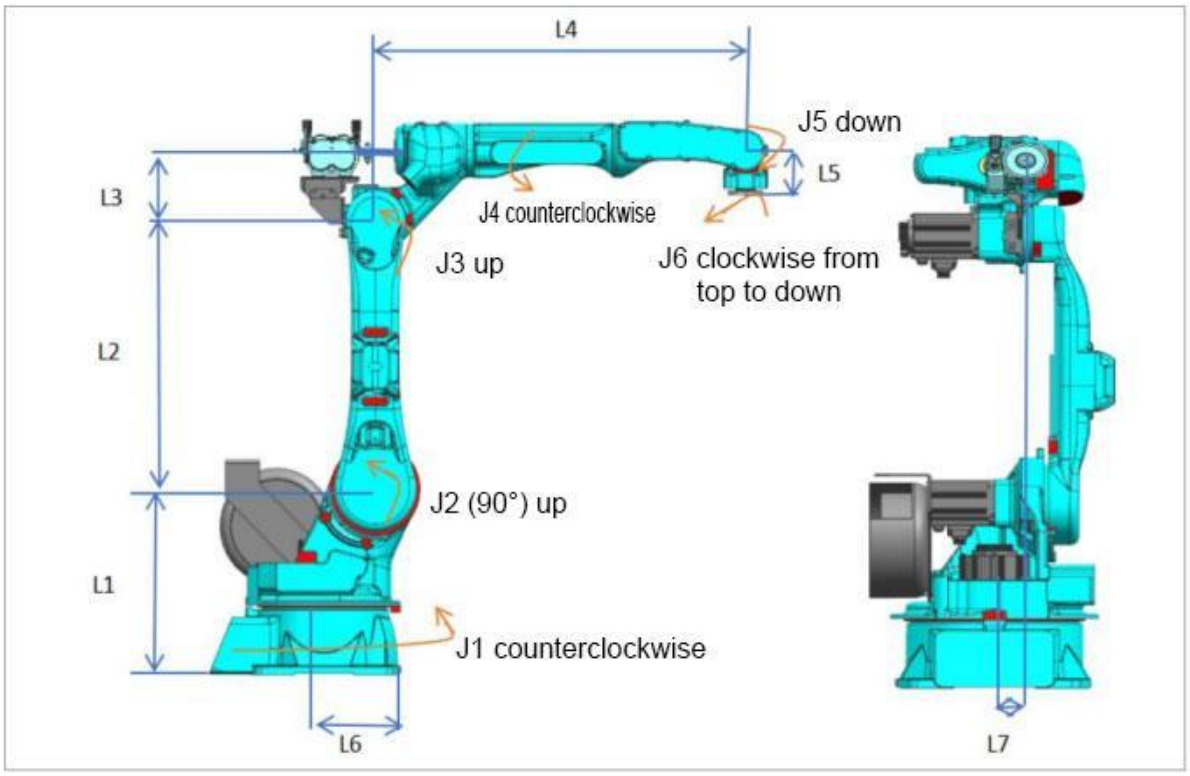
Solution:

① Simply fill in the length (in mm) corresponding to each rod length as shown in figure below.

② Please note that, if the axis 5 zero point is vertically down, please select "Vertical down by 90°" in the last item " axis 5 direction"; if the axis 5 zero point is horizontally forward, select "Horizontal 0°".



● Schematic diagram of DH parameters for BR-10W-1440 robot



● Schematic diagram of DH parameters for BR-12-2010 robot

6.3.9 Cartesian Coordinates inching is not correct (fail to go along straight line)

❖ **Phenomenon 1:** When the robot is manually operated to move the X-axis and Y-axis, it does not move straight, after being taught by two points, when the robot moves between two points with a straight-line command, it does not move straight.

Solution:

① Check that the robot zero point is correct
② Check that the robot has the correct reduction ratio for each axis
③ Check method: Make each joint axis actually rotate by 90 degrees with manual operation, check whether the coordinate value in the teach pendant also rotate by 90 degrees; if not, the axis reduction ratio is not correct, please contact the manufacturer to get the correct reduction ratio.
④ Check that the robot DH parameters (including the coupling ratio) are correct or not (contact the manufacturer for these parameters)
⑤ Check that the robot axes are orientated correctly or not (orientation labels are on the body)
⑥ If the problem cannot be solved yet, contact the manufacturer.

❖ **Phenomenon 2:** The robot's axis 5 is vertical downward, inching X, Y and Z axes to go straight normally, but the X, Y and Z axes do not go straight after changing the posture.

Solution:

① Check the robot zero point, reduction ratio, DH parameters, joint orientation .
② Check zero point setting of axis 5. If zero point of axis 5 is vertically down, select "vertically down by 90° " for the last item " axis 5 direction"; if the axis 5zero point is horizontally forward, select "0° horizontal".
③ If the problem cannot be solved yet, contact the manufacturer.

6.3.10 Inaccurate calibration result of tool hand

❖ **Phenomenon 1:** After calibrating the tool hand, selecting the tool hand and aligning the tip of the tool hand with a sharp point, and operating the TA, TB and TC of the tool coordinate system, it is found that there is a great deviation between the end of the tool hand and the position of the sharp point.

Solution:

① Check the robot zero point, reduction ratio, DH parameters (including coupling ratio), and joint orientation.

② Check the axis 5 zero point setting. If the axis 5 zero point is vertically down, select "vertically down by 90° " for the last item "axis 5 direction"; if the axis 5 zero point is horizontally forward, select "0° horizontally".

③ The calibration method is wrong and the calibration points are inaccurate, use the 20-point calibration method that comes with the system to re-calibrate.

④ If every point in the calibration process is calibrated accurately and all of the above parameters are correct, contact the manufacturer for a solution.

6.3.11 Significance of the 20-point calibration of the system

❖ An inaccurate robot zero point will result in inaccurate robot accuracy, so an accurate calibration of the zero point is required. A 20-point calibration compensates for the correct zero correctly, and the 20-point calibration with the tool hand will also calibrate the deviation of the end of the tool hand relative to the center of the flange (posture is not calibrated).

❖ The 20-point calibration can only compensate for errors within 3mm; if the robot's zero point is too different from the actual zero point, a successful calibration cannot be made.

❖ Click Calculate after 20-point calibration, if it shows that the calibration result has too large error, please recalibrate.

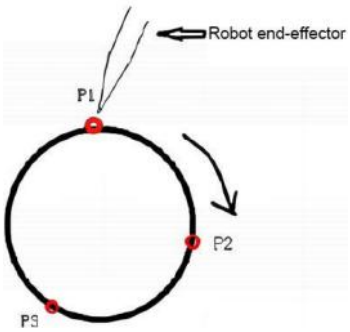
6.3.12 It cannot draw a whole circle

❖ **Phenomenon 1:** Robot with welding torch keeps constant posture when walking along a whole circle.

Solution: Modify the inserted MOVCA command, and check SPIN.

❖ **Phenomenon 2:** Completely inaccurate walking when drawing a circle

Solution:



Insert steps, with a total of four instructions:

① Click Insert, click Coordinate Switching Class, select SWITCHTOOL, and select the previously calibrated tool hand number;

② Move to any point of the circle you want to draw as in Figure P1, click Insert, click Motion Control Class, and select movj or movl;

③ Then move to any point of the circle you want to draw as shown in Figure P2 (to be different from the point in step 2), click on the "Coordinate System" button in the upper status bar, select "Tool" Coordinate System, click on Insert, click on the Motion Control Class, and select movca;

④ Then move to any point of the circle you want to draw as shown in Fig. P3 (to be different from the points in steps 2 and 3), click on the "Coordinate System" button in the upper status bar, select "Tool" Coordinate System, click on Insert, click on Motion Control Class, and select movca.

❖ **Phenomenon 3:** It has programmed the program according to steps in Phenomenon 2, but the circle is still not drawn accurately.

Solution:

Please check whether the tool hand is accurate or not.

Checking method: Find a cone and fix it on the plane, make the end tip of the robot aligned with the tip of the cone, switch the coordinate system to the tool coordinate system and switch to the tool hand, go in three postures of TA, TB and TC, to check whether it walks accurately or not, if there is a large deviation, please re-calibrate the tool hand, it is recommended to use the 20-point calibration.

6.3.13 Running a program too slowly

❖ **Phenomenon 1:** Running a program in run mode, the robot goes very slowly.

Solution:

① Program speed = demand speed x status bar speed;

② Please check if the command speed in the program is very low, and turn up the required demand speed;

③ Check that the speed percentage in the upper status bar is low, if so, turn up the speed by pressing the "V+" button on the teach pendant before starting the program in run mode;

④ If it is still very slow after checking all the above, please check the multiple of the acceleration and deceleration relative to the maximum speed in the joint parameter interface and Cartesian parameter interface in "Setting-Robot Parameters", if the multiple is very low, then adjust it upward, it can set to be to 4-8 times.

6.3.14 Remote mode runs too fast

❖ **Phenomenon 1:** The program runs too fast in remote mode.

Solution:

Refer to 6.3.13 for setting.

① Remote mode running speed = command speed x status bar speed

② The speed of the status bar of in remote mode is shown in the "Settings-Remote Program Settings" screen.

6.3.15 How to import and export files

Including but not limited to setting methods for version upgrade and file upload, time setting, IP setting, export/import program, one-key backup system, modification of teach pendant configuration, export/import controller configuration, export logs, automatic backup and restoration. (For details, see 5.3 Controller-System Settings)

6.3.16 Local IP is clear in the IP setting screen of the teach pendant

❖ **Phenomenon 1:** The IP of the teach pendant in "Settings-System Settings-IP Settings" is clear.

Solution:

① Connect the controller via computer or debug the teach pendant with the keyboard;

② Input command "cd space /etc/network", enter, "cp space interfaces_bak space interfaces", enter, "vi space interfaces", enter;

③ In the newly popped up interface, press "INS" key on your keyboard, change the IP to be 192.168.1.235, then press "ESC" key, type ":wq", enter, and restart the teach pendant.

6.3.17 Replacement of LOGO, startup image, program startup image

❖ **Replacing the logo (icon in the upper left corner):**

Operating steps:

① Prepare a logo image file, requirement: 145*60 pixels, png format, named Logo.png (pay attention to case);

② Compress the image file into a .zip format archive, such as logo.zip;

③ Place the .zip archive in the root directory of the USB stick, plug the USB stick into the teach pendant and upgrade the file.

❖ **Replacing the startup image (the two pictures of powering up and going through the progress bar):**

Operating steps:

① Prepare two images, htq_logo.bmp and htq_logo_sys.bmp, both with a resolution of 800*600, 24-bit color is recommended;

② Compresses two images into a .zip archive, such as open.zip;

③ Place the .zip archive in the root directory of the USB stick, plug the USB stick into the teach pendant and upgrade the file;

④ While restarting, press and hold the second button on the left row of the teach pendant from the top to the bottom, the START button and STOP button, four lines of text appearing on the teach pendant, of which the fourth line is in red "please manual restart your system", power off and restart the teach pendant.

❖ **Replacing the program start-up image:**

(StartImage.png is an image after completing the progress bar, SoftUpdatingBackground.png is the background image when upgrading the program)

① Prepare two pictures, both of the resolution 800*600, png format, named StartImage.png and SoftUpdatingBackground.png respectively (pay attention to the case), the latter is background image when the program is upgraded;

② Compress the two files into a .zip archive, such as background.zip;

③ Place the .zip archive in the root directory of the USB stick, plug the USB stick into the teach pendant and upgrade the file.

VII. MAINTENANCE

Warning

Robot maintenance actions must be performed only after the robot has been powered down!

7.1 Maintenance items

7.1.1 Routine maintenance items

Industrial robots operate under harsh operating conditions, and even if they are designed to carry out perfect design specifications, regular routine inspections and preventive maintenance must be performed. During routine operation of the system, maintenance and overhaul shall be performed on the following items.

No.	Item	Overhaul method
1	Oil seepage inspection	Inspect if there is any oil penetration from the robot product and wipe it off if there is such penetration.
2	Vibration, abnormal sound, motor heat	Inspect whether there is vibration and abnormal noise in each transmission mechanism, and whether the temperature of the motor is abnormally high.
3	Positioning accuracy inspection	Inspect for deviation from the last taught position and for deviation in the stop position.
4	Control cabinet air-cooling inspection	Inspect whether the fan on the rear side of the control cabinet is smoothly ventilated or not and has abnormal noise or not.
5	Inspection of peripheral cable fixings	Whether they are complete or not, whether they have wear and tear, rust and corrosion or not.
6	Inspection of peripheral electrical accessories	Inspect whether the robot's external wiring is connected properly or not, whether there is break or not, and whether the buttons are functioning properly or not.
7	Inspection of warnings	Confirm whether there is warnings appear on the teach pendant warning screen; and if there is warning, refer to the list of alarm codes for treatment.
8	Cleaning of manipulator	Clean the surface dirt of the manipulator daily

7.1.2 Periodic maintenance items

Overhaul and repair are performed at approximate intervals based on specified operating cycles or accumulated operating time. Regular maintenance procedures are performed to maintain the optimal performance of the robot, and regular overhaul and repair can be performed by the user in accordance with the table below.

Overhaul period	Item	Overhaul method
First time within 1 month and every 3 months	Cleaning of control unit air vent	Remove large amount of dust from the air vents of the control unit if such dust adheres to the vents
Every 3 months	Confirm whether there is trauma or peeling paint or not	Confirm whether the robot has any trauma or paint peeling due to interference with peripheral equipment or no. If there is any interference, eliminate the cause. If the damage caused by the interference is so large that it affects the use of the robot, it is necessary to replace the corresponding parts.
Every 3 months	Confirm whether there	Confirm whether the cable protection sleeve of the cable

	is damage to the cable protection sleeve or not	inside the unit is damaged by holes or tears or not. If there is damage, replace the cable protection sleeve. If the cable protection sleeve is damaged due to contact with peripheral equipment, etc., eliminate the cause.
Every 3 months	Confirmation whether there is damage exposure to water or not	Please check if water or cutting oil liquid is splashed on the robot. If water or cutting oil is splashed, eliminate the cause and wipe off the liquid.
First time within 3 months and every 1 year	Confirm whether there is damage to the cable connecting to the teach pendant, the control cabinet and the robot cable or not	Please check whether the connection cables of the teach pendant, control cabinet and robot have excessive twisting and any damage or not. If there is damage, replace this cable
First time within 3 months and every 1 year	Confirm whether there is damage to cables (movable parts) in the robot or not	Observe the movable part of the robot cable and check for damage to the cable wrapping and for localized bending or twisting.
First time within 3 months and every 1 year	Confirm whether there is damage to the end-effector (robot) cable or not	Check the end-effector cable for excessive twisting and damage. Replace this cable if there is damage.
First time within 3 months and every 1 year	Confirm whether there is looseness of connectors of each axis motor and other exposed connectors or not	Check the connectors of each axis motor and other exposed connectors for looseness.
First time within 3 months and every 1 year	Tightening of end-effector installation bolts	Tighten the end-effector installation bolts.
First time within 3 months and every 1 year	Tightening of main external bolts	Tighten the robot installation bolts, overhaul loose bolts and bolts that are exposed on the outside of the robot. Refer to the screw tightening torque table in Appendix A for the tightening moment of the bolts. Some bolts are coated with anti-loosening adhesive. If the bolts are tightened with a torque higher than the recommended tightening torque, the anti-loosening adhesive may peel off, so be sure to tighten the bolts with the recommended tightening torque.
First time within 3 months and every 1 year	Confirmation of mechanical brakes	Confirm whether the mechanical brake is free from trauma, deformation and other signs of collision or not, and whether the brake fixing bolts are not loose or not.
First time within 3 months and every 1 year	Cleaning of splashes, chips, dust, etc.	Check the robot body for attached or accumulated splashes, cutting chips, dust, etc. Clean if there is any accumulation. Pay particular attention to cleaning the movable parts of the robot (joints, balance cylinder rods, balance cylinder front/rear supports, cable protection sleeve).
First time within 3 months and every 1 year	Confirmation of cooling fan operation	Confirm whether the cooling fan is working properly or not (when attaching the cooling fan to each axis motor). Replace the cooling fan if it does not operate.
Every 1 year	Robot body battery	Replace the robot body battery.

	replacement	
Every 1 year	Lubricant replacement for each axis reducer	Please replace the lubricating oil of each axis reducer.
Every 4 years	Replacement of robot internal cables	Replace the internal cable of the robot. Please contact this Company for the replacement method.

7.2 Maintenance process

7.2.1 Clean robot

To ensure that the robot can operate for a long period of time, the robot shall be cleaned regularly every 3 months of operation.

The steps are as follows:

① Adjust the robot to the calibration state.

② To prevent danger, switch off the power, hydraulic and air pressure sources connected to the robot.

③ Use a vacuum cleaner to clean the manipulator or use a cloth to wipe it.

④ Clear base and arm of the manipulator.

⑤ If the manipulator is protected by grease, etc., remove as required (plastic protection shall be avoided).

⑥ To prevent the generation of static electricity, non-conductive surfaces such as spray equipment, hoses, etc. must be wiped with a dampened or moist rag. Do not use a dry cloth.

⑦ Ensure that all safety conditions are met before proceeding with the manipulator's subsequent work.

Warning

- **It is forbidden to use water jets on the manipulator, especially on joints, seals or cable inlets/outlets;**
- **The use of compressed air for robot cleaning is prohibited;**
- **It is forbidden to remove any robot protection device;**
- **It is prohibited to use solvent to clean the robot;**

7.2.2 Electrical cabinet maintenance

❖ **Power failure inspection:**

① Teach pendant cleaning, after switching off, use a rag with a small amount of cleaning solution to clean the teach pendant and the connection line before the teach pendant and the electrical cabinet.

② Fan inlet/outlet cleaning. Use a dust removal brush for cleaning and use a vacuum cleaner to remove the brushed dust. Do not use a vacuum cleaner to clean the parts directly, otherwise it will lead to electrostatic discharge, which will damage the parts, the filter cloth of the air inlet and outlet need to be replaced once in 500H hours.

③ After switching off, open the door of the control cabinet and use the air gun to remove the dust, and the air volume is not too large.

④ After switching off, put on the anti-static bracelet and touch the components in the cabinet with your fingers with slight force to check if there is any looseness.

❖ **Power up and check:**

① Measure the robot inlet voltage and the power module voltage with reference values of 380±10% and 24V±10%, respectively.

② After switching on, it is necessary to carry out a function test on each button on the teach pendant and the electrical cabinet to ensure that the enables and emergency stops all work and that the touch screen is accurate and good.

③ Make sure the cooling fans are all functioning properly.

7.2.3 Overhaul cables

To ensure that the robot can operate for a long period of time, the robot cables shall be checked every 6 months of operation.

❖ **Overhaul the external cables**

Overhaul steps:

① Adjust the robot to the proper posture.

② To prevent danger, switch off the power, hydraulic and air pressure sources connected to the operator.

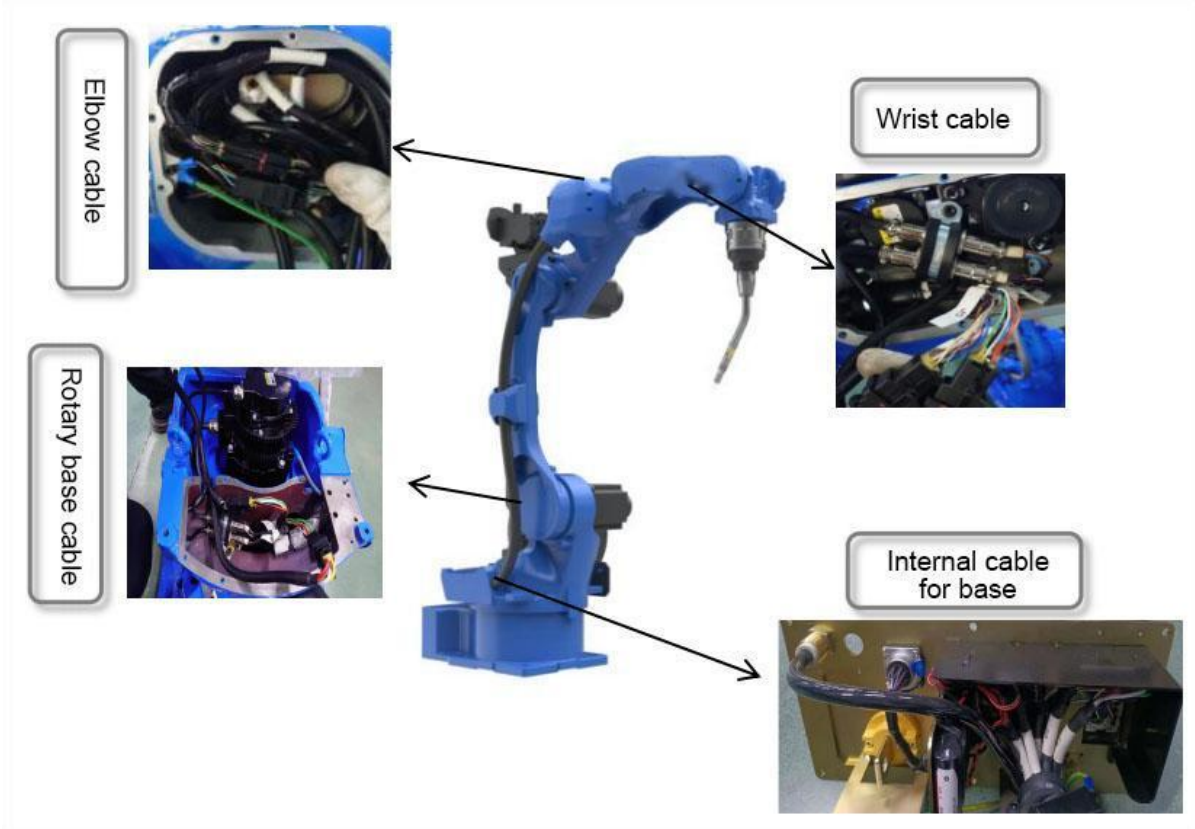
③ Use the naked eye to observe all external cables for wear or damage.

④ Check whether all cable connectors are intact or not.

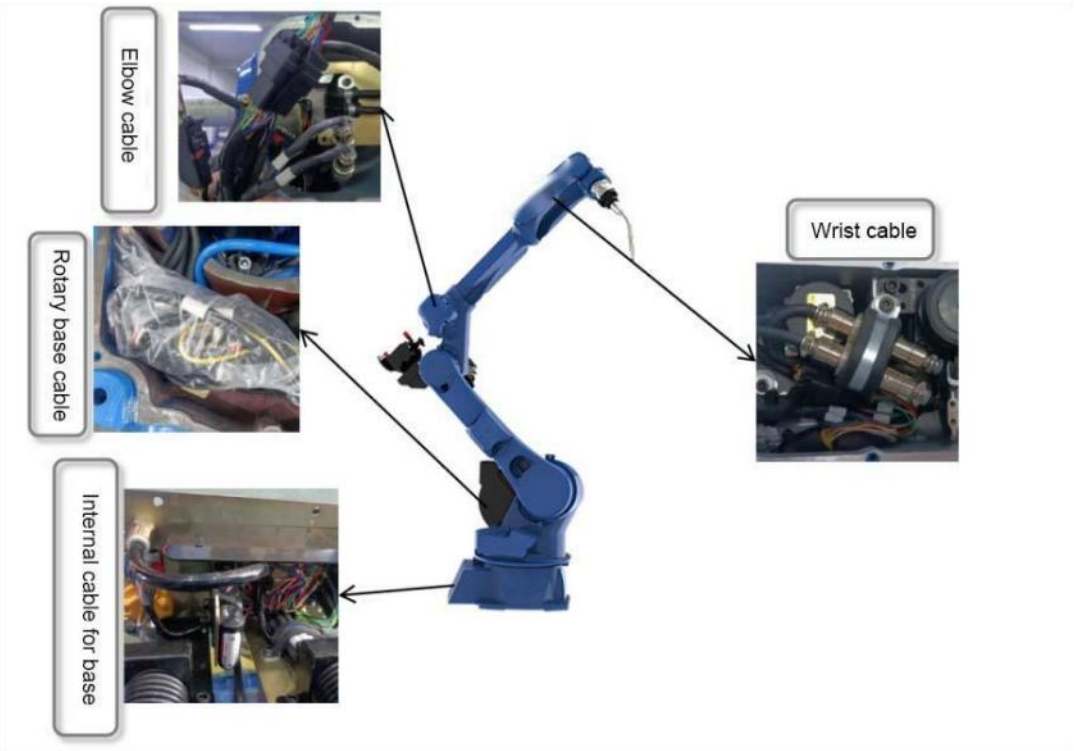
⑤ Check whether all brackets and restraints are intact and secured to the manipulator or not.

⑥ Check if there is wear or damage at the fixing point of the cable and bracket or not.

⑦ If cracked, worn or damaged, contact this Company for replacement.



● Cable Layout Schematic Diagram of BR-10W-1440 Robot

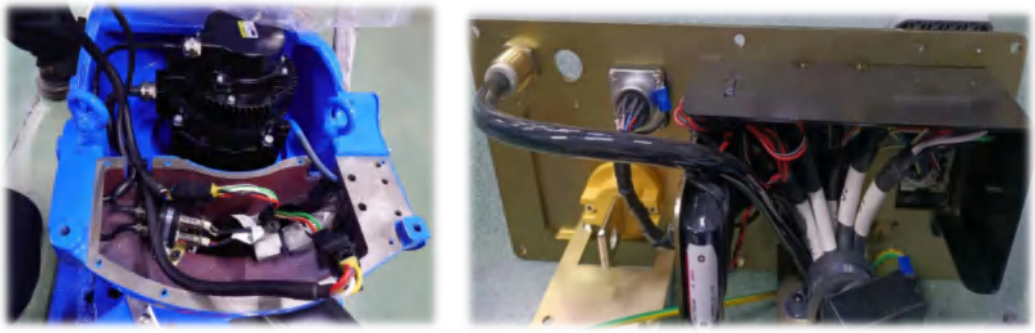


● Cable Layout Schematic Diagram of BR-12-2010 Robot

❖ **Overhaul the internal cables of the base**

Overhaul steps:

① Remove the electrical installation plate and pull out the cables inside the base.
② Check that the bracket secures the cable intact to the manipulator.
③ Check if there is wear or damage at the fixing point of the cable and bracket or not.
④ Check the internal cables for wear or damage.
⑤ If cracked, worn or damaged, contact this Company for replacement.
⑥ Check for loss of grease on internal cable surfaces.
⑦ If the cable surface grease disappears, such grease shall be replenished in time.
⑧ Fit the cables inside the base, keeping the sleeping "U" shape.
⑨ Install the electrical installation plate and apply sealant to the joint surface between the electrical installation plate and the base casting.



● Connection between J1 motor and J2 motor of the robot

❖ **Overhaul the internal elbow cables**

Overhaul steps:

① Remove the elbow cable fixing plate.
② Pull out the cable and check that the cable is securely connected to the fixing plate.
③ Check if there is wear or damage at the fixing point of the cable and bracket or not.
④ Check the internal cables for wear or damage.
⑤ If cracked, worn or damaged, contact this Company for replacement.
⑥ Check for loss of grease on internal cable surfaces.
⑦ If the cable surface grease disappears, such grease shall be replenished in time.
⑧ Fit the cable inside the elbow.
⑨ Install the cable fixing plate.

❖ **Overhaul the internal wrist cables**

Overhaul steps:

① Removing the cover
② Check if there is wear or damage at the fixing point of the cable and silica gel protection sleeve or not.
③ Check the internal cables for wear or damage.
④ If cracked, worn or damaged, contact this Company for replacement.
⑤ Install the cover plate and apply sealant to the joint surface of the cover plate and the small arm.

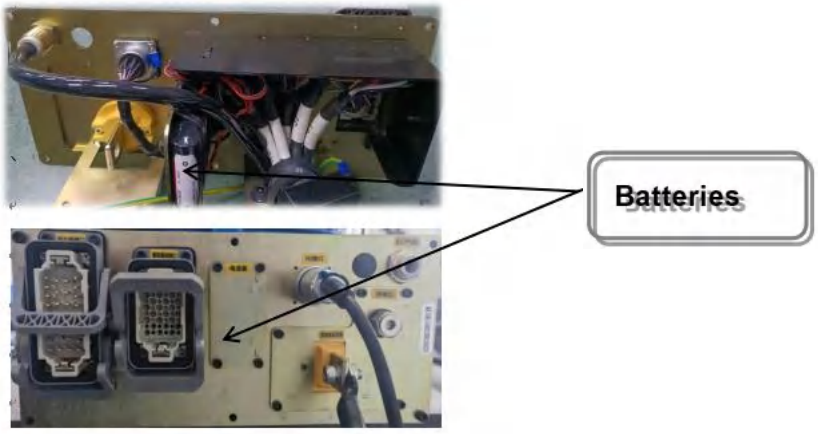
7.2.4 Replace the battery

Reminder

During the battery replacement process, the control cabinet should not be powered off. If the control cabinet is powered off, the robot's position information will be lost. After replacing the battery, zero calibration needs to be

Position data for each axis of the robot is saved by a backup battery.
The batteries shall be replaced periodically after every 1 year. In addition, the battery shall be replaced when the backup battery voltage drop alarm is displayed.
Battery replacement steps:

① To prevent danger, when replacing batteries, press the emergency stop button.
② Remove the cover of the battery compartment.
③ Remove the used batteries from the battery compartment.
④ Install the new batteries into the battery compartment. Be careful not to mistake the positive and negative polarity of the batteries.
⑤ Install the battery compartment cover.



- Schematic diagram of robot battery

7.2.5 Replacing the synchronous belt

① Adjust the manipulator to the proper posture and cut off power supply of the control unit;
② Remove the cover plate and loosen the motor assembly screws;
③ Replace the synchronous belt;
④ Install the motor installation base screws with the specified torque;
⑤ Install the cover plate and perform the manipulator calibration work.

7.2.6 Checking the main fixing bolts

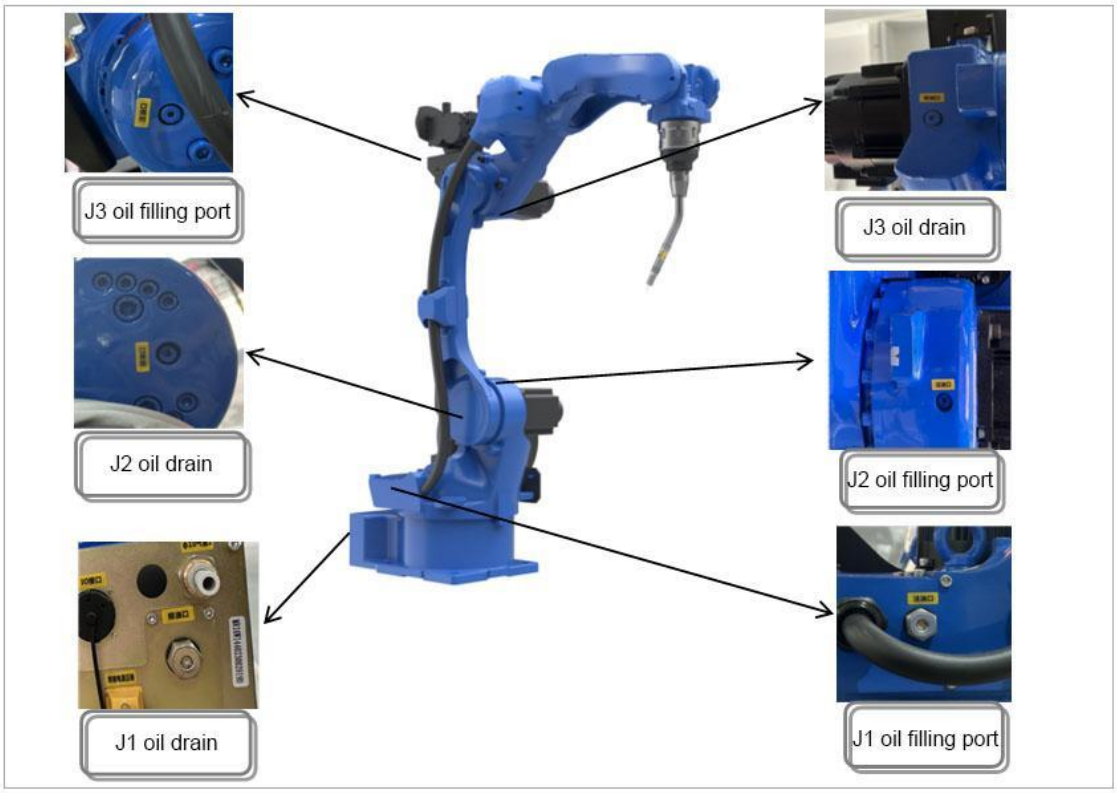
① Fastening screws and fixing clips that fix the manipulator to the foundation must be kept clean and must not come into contact with corrosive liquids such as water, acid and alkali solutions. This will avoid corrosion of the fasteners;
② If the screw(s) is/are loose, use a torque spanner to tighten the screw(s) with the appropriate torque;

7.2.7 Robot lubrication

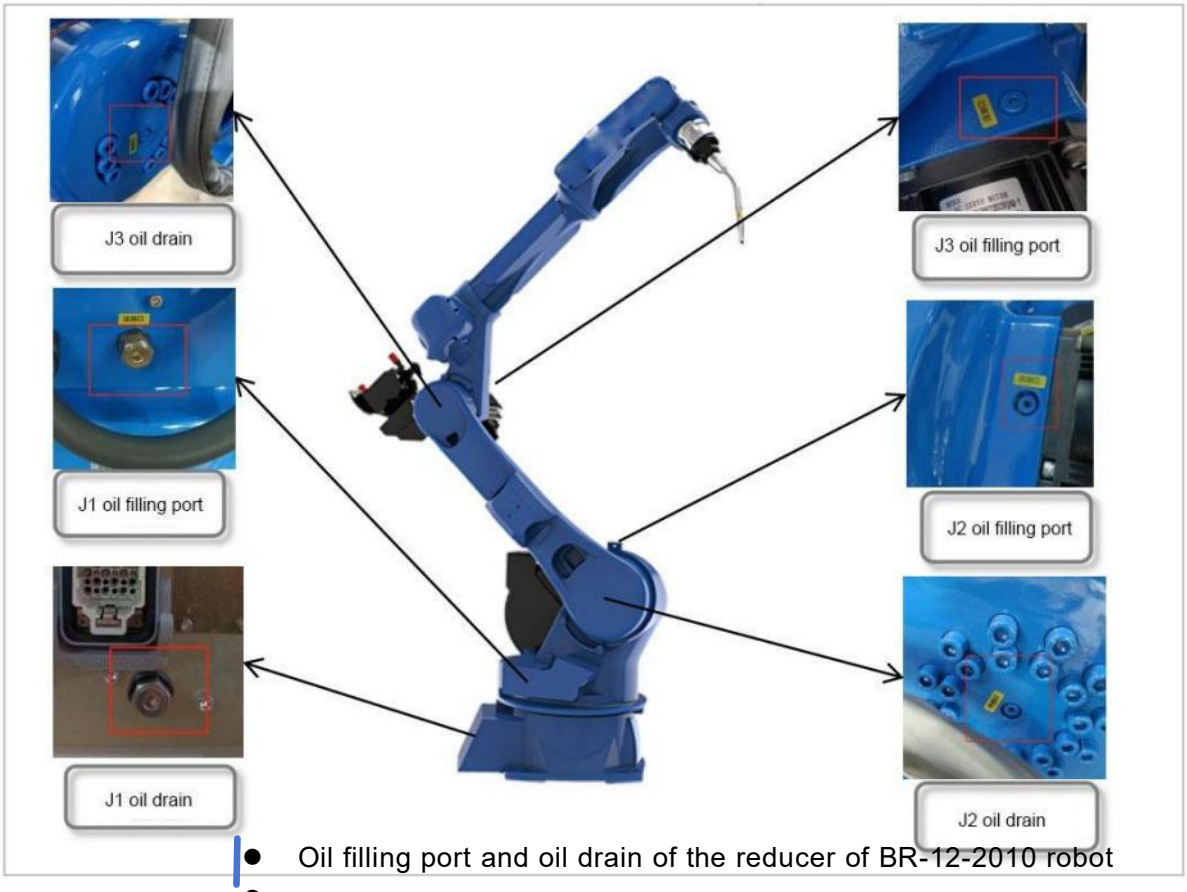
The internal lubricating grease needs to be replaced for every 11,520 hours or 3 years (whichever is shorter) of cumulative operating time for the reducers of axes from J1 to J6 of this series of robots.

Warning

- **Reducer oil temperature may be higher than 90°, replace when cool.**
- **Carefully and slowly open the oil drain to prevent oil splashing.**
- **Wear gloves to prevent allergic reactions**.



- Oil filling port and oil drain of the reducer of BR-10W-2010 robot



- Oil filling port and oil drain of the reducer of BR-12-2010 robot

7.2.8 Checking the axle brakes

During operation, each axis motor brake will wear normally. To determine if the brake is working properly, it must be tested at this time.

Test method: Check the brake on each axis motor as described below.

① Run the manipulator axis to the position where the total weight of the manipulator and all loads reach their maximum value (maximum static load);

② The motor is powered off;

③ Check whether all axes are maintained in the original positions or not.

If the manipulator does not change position even when the motor is powered off, the braking torque is sufficient. The manipulator can also be moved manually to check whether further protective measures are required or not. When the moving robot is brought to an emergency stop, the brakes help to stop it, therefore there may be wear. Therefore, repeated tests are required during the life of the machine to check whether the machine maintains its original capacity or not.

APPENDIXES

Appendix I Table of screw strength and screw tightening torque

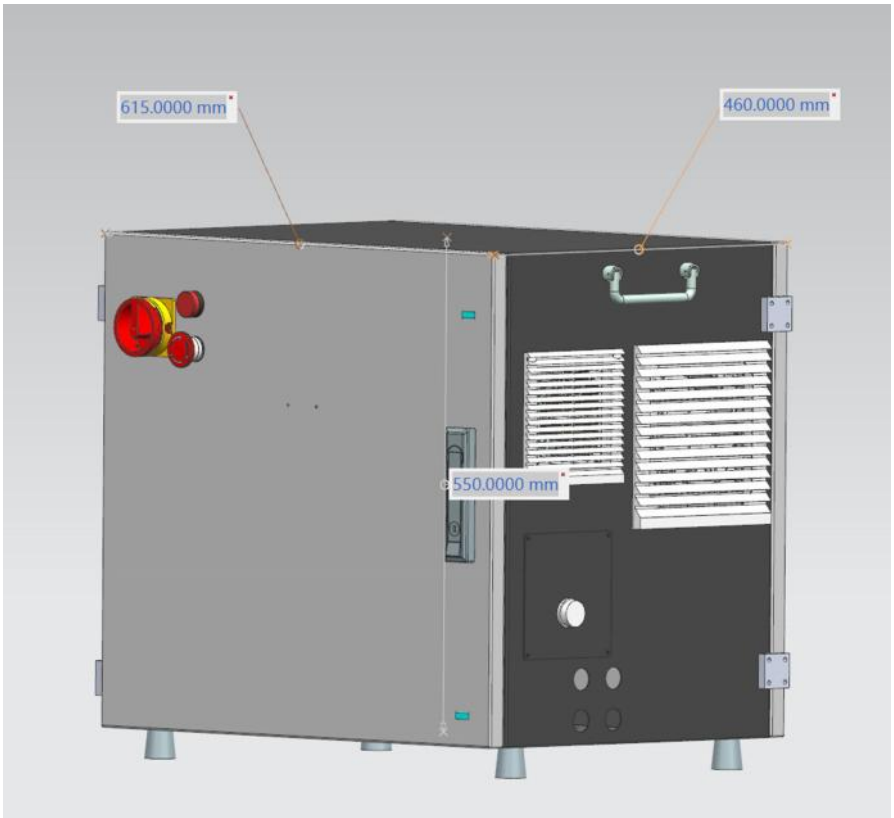
	M3	M3.5	M4	M5	M6	M7	M8	M10	M12
Bolt strength grade	Torque T(N-M)								
Grade 3.6	0.3	0.5	0.8	1.6	2.7	4.6	6.6	13	23
Grade 4.6	0.4	0.7	1.0	2.0	3.4	5.7	8.3	16	29
Grade 4.8	0.6	0.9	1.4	2.8	4.7	7.9	11	23	39
Grade 5.6	0.5	0.8	1.2	2.5	4.3	7.1	10	20	36
Grade 5.8	0.7	1.1	1.7	3.4	5.8	9.7	14	28	48
Grade 6.8	0.8	1.3	1.9	3.9	6.7	11.2	16	32	56
Grade 8.8	1.1	1.7	2.6	5.2	8.8	15	21	42	74
Grade 9.8	1.2	1.9	2.9	5.8	9.9	17	24	48	83
Grade 10.9	1.6	2.5	3.7	7.4	13	21	31	61	106
Grade 12.9	1.8	2.9	4.3	8.7	15	25	36	71	124
Tolerance	±0.1	±0.1	±0.2	±0.2	±0.5	±0.5	±1	±1	±2

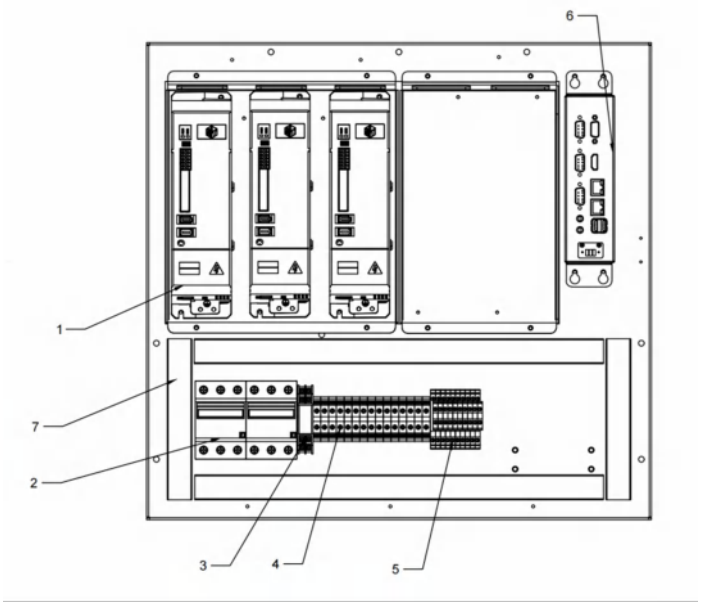
Appendix II List of recommended spare parts

BR-10W-1440				
No.	**Material code**	**Name**	**Quantity**	**Note**
1	01.02.0020	5-axis motor pulley Z=22	1	
2	01.02.0019	4-axis reducer pulley (Z=51) BR-10/12	1	
3	01.02.0018	4-axis motor pulley (Z=34) BR-10/12	1	
4	01.05.01.0098	2.6 KW QN motor	1	
5	01.05.01.0067	2.6 KW QN motor	1	
6	01.05.01.0034	1.3 KW QN motor	1	
7	01.05.06.0063	0.4 KW QN motor	1	
8	01.01.12.065	Robot batteries (palletizing: 2 batteries /unit; three, others)	3	

BR-12-2010				
No.	**Material code**	**Name**	**Quantity**	**Note**
1	01.02.0020	5-axis motor pulley Z=22	1	
2	01.02.0019	4-axis reducer pulley (Z=51) BR-10/12	1	
3	01.02.0018	4-axis motor pulley (Z=34) BR-10/12	1	
4	01.05.01.0068	5.0 KW QN motor	1	
5	01.05.01.0069	2.0 KW QN motor	1	
6	01.05.04.0024	0.4 KW WG motor	1	
7	01.05.01.0063	0.15KW QN motor (coarse axis)	1	
8	01.01.12.065	Robot batteries (palletizing: 2 batteries/unit; three, others)	3	

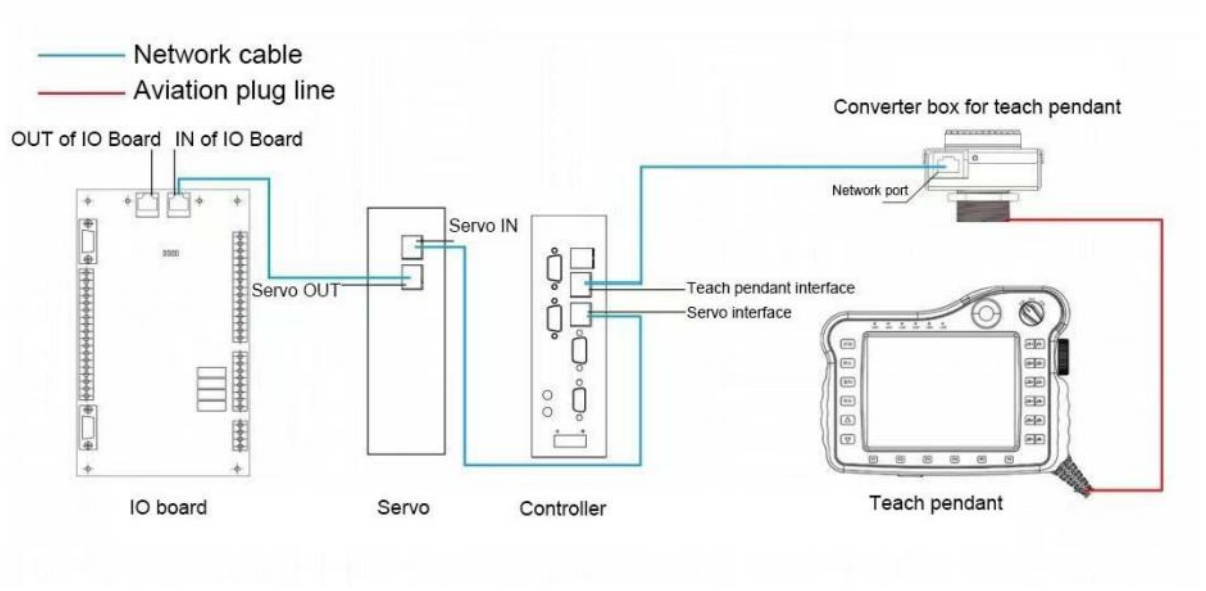
Appendix III Schematic diagram and electrical layout of the control cabinet





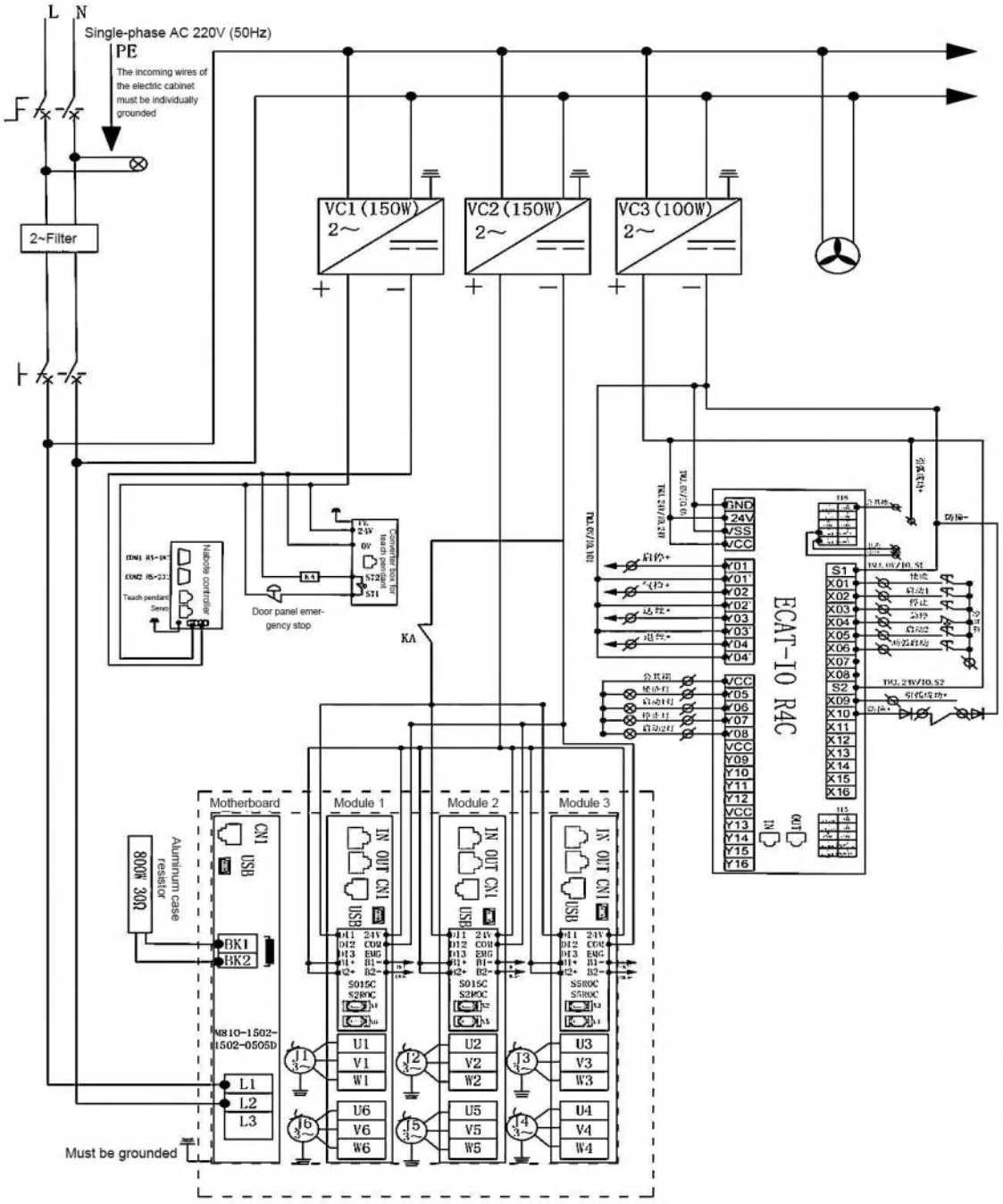
Electrical layout of the main board in the electric cabinet	
1	Servo drive
2	Circuit breaker
3	Relay
4	UK6N connecting terminal
5	Double-layer connecting terminal
6	Controller
7	Trunking

Appendix IV Schematic diagram of network cable connection (network cable in blue)

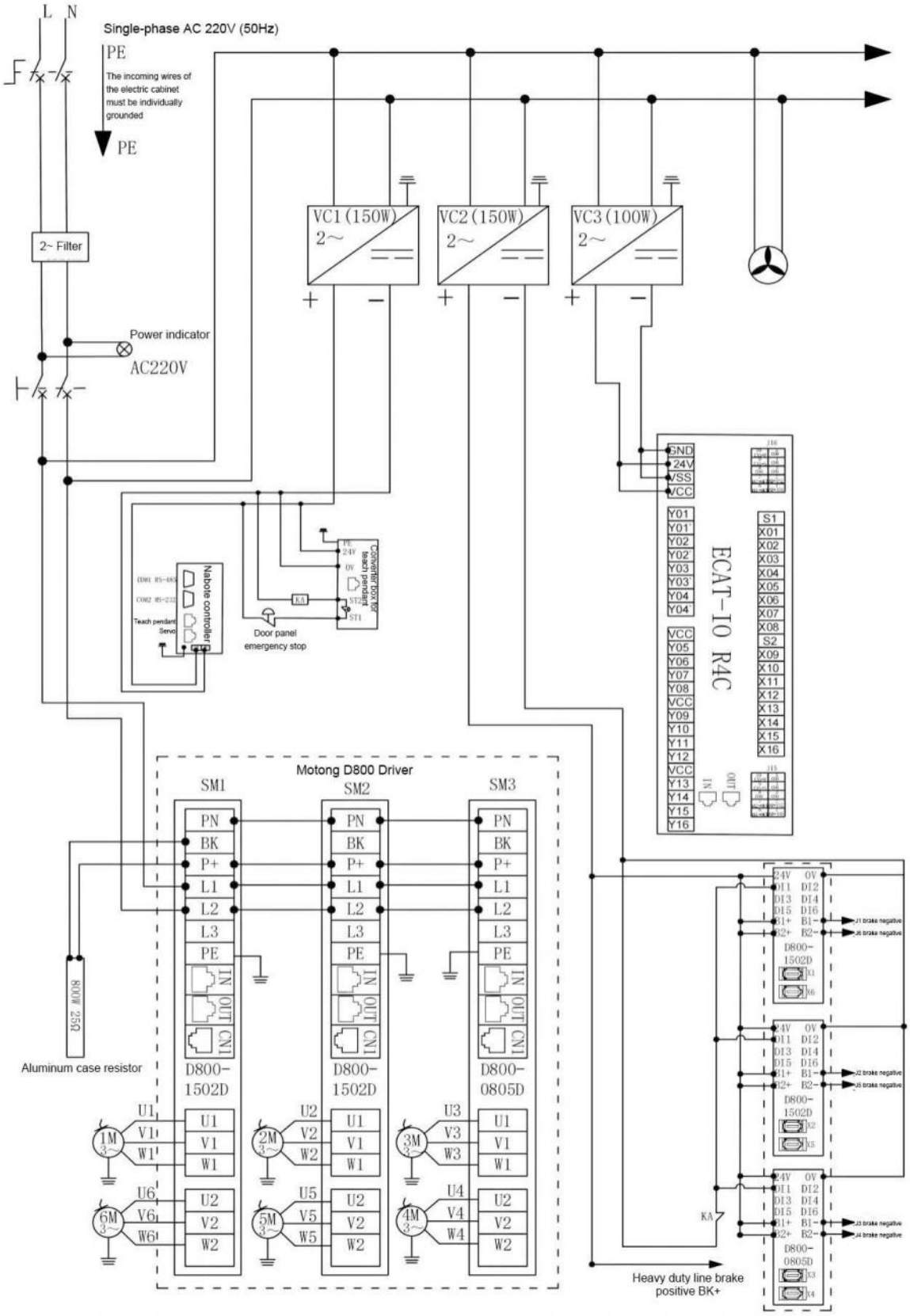


Appendix V Electrical schematic diagram of the control cabinet

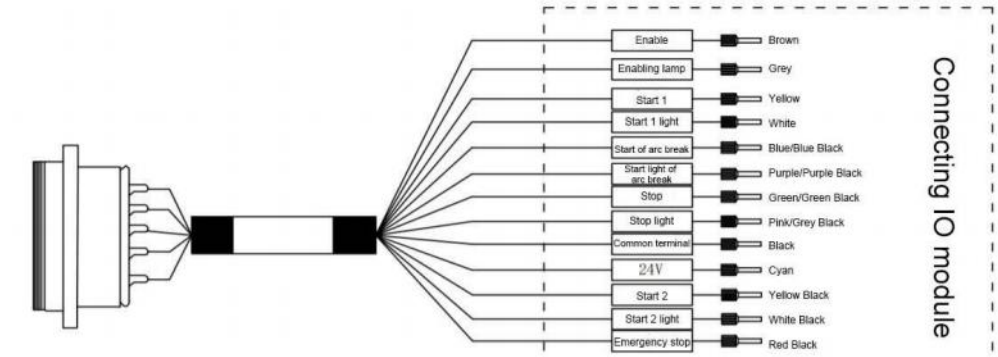
- BR-10W-1440 Robot



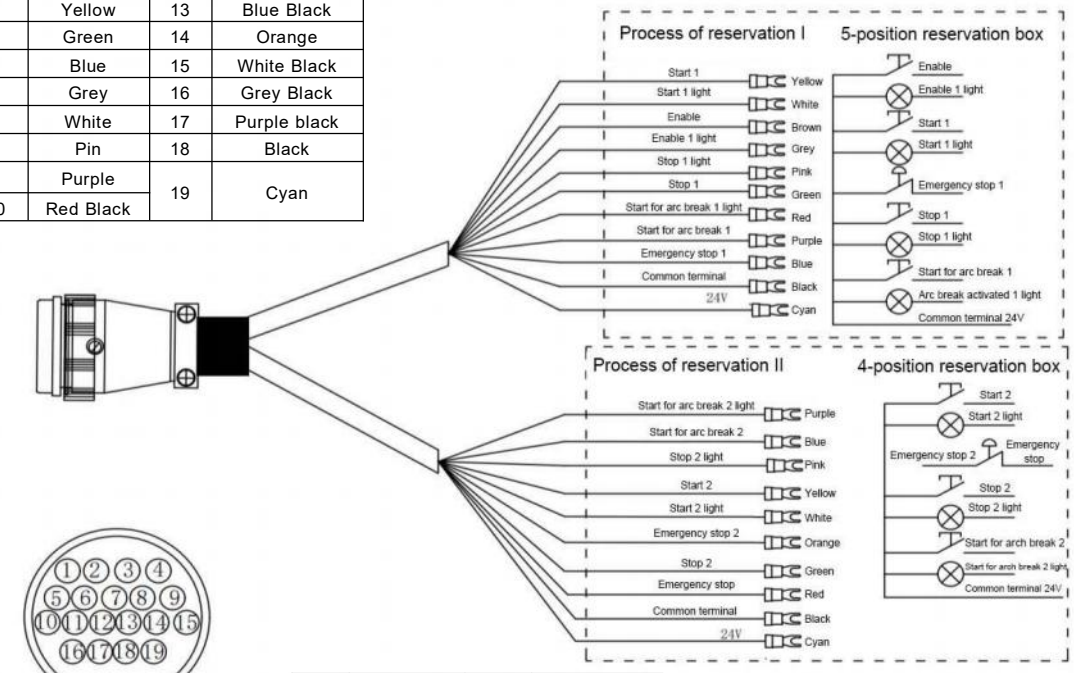
- BR-12-2010 robot



Appendix VI Schematic diagram of IO interface of reservation box and control cabinet



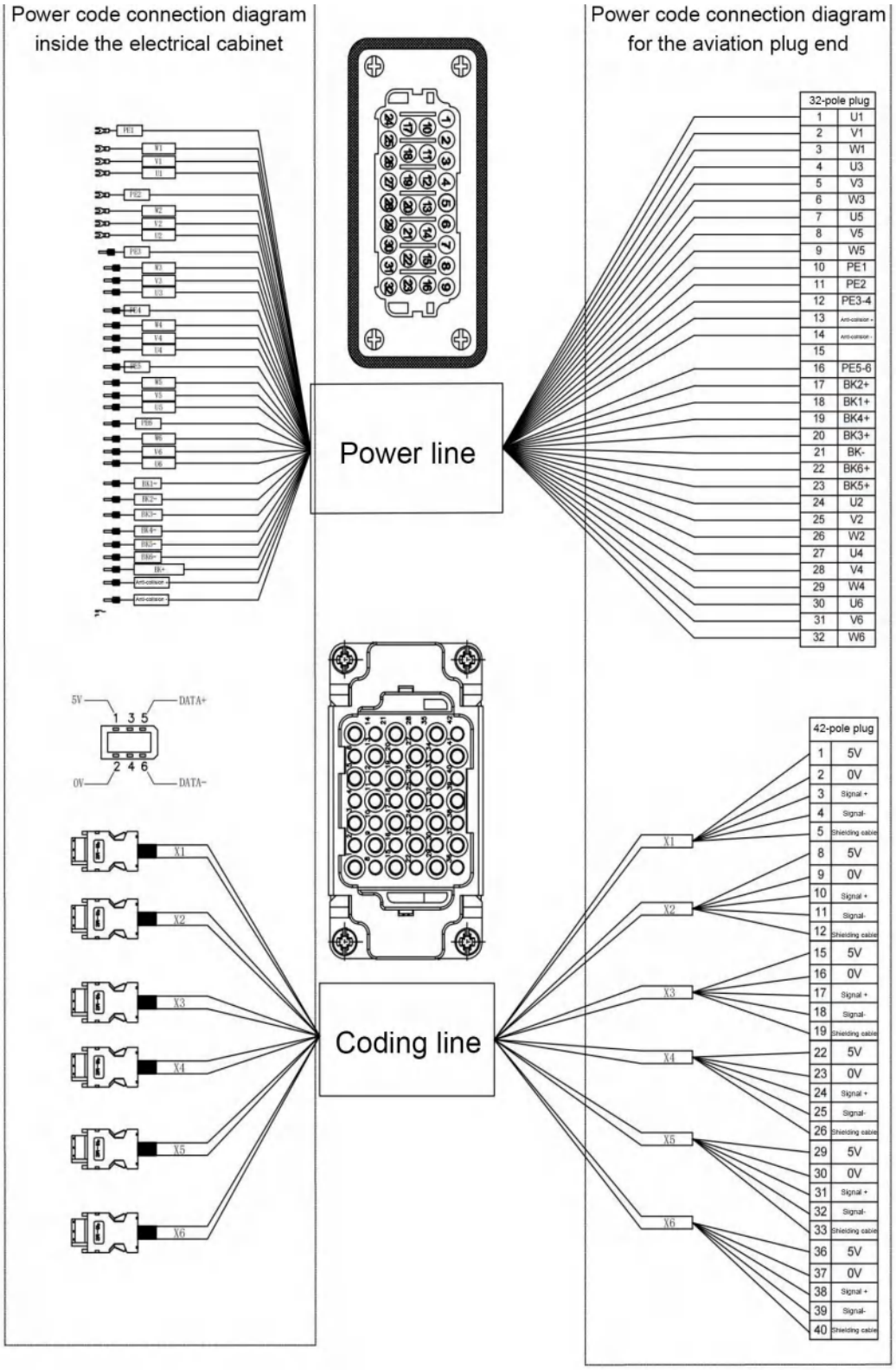
Pin	Color	Pin	Color
1	Red	11	Yellow black
2	Brown	12	Green Black
3	Yellow	13	Blue Black
4	Green	14	Orange
5	Blue	15	White Black
6	Grey	16	Grey Black
7	White	17	Purple black
8	Pin	18	Black
9	Purple	19	Cyan
10	Red Black		



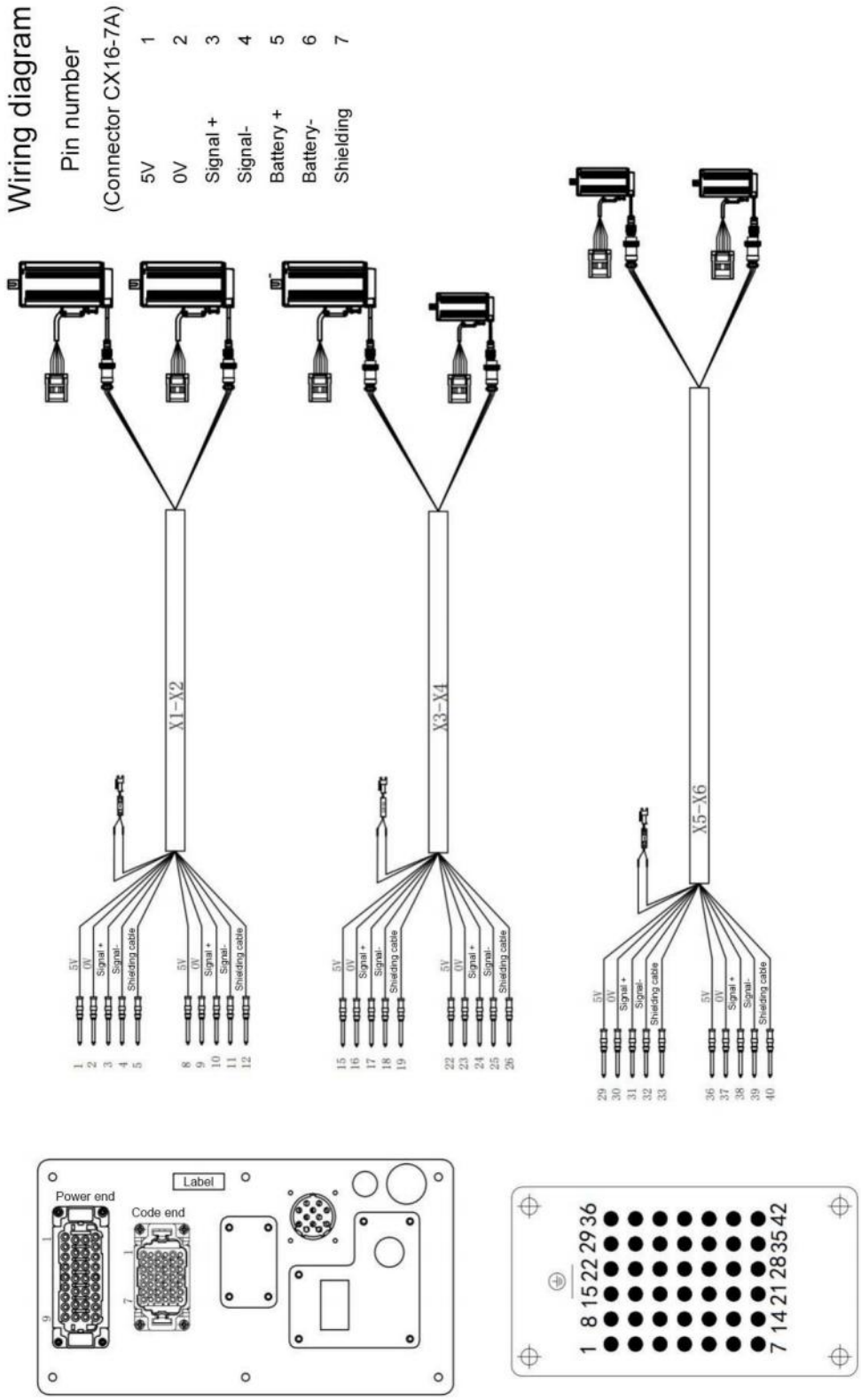
Soldered end of plug

Pin	Color	Pin	Color
1	Red 1	11	Yellow 2
2	Brown 1	12	Green 2
3	Yellow 1	13	Blue 2
4	Green 1	14	Orange 2
5	Blue 1	15	White 2
6	Grey 1	16	Pink 2
7	White 1	17	Purple 2
8	Pink 1	18	Black-Black
9	Purple 1	19	Cyan-Cyan
10	Red 2		

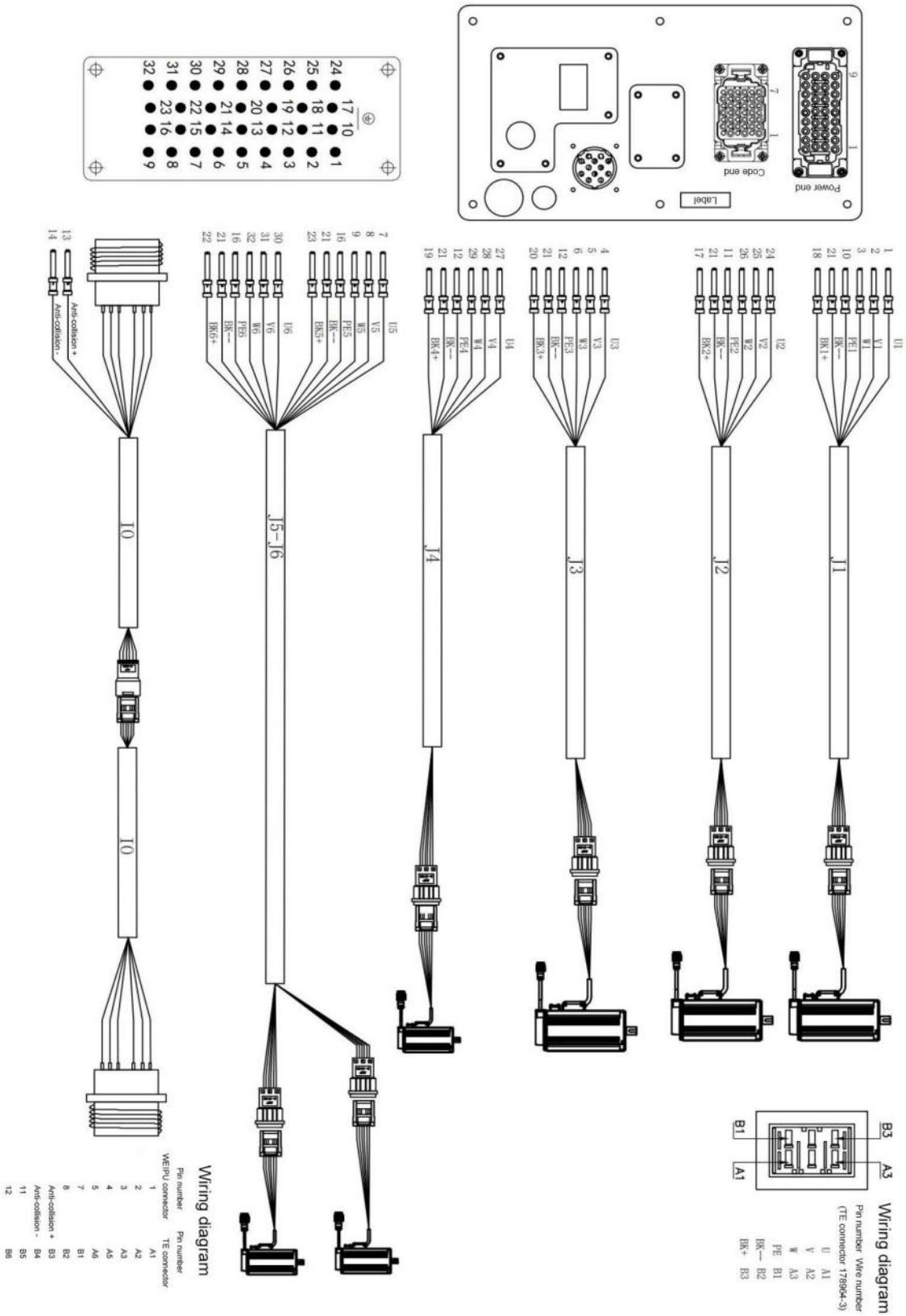
Appendix VII Schematic diagram of power line and coding line connection



Appendix VIII Schematic diagram of coding lines on the body side



Appendix IX Schematic diagram of power lines on the body side



Appendix X Description of driver parameters and alarm treatment opinions

❖ Motong Drive

◆ I. Description of parameters

PE01 0x2E01 Drive model;
PE02 0x2E02 Servo motor code, motor and code must match;
PE03 0x2E03 Parameter Management, enter 100, wait for one minute and restart, the drive restores the factory settings and the parameters are initialized;
PE05 0x2E05 Maximum speed threshold 0~6000rpm;
PE08 0x2E08 Motor direction logic;
PE09 0x2E09 Encoder type setting-ones place: Encoder type 0: Incremental 1: Multi-turn absolute value 2: Single-turn absolute value;
PE11 0x2E0B The delay time (100~500ms) between servo receiving Servo On command and band-type brake On, is now changed to 400 by default;
PE12 0x2E0C The delay time (1~1000ms) between the servo receiving the Servo Off command and the motor not being energized, is now changed to 400 by default;
PE17 0x2E11 Enable 0 : Servo OFF, 1 : Servo ON 1 0 ;
PE18 0x2E12 External Emergency Stop Shielding 0: External Emergency Stop Shielding 1: External Emergency Stop active;
PE18 write 0, will not carry out the linkage alarm, the FF18 alarm does not appear on the top of the teach pendant (FF18 indicates that there is no abnormality in the current module, but there is abnormality in other modules);
PE20 0x2E14 Velocity rigidity coefficient, associative adjustment velocity gain 50~500% ;
PE21 0x2E15 The higher the speed loop gain, the faster the response, too large can cause vibration;
PE22 0x2E16 Velocity loop integration time constant, the larger, the stronger integration effect, the stronger the velocity tracking ability;
PE23 0x2E17 Position ring increment, the larger it is, the faster the position is tracked, too large, it causes vibration (all 6 joints must be the same);
PE24 0x2E18 the higher the 2nd speed loop gain, the faster the response, too large can cause vibration;
PE25 0x2E19 2nd velocity loop integration time constant, the smaller, the stronger integration effect, the stronger the velocity tracking capability 0~500;
PE26 0x2E1A 2nd position loop gain (same as PE23), the higher, the position tracking the faster, too large will cause vibration;
PE27 0x2E1B Torque speed function switch, change to 100 to enable 2-stage gain;
PE28 0x2E1C Velocity feedforward gain, increase, to reduce steady state position deviation, too large to cause overshoot;
PE29 0x2E1D Velocity Feedforward Smoothing Filter Constant, smoothes the amount of velocity feedforward, adjusted in concert with the velocity feedforward gain;
PE30 0x2E1E Damping coefficient, position loop damping coefficient, 50~500 1 100;
PE31 0x2E1F DI1 function setting (default 000006: emergency stop), PE32 0x2E20 DI2 function setting;
PE33 0x2E21 DI3 function setting, PE34 0x2E22 DI4 function setting (EMG);
PE37 0x2E25 DI Terminal filter time 0~32ms 1 5;
PE38 0x2E26 Electronic gear selection;
PE41 0x2E29 Moving average filter constant 0~1024(x0.25ms) 1 0 (6 joints must be consistent);
PE49 0x2E31 Position deviation limit 0.1 to 50.0 turns 0.1 10.0 ■;
PE50 0x2E32 EtherCAT communication cycle (6 joints must be consistent. Nabote is set to 4, Baoyuan is set to 8);
PE51 0x2E33 Quadrant protrusion CCW direction compensation value, PE52 0x2E34 quadrant protrusion CW direction compensation value;
PE53 0x2E35 Quadrant protrusion compensation delay 0~1000ms , PE54 0x2E36 quadrant protrusion compensation filter 0~100ms;
PE55 0x2E37 Gravity compensation value 0~1000‰ , PE56 0x2E38 Gravity compensation polarity 0: CCW 1: CW;
PE57 0x2E39 Trap frequency 10-5000 Hz ;
PE58 0x2E3A Trap depth 0~20 , PE59 0x2E3B trap gain 0~500%;
PE71 0x2E47 Adaptive rigidity 0~300 (Nodding occurs in the enabling process with gravity or load condition, increase appropriately);
PE72 0x2E48 The first set of gain velocity inflection points 0~6000rpm 1 6000 (used with PE27=100);
PE73 0x2E49 The second set of gain velocity inflection points 0~6000 rpm 1 6000 (used with PE27=100);
PE92 0x2E5C Function code E5DA: Clear the encoder multiturn value, restart to take effect.

◆ II. Driver Alarm Codes and Treatment Opinions

(I) Er- 001 Emergency stop alarm;
① The controller is connected to the drive's external EMG emergency stop port;
Conditions for the EMG function to take effect: PE-18 is set to 1, PE-31 and PE-34 are set to 06, the control system signals an emergency stop command and the drive executes the commanded emergency stop alarm.
② The controller is not connected to the drive EMG emergency stop port;

Check whether the value of drive parameter PE- 18 is 0 or not; PE-18 is set to 1, PE-37 is set to 0, and PE-31 to 34 are set to 0.

(II) Er-002 Axis 1 overcurrent alarm; Er-003 is Axis 2 overcurrent alarm.
①Motor code (PE-02,PF-02) error;
Check the motor code, if you don't know what the motor code is, please contact technicians of this Company.
② Is the encoder cable of Axis 1 connected to the encoder port of Axis 2?
Check whether the encoder cable is plugged into the wrong port or not, the encoder port (ECD1) must be wired to match the power cable (UVW) port on Axis 1.
③ Short circuit in three phases of motor or power line (UVW);
Use a multimeter to measure whether the resistance between U-phase and V-phase, U-phase and W-phase, and V-phase and W-phase is equal, if the resistance value differs by 20% or less, continue to use a multimeter to measure whether the resistance of the three phases of the UVW and the ground is infinite or not, and if the alarm still occurs after confirming that there is no abnormality, it is necessary to replace the driver.
④ Report the overcurrent;
Check the power and encoder wires for breakage or poor contact, if not, the drive needs to be replaced.

(III) Er-004 External Bus Disconnect
① Communication between driver modules is abnormal;
Check whether the black (IBUS) wire on the top of the drive is loose or not, or whether there is a broken terminal causing poor contact, re-insert or replace the (IBUS) wire.
② No braking resistor is connected;
Check d0-16 (current bus voltage), check d0-17 (historical minimum voltage after motor enable), d0-18 (historical maximum voltage after motor enable), when the maximum bus voltage reaches 390V, it is necessary to connect to the braking resistor.
(iii) The bus voltage reaches 395V;
Check whether the input voltage is within a reasonable range (187V to 242V) or not. Braking resistor is not connected, is not of the right size, or is damaged.
There is connection to the braking resistor, maximum voltage reaches 395V, drive power module braking function fails, it need to replace the drive.

(IV) Er-005 Axis 1 Overload; Er-006 Axis 2 Overload
① The brake is not switched on;
Check whether the external 24V switching power supply and wiring are normal, if the wiring is normal, the enabling brake is still not open, the multimeter to measure the voltage between B+ and B-is 24V, please replace the motor; in the absence of on the enabling, with a multimeter to measure the voltage between B + and B-is 24V, it need to replace the drive.
② Motor code error;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
③ Encoder wire is reversed;
Is the encoder wire of Axis 1 connected to the encoder port of Axis 2?
④ The motor is blocked;
Loosen the motor axis load and control the motor operation separately, if it can not be driven, please replace the motor; if it can drive the motor normally, please check whether the mechanical structure of the reducer is jammed.
⑤ Incorrect wiring of the motor power cord;
Is the motor power line UVW three-phase phase sequence connected incorrectly.
(vi) Motor zero point is lost;
Check whether the motor zero point is normal or not.

(V) Er-007 for axis 1 motor initialization; Er-008 for axis 2 initialization
① Encoder wiring error;
Check whether the motor encoder connector is loose or not, whether the 1394 plug tabs are functioning properly or not, whether the encoder wires are shielded with a twisted pair or not, and whether the diameter of the individual wires is equal to or greater than 0.3 mm^2 or not.
②Motor failure;
Check whether the motor three-phase is normal or not and shorted to ground or not.
③ Drive failure;
The drive needs to be restored to factory settings, the lower enable setting PE-03 is 0100, wait for PE-03 to change back to 0000 and restart after power off, if it still alarms, it need to replace the drive.

(VI) Er-009 is an abnormal motor current for Axis 1; Er-010 is an abnormal motor current for Axis 2.
① The motor power cord is not connected;
Check whether the motor power cord is connected or not.
② UVW Three-phase wiring is connected in the wrong order;.
Wiring in the correct order for UVW three-phase wiring
(iii) The power line butt terminal is loose or disconnected;
Re-plug the powerline port and measure with a multimeter to see if the UVW ends are conducting.
④ The motor code is set incorrectly;

Check the motor code, if you don't know what the motor code is, please contact our technician.
(vii) Internal failure of the drive;
Swapping test of power line and coding line of the same power motor. If axis 1 still alarms, replace the drive.
⑧ Exceed the maximum speed of the motor;
Monitor the motor speed.
⑨Whether PE-21/PF-21 is too large or not;
Look at the waveform to modify the PE-57 , PF-57 trap frequency.
⑩ Abnormal bus voltage;
Check whether the input voltage is within a reasonable range (187V to 242V) or not.
⑪ Motor zero point is lost;
Check whether the motor zero point is normal or not.

(VII) Er-011 DC bus undervoltage
① The supply voltage of the on-site power grid is too low;
Measure the AC voltage between L1 and L2 with a multimeter to see if it is lower than 195V, monitor the do-16, d0-17, d0-18 voltage values, and add a transformer or voltage regulator if the voltage is unstable.

(VIII) Er-012 DC bus overvoltage
(1) The braking resistor resistance value is large, resulting in a long time to release energy;
General machine: suggestions for 3-axis: 200W 20 or 25R; suggestions for 5-axis: 400W~500W 20 or 25R.
High-speed machine: the resistance value of the resistor remains unchanged, the power can be increased appropriately
Smaller resistance value will damage the drive-control integration, larger, braking effect is not good, 20 ohms~25 ohms is suggested.
② The supply voltage of the on-site power grid is too high;
Measure the AC voltage between L1 and L2 with a multimeter to see if it is higher than 240V, and monitor the do-16, d0-17, d0-18 voltage values, if the voltage is too high, you need to add a transformer or voltage regulator.
(iii) The supply voltage is normal and the bus voltage is over 400V;
The encoder line 0V,5V is reversed.

(IX) Er-013 is too large for Axis 1 position command; Er-014 is too large for Axis 2 position command.
①Multi-axis linkage may be caused by the controller failure to enable, give priority to troubleshoot other faults (e.g. drive module has reported Er-020, give priority to troubleshoot Er-020);
② The master position command increment is too large, and the master encoder unit is set incorrectly;
Monitor the control system for sudden changes in the command waveform, and contact the control manufacturer for handling in case of sudden changes.
(iii) The synchronization period is set incorrectly;
Is the synchronization period set correctly (PE-50).
④ The driver is not set to absolute value type, resulting in loss of reference point after power up;
Whether the ones place of PE-09 parameter is set to 1 or not.
⑤ Electronic gear parameters are set incorrectly, commands given by the system will change suddenly;
Whether the electronic gear parameters of the control system are set correctly or not PE/PF (parameters 38,39,40).

(X) Er-015 Drive overheating
① The ambient temperature is too high and the installation environment is not forcibly ventilated;
The electric cabinet needs to be fitted with a cooling fan.
② The drive fan is damaged and the drive exceeds 75℃, causing a drive alarm;
Check for damage to the drive's fan, in case of a damaged fan, it requires replacement of the fan, monitor d0- 19 values, if it is above 75, the drive will alarm.
(iii) Abnormal temperature sampling
If the heat dissipation design of the electric box is reasonable, monitor whether the load ratio of d0-09 and d0-59 is within the range of 100% or not, and if the alarm occurs within the range, it is necessary to return to the test. If the heat dissipation design of the electric box is unreasonable, suggest the customer to optimize the heat dissipation design.

(XI) Er-016 Fail to write EEPROM
①EEPROM abnormality;
The drive needs to be restored to factory setting, the lower enable setting PE-03 is 0100, after PE-03 is changed back to 0000, power off and restart, there is still an alarm, the drive needs to be replaced.

(XII) Er-017 Fail to read EEPROM
①Contact technicians of this Company for treatment.

(XIII) Er-018 for excessive position deviation of Axis 1; Er-019 for excessive position deviation of Axis 2
① Motor code error;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
② The maximum motor speed has been reached;

Check whether the bus voltage is normal or not, the motor can not reach the maximum speed if the voltage is low, check the maximum speed of motors PE-05, PF-05, check whether the waveform motor reaches the maximum speed, it can not exceed the maximum speed of the motor, the maximum speed needs to be set in the system.

(XIV) Er-020 for axis 1 encoder error; Er-028 for axis 2 encoder error
① Encoder wiring error;
Check whether the motor encoder connector is loose or not, whether the 1394 plug shrapnel is normal or not, that the encoder wires are shielded with twisted pair or not, and whether the diameter of the single wire is equal to or greater than 0.3mm² or not.
② No earth wire is connected;
The equipment grounding terminal is effectively connected to the plant earth.
③ The motor code is not correct;
Check whether the motor code is correct or not. Incorrect motor settings for Tamagawa and Sankyo protocols can cause errors to be reported.

(XV) Er-021 is abnormal speed measurement for Axis 1; Er-029 is abnormal speed measurement for Axis 2.
① Motor encoder abnormality;
Replace the motor.

(XVI) Er-022 for axis 1 encoder initialization; Er-030 for axis 2 encoder initialization
① Encoder wiring error;
Check whether the motor encoder connector is loose or not, whether the 1394 plug shrapnel is normal or not, whether the encoder wires are shielded with twisted pair or not, and whether the diameter of the single wire is equal to or greater than 0.3mm² or not.
② The motor code is incorrect;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
③ The drive is damaged;
Check whether the black (IBUS) wire on the top of the drive is loose or not, or damaged terminals resulting in poor contact, listen for the drive module relay to have suction sound after power up, if not, replace the power module.

(XVII) Er-024 External bus error
①PE- 18 , PF-18 is set to 1, and the associated alarm function takes effect;
Clear the other alarm code before cancelling the associated alarm.

(XVIII) Er-027 EEPROM Parameter Check Error
①EEPROM abnormality;
The drive needs to be restored to factory settings, the lower enable setting PE-03 is 0100, wait for PE-03 to change back to 0000 and restart after power off, if it still alarms, it needs to replace the drive.

(XIV) Er-032 Parameter initialization error
①EEPROM abnormality;
The drive needs to be restored to factory settings, the lower enable setting PE-03 is 0100, wait for PE-03 to change back to 0000 and restart after power off, if it still alarms, it needs to replace the drive.

(XX) Er-033 Communication interruption
① The control system is not synchronized with the drive communication cycle;
Sets whether the PE-50, PF-50 parameter is the value of d0-52 divided by 4 or not.
② The control system network port is damaged;
Check whether the controller network port light is blinking or not, replace the controller if such light is not blinking.
③ The drive network port is damaged;
Check whether the drive network port light is blinking or not, replace the drive if such light is not blinking.
④ Abnormal network cable connecting the control system to the driver;
Test the cable by replacing it with another cable, if the alarm does not appear, the cable is faulty.
⑤ Whether a valid ground is connected or not;
Check whether the electrical cabinet grounding wire is reliable or not.

(XXI) Er-034 for Axis 1 Battery Failure; Er-035 for Axis 2 Battery Failure
① Battery voltage is lower than 3.3V;
The machine returns to zero and then replaces the battery with a new one, clearing the alarm then the system resets the zero position for this axis.
② Battery voltage is higher than 3.3V;
Check whether the encoder plug is loose or not, if the alarm repeats after 1 minute since clearing alarm, check whether the encoder wiring is shorted, disconnected, or falsely welded or not, if not, replace the battery board or battery box.

(XXII) Er-036 is axis 1 multiturn value loss; Er-037 is axis 2 multiturn value loss.
① Battery voltage is 3.6V;

Plugging and unplugging the encoder wire causes this problem, clearing the alarm to reset the zero point, the problem can be solved..
② Battery voltage is lower than 3.0V;
Replace the battery with a new one, clear the alarm then the system resets the zero position for this axis.

(XXIII) Er-040 is abnormal axis 1 speed measurement; Er-041 is abnormal axis 2 speed measurement.
① The motor code is set incorrectly;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
② Motor encoder abnormality;
Replace the motor.

(XXIV) Er-042 for Axis 1 motor galloping; Er-043 for Axis 2 motor galloping
① Motor code error;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
② The parameters of PE-09 , PF-09 are set incorrectly;
Check the Soft Protection PE-09 and PF-09 parameters, monitor the d0-97 and d0-98 parameters, set the decimal value to 6 for versions before 2020 917, set the decimal value to 5 for versions from 2020 917 to 2021 701, and set only the ones-place value for versions after 2021 701 (Software Protect function is on by default).
③ Motor abnormality;
Check whether motor zero point and motor encoder are abnormal or not.

(XXV) Er-044 is an Axis 1 current sampling overload; Er-045 is an Axis 2 current sampling overload.
① The motor code is set incorrectly;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
② Line problems;
Check whether there is any abnormality in the wiring of the electric box or not, whether there is any looseness in the motor power line and encoder connector or not, whether there is any wear of the line or not, and whether there is any short circuit to the ground or not.
(iii) Voltage saturation;
Use the keypad to monitor d0-06, d0-08 of axis 1, d0-56, d0-58 of axis 2 (d0-06, d0-56: max. 28500; d0-08, d0-58: max. 17500). If in the range, it shall check whether motor is calibrated or not; if the motor is not calibrated, it needs to send the motor back for calibration; in case of exceeding the range, it needs to replace the drive.

(XXVI) Er-046 is Axis 1 current sampling overcurrent; Er-047 is Axis 2 current sampling overcurrent.
① The motor code is set incorrectly;
Check the motor code, if you don't know the motor code, please contact technicians of this Company.
②Line problems;
Check whether there is any abnormality in the connection lines of the control cabinet or not, whether there is any looseness in the motor power line and encoder connector or not, whether there is any wear of the line or not, and whether there is any short circuit to the ground or not.
③ The servo parameters are not set appropriately;
PE-09, PF-09, this alarm will appear if the software protection is turned on; if the software protection is not turned on, the drive and motor will be damaged directly (mandatory turning on software protection for machines from 202107 onwards, it is not related to parameter 9).

(XXVII) Er-227 Drive hardware encryption error
① Upgrading the firmware version is interrupted;
Just re-upgrade.
Note about program upgrades:
It is not recommended to upgrade the driver after 2020.9 to the version before 2020.9, if you must upgrade, you need to set PE92 to AAAA before upgrading; after upgrading the version before 2020.9 to the version 2020.9, it need to restore the factory settings, and similarly, it need to restore the factory settings when upgrading back; If there is a big difference between the version before and after the upgrade, it is recommended to restore the factory settings and set the parameters to run.

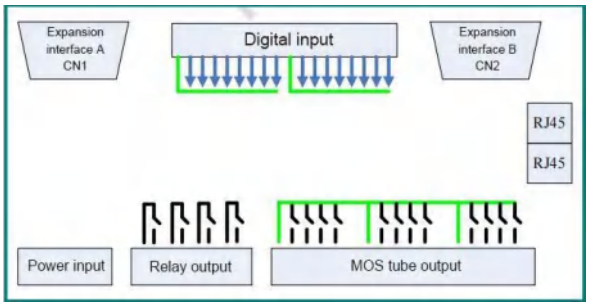
Appendix XI Details of IO Board (R4C)

R4C Basic Specifications	
Name	inexbot_IO_R4C
Size	122*200mm
Bus speed	100Mbps
Distributed clock	Supported

Power supply	24V DC
Digital input	16-Input, Polarity Assignable
Digital output	16-output (4 relays, 12 MOS tubes), short-circuit protection
Analogue input	2-way, 0~10V
Analogue output	2-way, 0~10V
Encoder	2-way, AB phase counting (differential signal interface)
Extension Interface	Can interface
Operating temperature	0~60°
Relative humidity	95%, non-condensation
Communication cycle	Minimum at 200us

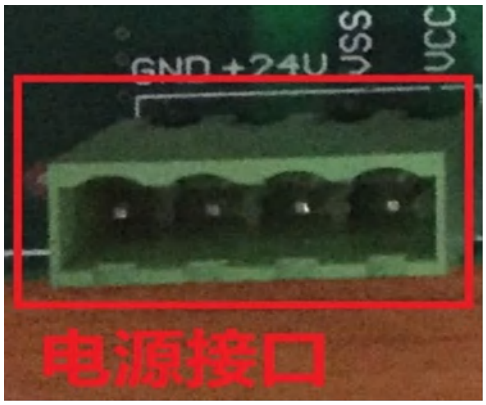
Layout figure

layout plan



R4C Power Interface Requirements	
Requirement	24V DC Input
Control power supply:	GND (negative) and +24V (positive) connected to DC24V, power 1A or more

❖ R4C Power Interface Requirements



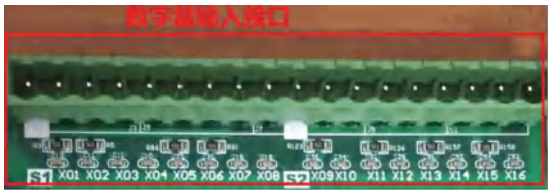
Power supply:	VSS (negative) and VCC (positive) connected to DC24V~26V, power 2A or more, need to increase the power supply power according to the actual load.
Note	The control power supply and power supply can be powered by the same power supply.
	When the load power of the output circuit is large, or the use the environment is relatively harsh, it is recommended that the control power supply and power power supply are separated.

❖ R4C Power and Communication Indicator

R4C Power and Communication Indicator	
POWER	Power supply
RUN	Successful communication
LINK-IN	Input network port is connected
LINK-OUT	Output network port is connected

RUN status of communication indicator	
INIT status:	Off for long time
Pre-OP status:	Fast flash
Safe-OP status:	Slow flash
OP Status:	On for long time

❖ Digital input interface

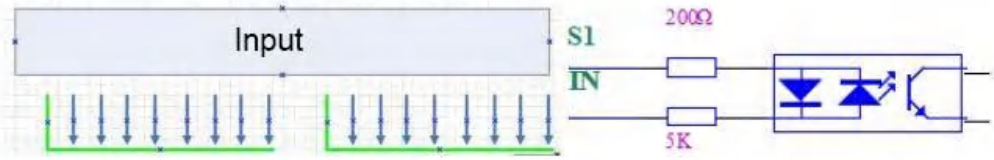


As shown in the figure, the inputs are divided into two types: X01~X08 are grouped with common terminal S1, and X09~X16 are grouped with common terminal S2.

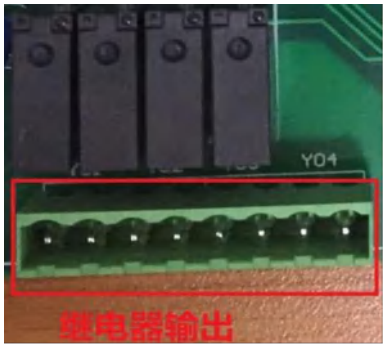
The inputs are recommended to be at 24V level, and the input polarity is configurable, the input end is active at low level if the common terminal is connected to a high level; the input end is active at high level if the common terminal is connected to a low level;

Each input port has a corresponding LED to indicate status.

➢ Equivalent circuit:

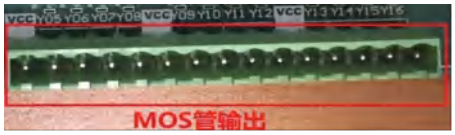


❖ Relay output interface



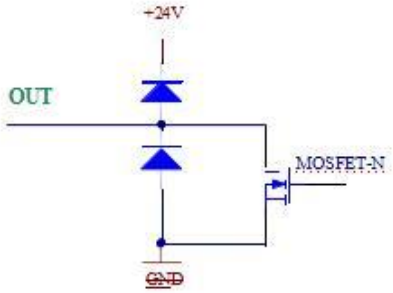
R4C-Relay output interface	
Relay output four ways	Y01-04, One switch output per way
Relay Output specification	7A-250VAC, 7A-30VDC
LED	Each output port has a corresponding LED to indicate the status
Note	Relays have a service life of approx. 100,000 cycles, please note the switching frequency.

❖ MOS tube output interface

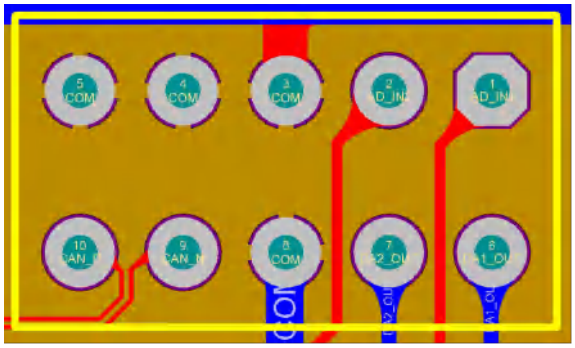


R4C-MOS tube output connector	
MOS tube	NPN structure, output two states: low level 0V and off-state.
Output capability	0.5 Amp/channel (25°C)
Note	A relay adapter is recommended if the way output power is greater than 0.3Amp.
	The MOS outputs are divided into three groups, with four outputs in each group.
	Each group has a corresponding VCC output of 24V (VCC voltage).

➢ Equivalent circuit:

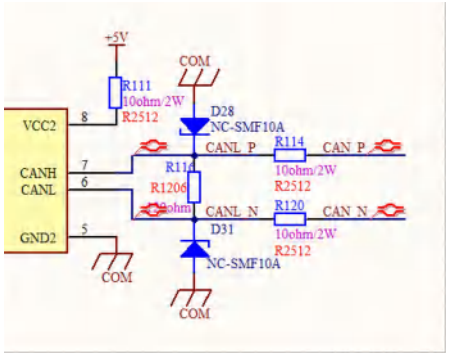


❖ Extension interface A (CN1)

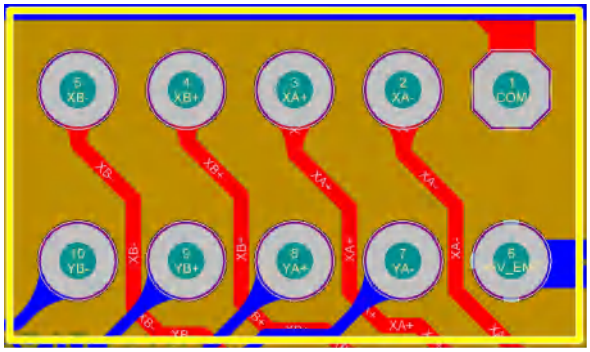


Signal definition of extension interface A (CN1)					
Pin	Definition	Description	Pin	Definition	Description
1	AD_IN1	Analogue input channel 1	6	DA1_OUT	Analogue output channel 1
2	AD_IN2	Analogue input channel 2	7	DA2_OUT	Analogue output channels 2
3	COM	Signal ground	8	COM	Signal ground
4	COM	Signal ground	9	CAN_N	can interface negative end
5	COM	Signal ground	10	CAN_P	can interface positive end
Note: Twisted pair shielded cable is required for using differential signals on the interface. Analogue input: 0~10V Analogue output: 0~10V					

➢ Equivalent circuit:

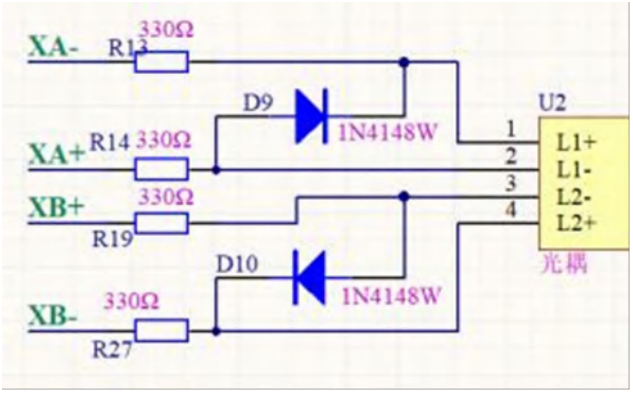


❖ Extension Interface B (CN2)



Signal definition of extension interface B (CN2)					
Pin	Definition	Description	Pin	Definition	Description
1	COM	Signal ground	6	+5V_ENC	Encoder 5V Power Supply
2	XA-	A phase negative end of Axis 1 Encoder	7	YA-	A phase negative end of Axis 2 Encoder
3	XA+	A phase positive end of Axis 1 Encoder	8	YA+	A phase positive end of Axis 2 Encoder
4	XB+	B phase positive end of Axis 1 Encoder	9	YB+	B phase positive end of Axis 2 Encoder
5	XB-	B phase negative end of Axis 1 Encoder	10	YB-	B phase negative end of Axis 2 Encoder
Note: Twisted pair shielded cable is required for using differential signals on the interface. Encoder selection recommendation: 5V supply, differential output, quadrature outputs for phase AB Data type: 32-bit signed data. Encoder power-up value is 0, range:-2147483648~2147483647					

➢ Equivalent circuit:



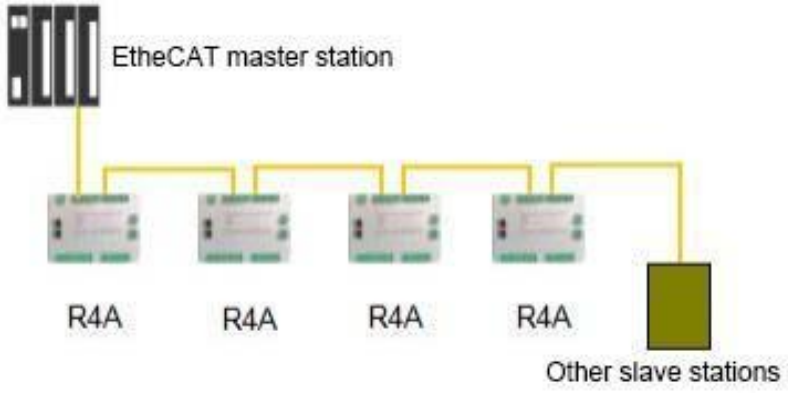
Appendix XII Details of IO Board (R4A)

❖ Overview

The R4A Remote IO Module provides a standard EtherCAT communication interface and is a standard EtherCAT slave device that can be connected to any EtherCAT communication network. The R4A module provides one IN port and one OUT port for connecting EtherCAT communication devices with RJ45 connectors.

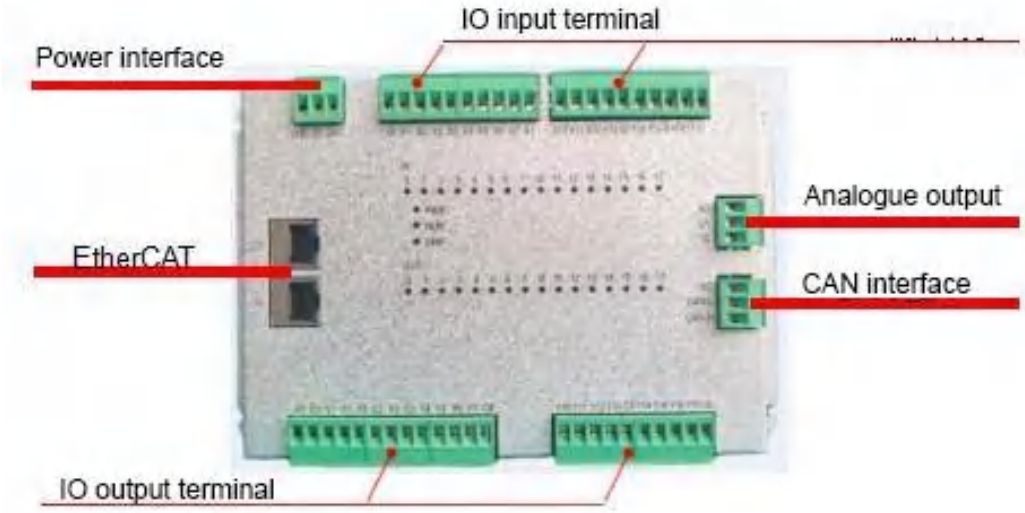
The R4A Remote IO Module connects distributed IO control points to the EtherCAT network, where the R4A module is a slave with its own input and output points in various combinations of functions to meet the needs of different applications.

The R4A module is connected to the EtherCAT network as shown below:



As shown in the figure, the R4A remote IO module can transmit digital inputs from the industrial site to the master station via the EtherCAT bus, and can transmit control data from the master station to the digital outputs, analogue outputs, etc. of the industrial site.

❖ Composition

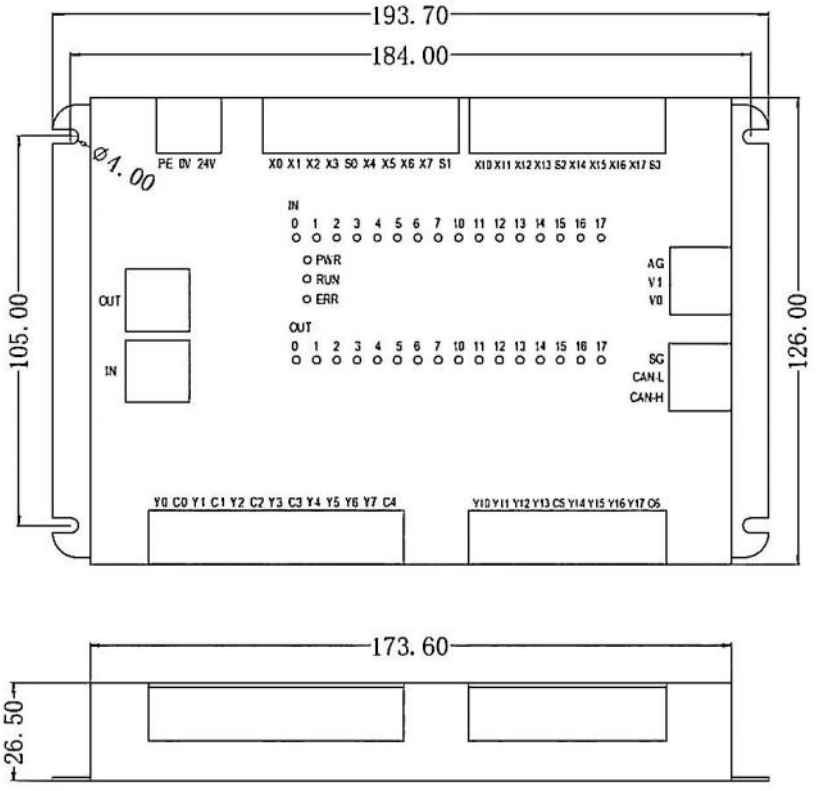


❖ Specification

EtherCAT communication interface	
Connector	RJ45
transmission method	100BASE-TX
transmission cable	CAT 5 network cable (shielded)
electrical isolation	500VDC
transmission rate	100M
Power supply specifications	
Power Supply voltage	24VDC (18~36V)
power consumption	
weight	
Environmental specifications	
Interference with immunity	ESD(IEC 61131-2,IEC 61000-4-2):8KVAirDischarge EFT(IEC61131-2,IEC61000-4-4): PowerLine:±2kV,Digital Input:±2kV ComunicationI/O: ±2kV ConductedSusceptibilityTest(EN61000-4-6,IEC61131-29.10):150kHz~80MHz,10V/m RS (IEC 61131-2,IEC 61000-4-3): 26MHz~1GHz,10V/m
Operating/storage environment	Operation: 0°C~50°C (temperature), 50~90% (humidity), contamination level 2 Storage: -25°C~70°C (temperature), 5~95% (humidity)
Vibration/shock resistance	International Standards IEC 61131-2,IEC 68-2-6 (TESTFc)/IEC 61131-2&IEC 68-2-27 (TESTEa)

❖ Installation

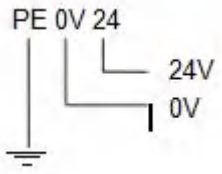
The R4A is fixed with flat screws, using M3 screws to fix the installation holes on the corners to the cabinet. The R4A has semi-closed fixing holes, making it easier to remove and install in the field. To remove the R4A module, first remove all the wiring plugs and then remove the fixing screws on the corners, then the module can be removed smoothly.
The exterior dimensions are shown below:



❖ Hardware connection

- The R4A provides two RJ45 interfaces, one for IN and one for OUT. R4A module can automatically assign an address without the need to set an IP address.
- Power interface

  The power interface for the R4A module is located on the upper left side of the module and the power supply is a 24V DC input. Please refer to the following diagram, take care to connect to the ground properly, grounding can be made through directly connecting to the cabinet enclosure or to a grounded rail.



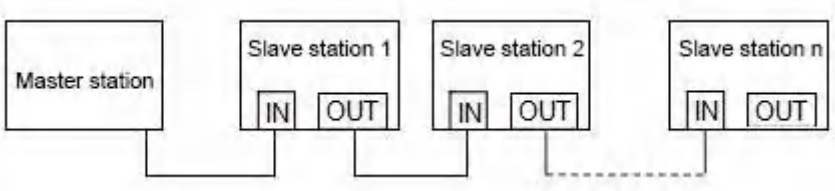
- EtherCAT interface

  The R4A module provides two RJ45 interfaces, an IN interface for connecting to a higher-level EtherCAT device and an OUT interface for connecting to a lower-level EtherCAT device.

① **The EtherCAT interface provided by the R4A has the characteristics shown in the table below:**

Communication rate	100M
Communication cable	Shielded Super Category 5 CAT-5E Communication Cable
Number of nodes	65535 nodes per network segment
Interface form	RJ45 with communication status light indicator
Number of interfaces	IN Interface, OUT Interface

② **EtherCAT network wiring schematic diagram**



③ **Cable Selection**

EtherCAT is based on the standard IEEE 802.3 protocol and uses standard shielded Category 5 CAT-5E cables. Since most EtherCAT modules have a built-in switch and provide at least two RJ45 communication ports, a special switch is no longer required for wiring in general applications, only the cables can be provided for completing wiring in field. The maximum communication distance between two devices in an EtherCAT network is 100 meters.
If a standard communication cable is not used, the maximum communication distance may not be reached.

④ **EtherCAT address setting**

The R4A module supports automatic address assignment and does not require any physical switches to set its address, the EtherCAT master assigns the address automatically and there is no need to configure the IP address manually.

⑤ Input and output specifications

The R4A Remote IO Module provides 16 digital input channels, 16 digital output channels, and 2 analogue voltage output channels.

Analogue voltage output channel.

R4A terminal arrangement:

Digital Input Terminals

X0	X1	X2	X3	S0	X4	X5	X6	X7	S1
X10	X11	X12	X13	S2	X14	X15	X16	X17	S3

Digital Output Terminals

Y0	C0	Y1	C1	Y2	C2	Y3	C3	Y4	Y5	Y6	Y7	C4

Y10	Y11	Y12	Y13	C5	Y14	Y15	Y16	Y17	C6

Analogue output terminals

AG
V1
V0

CAN communication terminals

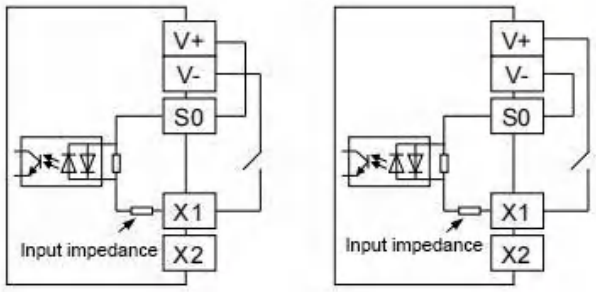
SG
CANL
CANH

Note: The S0~S3 common terminals of the input channels are independent, and the C0~C6 common terminals of the output channels are also independent mutually.

⑥ Digital Input Specifications

The R4A series modules provide both sink and source inputs. Detailed input channel parameters are listed in the table below:

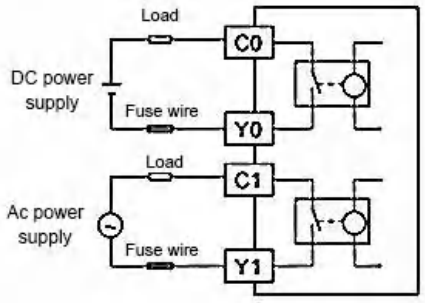
Input Points	16 points.
connection method	Open shedding terminals (5.08mm for spacing)
Input form	Sink/Source
Input Voltage	DC24V
Input signal form	For sink input: NPN open set insulated gate bipolar transistor For source input: PNP open set insulated gate bipolar transistor

Input circuit isolation	Optical coupling isolation
Input Motion Display	LED on the panel lights up when an input signal is detected
Input circuit composition	 Sink Input Source Input

Note: The common terminal of X0~X3 is S0, the common terminal of X4~X7 is S1, the common terminal of X10~X13 is S2, and the common terminal of X14~X17 is S3.

⑦ Digital output specifications

The output channels of the R4A provide output in the form of relay. The detailed parameters of the relay output channels are shown in the table below:

Output points	16 points.
Connection method	Open shedding terminals (5.08mm for spacing)
Output type	Relay
Load capacity	5A@30VDC, 5A@250VAC
Circuit isolation	Relay Isolation
Output motion display	The corresponding LED light is on if there is signal output
Output circuit composition	

⑧ Analogue output

The R4A module provides two analogue output channels, and the analogue outputs are voltage type 0-10V signals. The output value 0-4000 corresponds to the output voltage 0-10V, i.e., when the output value is 4000, the output channel outputs 10V voltage, and when the output value is 2000, the output channel outputs 5V voltage.

Note: The analogue output channels are fully isolated, with an internal DC/DC isolated power supply, and there is no need to connect an external power supply at the terminal.

The wire end is then connected to the external power supply.

⑨ Fault diagnosis

The R4A has three indicator lights to indicate the operating status, including the PWR light, the RUN light, and the ERR light. Description of the PWR power indicator light display:

Indicator status	Indicator function	Troubleshooting
lights out	No power supply	Connect the R4A power cord correctly and confirm that the power supply is normal.
Green light on	proper functioning	No treatment is required.

Description of the RUN power indicator light display:

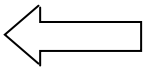
Indicator status	Indicator function	Troubleshooting
lights out	No power supply or initialization state	Connect the R4A module power cord correctly and confirm that the power supply is normal.
green light flashing	Module is in preoperational state	1) Confirm whether the connection to the master station is correct or not 2) Confirm whether the master station is in operation or not
Double flash green light	Module in safe operating condition	Confirm whether the master station is in operation or not
Green light on	Module is in operation	No treatment required.

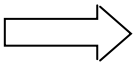
Description of the ERR power indicator light display:

Indicator status	Indicator function	Troubleshooting
lights out	proper functioning	No treatment is required.
red light flashing	Configuration is abnormal, it could not complete the state transition requested by the master station.	Confirm whether the configuration is correct or not.
red light, double blinking	Sync Manager Timeout	Confirm whether the module is properly connected to the master station or not.

10 IO data structure

For the digital input points and output points of the R4A module, the input points are numbered according to X0~X7, X10~X17, and the output points are number according to Y0~Y7, Y10~Y17, the input and output point data of R4A module are corresponding in order:

	EtherCAT master station	Data flow	R4A
Input data	Master Input Register 0		X0~X7
	Master Input Register 1		X10~X17
	Master Input Register 2		
	Master Input Register 3		
	Master Input Register 4		
	Master Input Register 5		COUNT_IN_1
	Master Input Register 6		
	Master Input Register 7		
	Master Input Register 8		
	Master Input Register 9		COUNT_IN_2

	Master Output register 0		Y0~Y7
	Master Output Register 1		Y10~Y17
	Master Output Register 2		
	Master Output Register 3		
	Master output register 4		V1
	Master output register 5		
	Master output register 6		COUNT_CTRL
	Master output register 7		

As shown in the table above, the input data of R4A contains 16 digital inputs and two high-speed count inputs. X0~x17 are 16 digital input signals. The count value of high-speed counter is 32 bits, the maximum count frequency is 500K, and it is the unidirectional accumulative counting, the input source of COUNT_IN_1 count value is X0, and the input source of COUNT_IN_2 count value is X2. 10 bytes in total of input data correspond to 10 input bytes of data in the master station.

The output data contains analogue and digital data. Additionally, a counter control word is provided, so the output data has a total of 8 bytes.Y0~Y17 are 16 relay output signals, the common terminals are C0~C6 respectively.V0 and V1 are 2 analogue output signals, the one-word data where V0 is located corresponds to the output of analogue channel 1, the range is 0-4000, and corresponding to the voltage output of 0-10V at the V0 output terminal. The one-word data where V1 is located corresponds to the output of analogue channel 2.

COUNT_CTRL is the count value of low byte control COUNT_IN_1 of high-speed counter control word and the count value of high byte control COUNT_IN_2. When the low byte of COUNT_CTRL is 0->1, R4A will reset the count value of COUNT_IN_1. Similarly, when the high byte of COUNT_CTRL is 0->1, R4A will reset the count value of COUNT_IN_2.