AUCTECH B Series Universal Six-axis Large Load Robot Instruction Manual (BR60E-2680/BR80E-2250/BR120E-2250)

Version V2.2

Guangzhou Auctech Automation Technology Ltd.

Statement

❖ Thank you for using the AUCTECH general-purpose 6-axis heavy-load handling, loading/unloading 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 Guangzhou Auctech Automation Technology Ltd. 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 heavy-load handling, loading/unloading robots, this manual contains information on safe handling, installation, operation, repair and maintenance, this manual can be downloaded from the Company's website (www.auctech.com.cn) for reading.

◆ Equipment description:

1. Overview:

This series of handling robots mainly consist of robot body, robot electronic control cabinet, teach pendant, end effector, sensing devices, etc. This model of loading/unloading and handling robot can achieve industrial processing for parts of large quantities, small parts, heavy parts, and achieve industrial processing with strong repeatability, and has functions such as high-precision positioning, fast handling and gripping, shortening operation rhythm, improving efficiency of the machine tool, and expanding production capacity of the factory .
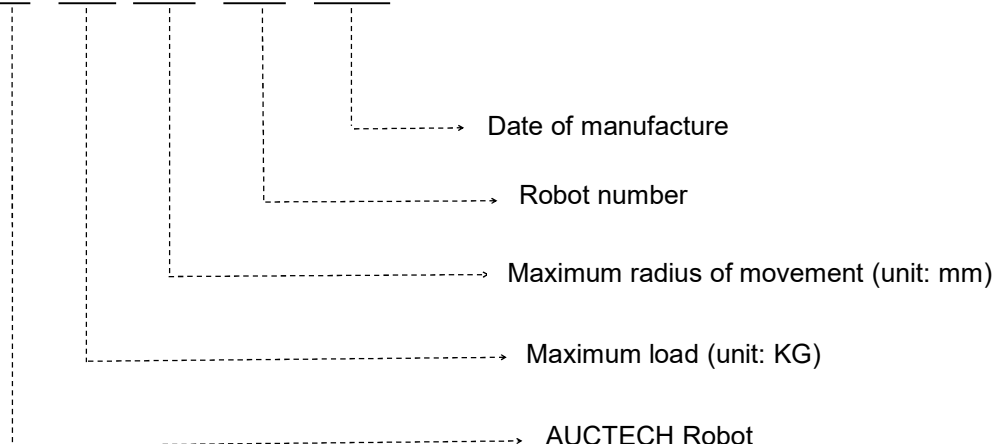
2. Performance characteristics:

① High speed: Continuous and stable high-speed work to improve productivity.
② High precision: Precise control of movements, reduction of human error, fast handling and gripping
③ Highly flexible: Quickly and flexibly adapt to new tasks and products, shorten delivery time.
④ Digitization: Full digital control system for achieving precise control of the handling and gripping process.
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:

Mainly used in machine tool loading and unloading, automatic assembly lines, automatic handling of small products or large heavy objects, product spraying, cutting and processing for plastic parts and metal parts in the automobile industry, household appliances, consumer electronic products, optics and other fields.

◆ Robot serial number description:

Example: BR 80E - 2250 2300 2023

- - - - > Date of manufacture

- - - - > Robot number

- - - - > Maximum radius of movement (unit: mm)

- - - - > Maximum load (unit: KG)

- - - - > AUCTECH Robot

Foreword

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

Type of robot	Model name	Effective load	Robot weight
General-purpose 6-axis handling and loading/unloading robot	BR60E-2680	60KG	655KG
	BR80E-2250	80KG	678KG
	BR120E-2250	120KG	678KG

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 special content**

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

Contents

Contents

I. PRODUCT SPECIFICATION AND PERFORMANCE

1.1 Structural composition of robot body

Robot body model

● BR60E-2680 robot model

Composition of robot body

● BR80E-2250/BR120E-2250 robot model
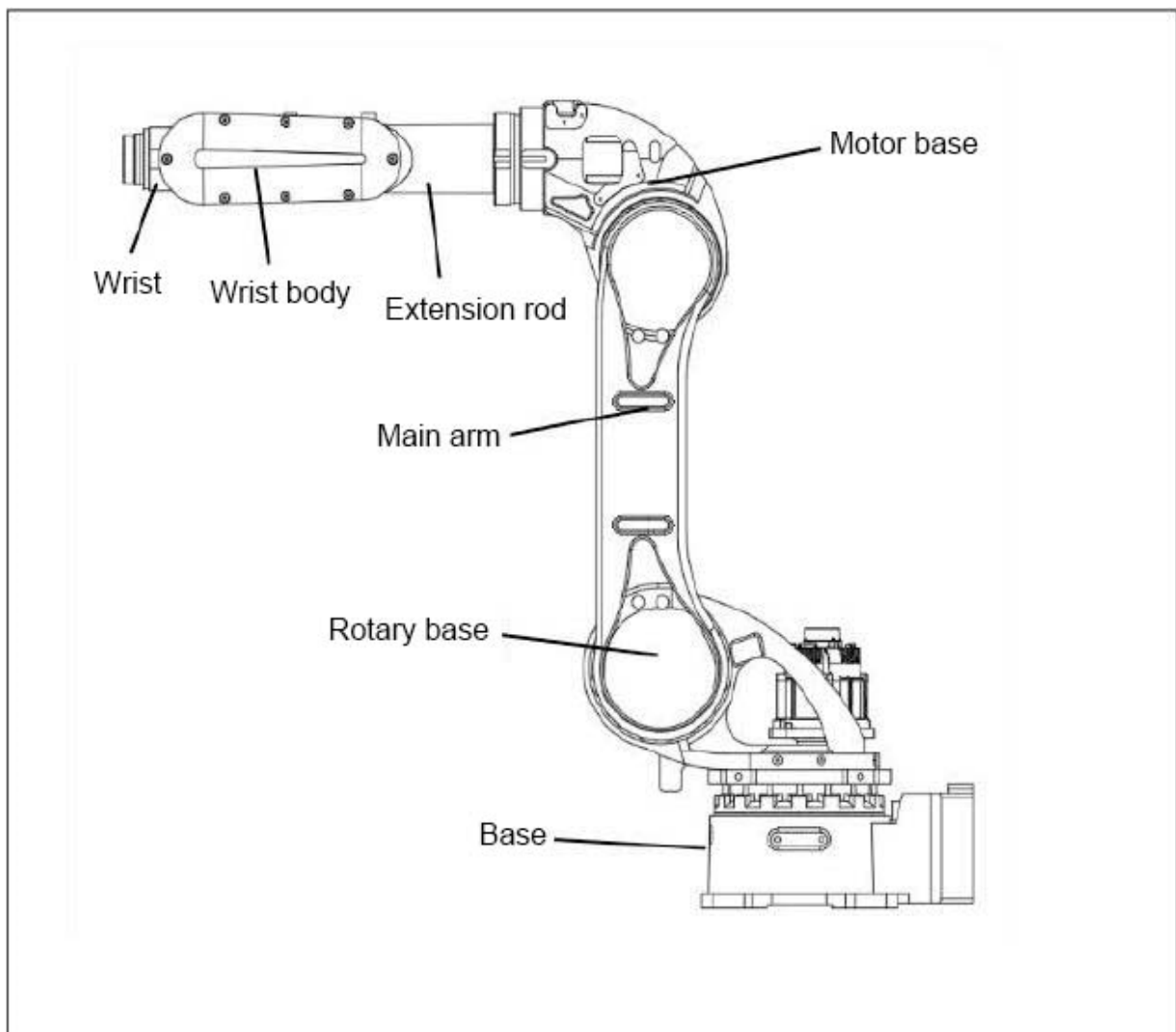
(BR60E-2680/BR80E-2250/BR120E-2250)
Diagram of robot composition

1.2 Robot motion orientation
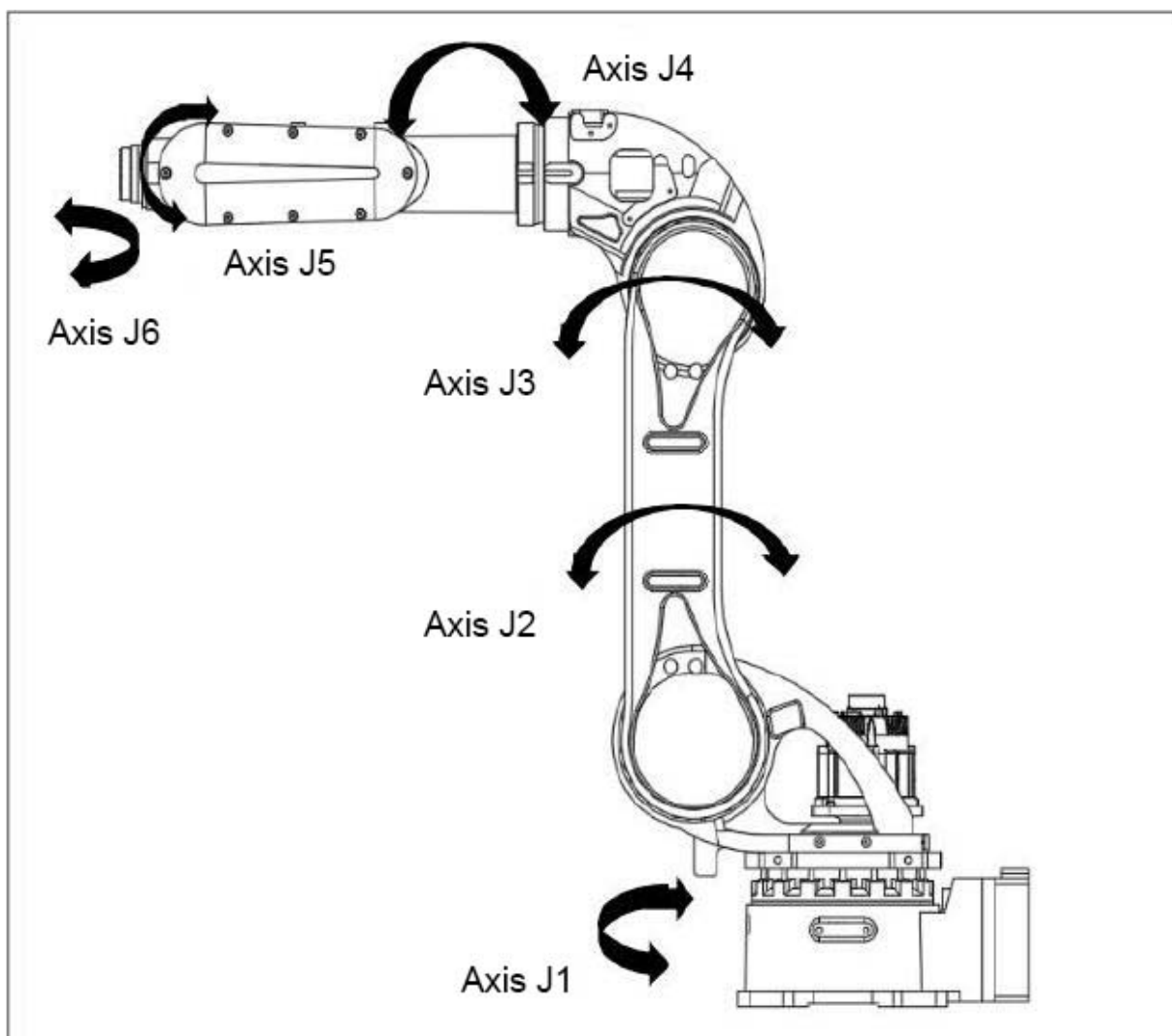
(BR60E-2680/BR80E-2250/BR120E-2250)
Schematic diagram of robot motion orientation

1.3 External dimensions and motion range of the robot
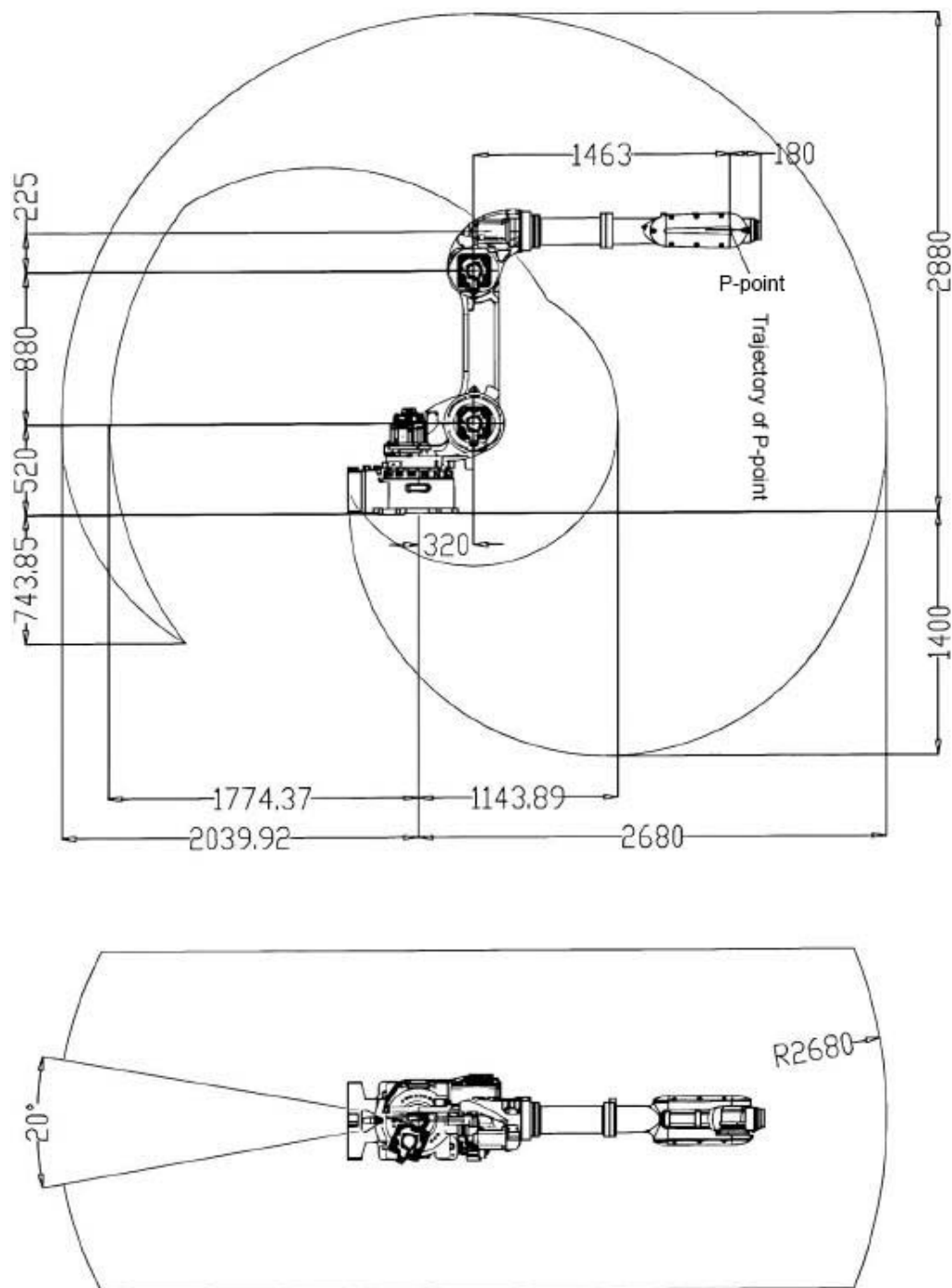
External dimensions and motion range of BR60E-2680 robot

(Unit: mm; shaded area: motion range of p-point)

External dimensions and motion range of BR80E-2250/BR120E-2250 robot
(Unit: mm; shaded area: motion range of p-point)
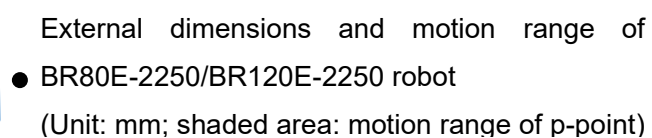
1.4 Loading conditions of the wrist

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.
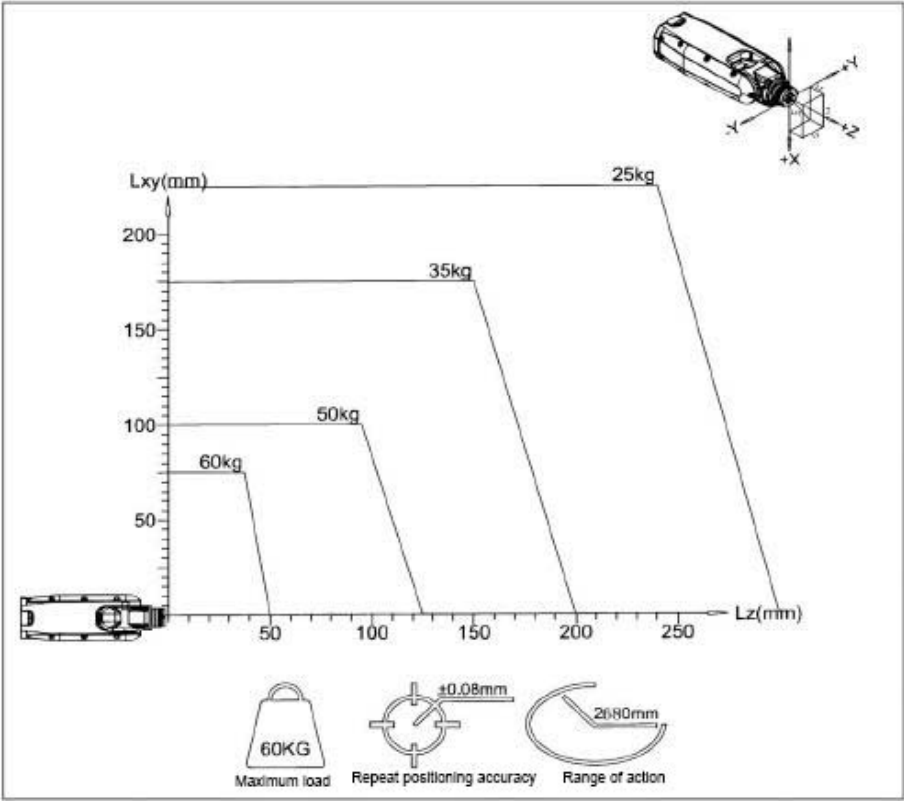
● Figure of wrist load of BR60E-2680 robot
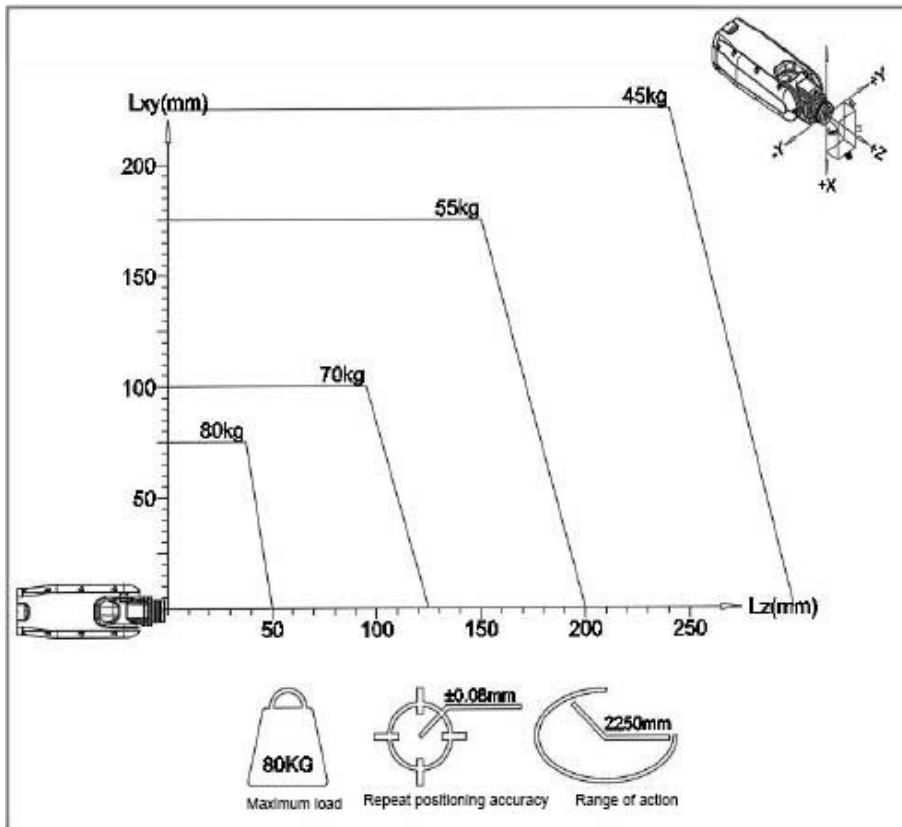
Figure of wrist load of
BR80E-2250 robot
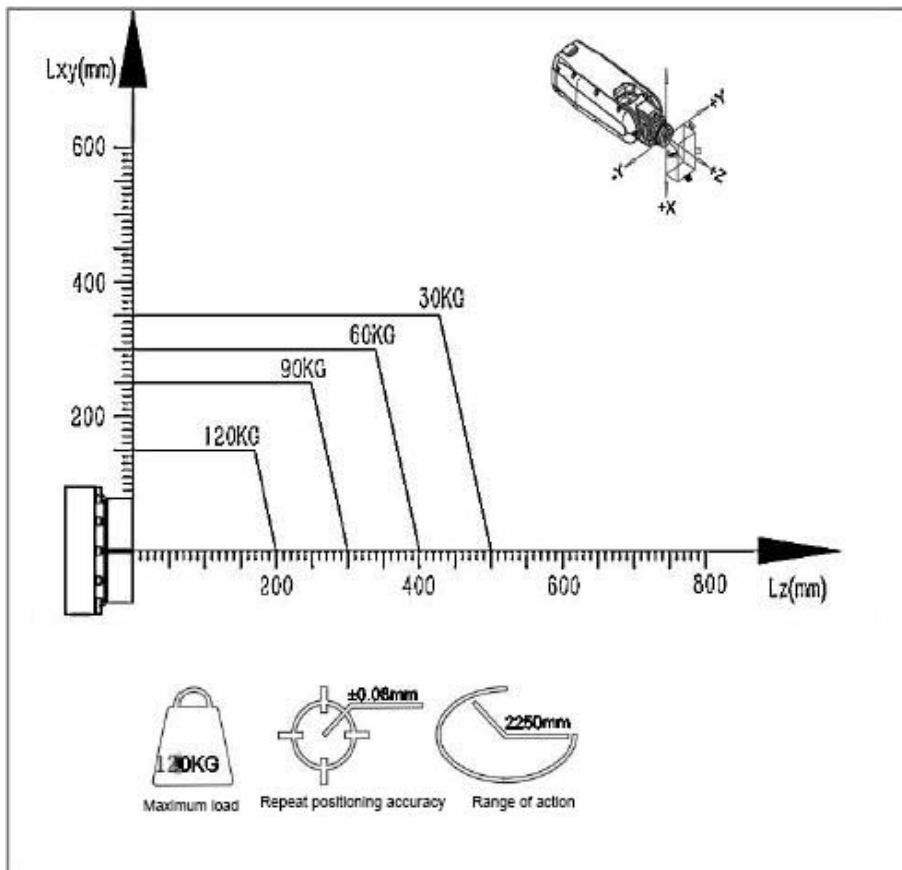
Figure of wrist load of
BR120E-2250 robot

1.4 Equipment specification and parameters

1.4.1 Robot body specification and parameters

Model	BR60E-2680
Number of axes	6-axis
Radius of movement	2680mm
Limited load	60KG
Level of protection	J1 and J2 axes IP56 (J3, J4, J5 and J6 axes IP67)
Installation mode	Floor mounted/bracket mounted/hang upside down
Power capacity	20KVA
Input/output signals	Standard 16-input/16-output 24VDC
Robot weight	655KG
Repeat positioning accuracy	$\pm 0.08mm$
Range of motion	
Axis 1 S	$\pm 160°$
Axis 2 L	$+90°$ to $-120°$
Axis 3 U	$+140°$ to $-70°$
Axis 4 R	$\pm 190°$
Axis 5 B	$+30°$ to $-210°$
Axis 6 T	$\pm 360°$
Movement speed	
Axis 1 S	$214°/s$
Axis 2 L	$149°/s$
Axis 3 U	$175°/s$
Axis 4 R	$378°/s$
Axis 5 B	$285°/s$
Axis 6 T	$370°/s$
Fields of application	Loading and unloading, spraying, handling, cutting, polishing
Torque	

Axis 4 R (N.m)	210
Axis 5 S (N.m)	210
Axis 6 T (N.m)	130
Built-in air tube	Ø8/Ø10
Installation mode	Ground, wall installed, tilted, hang upside down
	Temperature 0-45°C Humidity: 20~80%RH (no condensation) Vibration acceleration 4.9m/s^2 (0.5G) or less Altitude below 1000m
Installation environment	No igniting or corrosive gases or liquids, no splashing water, less oil or dust, stay away from electromagnetic sources and magnetic fields

Model	BR80E-2250
Number of axes	6-axis
Radius of movement	2250mm
Limited load	80KG
Level of protection	J1 and J2 axes IP56 (J3, J4, J5 and J6 axes IP67)
Installation mode	Floor mounted/bracket mounted/hang upside down
Power capacity	19KVA
Input/output signals	Standard 16-input/16-output 24VDC
Robot weight	678KG
Repeat positioning accuracy	±0.08mm
Range of motion	
Axis 1 S	±165°
Axis 2 L	+90° to -120°
Axis 3 U	+140° to -70°
Axis 4 R	±190°
Axis 5 B	+30° to -210°
Axis 6 T	±360°
Movement speed	
Axis 1 S	216°/s

Axis 2 L	$150°/s$
Axis 3 U	$175°/s$
Axis 4 R	$378°/s$
Axis 5 B	$286°/s$
Axis 6 T	$370°/s$
Fields of application	Loading and unloading, spraying, handling, cutting, polishing
Torque	
Axis 4 R (N.m)	210
Axis 5 S (N.m)	210
Axis 6 T (N.m)	130
Built-in air tube	φ8/φ10
Installation mode	Ground, wall installed, tilted, hang upside down
	Temperature 0-45°C
	Humidity: 20~80%RH (no condensation)
	Vibration acceleration $4.9m/s^2$(0.5G) or less
	Altitude below 1000m
Installation environment	No igniting or corrosive gases or liquids, no splashing water, less oil or dust, stay away from electromagnetic sources and magnetic fields

Model	BR120E-2250
Number of axes	6-axis
Radius of movement	2250mm
Limited load	120KG
Level of protection	J1 and J2 axes IP56 (J3, J4, J5 and J6 axes IP67)
Installation mode	Floor mounted/bracket mounted/hang upside down
Power capacity	6.5KVA
Input/output signals	Standard 16-input/16-output 24VDC
Robot weight	678KG
Repeat positioning accuracy	±0.08mm
Range of motion	

Axis 1 S	±165°
Axis 2 L	+90° to -120°
Axis 3 U	+140° to -70°
Axis 4 R	±190°
Axis 5 B	+30° to -210°
Axis 6 T	±360°
Movement speed	
Axis 1 S	123°/s
Axis 2 L	115°/s
Axis 3 U	112°/s
Axis 4 R	180°/s
Axis 5 B	172°/s
Axis 6 T	219°/s
Fields of application	Loading and unloading, spraying, handling, cutting, polishing
Torque	
Axis 4 R (N.m)	210
Axis 5 S (N.m)	210
Axis 6 T (N.m)	130
Built-in air tube	08/01C
Installation mode	Ground, wall installed, tilted, hang upside down
	Temperature 0-45°C Humidity: 20~80%RH (no condensation) Vibration acceleration 4.9m/s² (0.5G) or less Altitude below 1000m
Installation environment	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	BR60E-2680 / BR80E-2250/BR120E-2250
Overall dimensions	850(W)*550(D)*920(H)mm (including protrusions)
Approximate mass	170kg
Cooling method	Direct cooling
Power supply specifications	Three-phase AC380V50/60HZ
Grounding	Industrial grounding (specialized grounding with an grounding resistance of 100Ω or less)
Input and output signals	General-purpose signal: Input: 16; 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) RS232 (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; it can be used up to at the altitude 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

Item	BR60E-2680 / BR80E-2250/BR120E-2250
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 composition
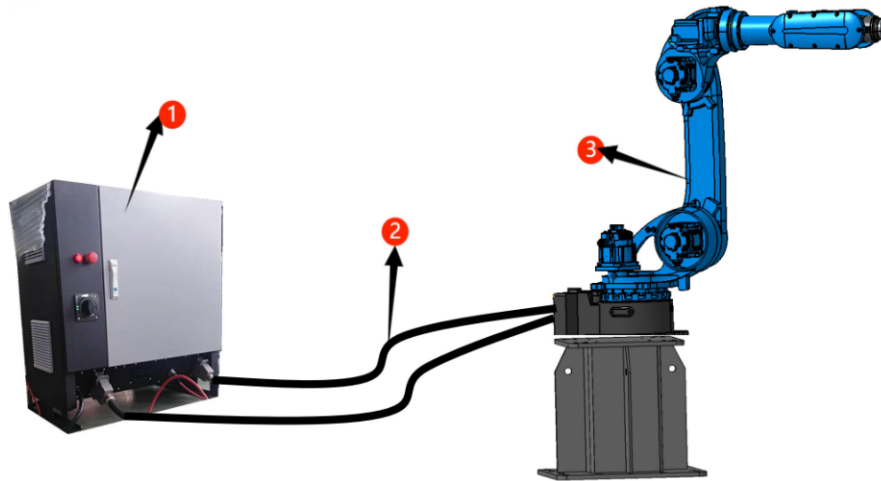
- (BR60E-2680/BR80E-2250/BR120E-2250)
  Schematic diagram of robot system composition

1-Robot body; 2-Control cabinet; 3-Connecting cable

Note

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

1.5.2 Connection between the robot body and the base and description

Battery pack

Air duct interface 1

Encoder cable interface

Air duct interface 2

Power line interface

Robot number

IO interface
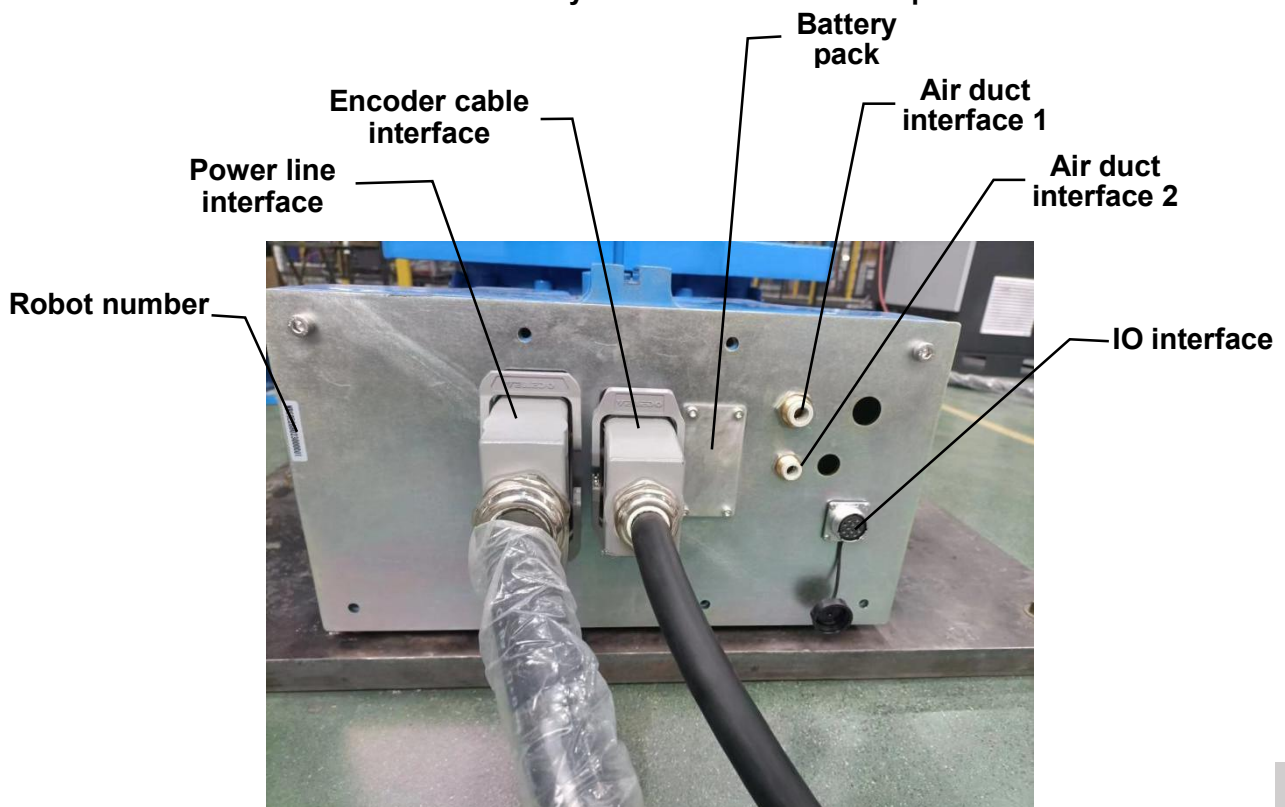
1.5.3 Schematic diagram of the robot control cabinet

Emergency stop switch

Power indicator light

Robot number

Power switch

Encoding cable interface

Teach pendant wire interface

Power line interface
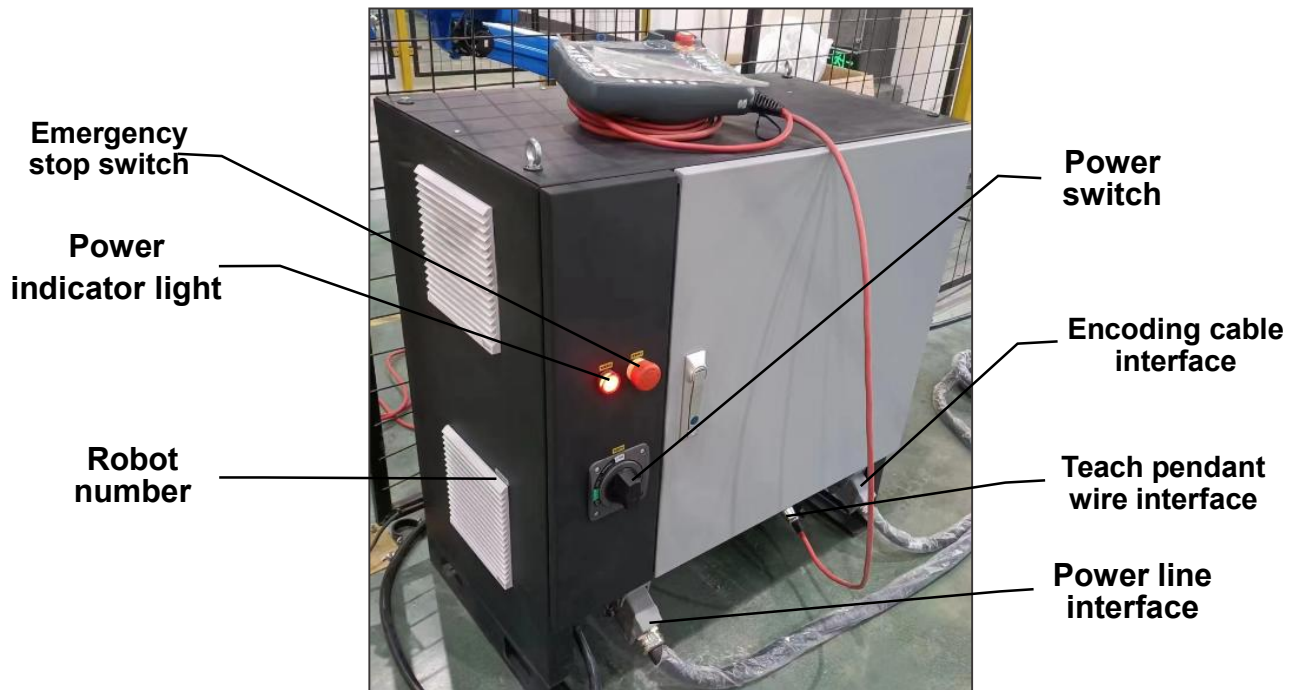
Reminder

- 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.

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.**
Marking for Handling and	**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.**

19

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 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 %.

(i)
Reminder
| **Carbon dioxide extinguishing agent shall be used in case of fire in the robot!** |

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

Danger

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.

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 With the forklift, handle and transport the robot to the installation location.

ⓘ Reminder

1. Do not use the jaws of the forklift and crane, etc., to apply impact forces to the transported components;
2. Do not hang chains, etc., on transported components.
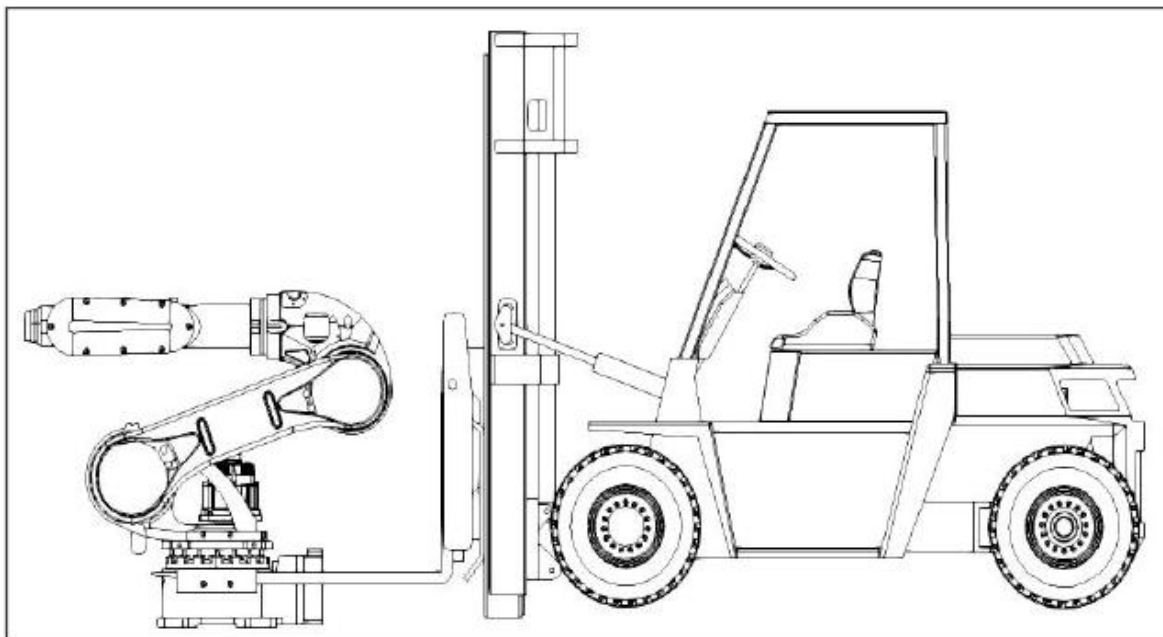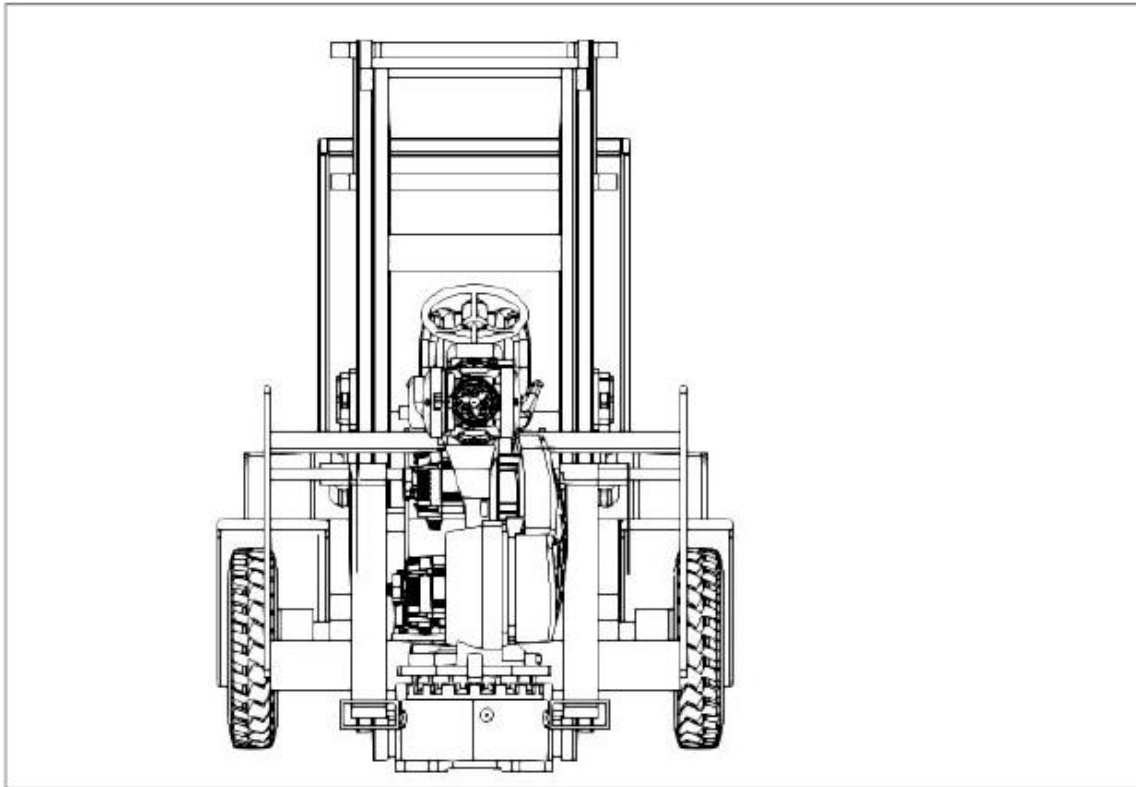
• (BR60E-2680/BR80E-2250/BR120E-2250)
  Schematic diagram of robot handling

• Angle of each joint for robot transport

BR60E-2680/BR80E-2250/BR120E-2250	Joint	J1	J2	J3	J4	J5	J6
	Angle	0°	69°	-69°	0°	0°	0°

3.1.2 Control cabinet handling and placement

Range of action
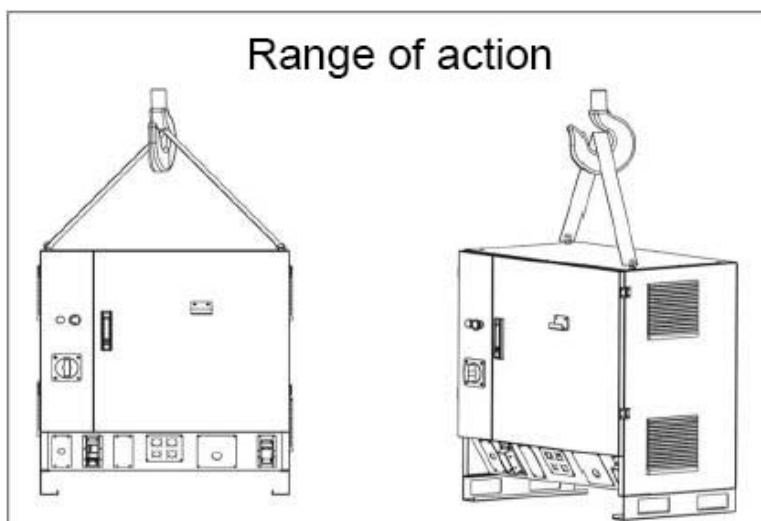
• Schematic diagram of electric
  control cabinet lifting

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
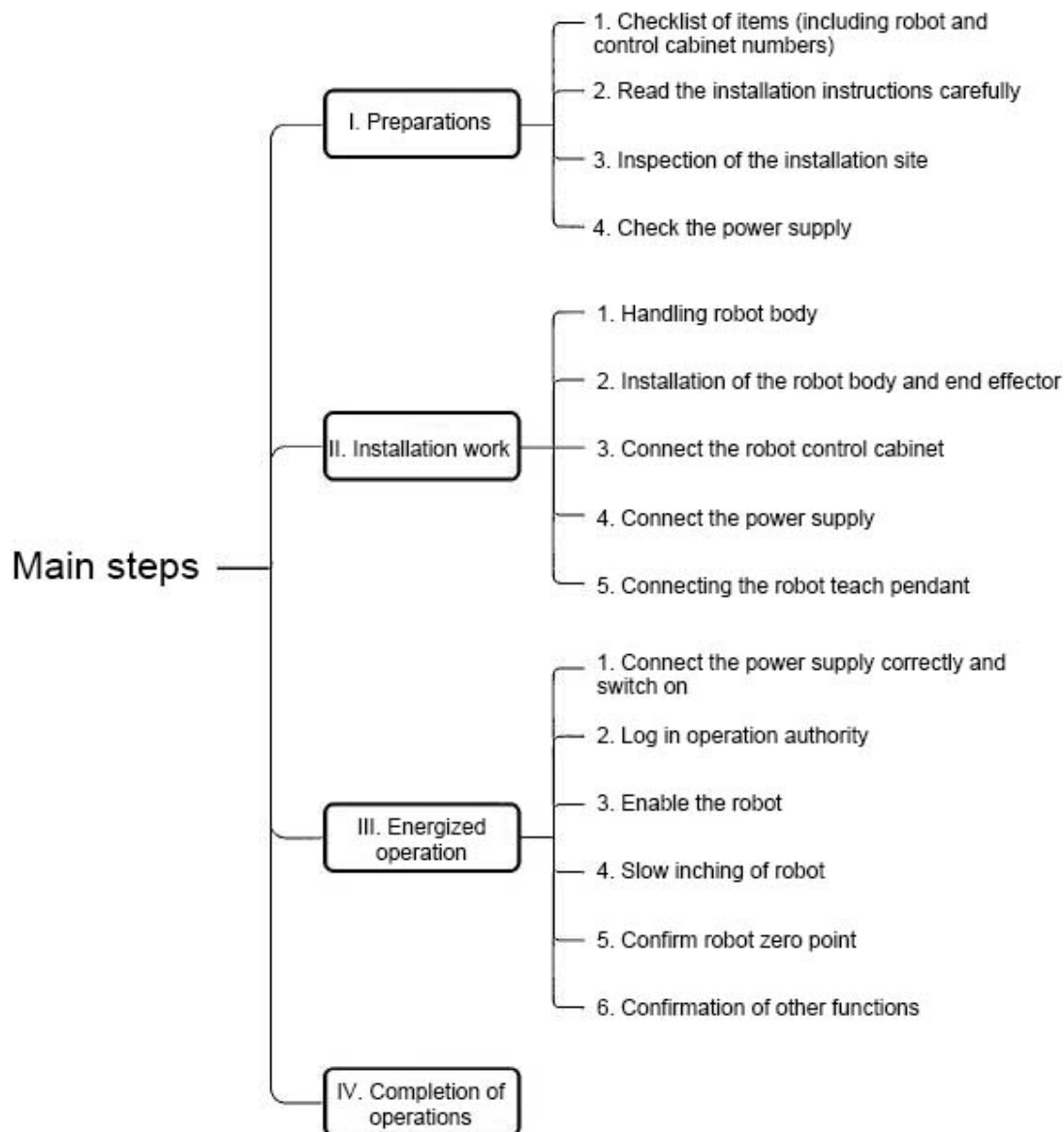
3.3 Unpacking and inspection

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, quantity and type of products according to the packing list.

No.	Product name	Unit	Quantity
1	Robot body	Set	1
2	Electronic control cabinet of the robot	Set	1
3	Teach pendant	Unit	1
4	IO plug/12-pole	Pcs	2
5	Cabinet key	Pcs	2
6	Certificate of conformity	Copy	1
7	System User's Manual	Copy	1
8	Driver User's Manual	Copy	1

3. 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.

● BR60E-2680/BR80E-2250/BR120E-2250

Base mounting dimensions

End flange installation dimensions

Four-axis mounting dimensions
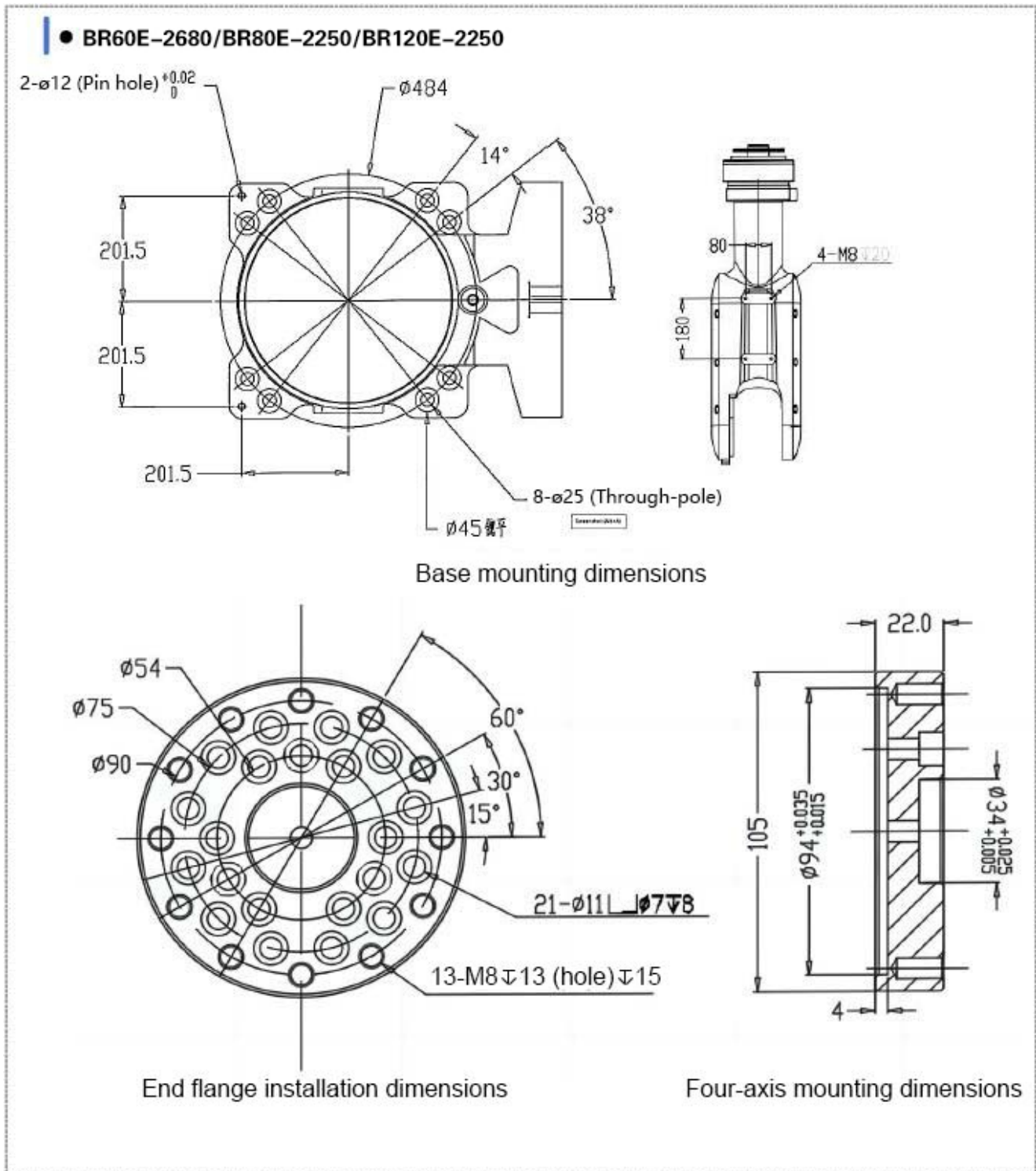
3.6 Robot fixing

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 fixing 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 M20 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 CALIBRATION

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

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 of the robot**

➤**(applicable to models BR60E-2680 / BR80E-2250/BR120E-2250)**

J1 axis calibration diagram
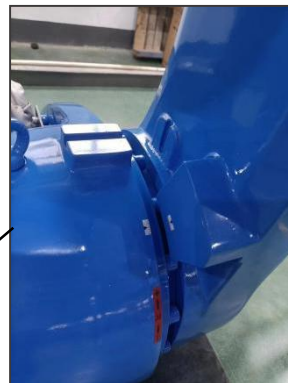
J2 axis calibration diagram

J3 axis calibration diagram
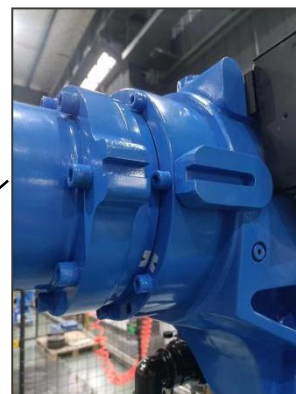
J4 axis calibration diagram

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
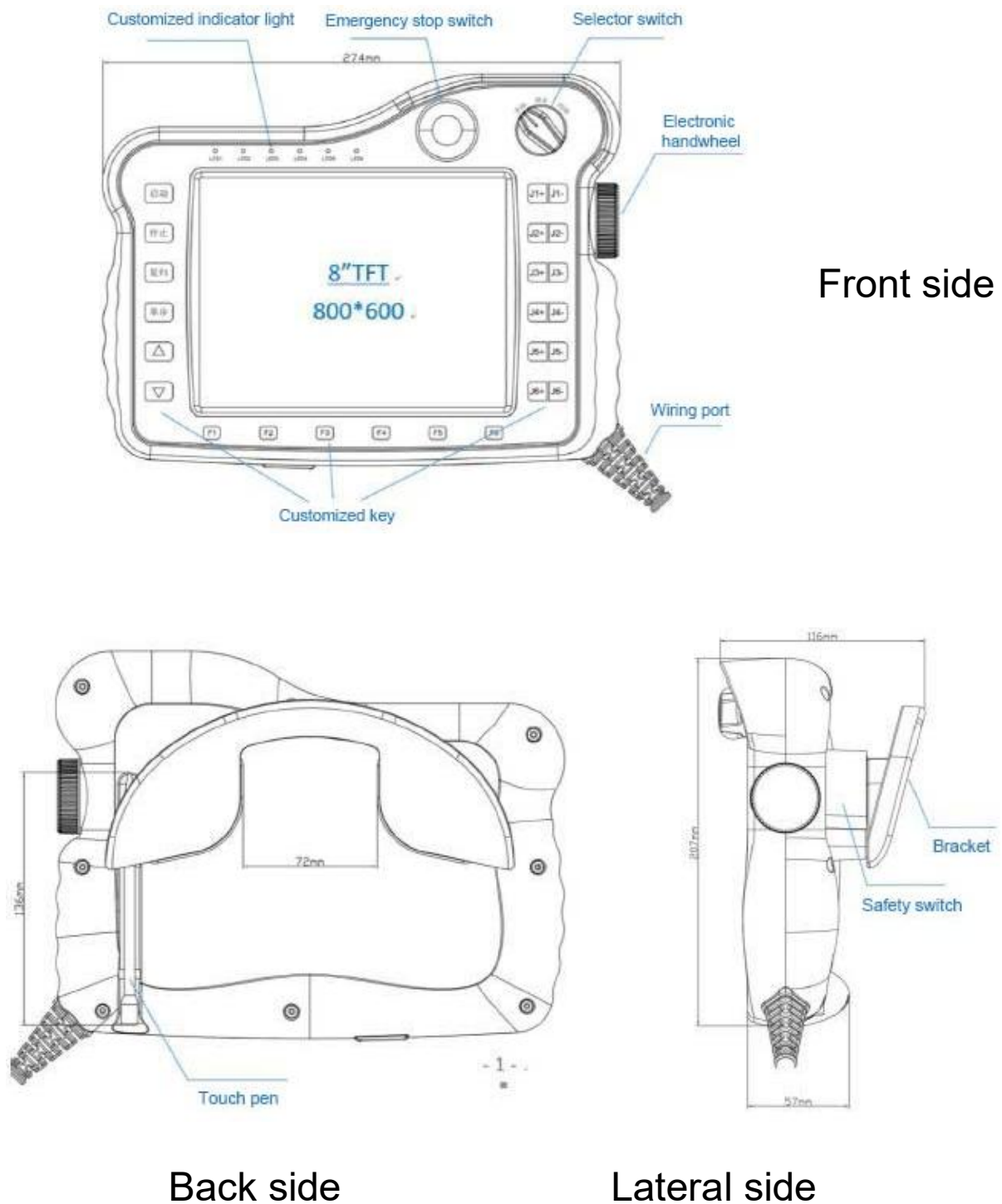
5.1.3 Description of the physical keys of the teach pendant

Left buttons		Right buttons	
Servo	Switching the current servo state	Stop	Pausing the program in run mode
Robot	Switching the current robot (only available in multi-robot mode)	Start	Starting the program in run mode
EXT	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
Home	Zero Return Button	+	Run in positive direction of the corresponding axis during teach
PSP	Reset Return Button	(rotary)	Rotary switch: left, switches to teaching mode
Clear	Error clearing after servo error reporting (only available in teaching mode)	(rotary)	Rotary switch: center, switches to run mode
O	Reserve	(rotary)	Rotary switch: right, switch to remote mode
Lower button		**Three-segment key**	
F/B	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
Step	Run the program in a single step in teaching mode		Press the button to bottom to power down the robot.
V−	Reduce teach or running speed		Release the button to control the robot to power down
V+	Increase teach or running speed	**Rest buttons**	
Tool	Switch tool hand		Emergency stop button

	Switching coordinate systems		Knob with roller
Coord			

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
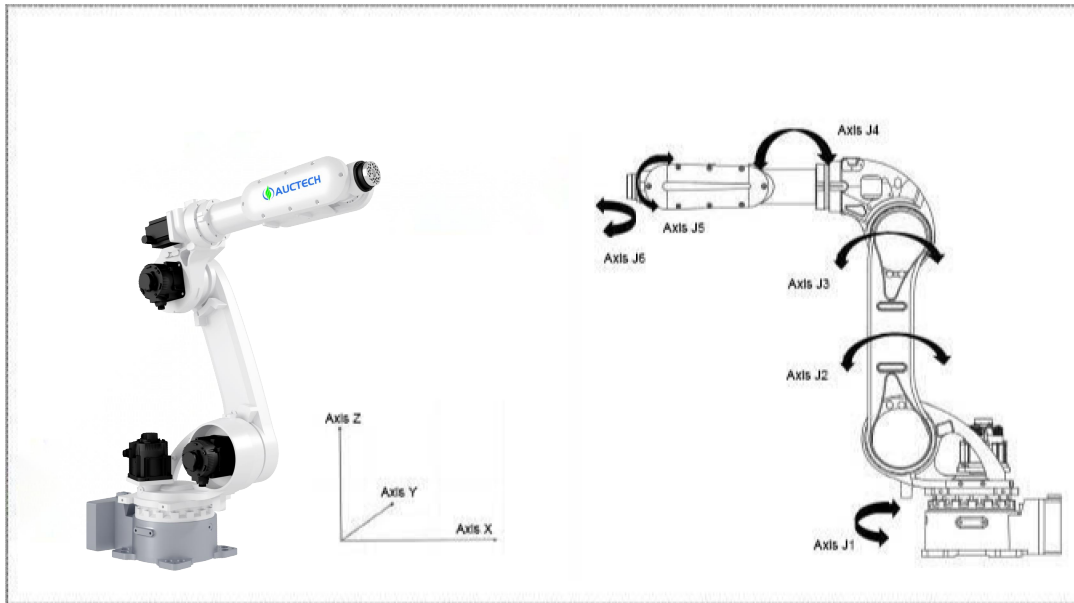
BR60E -2680 / BR80E-2250/BR120E-2250

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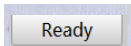
The robot is made to move by means of the inching buttons "-" and "+" on the right side of the teach pendant panel, this operation is only allowed in the teaching mode. After the servo is enabled, the robot's coordinate system type and motion rate need to be set before electric operation.

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.
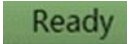
(7) Press the button on the right side of the corresponding join , the corresponding axis run in the positive direction in teaching mode;

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.
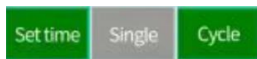
(6) Press the button the robot will pause the program.

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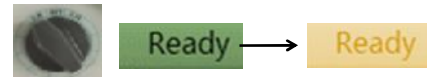
At the same time, the sound of opening the robot body motor band-type brake is heard.

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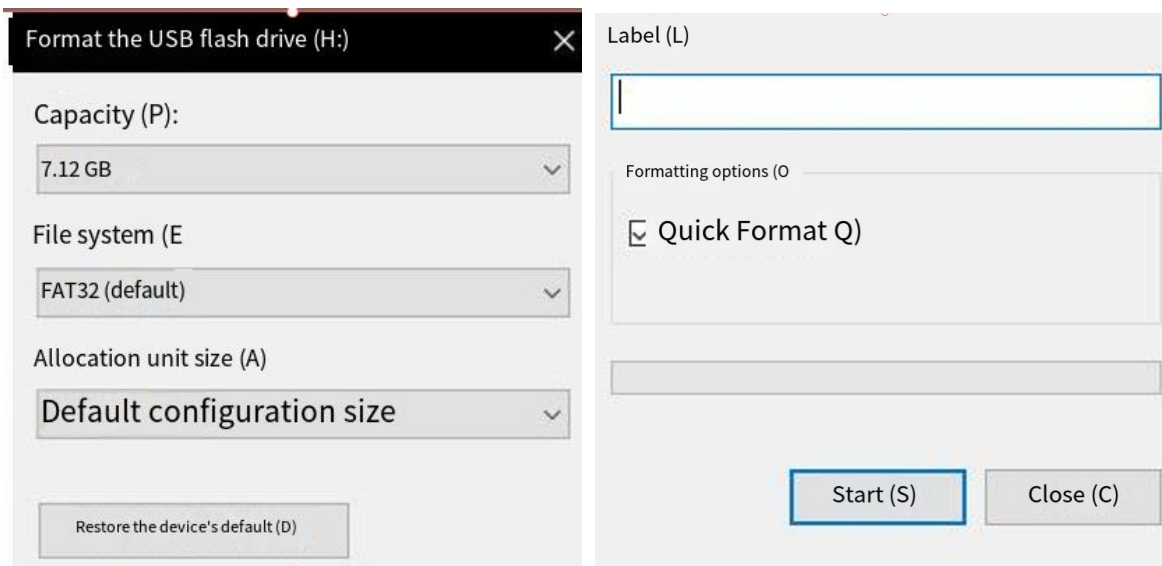
⑥   Click the Start button and click the [OK] button in the pop-up confirmation box;

⑦   When the "Formatting Completed" window pops up, the FAT32 format USB stick is formatted.
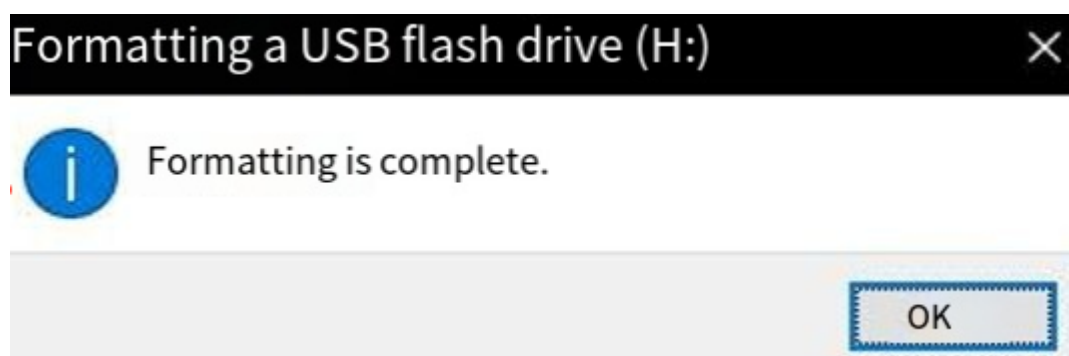
5.3.2 Version upgrade and upload Files

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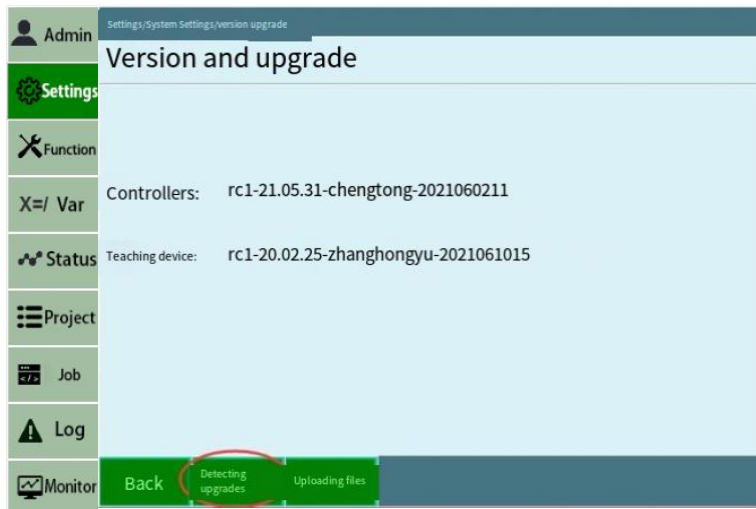
② Click the [Detect Upgrade] option under [Settings]-[System Settings]-[Versions and Upgrades] on the robot teach pendant;

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.
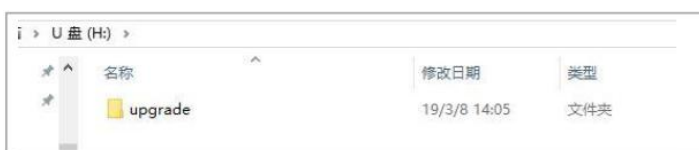
③ The files to be uploaded are placed in the upgrades folder;
④ Insert the USB stick into the USB port of the teach pendant;
⑤ Click [Settings]-[System Settings]-[Version Upgrade] screen on the robot teach pendant;
⑥ Click the Upload File button;
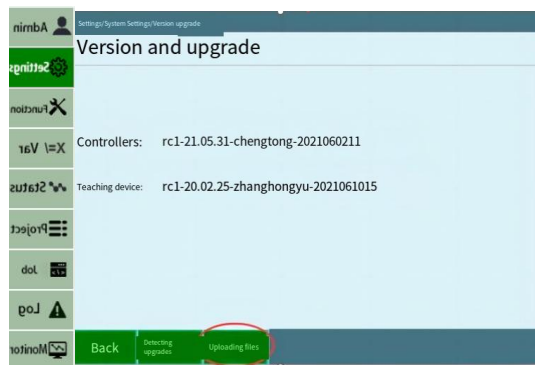
⑦ Select the file to upload from the detected files that pop up, and click the [OK] option.

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.
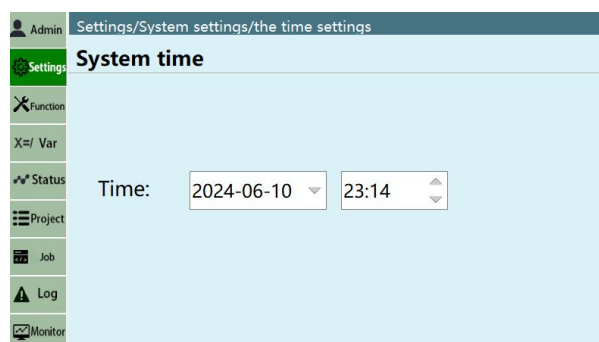
④ Click the [Save] option.

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-More screen;

② Click the [Restore Factory Settings] button;

③ Click the [OK] button in the pop-up dialogue box.

Settings/System settings/More settings

| Factory reset | Wizard | Restart |

Clear job
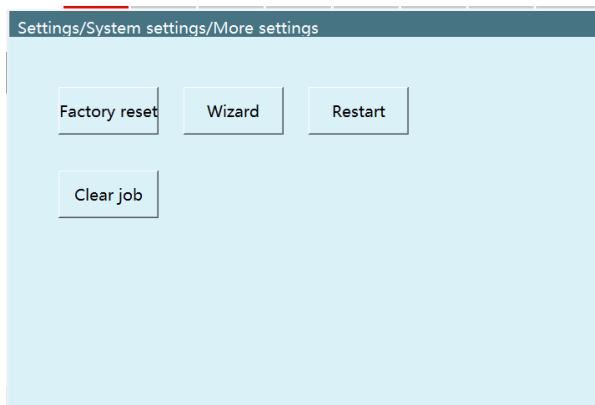
5.3.10 Screen calibration

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.
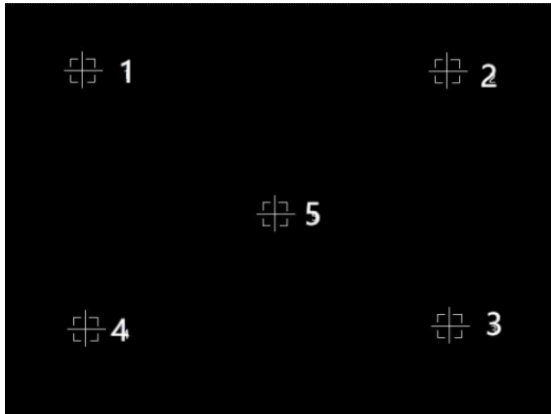
5.3.11 Controller automatic backup and restoring function

❖ **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;

Boot -20.06.0-3.4.5-20201014100208

Power-on - 20.060-3.4.5-20201014063243

Restart -20.06.0-3.4.5-20201014063204

Boot -20.06.0-3.4.5-20201014062338

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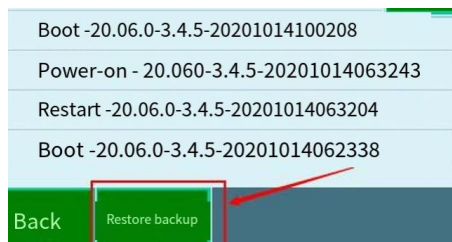
③ A pop-up box prompts, click and confirm;

Tips

Are you sure to restore the
backup?

Click to confirm the program,
parameters will be returned to the
historical version, can not be restored!

OK   Cancel
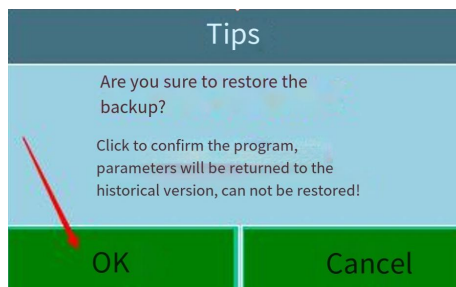
④ Do not disconnect the power during the restoration process.

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.

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

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;

See appendix for details of servo alarms and treatment solutions

Note

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°".
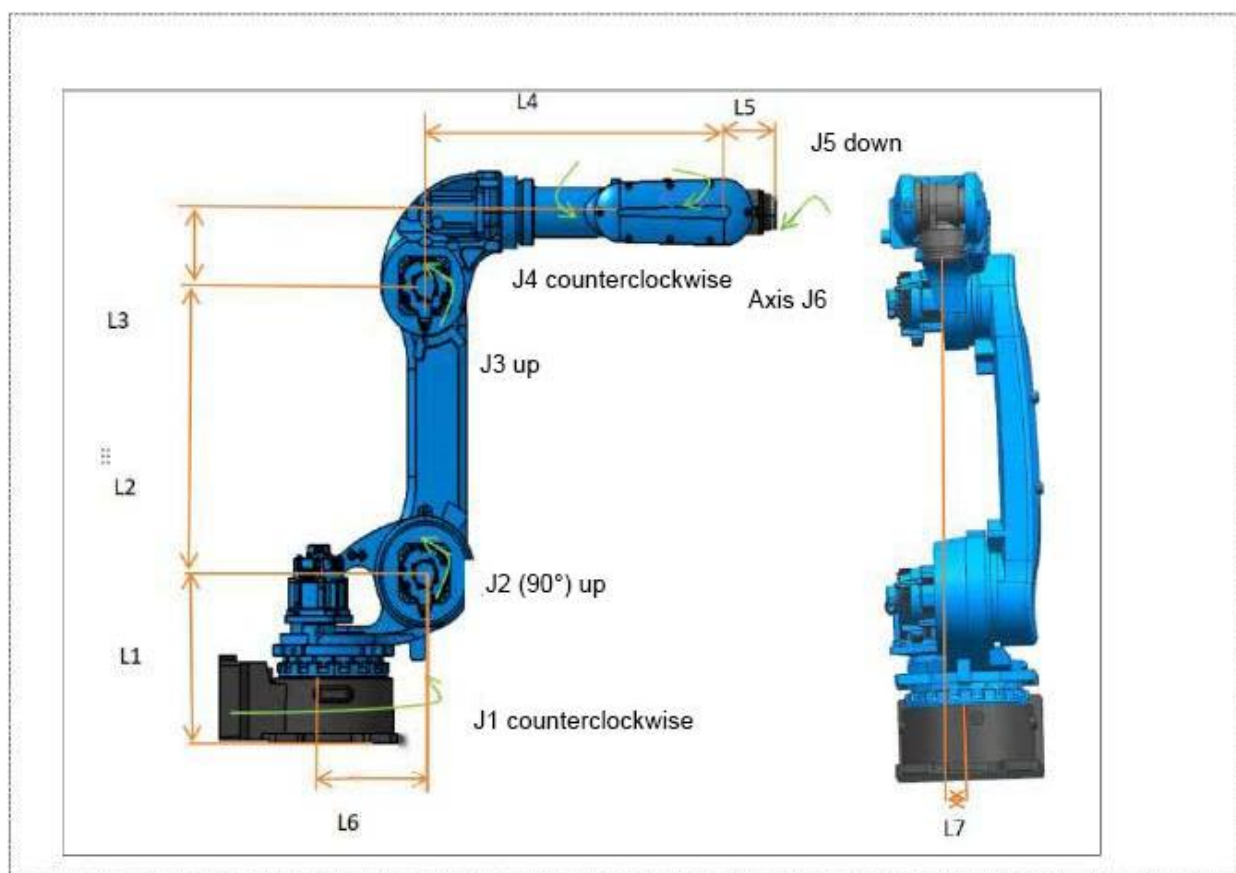
● BR60E-2680/BR80E-2250/BR120E-2250 DH parameter schematic diagram

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 re-calibrate.

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:
To teach the robot to walk along a complete circle, the move command is MOVCA. Before inserting the command, click on the "Tool" button in the upper status bar and select the previously calibrated tool hand;
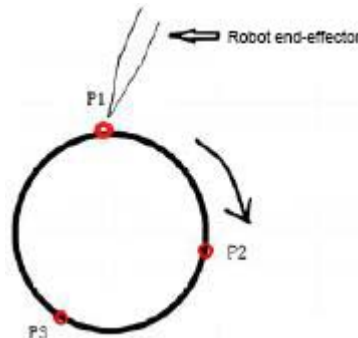
Insert steps, with a total of four instructions:
① Click Insert, click Coordinate Switching Class, select SWITCHTOOL, and select the previously calibrated tool hand number;
② Move to any point of the circle you want to draw as in Figure P1, click Insert, click Motion Control Class, and select movj or 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.

Settings/remote program Settings

Remote mode Speed: 15 ▼

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 is damage to the cable protection sleeve or not	Confirm whether the cable protection sleeve of the cable 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 replacement	Replace the robot body battery.
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.

<table>
<tr>
<td>

⚠️

Warning
</td>
<td>

- **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;**
</td>
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</table>

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.
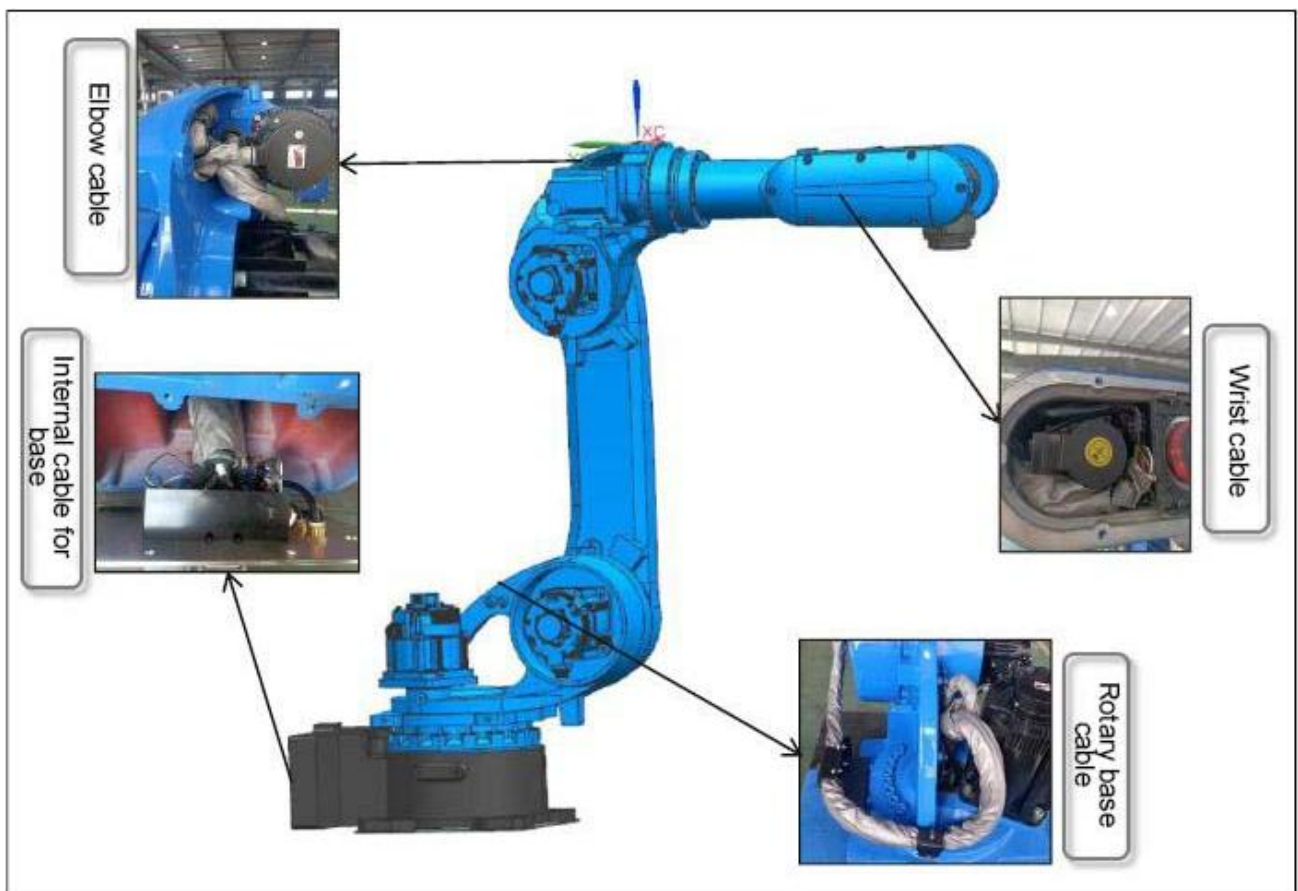
● BR60E-2680 **/** BR80E-2250/BR120E-2250
Cable Layout Schematic Diagram of Robot

❖ **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.

❖ **Overhaul the internal cables of the elbow**

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 cables of the wrist**

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 performed.

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.
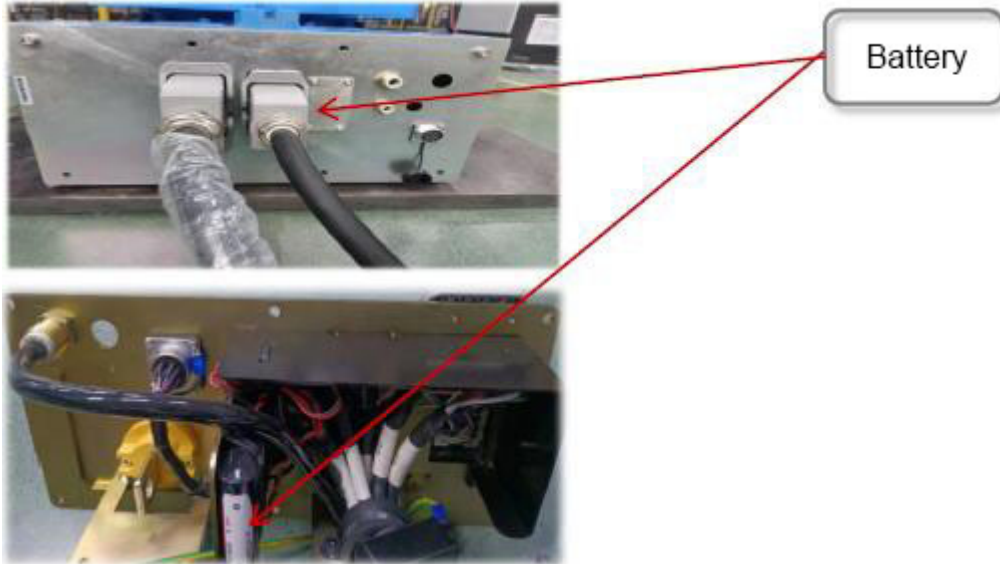
Battery

● Schematic diagram of robot battery position

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.**
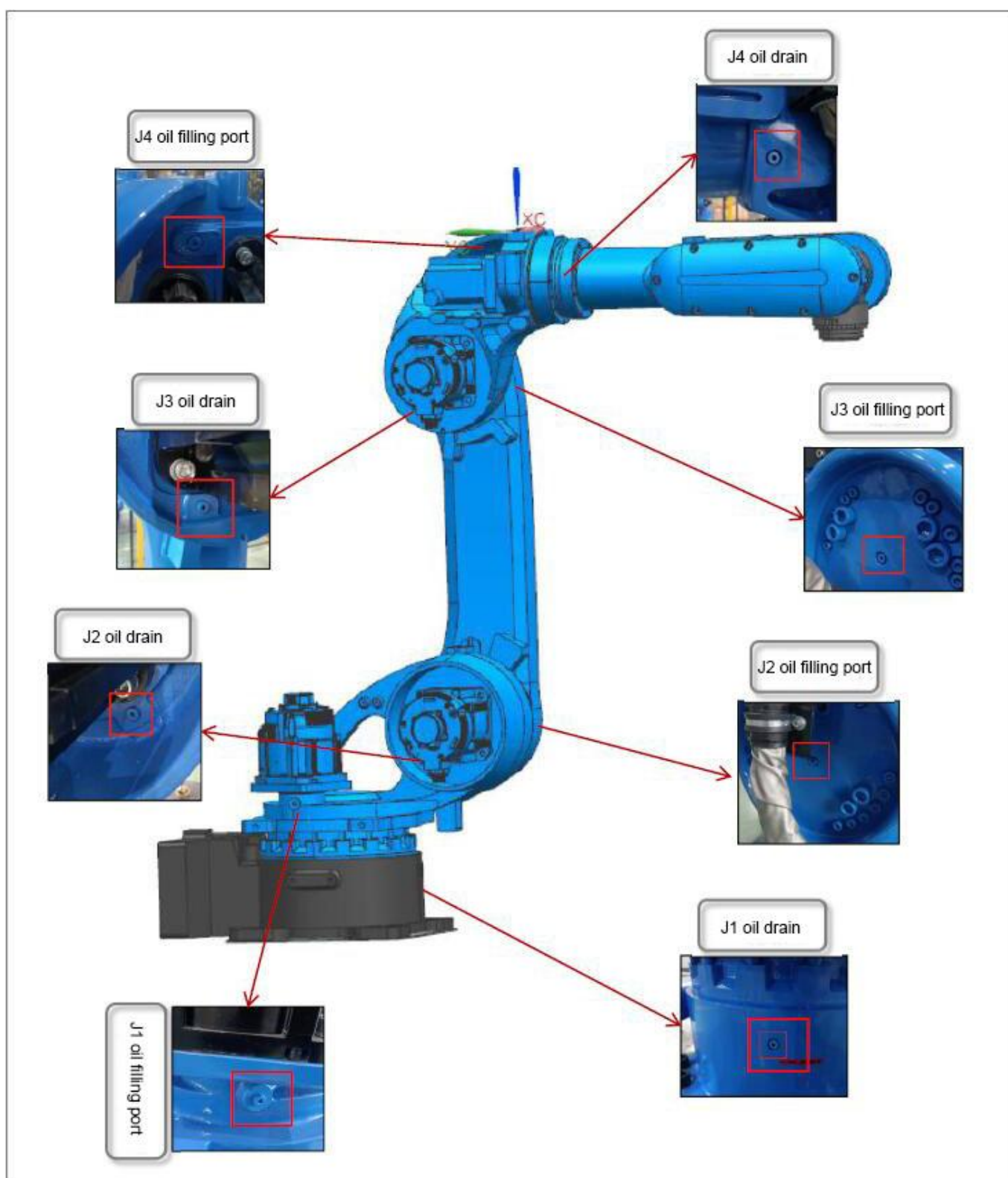
BR60E-2680/ BR80E-2250/BR120E-2250

• Oil filling port and oil drain of the reducer of the 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

Model	No.	Material code	Name	Qty
BR60E-2680 BR80E-2250 BR120E-2250	1	01.02.0443	5-axis motor pulley(Z=48,)	1
	2	01.02.0431	4-axis reducer flange	1
	3	01.02.0445	4-axis reducer inner sleeve	1
	4	01.05.12.0003	8.9KW TH motor MR80-1 axis (axis length: 50)	1
	5	01.05.12.0004	8.9KW TH motor MR80-2 axis (axis length: 70)	1
	6	01.05.12.0001	5.8KW TH motor	1
	7	01.05.12.0010	3.6KW motor	1
	8	01.05.06.0028	2KW Xinzhou motor	1
	9	01.05.06.0028	2KW Xinzhou motor	1
	10	01.01.12.065	Robot batteries (palletizing: 2 batteries /unit; three, for others)	3

Appendix III Electrical layout of the control cabinet

Electrical layout of the main board in the electric cabinet	
1	Servo drive
2	3P circuit breaker
3	Intermediate relay
4	AC contactor
5	Filter
6	2P circuit breaker
7	UK6N wiring terminal
8	Double-layer wiring terminal
9	UK5N wiring terminal
10	Switch power supply
11	Controller
12	Six-way relay module
13	
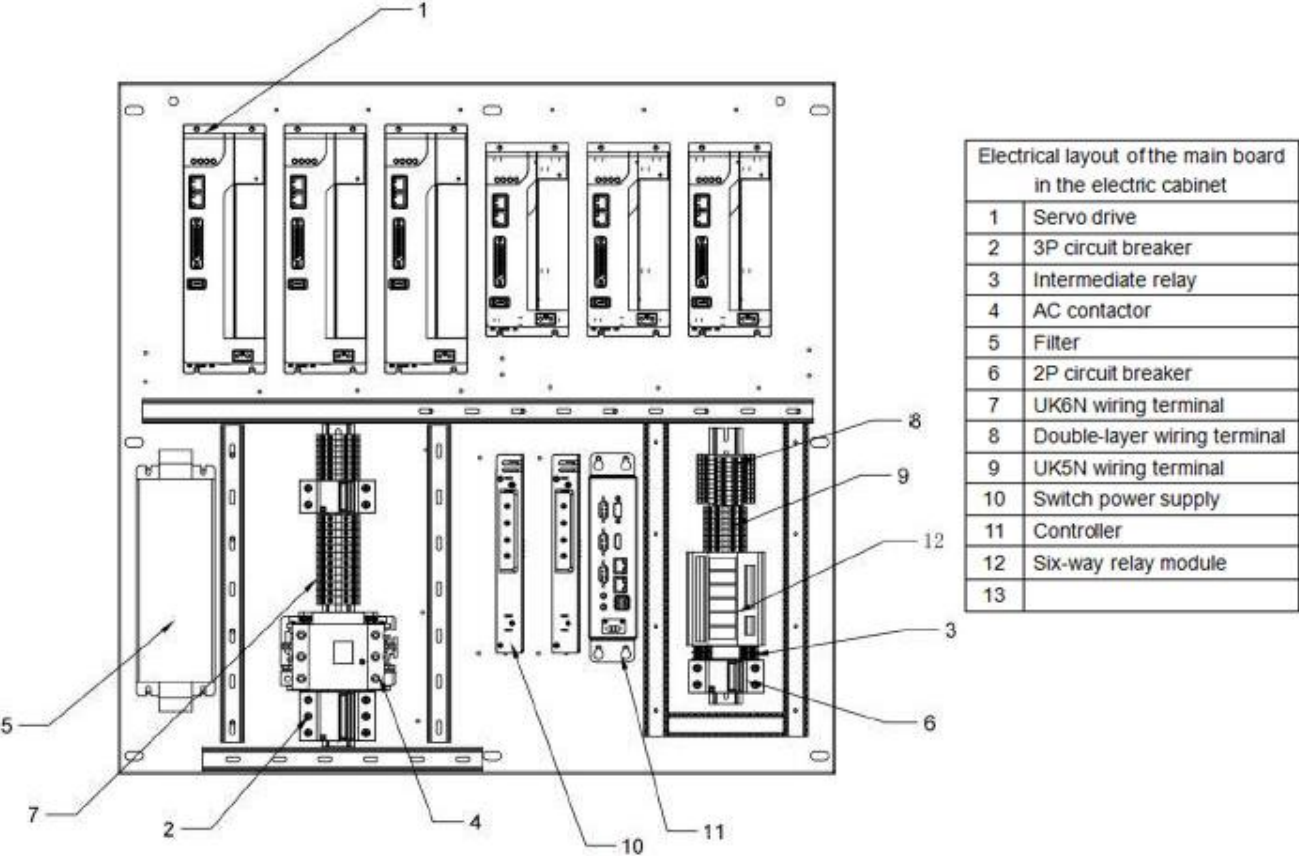
Appendix IV Schematic diagram of network cable connection (network cable in blue)
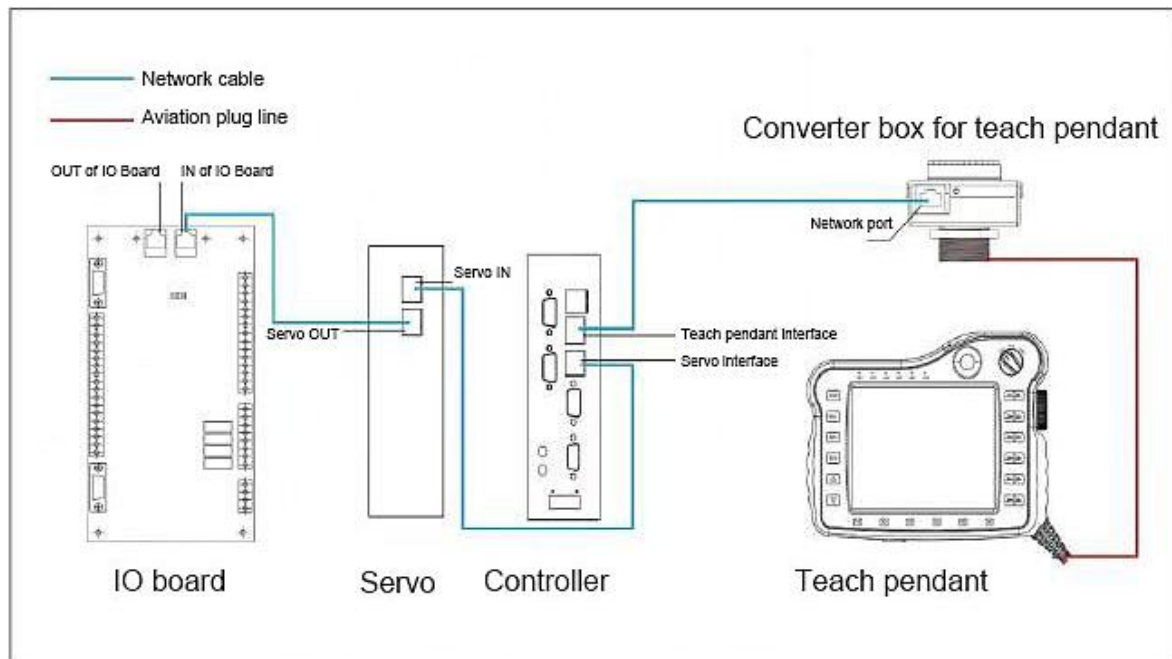
Appendix V Electrical schematic diagram of the control cabinet
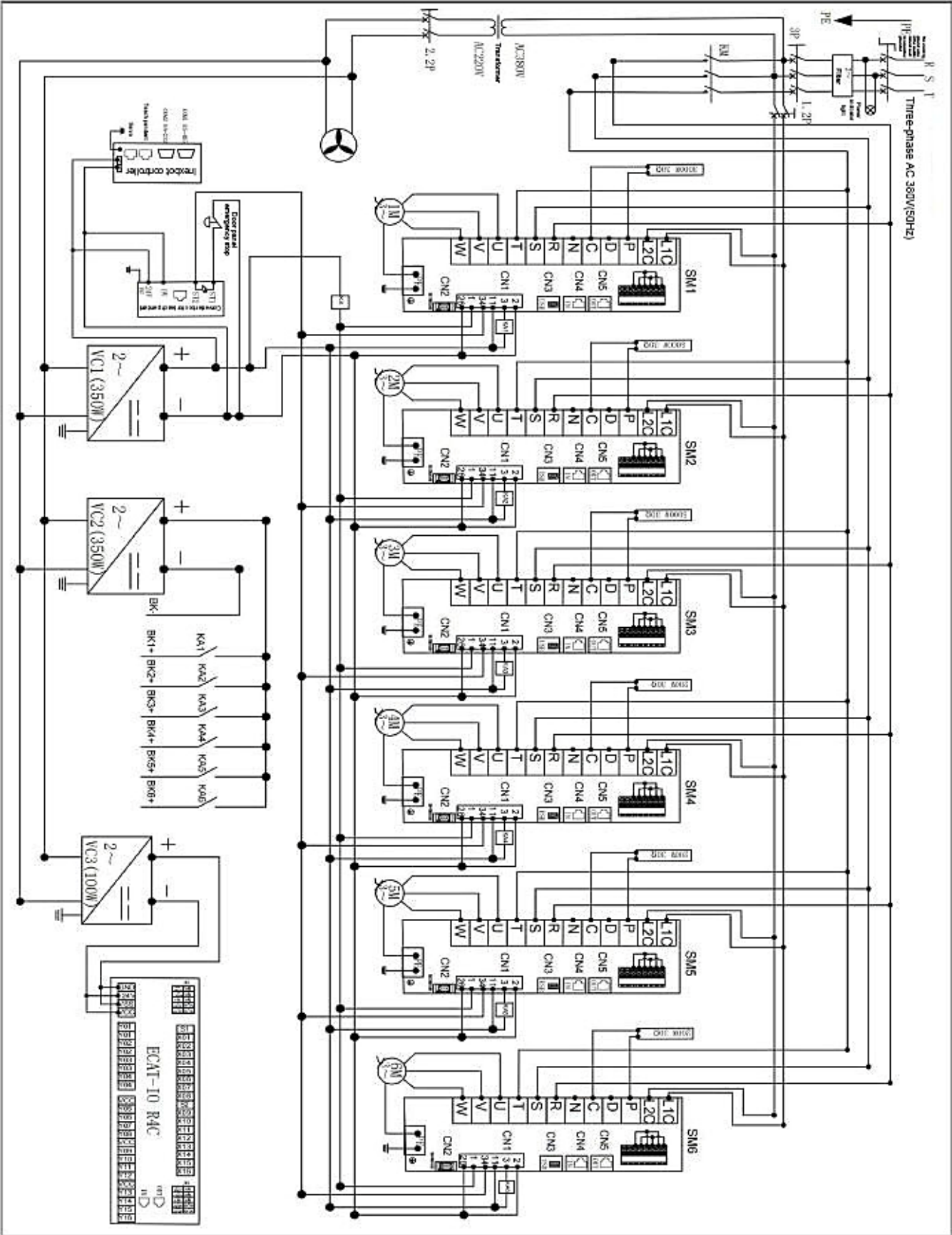
Appendix VI Schematic diagram of IO interface of reservation box and control cabinet (optional)

Enable	Brown
Enabling light	Grey
Start 1	Yellow
Start 1 light	White
Arc breaking start	Blue/Blue Black
Arc breaking start light	Purple/Purple Black
Stop	Green/Green Black
Stop light	Pink/Grey Black
Common terminal	Black
24V	Cyan
Start 2	Yellow Black
Start 2 light	White Black
Emergency stop	Red Black

Connecting IO module

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	Pink	18	Black
9	Purple	19	Cyan
10	Red Black		

Appendix VII Schematic diagram of power line and coding line connection

Power code connection diagram inside the electrical cabinet

Power code connection diagram for the aviation plug end

Power line

Coding line

32-pole plug	
1	U1
2	V1
3	W1
4	U3
5	V3
6	W3
7	U5
8	V5
9	W5
10	PE1
11	PE2
12	PE3
13	Anti-collai ali +
14	Anti-collai ali -
15	PE4
16	PE5-6
17	BK2+
18	BK1+
19	BK4+
20	BK3+
21	BK-
22	BK6+
23	BK5+
24	U2
25	V2
26	W2
27	U4
28	V4
29	W4
30	U6
31	V6
32	W6

42-pole plug	
1	5V
2	0V
3	Signal +
4	Signal -
5	Shielded wire
8	5V
9	0V
10	Signal +
11	Signal -
12	Shielded wire
15	5V
16	0V
17	Signal +
18	Signal -
19	Shielded wire
22	5V
23	0V
24	Signal +
25	Signal -
26	Shielded wire
29	5V
30	0V
31	Signal +
32	Signal -
33	Shielded wire
36	5V
37	0V
38	Signal +
39	Signal -
40	Shielded wire

Appendix VIII Schematic diagram of coding lines on the body side

Appendix IX Schematic diagram of power lines on the body side
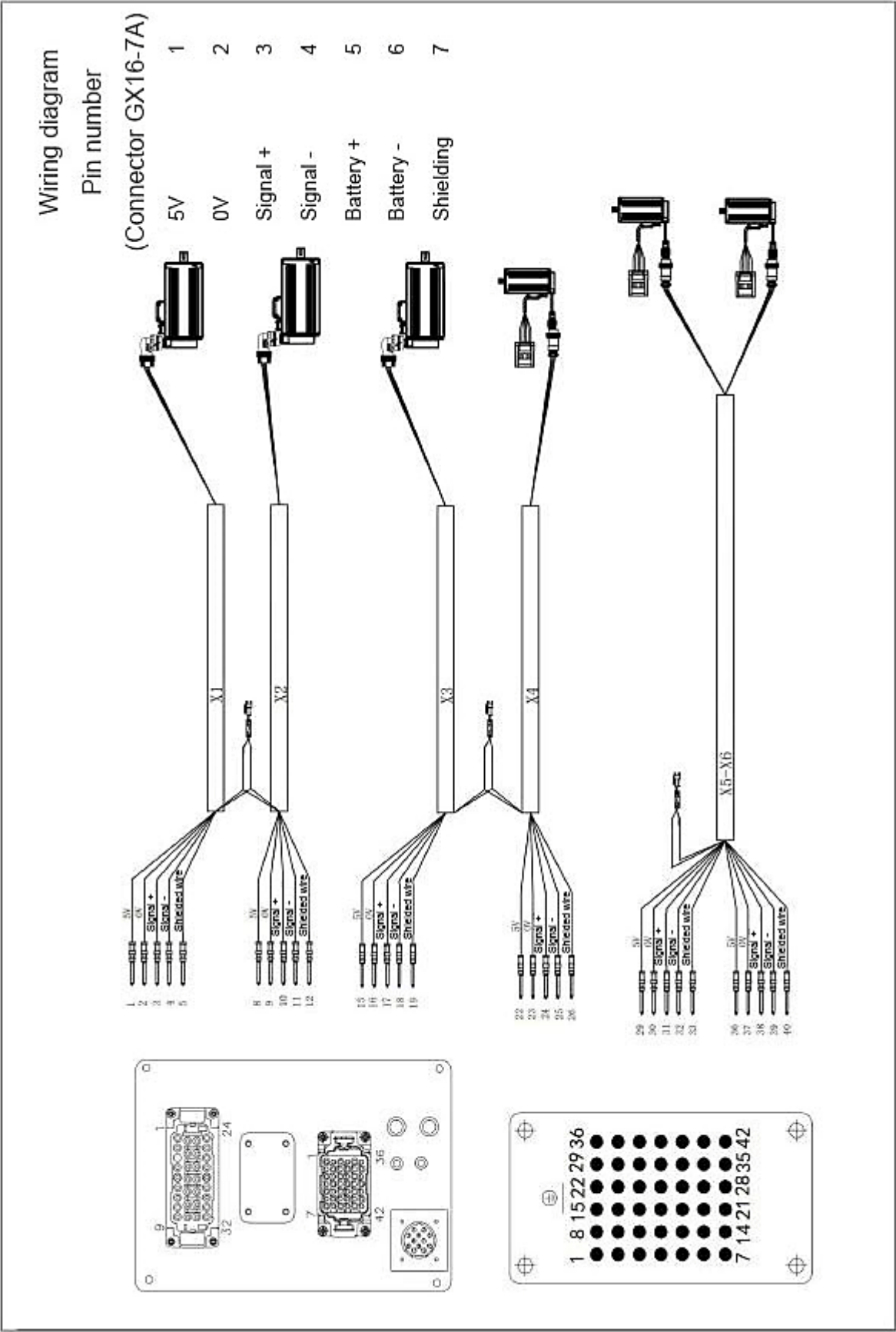
Appendix X Driver Parameter Description and Alarm Treatment Opinions

❖ Lead-Motion Drive

◆ I. Description of parameters

Pn Number   Meaning
Pn000   Basic switch for function selection; ETHERCAT bus control as control method
Pn002   Function selection basic switch; normal use absolute value code
Pn009   "Function selects basic switch; selects current control mode 2, speed checkout 2 to smooth the of current, speed commanded operation."
Pn100   Velocity loop gain
Pn101   Speed command integration time parameter
Pn102   Position loop gain
Pn103   Ratio of inertia
Pn123   Friction compensation factor
Pn140   "Model tracking control class switch; use of model tracking, vibration suppression function via auxiliary function
          Make automatic adjustments"
Pn141   Model tracking gain
PN20E   Electronic gear ratio molecules
Pn210   Electronic Gear Score Master
Pn216   Position command acceleration and deceleration time parameters
Pn217   Position command averaging filter
Pn304   JOG Speed
Pn401   First torque input filter time constant
Pn406   Emergency stop torque limitation
Pn506   Brake command-servo OFF delay time
Pn507   Brake command output speed value
Pn508   Servo OFF-brake command wait time
Pn50A   "Input signal selection; fix the signal all the time as positive rotatable driveable, CN1-9 input signal
          Effective when ON (closed), and the allocation of the compliance input signal is changed according to the different signals."
Pn50E   Input signal selection; output servo ready signal from CN1-7, 6 output terminals. Output same speed check-out signal from CN1-5, 4 output terminals. Output positioning completion signal from CN1-5, 4 output terminals.
Pn50F   Output signal selection; brake signal from CN1-3, 2 output terminals
Pn515   Input signal selection; the command pulse input multiplier switching input signal is always fixed to invalid
Pn520   Alarm value for excessive deviation between positions
Pn522   Positioning Finish Width
Pn524   NEAR signal width
Pn600   Regenerative Resistor Capacity
Pn604   Motor Model Selection
Pn606   Gravity compensation switch, bit control parameter 1; automatic adjustment of the predicted torque enable
Pn609   Forward commutation feedforward torque
Pn610   Forward commutation feed-forward torque filtering
Pn611   Negative commutation feedforward torque
Pn612   Negative commutation feed-forward torque filtering
Pn613   Speed deviation alarm threshold
Pn614   Speed deviation alarm time
Pn615   Blocking protection torque
Pn617   Blocking protection speed
Pn700   Serial communication encoder single-turn digits

Pn702   Motor rated power
Pn703   Number of motor poles
Pn704   Rated motor torque
Pn705   Maximum motor torque
Pn706   Peak motor rated current
Pn707   Maximum peak motor current
Pn708   Motor rated speed
Pn709   Maximum motor speed
Pn70A   Motor inertia
Pn70B   Motor phase resistance
Pn70C   Motor phase inductance
Pn717   Motor Model Configuration

List of auxiliary functions
Fn Number   Function
Fn000   Display Alarm Record
Fn002   JOG Run
Fn003   Origin Search
Fn004   The programme JOG runs
Fn005   Initialization of parameter setting values
Fn006   Delete Alarm Record
Fn008   Absolute encoder Initialization, encoder alarm reset
Fn009   Automatic adjustment of analogue speed/analogue torque command offsets
Fn00A   Manual adjustment of speed command bias
Fn00B   Manual adjustment of torque command bias
Fn00C   Adjusting the bias of the analogue monitor output
Fn00D   Adjusting the gain of the analogue monitoring output
Fn00E   Bias adjustment of motor current detection signal - automatic
Fn00F   Bias adjustment of motor current detection signal - manual
Fn010   Parameter Write Disable
Fn012   Displays ARM and FPGA software version, driver power level
Fn013   Setting the rotation limit value in case of "rotation limit value inconsistency (A.CCO) alarm".
Fn015   Inertia Ratio Recognition
Fn01B   Detection value Initialization for vibration detection
Fn030   Software reset
Fn200   Setting self-adjusting value
Fn201   Advanced Auto Adjustment
Fn202   Command input type advanced auto tuning
Fn203   Single-parameter tuning
Fn204   Vibration control function
Fn205   Vibration suppression function
Fn206   EasyFFT
Fn207   Online Vibration Monitoring

◆   **II. Driver Alarm Codes and Treatment Opinions**

1. Treatment in case of alarm

Ws.1: The stopping method in case of alarm depends on Pn001.0. The factory setting is dynamic brake (DB) stop.
Ws.2: The method of stopping in case of an alarm depends on Pn0OB.1. The factory setting is a zero-speed stop with a speed command of zero.

For torque control, the stopping method of Ws.1 is generally used. By setting Pn00B.1=1, the same stop method as Ws.1 can be set. This stopping method can be used to prevent damage to the machine due to different stopping methods in case of alarms when multiple servomotors are used.

2. Can the alarm be reset

Possible: The alarm can be deactivated by alarm reset. However, the alarm cannot be deactivated if the cause of the alarm has not been completely eliminated.

No: Unable to deactivate the alarm.

3. List of alerts

Alarm No.	Alarm name	Alarm content	Stopping method in case of alarm	Alarm reset Yes/No
A.001	Drive Model Identification Alarm	The recognized servo drive model does not match the drive model present in the EEPROM.	Ws.1	No.
A.002	Motor type parameter not set	Motor type not set in drive parameter Pn604	Ws.1	No.
A.003	Emergency stop alarm	FSTP emergency stop alarm input signal valid	Ws.1	No.
A.004	Mismatch between function and model	Pn000.1 selects a control mode that includes "speed control (analogue command)", but the drive has no analogue input function.	Ws.1	No.
A.020	Parameter and checksum exceptions	Data abnormality in the internal parameters of the Servo Drive.	Ws.1	No.
A.021	Parameter Formatting Exception	The data format of the Servo Drive's internal parameters is abnormal.	Ws.1	No.
A.022	System and calibration exceptions	Data abnormality in the internal parameters of the Servo Drive.	Ws.1	No.
A.030	Abnormalities in the main circuit detection section	Various check-out data of the main circuit are abnormal.	Ws.1	Yes
A.040	Parameter setting abnormality	Out of set range.	Ws.1	No.
A.041	Crossover pulse output setting abnormality	The number of encoder division pulses (Pn212) does not comply with the setting range or setting conditions.	Ws.1	No.
A.042	Parameter combination anomaly	The combination of multiple parameters is outside the set range.	Ws.1	No.
A.050	Combinatorial error	Outside the range of combinable motor capacities.	Ws.1	Yes
A.0b0	Servo ON command invalid alarm	The servo-ON (/S-ON) signal is externally input after the motor power-on assist function is executed.	Ws.1	Yes

A.100	Overcurrent detection	The overcurrent flows through the power transistor.	Ws.1	No.
A.101	Overcurrent detection	The overcurrent flows through the power transistor [VCE saturation].	Ws.1	No.
A.300	Regenerative fault	Regenerative class failure.	Ws.1	Yes
A.320	Regeneration overload	A regenerative overload has occurred.	Ws.2	Yes
A.330	Incorrect wiring of main circuit power supply	The setting of AC input/DC input is incorrect. The power supply is wired incorrectly.	Ws.1	Yes
A.400	Overvoltage	Main circuit bus voltage is too high.	Ws.1	Yes
A.410	Undervoltage	Main circuit bus voltage undervoltage.	Ws.2	Yes
A.510	Overspeed	The motor speed is above the maximum speed.	Ws.1	Yes
A.511	Crossover pulse output overspeed	The set number of encoder crossover pulses has been exceeded. (Pn212) the upper limit of the pulse output speed.	Ws.1	Yes
A.520	Vibration alarm	Detect abnormal vibration of the motor speed.	Ws.1	Yes
A.521	Auto-tuning alarms	Vibration detected in self-tuning function auto-tuning	Ws.1	Yes
A.710	Overload (instantaneous maximum load)	Runs for seconds to tens of seconds at a torque that greatly exceeds the rated value.	Ws.2	Yes
A.720	Overload (continuous maximum load)	Continuous operation at a torque exceeding the rated value.	Ws.1	Yes
A.730 A.731	DB Overload	Due to DB (Dynamic Brake) action, the rotational energy exceeds the capacity of the DB resistor.	Ws.1	Yes
A.740	Inrush current limiting resistor overload	The main circuit power supply is turned on too frequently.	Ws.1	Yes
A.7A0	Heat sink overheating	Servo drive heatsink temperature exceeds 90°C	Ws.2	Yes
A.810	Encoder Backup Alarm	The encoder is completely depleted of power and the position data is erased	Ws.1	No.
A.820	Encoder sum check alarm	The sum check result of the encoder memory is abnormal.	Ws.1	No.
A.830	Encoder battery alarm	The battery voltage is below the specified value when the control power is switched on.	Ws.1	Yes
A.840	Encoder data alarm	The internal data of the encoder is abnormal.	Ws.1	No.

A.850	Encoder overspeed	When the power is turned on, the encoder rotates at high speed.	Ws.1	No.
A.860	Encoder overheating	The internal temperature of the encoder is too high.	Ws.1	No.
A.b10	Speed command A/D exception	The A/D converter for the speed command input is faulty.	Ws.2	Yes
A.b11	Speed command A/D conversion data abnormality	The A/D conversion data for the speed command is abnormal.	Ws.2	Yes
A.b20	Torque command A/D abnormality	Faulty A/D converter for torque command input.	Ws.2	Yes
A.b31	Current detection fault 1	U-phase current detection loop fault.	Ws.1	No.
A.b32	Current detection fault 2	V phase current detection loop fault.	Ws.1	No.
A.b33	Current detection fault 3	Current detection loop fault.	Ws.1	No.
A.C10	Preventing uncontrolled detection	The servo motor is out of control.	Ws.1	Yes
A. C80	Encoder Clear Fault (Abnormal setting of the upper limit of the number of revolutions)	Absolute encoders with multiple rotations are cleared or set incorrectly.	Ws.1	No.
A. C90	Encoder communication failure	Communication between the encoder and servo drive is not possible.	Ws.1	No.
A.C91	Encoder communication position data acceleration abnormality	A malfunction occurred in the calculation of the position data of the encoder.	Ws.1	No.
A.C92	Encoder communication timer exception	The timer for communication between the encoder and the servo driver has failed.	Ws.1	No.
A. CAO	Abnormal encoder parameters	The parameters of the encoder are corrupted.	Ws.1	No.
A.Cb0	Encoder calibration abnormality	The content of the communication with the encoder is incorrect.	Ws.1	No.
A. CCO	Inconsistency in the upper limit of the number of revolutions	The upper limit of the number of rotations of the encoder and the servo drive are not the same.	Ws.1	No.
A.d00	Excessive positional deviation	In the servo-ON state, the position deviation exceeds the excessive position deviation alarm value (Pn520).	Ws.1	Yes
A.d01	Excessive position deviation alarm when servo ON	Servo ON when the position deviation is above the setting value of Pn526 in servo 0FF.	Ws.1	Yes
A.d02	Speed limit at servo-ON Excessive positional deviation	If the servo is turned ON in the position deviation accumulation state, the speed is limited by the speed limit value (Pn529) when the servo is	Ws.2	Yes

		turned ON. If a command pulse is input in this state, the set value of the excessive position deviation alarm value (Pn520) is exceeded without releasing the limit.		
A.d10	Excessive deviation between motor-load position	Excessive deviation between motor one load position.	Ws.2	Yes
A.F10	Power line phase loss	The low-voltage state of one of the R, S, or T phases persists for 1 second or more while the main power supply is ON.	Ws.2	Yes

4. Causes of alarms and treatment measures

When the Servo Drive fails, the alarm "A. Mouth" will be displayed on the panel monitor.

The causes of the alarms and the measures to deal with them are listed below, and if you follow the table below, you can eliminate the malfunction.

Alarm No.: Alarm name (content of alarm)	Reason	Confirmation method	Treatment measures
A.001. Drive Model Identification Alarm	The model number recognized by the servo drive is different from the model number of the drive stored in the EEPROM.	Use Fn012 to see if the recognized drive model (power and voltage rating) matches the model number on the drive nameplate.	1. If you are sure that the recognized drive model is correct, eliminate the alarm by the following method: (1) Set Pn602.2=1, drive power-off (2) Execute Fn005 to restore factory value 2. If it is confirmed that the drive model is recognized incorrectly, it is necessary to find out why the hardware identification ID is wrong.
A.002. Motor type parameter not set	Drive parameter Pn604 does not set the motor model number.	Check the value of drive parameter Pn604, if it is 50 it will alarm A.002	Set the value of Pn604 according to the actual motor model and the list of motor parameters.
A.003. emergency stop alarm	Emergency stop alarm input signal valid		Disengage the emergency stop input signal
A.004. Mismatch between function and model	Mismatch between function and drive model		Reset the Pn000.1 control method. Replace the drive with one that has an analogue input function.
	The supply voltage drops transiently.	Measure the supply voltage.	Set the power supply voltage within the specification range and initialize the parameter setting values (Fn005).
	The power supply is switched off during the parameter writing process.	Confirm the timing of the power failure.	After initializing the parameter setting values (Fn005), enter the parameters again.

A.020. Parameter and checksum exceptions (Data abnormality in servo driver internal parameters)	The number of writes to the parameter has exceeded the maximum value.	Verify that frequent parameter changes are made from the upper unit.	Possible servo drive failure. Replace the servo drive. Change the parameter writing method.
	The following are some of the reasons for this change from AC power, ground, and Noise from static electricity, etc. Misbehaviour was generated.	If the alarm occurs even after the power is turned on several times, noise may be the cause.	Take measures to prevent noise disturbance.
	Failure of a component inside the Servo Drive due to gas, water droplets or cutting oil.	Confirm the installation environment.	The servo drive may be faulty. Replace the servo drive.
	Servo drive failure.	If the alarm occurs even after the power is turned on several times, there may be a malfunction.	Possible servo drive failure. Replace the servo drive.
A.021. Parameter Formatting Exception (Abnormal servo drive internal parameters)	The software version to which the parameters are written is updated compared to the software version of the servo drive that generated the alarm.	Use Fn012 to confirm that the software versions are the same. If the versions are different, an alarm may occur.	Write the software version and model of the same its The parameters of the servo drive are then turned on.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.022. System and calibration exceptions (Data abnormality in servo driver internal parameters)	The supply voltage drops transiently.	Measure the supply voltage.	The servo drive may be faulty. Replace the servo drive.
	The power is turned off during the setting of auxiliary functions.	Confirm the timing of the power failure.	Possible servo drive failure. Replace the servo drive.
	Servo drive failure.	If the alarm occurs even after the power is turned on several times, there may be a malfunction.	The servo drive may be faulty. Replace the servo drive.
A.030. Main circuit detector failure	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.040. Parameter setting abnormality (exceeds set range)	The servo drive capacity does not match the servo motor capacity.	Confirm the capacity and combination of the Servo Drive and Servomotor.	Match the capacity of the servo drive with that of the servo motor.
	Servo drive failure.		Possible servo drive failure. Replace the servo drive.

	Outside the parameter setting range.	Confirm the setting range of the changed parameter.	Make the changed parameter a value within the set range.
	The set value of the electronic gear ratio is outside the set range.	Verify that the electronic gear ratio is 0.001 < (Pn20E/Pn210) < 4000.	Set the electronic gear ratio to 0.001 < (Pn20E/Pn210) < 4000.
A.041. Crossover Pulse Output Setting exceptions	The number of encoder division pulses (Pn212) does not satisfy the setting range and setting conditions.	Confirm Pn212.	Set Pn212 to the appropriate value.
A.100/A.101 Overcurrent detection	Incorrectly wired or poorly contacted main circuit cable	Verify that the wiring is correct.	Modify wiring.
	A short or ground fault has occurred within the main circuit cable.	Verify that there are no short circuits between the UVW phases of the cable and between the UVW and ground.	The cable may be short-circuited. Replace the cable.
	Short circuit inside the servomotor or short circuit to ground.	Verify that there is no short circuit between the UVW phases of the motor terminals, or between UVW and ground.	The servo motor may be faulty. Replace the servo motor.
	A short circuit or ground has occurred inside the servo drive.	Verify that there is no short circuit between the UVW phases of the servo motor connection terminals of the servo driver or between the UVW and the ground. For details, refer to "3.1 Main Circuit Wiring".	The servo drive may be faulty. Replace the servo drive.
A.100/A.101 Overcurrent detection	Incorrectly wired or poorly connected regenerative resistor.	Verify that the wiring is correct Refer to "3.6 Connecting Regenerative Resistors" for details.	Modify wiring.
	The dynamic brake (emergency stop due to DB, service drive) is used frequently, or a DB overload alarm has occurred.	Confirm the DB usage frequency by using the DB resistance power consumption (Un0OB). Alternatively, use the alarm log display (Fn000) to check whether a DB overload alarm A.730 or A.731 has occurred.	Change the servo drive selection, operation method and mechanism to reduce the frequency of DB use.
	The regeneration resistance is too high and the regeneration capacity is exceeded.	Use the regenerative load ratio (Un00A) to check how often the regenerative resistor is used.	Revisit the regeneration resistance value, taking into account the operating conditions and load.
	The regeneration resistor value of the servo drive is too small.	Use the regenerative load ratio (Un00A) to check how often the regenerative resistor is used.	Change the regeneration resistance value to a value above the minimum allowable resistance value of the servo driver.
	High loads during	Check that the operating	Reduce the load on the

	servomotor stops or low-speed operation	conditions are outside the servo driver's specifications.	servo motor. or Operate at a higher operating speed.
	Misoperation due to noise.	Improve the noise environment for wiring, installation, etc., and confirm the effect.	Take measures to prevent noise, such as wiring the FG correctly. Also, use the same wire size for the FG as in the "Servo driver main circuit wire size".
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo drive may be faulty Replace the servo drive.
A.300 regenerative fault	Regenerative drain IGBT failure in servo drive.		Replace the servo drive.
A.320. regeneration overload	The supply voltage is out of specification.	Measure the supply voltage.	Set the supply voltage within specifications.
A.320. regeneration overload	The jumper of servo driver power terminals P-D with built-in regenerative resistor is disconnected.	Confirm the wiring of the power terminal jumper wires.	Connect the jumper cables correctly.
	External regenerative resistor has bad, disconnected or broken wiring.	Verify the wiring of the external regenerative resistor.	Proper wiring of external regenerative resistors 0
	Insufficient external regeneration resistor value or capacity, or continuous regeneration.	Reconfirm the operating conditions or capacity.	Change the regenerative resistance value, regenerative resistance capacity. Make adjustments to the operating conditions again.
	Continuous negative load, continuous regeneration.	Confirm the load applied to the running servomotor.	The system, including servo, mechanical, and operating conditions, is revisited.
	The capacity set in parameter Pn600 is less than the capacity of the external regeneration resistor.	Confirm the connection of the regenerative resistor and The value of Pn600.	Setting value for calibration parameter Pn600.
	The external regeneration resistor value is too large.	Verify that the regeneration resistor value is correct.	Change it to the correct resistance value and capacity
	Servo drive failure.		Possible servo drive failure. Replace the servo drive.

A.330. Main circuit power supply wiring error *Detected when main circuit power supply is switched on	High supply voltage inside servo drive, regenerative resistor disconnected.	Measure the resistance of the regenerative resistor with a measuring instrument.	Replace the servo driver when using the regenerative resistor built into the servo driver. When using an external regeneration resistor, replace the regeneration resistor.
	When AC power input is set, DC power is input.	Confirm that the power supply is a DC power supply.	Keep the setting of the power supply the same as the power supply in use.
	AC power is input when DC power input is set.	Confirm that the power supply is AC power.	Keep the setting of the power supply the same as the power supply in use.
	Use M1-01B, 02B, 04B to set the regeneration resistor capacity (Pn600) to a value other than "0" without an external regeneration resistor.	Verify the connection of the external regeneration resistor and the value of Pn600.	Connect an external regenerative resistor, or connect an external regenerative resistor without the To externally regenerate the resistor, set the Pn600 is set to 0.
	The jumper wire of servo drive power supply terminals P-D of capacities other than M1-01B, 02B and 04B is disconnected.	Confirm the wiring of the power terminal jumper wires.	Connect the jumper cables correctly.
	Servo drive failure.		Possible servo drive failure. Replace the servo drive.
A.042*1. Parameter combination anomaly	The speed of the programme JOG operation (Fn004) does not comply with the set range because the electronic gear ratio (Pn20E/Pn210) or servomotor has been changed.	Confirm that the detection condition formula* is valid.	Reduced electronic gear ratio (Pn20E/Pn210) value.
	Program JOG operation due to change in program JOG movement speed (Pn533). The speed of (Fn004) does not match the set range.	Confirm that the detection condition formula *1 is valid.	Increase programmed JOG movement speed (Pn533) values.

	Due to a change in the electronic gear ratio (Pn20E/Pn210) or servomotor, the travel speed of the advanced auto tuning does not correspond to the set range.	Confirm that the detection condition formula *1 is valid.	Reduced electronic gear ratio (Pn20E/Pn210) value.
A.050. combinatorial error (outside the range of combinable motor capacities)	The servo drive capacity does not match the servo motor capacity.	recognize as $1/4 \leq \dfrac{motor\ capacity}{Servo\ unit\ capacity} \leq 4$	Match the capacity of the Servo Drive with that of the Servomotor.
	Encoder failure.	Replace the servomotor with another one and make sure that the alarm does not occur again.	Replace the servo motor (encoder).
	Servo drive failure.	-	It is possible that the servo drive is faulty. Replace the servo drive.
A.0b0. Invalid servo ON command (fire) alarm	After the motor power-on assist function is performed, an external service ON (/S-ON) signal is input.	-	Turn on the power to the Servo Drive again. Or perform a software reset.

*1. Detection condition formula

An alarm is detected when either of the following condition formulas holds.

- $Pn533[min^{-1}] \times \dfrac{Encoder\ resolution}{6 \times 10^5} \leq \dfrac{Pn20E}{Pn210}$

- $Maximum\ motor\ speed\ [min^{-1}] \times \dfrac{Encoder\ resolution}{About\ 3.66 \times 10^{12}} \leq \dfrac{Pn20E}{Pn210}$

(Continued)

Alarm No.: Alarm name (Content of the alert)	Reason	Confirmation method	Treatment measures

A.400. overvoltage (Overvoltage is detected by the main circuit power supply section inside the servo driver.)	The AC220V servo drive's AC supply voltage is detected to be above 310V; AC380V servo drive AC supply voltage is detected to be above 580V.	Measure the supply voltage.	Adjust the supply voltage to within the product specifications.
	The power supply is unstable or has been affected by a lightning strike.	Measure the supply voltage.	If the alarm still occurs when the power is turned on again after improving the power condition, setting the surge suppressor, etc., the servo driver may be defective. Replace the servo driver.
	Acceleration and deceleration at AC supply voltages above specification range	Confirm the supply voltage and operating speed and torque.	Adjust the AC supply voltage to within the product specifications.
	The value of the external regeneration resistor is larger than the operating condition.	Confirm the operating conditions and regeneration resistance value.	Revisit the regeneration resistance value, taking into account the operating conditions and load.
	Operate in a state above the allowable moment of inertia ratio.	Verify that the ratio of inertia is within the permissible ratio of inertia.	Extend the deceleration time, or reduce the load.
	Servo drive failure.		Without turning on the main circuit power If the alarm still occurs when the control power is turned on again under the following conditions, the servo drive may be faulty. Replace the servo drive.
A.410. undervoltage (Undervoltage is detected by the main circuit power supply section inside the servo driver.)	The AC220V servo drive AC supply voltage is detected to be below 120V; The AC supply voltage of the AC380V servo drive is detected to be below 230V;	Measure the supply voltage.	Adjust the supply voltage to the normal range.
	Supply voltage drops during operation.	Measure the supply voltage.	Increase power supply capacity.
	Transient power outages occur.	Measure the supply voltage.	If the instantaneous blackout hold time is changed (Pn509) is set to a smaller

			value.
	Blown fuse in servo drive		Replace the servo drive, connect the reactor and use the servo drive again.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.510. overspeed (Motor speed above maximum speed)	The motor wiring is in the wrong phase sequence of U, V, and W.	Confirm the servo motor wiring.	Verify that there is no problem with the motor wiring.
	The command input value exceeds the overspeed value.	Confirms the input command.	Reduce the command value, or adjust the gain.
	Motor speed exceeds maximum speed	Confirm the waveform of the motor speed.	Decrease the speed command input gain, adjust the servo gain, or adjust the operating conditions.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.511. Crossover pulse output overspeed	The output frequency of the crossover pulse is too high and exceeds the limit value.	Confirm the crossover pulse output setting.	Reducing the number of encoder crossover pulses (Pn212) setting.
	The motor speed is too high and the output frequency of the crossover pulse exceeds the limit value.	Confirm the crossover pulse output setting and motor speed.	Reduce motor speed.
A.520. vibration alarm	Detecting abnormal motor speed vibration	Check the abnormal sound of the motor and the waveforms of speed and torque during operation.	Reduce motor speed. or reduce the speed loop gain (Pn100).
	The value of the ratio of inertia (Pn103) is larger than the actual value or has changed significantly.	Confirm the ratio of rotational inertia.	Correctly set the moment of inertia ratio (Pn103).
A.521. Advanced Auto-Adjustment Alarms (In single-parameter tuning, Vibration detected in	The motor vibrates heavily when using the self-adjustment function.	Confirm the waveform of the motor speed.	Reduce the load to below the permissible ratio of rotating inertia, or increase the load value for the self-adjusting value setting (Fn200), or reduce the rigidity value.

EasyEFT, self-tuning function)	In performing single-parameter tuning, EasyFFT process, the motor It's a lot of vibration.	Confirm the waveform of the motor speed.	Implement the processing measures in each functional step.
A.710: overloaded (Maximum instantaneous load) A.720: overloaded (Maximum continuous load)	Poor motor wiring, encoder wiring or poor connections.	Confirm wiring.	Confirm that there is no problem with the motor wiring and encoder wiring.
	The motor is running beyond the overload protection characteristics.	Verify the motor's overload characteristics and operating instructions.	Revisit load conditions, operating conditions. Alternatively, revisit the motor capacity.
	The motor does not drive due to mechanical factors, resulting in excessive loads during operation.	Confirm the run command and motor speed.	Improvement of mechanical factors.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.730: A.731: DB Overload (Excessive power consumption of the dynamic brake detected)	The motor is being driven by an external force.	Confirm the operating status.	Do not drive the motor by external force.
	The rotational energy when DB stops exceeds the capacity of the DB resistor.	Confirm the frequency of DB usage by DB resistor power consumption (Un0OB).	Try the following measures. Reduce the command speed of the servo motor. Reduce the ratio of rotational inertia. Reduce the number of DB stops.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.740: Inrush current limitation Resistor overload (Main circuit power on. Frequency too high.)	The number of times the inrush current limiting resistor is allowed to exceed 0N/0FF of the main circuit power supply.		Reduces the number of 0N/0FF times for the main circuit power supply.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.7A0. Heat sink overheating	Ambient temperature is too high.	Measure the ambient temperature with a thermometer.	Improve the mounting conditions of the servo drive and reduce the ambient temperature.
	It was run after resetting the overload alarm several times by switching off the power.	Display via alarm log (Fn000) Acknowledge the overload alarm.	Change the reset method of the alarm.
	Excessive load, or running beyond	The operating load is confirmed by the	Revisit load conditions,

	regeneration capacity	cumulative load factor (Un009), and the regenerative capacity is confirmed by the regenerative load factor (Un00A).	operating conditions.
	The servo drive is mounted in an unreasonable direction and at an unreasonable interval from other servo drives.	Confirm the installation status of the servo driver.	Mount the servo drive according to the mounting standard of the servo drive.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.810. Encoder Backup Alarm *Only detected when connecting an absolute encoder. * Detected on the encoder side	Power on the absolute encoder for the first time.	Verify that the power is turned on for the first time.	Perform encoder setting operations (Fn008).
	The encoder cable was removed and connected again.	Verify that the power is turned on for the first time.	Confirm the encoder connection and perform the encoder setting operation (Fn008).
	Failure of the servo drive's control power supply (+5V) and the battery power supply	Verify that the battery and plug status of the encoder plug are correct.	After restoring power to the encoder (replacing batteries, etc.), perform the encoder setting operation (Fn008).
	Absolute encoder failure.		If the alarm is not canceled even if the setting operation is repeated, replace the servomotor.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.820. Encoder sum check (fire) alarm * Detected on the encoder side	Encoder failure.		For absolute encoders Set (Fn008) the encoder again. If the alarm still occurs frequently, the servo driver may be faulty. Replace the servo motor. 1 For rotary absolute encoders or incremental encoders The servo motor may be faulty. Replace the servo motor.
	Servo drive failure.		The servo drive may be faulty. Replace the servo

			drive.
A.830. Encoder battery alarm (Absolute encoder battery voltage below specified value)	Battery is poorly connected, not connected.	Confirm the battery connection.	Connect the battery correctly.
	Battery voltage is lower than specified (2.7V).	Measure the voltage of the battery.	Replace the battery.
	Servo drive failure.		The servo drive may be faulty. Replace the servo drive.
A.840. Encoder data alarm * Detected on the encoder side	Encoder malfunction.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Encoder malfunction due to noise or other disturbances.		Peripheral wiring of the encoder (separation of the encoder cable from the servomotor main circuit cable, grounding, etc.) is performed correctly.
A.850. Encoder overspeed *Detected when control power is turned on * Detected on the encoder side	When the control power is switched on, the servomotor rotates at a speed of 200 min^1 or more.	Monitoring by motor rotation speed (Un000) to confirm the motor speed when the power is turned on.	Adjust the servo motor speed to dissatisfaction 200min-1, then turn on the control power.
	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.860. Encoder overheating *Only detected when connecting an absolute encoder. * Detected on the encoder side	High ambient temperature of servo motor	Measure the ambient temperature of the servo motor.	Adjust the ambient temperature of the servomotor to 40°C or less.
	The servomotor is running at a load that exceeds the rated value.	The motor load is confirmed by the cumulative load factor (Un009).	Adjust the load of the servomotor to within the rated value before running.
	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.

A.C10. Preventing uncontrolled detection *Detected at servo ON	Motor wiring U, V, W phase sequence is incorrect.	Confirm motor wiring.	Verify that there is no problem with the motor wiring.
	Encoder Failure		If the motor is wired correctly, the alarm still occurs when the power is turned on again. If this is the case, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.C80. Encoder clearing abnormality (Upper limit value of rotation number Setting abnormality)	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.C90. Encoder communication failure	Encoder connection port contact Bad, or incorrectly wired plug.	Check the status of the port for encoder connection.	Plug the encoder in again to confirm the wiring of the encoder.
	Encoder cable breakage, short The cable has been used with more than the specified impedance.	Verify the status of the encoder cable.	Use the encoder cable required by the specification.
	Corrosion due to temperature, humidity, gases; short circuits due to water droplets, cutting oil; poor plug contact due to vibration.	Confirm the usage environment.	Improve the operating environment and replace the cable. If this does not improve the situation, replace the Servo Drive.
	False operation due to noise interference.		Peripheral wiring of the encoder (separation of the encoder cable from the servomotor main circuit cable, grounding, etc.) is performed correctly.

	Servo drive failure.		If no alarm occurs when the control power is switched on after connecting the servomotor to another servo drive, the servo drive may be defective. Replace the servo drive.
A.C91. Encoder communication position data acceleration abnormality	Engagement of the encoder cable, damage to the cladding, interference with the signal line.	Verify the status of the encoder cable and access port.	Verify that the encoder cable is laid correctly.
	Encoder cables are bundled with high-current cables or are too far apart. Nearly.	Confirm the setting status of the encoder cable.	Route the encoder cable in a position where it will not be exposed to surge voltages.
	The potential of the FG varies due to the influence of equipment on the motor side (welder, etc.).	Confirm the setting status of the encoder cable.	Ground the machine to stop the shunt to the encoder side FG.
A.C92. Encoder communication timer Exception	The encoder signal line is disturbed.		Implement encoder wiring anti-interference countermeasures.
	The encoder is subjected to excessive vibration shocks.	Confirmation of use.	Reduce mechanical vibration. Or install the servo motor correctly.
	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.b10. Speed command A/D exception *Detected at servo ON	Speed command input malfunction		Reset the alarm and run it again.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.b11. Speed command A/D	Speed command input malfunction		Reset the alarm and run it again.

conversion Data exception	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty and the servo driver should be replaced.
A.b20. Torque command A/D abnormality *Detected at servo ON	Torque command input reading section error		Reset the alarm and run it again.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.b31. Current detection fault 1	U phase current detection circuit fault.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.b32. Current detection fault 2	V phase current detection circuit fault.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.b33. Current detection fault 3	Current detection loop fault.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
	The servo motor main circuit cable is disconnected.	Verify that the servo motor main circuit cable is not disconnected.	Repair motor cables.
A.C10. Preventing uncontrolled detection *Detected at servo ON	Motor wiring U, V, W phase sequence is incorrect.	Confirm motor wiring.	Verify that there is no problem with the motor wiring.
	Encoder Failure		If the motor is wired correctly, the alarm still occurs when the power is turned on again. If this is the case, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.C80. Encoder clearing abnormality (Upper limit value of rotation number setting abnormality)	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the

			servo driver may be faulty. Replace the servo drive.
A.C90. Encoder communication failure	Encoder connection port contact Bad, or incorrectly wired plug.	Check the status of the port for encoder connection.	Plug the encoder in again to confirm the wiring of the encoder.
	Encoder cable breakage, short The cable has been used with more than the specified impedance.	Verify the status of the encoder cable.	Use the encoder cable required by the specification.
	Corrosion due to temperature, humidity, gases; short circuits due to water droplets, cutting oil; poor plug contact due to vibration.	Confirm the usage environment.	Improve the operating environment and replace the cable. If this does not improve the situation, replace the Servo Drive.
	False operation due to noise interference.		Peripheral wiring of the encoder (separation of the encoder cable from the servomotor main circuit cable, grounding, etc.) is performed correctly.
	Servo drive failure.		If no alarm occurs when the control power is switched on after connecting the servomotor to another servo drive, the servo drive may be defective. Replace the servo drive.
A.C91. Encoder communication position data acceleration abnormality	Engagement of the encoder cable, damage to the cladding, interference with the signal line.	Verify the status of the encoder cable and access port.	Verify that the encoder cable is laid correctly.
	Encoder cables are bundled with high-current cables or are too far apart. Nearly.	Confirm the setting status of the encoder cable.	Route the encoder cable in a position where it will not be exposed to surge voltages.
	The potential of the FG varies due to the influence of equipment on the motor side (welder, etc.).	Confirm the setting status of the encoder cable.	Ground the machine to stop the shunt to the encoder side FG.

A.C92. Encoder communication timer abnormality	The encoder signal line is disturbed.		Implement encoder wiring anti-interference countermeasures.
	The encoder is subjected to excessive vibration shocks.	Confirmation of use.	Reduce mechanical vibration. Or install the servo motor correctly.
	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A. CAO. Abnormal encoder parameters	Motor model parameter setting error	Confirm that the motor model number corresponding to the value set in Pn604 is the same as the actual motor model number.	Reset Pn604 and switch on the power again.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A. CbO. Encoder Return Calibration exceptions	Incorrect encoder wiring, poor contact.	Confirm the wiring of the encoder.	Verify that there is no problem with the encoder wiring.
	The encoder cables are of different sizes and are subject to noise interference.		Change the cable specification to double stranded wire or double stranded overall shielded wire with a core of 0.12 mm² or more, tinned soft copper stranded wire.
	Encoder cable wiring distance too long, noise interference.		The maximum wiring distance is 50m.
	Potential of FG due to motor side equipment The change is due to the impact of the new technology (welding machines, etc.).	Verify the status of the encoder cable and access port.	Ground the machine to stop the shunt to the encoder side FG.
	The encoder is subjected to excessive vibration shocks.	Confirmation of use.	Reduce mechanical vibration. Or install the servo motor correctly.

	Encoder failure.		Turn the power on again. If the alarm still occurs, the servo motor may be defective. Replace the servo motor.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A. CCO. Upper limit of rotations inconsistencies	The upper limit of the number of revolutions of the DD motor (Pn205) is different from that of the encoder.	Confirm Pn205.	Set the setting value of Pn205 correctly (0 to 65535).
	The upper rotation limit value of the encoder is different from that of the servo drive or has been changed.	Confirm the value of servo drive Pn205.	Setting change Fn013 when an alarm occurs.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.d00. Excessive positional deviation (Position deviation exceeds the excessive position deviation alarm value (Pn520) in the servo-on state.)	Incorrect wiring of U, V, W of servo motor.	Confirm the connection of the servo motor main circuit cable.	Verify that the motor cable or encoder cable does not have poor contact or other problems.
	Higher frequency of positional instructions	Try to reduce the command pulse frequency before running.	Reduce the position command pulse frequency or command acceleration, or adjust the electronic gear ratio.
	Position command acceleration is too large.	Try reducing the command acceleration before running	Smoothing functions such as position command acceleration and deceleration time constants (Pn216) have been added.
	Position relative to operating conditions Excessive deviation alarm value (Pn520) is lower.	Confirmation of excessive position deviation alarm values (Pn520) is appropriate.	Set the value of parameter Pn520 correctly.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.

A.d01. When servo ON Excessive position deviation alarm	If the position deviation is above the setting value of Pn526 in servo-off, servo 0N.	Check the amount of position deviation (Un008) at servo 0FF.	Set so that the position deviation is cleared at servo 0FF. Or set the correct alarm value (Pn526) for excessive position deviation when the servo is ON.
A.d02. When servo ON Excessive position deviation alarm due to speed limit	If the servo is turned ON in the position deviation accumulation state, the speed limit value is passed when the servo is turned ON. (Pn529) to limit the speed. If a position command is entered in this state, the position deviation alarm value (Pn520) is exceeded. Setting value.		Set so that the position deviation is cleared at servo 0FF. Or set the correct alarm value for excessive position deviation (Pn520). Or set the speed limit value (Pn529) to the correct value when the servo is ON.
A.d10. Excessive deviation between motor-load position	The motor rotates in the opposite direction to the direction in which the external encoder is mounted.	Confirm the direction of rotation of the motor and the direction of mounting of the external encoder.	Reverse the external encoder mounting direction Or set the direction of rotation in "How to use the external encoder (Pn002.3)" to the opposite direction.
	Load position of workpiece table, etc. and mounting fault of external encoder joint.	Confirm the external encoder joint.	Mechanical bonding again.
A.F10. Power line out of phase (In the case of the main power supply ON The R, S, and T phases of the state Low voltage condition in one phase of the (The state lasted more than a second.) Detected when the	Poorly wired three-phase power supply.	Confirm power wiring.	Verify that there is no problem with the power supply wiring.
	The three-phase power supply is unbalanced.	Measure the voltage of each phase of a three-phase power supply.	Corrects power supply imbalance.
	No single-phase input reference is made Number setting (Pn00B.2 = 1) It's just a direct input of single-phase power.	Confirm power supply and parameter settings.	Set power inputs and parameters correctly.

101

main circuit power is turned on	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo driver may be faulty. Replace the servo drive.
A.900. Excessive positional deviation	Incorrect wiring of U, V, W of servo motor.	Confirm the wiring of the servo motor main circuit cable.	Check that the motor cable or encoder cable is not in bad contact.
	Lower gain of servo drives	Verify that the servo drive gain is not too low.	Increase servo gain with advanced auto tuning, etc.
	Higher frequency of position command pulses	Try reducing the command pulse frequency before running.	Reduce the position command pulse frequency or command acceleration, or adjust the electronic gear ratio.
	Position command acceleration is too large.	Try reducing the command acceleration and then run it again.	Smoothing functions such as position command acceleration and deceleration time constants (Pn216) have been added.
	Alarm value for excessive position deviation relative to operating conditions (Pn520) lower	Verify that the excessive position deviation alarm value (Pn520) is appropriate.	Set the value of Pn520 correctly.
	Servo drive failure.		Turn the power on again. If the alarm still occurs, the servo drive may be faulty. Replace the servo drive.
A.901. When servo ON Excessive positional deviation	Accumulated position deviation at servo-ON exceeds Pn526 Pn528 Setting of 100 The following are some examples.		Set so that the bit deviation is cleared at servo 0FF. Or set the appropriate warning value (Pn528) for excessive position deviation when the servo is ON.
A.910. overloaded (Changes to overload alarm (A.710 A.720) before warning)	Bad motor wiring, bad encoder wiring or bad connections.	Confirm wiring.	Verify that there are no problems with the motor wiring or encoder wiring.
	The motor is running beyond the overload protection characteristics.	Confirm the motor's overload characteristics and operating instructions.	Revisit load conditions, operating conditions. Or revisit the motor capacity.

102

	The motor does not drive due to mechanical factors, resulting in excessive loads during operation.	Confirm the run command and motor speed.	Improvement of mechanical factors
	Servo drive failure.		Possible servo drive failure. Replace the servo drive.
A.911. vibration	Detection of abnormal vibration in motor operation	Check the motor for abnormal sounds and waveforms of speed and torque during operation.	Reduce the motor speed. Or reduce the servo gain by single parameter adjustment, etc.
	The value of the ratio of inertia (Pn103) is larger than the actual value or has changed significantly.	Confirm the ratio of rotational inertia.	Set the moment of inertia ratio (Pn103) correctly.
A.920. regeneration overload (Changes to regenerative overload (A.320) prior to the warning)	The supply voltage is out of specification.	Measure the supply voltage.	Set the supply voltage within specifications.
	External regeneration resistor value, servo drive capacity, or regeneration resistor capacity is insufficient, or in continuous regeneration.	Reconfirm the operating conditions or capacity.	Change the regenerative resistor value, regenerative resistor capacity, or servo drive capacity.
	Continuous negative load, continuous regeneration.	Confirm the load applied to the running servomotor.	The system, including servos, machinery, and operating conditions, is revisited.
A.921. DB Overload (Changed to DB overload (A.731) prior to the warning)	The motor is being driven by an external force.	Confirm the operating status.	Do not drive the motor by external force.
	The rotational energy when DB stops exceeds the capacity of the DB resistor.	Confirm the frequency of DB usage by DB resistor power consumption (Un0OB).	Try the following measures. Reduce the command speed of the servo motor. Reduce the rotational inertia. Reduce the number of DB stops.
	Servo drive failure.		Possible servo drive failure. Replace the servo drive.

Other description

Warning No.	Name of warning	Content of the warning

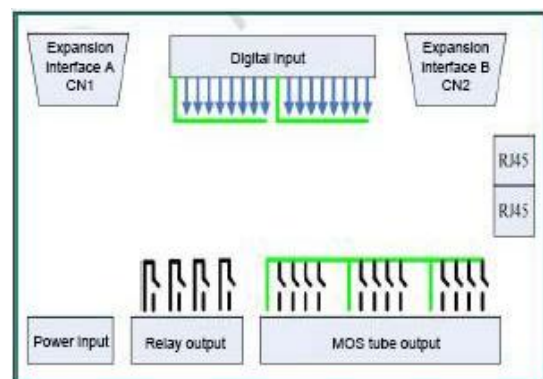| A.900	Excessive positional deviation	Accumulated positional deviation exceeds the ratio set by Pn520 x Pn51E. 100
A.901	Position deviation at servo-ON oversize	Position deviation accumulated during servo-ON exceeds 100 % of the Pn526xPn528 setting. The following are some examples.
A.910	Overloaded	Warning display before an overload (A.710 or A.720) alarm is about to be reached. If operation continues, an alarm may occur.
A.911	Vibratory	Abnormal vibration during motor operation is detected. As with the A.520 detection value, the vibration detection switch (Pn310) is used to set alarm or warning.
A.920	Regeneration overload	Warning display before a regenerative overload (A.320) alarm is reached. If operation continues, an alarm may occur.
A.921	DB Overload	Warning display before a DB overload (A.731) alarm is about to be reached. If operation continues, an alarm may occur.
A.930	Batteries for absolute encoders Failure	Is a warning indication of undervoltage of the absolute encoder battery.
A.941	Parameter changes that require power to be turned back on	Changed parameters that require power to be reconnected.
A.971	Undervoltage	Warning display before an undervoltage (A.410) alarm is about to be reached. If operation continues, an alarm may occur.
A.9A0	Overtravel	Overtravel was detected in the servo ON.

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

Physical figure

Layout figure

❖ R4C Power Interface
Requirements
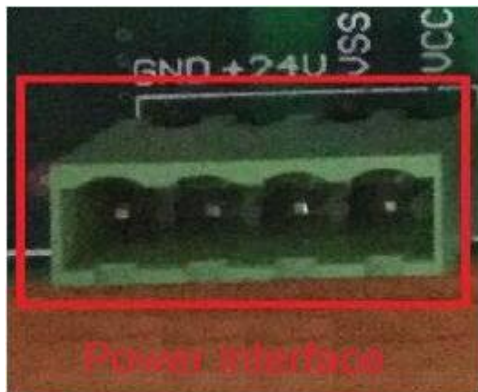
R4C Power Interface Requirements	
Requirement	24V DC Input
Control power supply:	GND (negative) and +24V (positive) connected to DC24V, power 1A or more
Power supply:	VSS (negative) and VCC (positive) connected to DC24V~26V, power 2A or more, need to increase the power supply power according to the actual 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
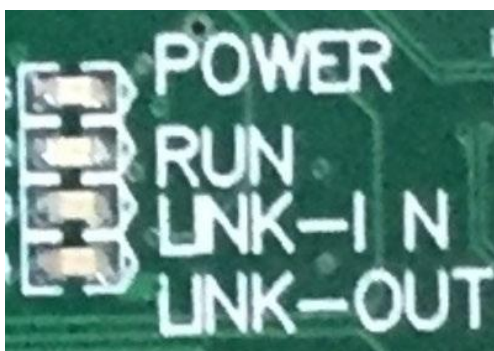
R4C Power and Communication Indicator	
POWER	Power supply
RUN	Successful communication
LINK-IN	Input network port is connected
LINK-OUT	Output network port is connected

| 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
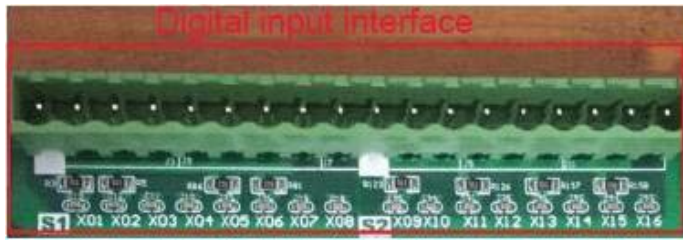
As shown in the figure, the inputs are divided into two types: X01~X08 are grouped with common terminal S1, and X09~X16 are grouped with common terminal S2.
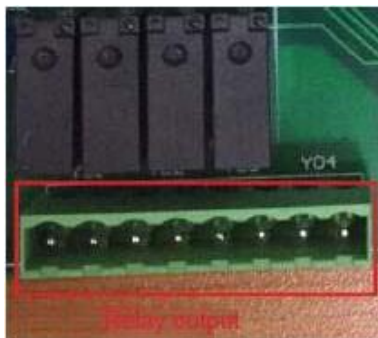
The inputs are recommended to be at 24V level, and the input polarity is configurable, the input end is active at low level if the common terminal is connected to a high level; the input end is active at high level if the common terminal is connected to a low level;

Each input port has a corresponding LED to indicate status.
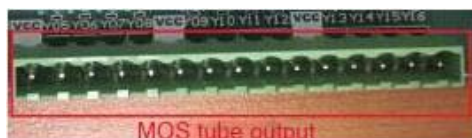
➢ Equivalent circuit:
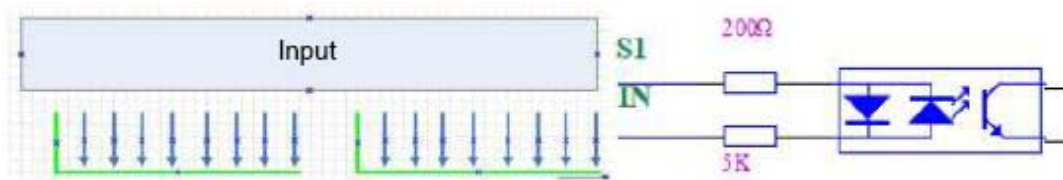
❖ Relay output interface

| 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:
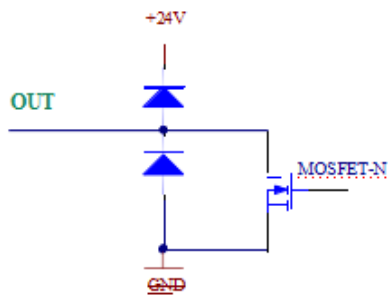
❖ Extension interface A (CN1)
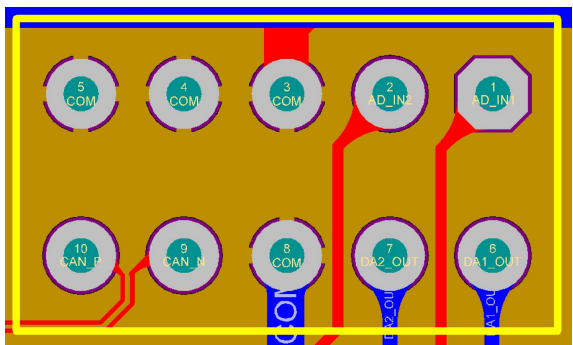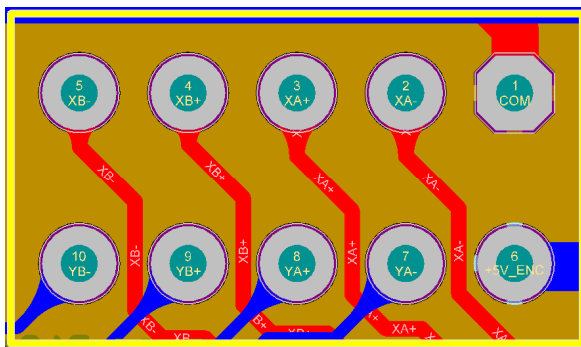

Signal definition of extension interface A (CN1)					
Pin	Definition	Description	Pin	Definition	Description
1	AD_IN1	Analogue input channel 1	6	DA1_OUT	Analogue output channel 1
2	AD_IN2	Analogue input channel 2	7	DA2_OUT	Analogue output channels 2
3	COM	Signal ground	8	COM	Signal ground
4	COM	Signal 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:
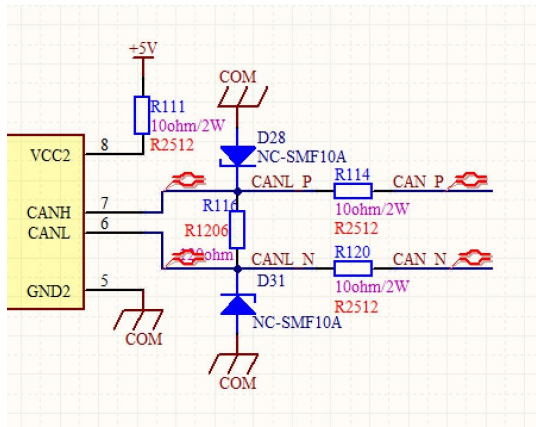
❖ Extension Interface B (CN2)

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:
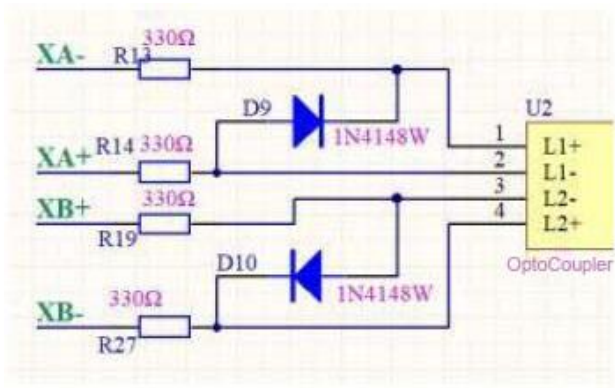
Appendix XII Details of IO Board (R4A)

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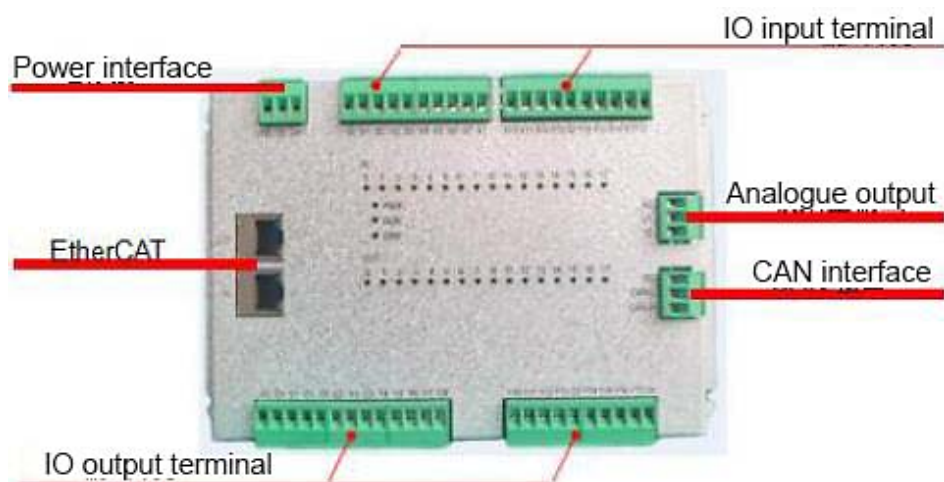
The R4A Remote IO Module connects distributed IO control points to the EtherCAT network, where the R4A module is a slave with its own input and output points in various combinations of functions to meet the needs of different applications.

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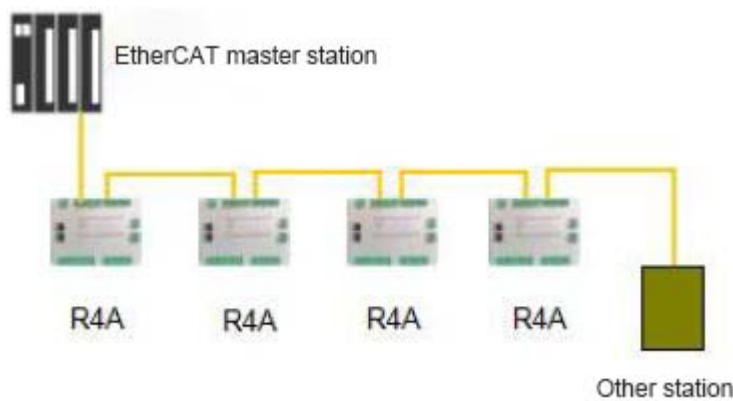
As shown in the figure, the R4A remote IO module can transmit digital inputs from the industrial site to the master station via the EtherCAT bus, and can transmit control data from the master station to the digital outputs, analogue outputs, etc. of the industrial site.

❖ 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): 8KV Air Discharge EFT (IEC 61131-2, IEC 61000-4-4): Power Line: ±2kV, Digital Input: ±2kV Comunication I/O: ±2kV Conducted Susceptibility Test (EN61000-4-6, IEC 61131-2 9.10): 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 (TEST Fc)/IEC 61131-2&IEC 68-2-27 (TEST Ea)

❖ 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:
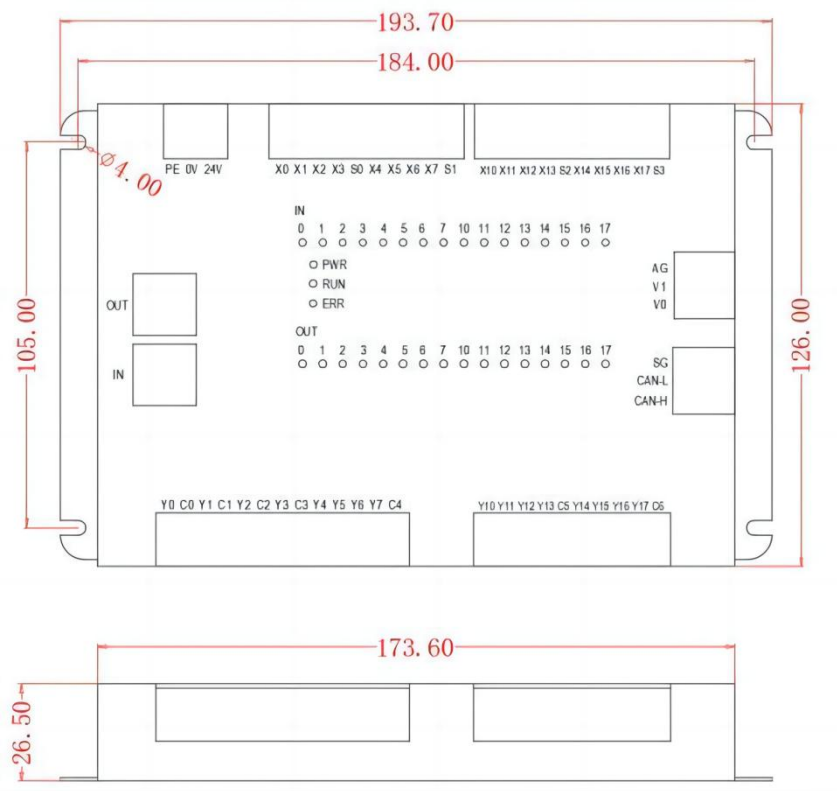
❖ Hardware connection

● 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.
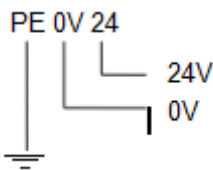

● EtherCAT interface

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**
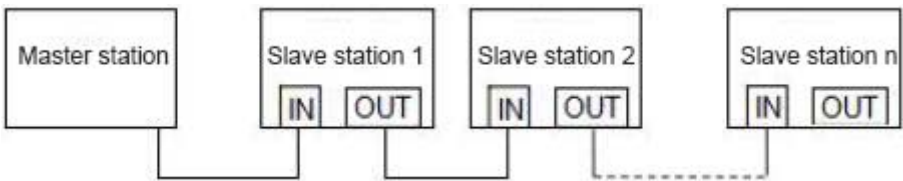
③ **Cable Selection**

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
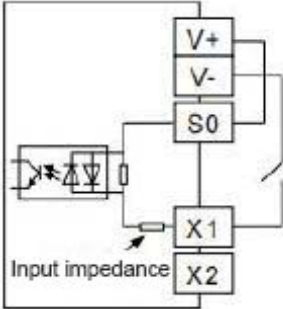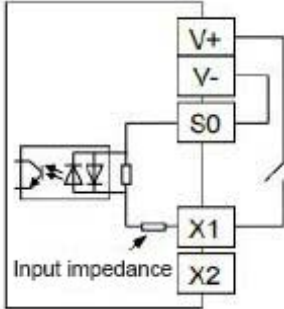
AG
V1
V0

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.

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:

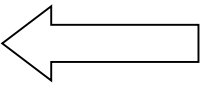| Indicator status	Indicator function	Troubleshooting
Lights out	No power supply	Connect the R4A power cord correctly and confirm that the power supply is normal.
Green light on	Proper functioning	No treatment is required.

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	⬅	COUNT_IN_1
	Master Input Register 5		
	Master Input Register 6		
	Master Input Register 7		
	Master Input Register 8		
	Master Input Register 9		COUNT_IN_2
Output data	Master Output Register 0		Y0~Y7
	Master Output Register 1		Y10~Y17
	Master Output Register 2		V0

	Master Output Register 3		
	Master output Register 4		
	Master output Register 5	⟹	V1
	Master output Register 6		
	Master output Register 7		COUNT_CTRL
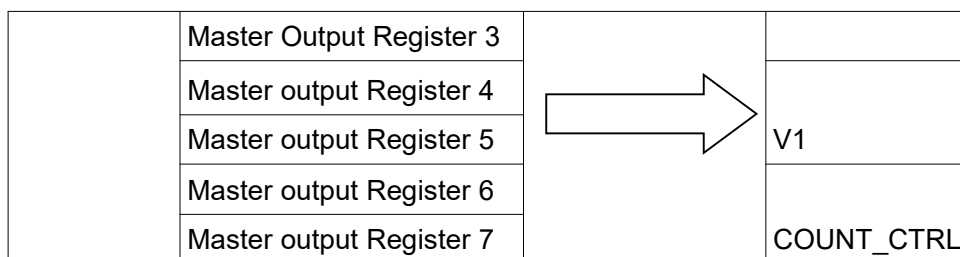
As shown in the table above, the input data of R4A contains 16 digital inputs and two high-speed count inputs. X0~x17 are 16 digital input signals. The count value of high-speed counter is 32 bits, the maximum count frequency is 500K, and it is the unidirectional accumulative counting, the input source 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.

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